



HAL
open science

The grammatical and conceptual ingredients of what happens next

Bridget Copley

► **To cite this version:**

Bridget Copley. The grammatical and conceptual ingredients of what happens next. Linguistics. Université de Nantes, 2018. tel-01709927v1

HAL Id: tel-01709927

<https://hal.science/tel-01709927v1>

Submitted on 15 Feb 2018 (v1), last revised 8 Jun 2018 (v2)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

UNIVERSITÉ DE NANTES
Ecole Doctorale “Education, Langages, Interactions,
Cognition, Clinique” (ELICC)

DOSSIER DE CANDIDATURE AU DIPLÔME
D’HABILITATION À DIRIGER DES RECHERCHES

THE GRAMMATICAL AND CONCEPTUAL
INGREDIENTS OF WHAT HAPPENS NEXT

Bridget Lynn Copley

Dossier de synthèse

Soutenance : 4 juin 2018

COMPOSITION DU JURY

Prof. Hamida Demirdache Université de Nantes	directrice
Prof. Brenda Laca Université Paris 8	présidente
Prof. Cleo Condoravdi Stanford University	rapportrice
Prof. Louise McNally Universitat Pompeu Fabra	rapportrice
Prof. Manfred Krifka Humboldt-Universität zu Berlin/ Leibniz-Zentrum Allgemeine Sprachwissenschaft	examineur

REMERCIEMENTS

My thanks to:

my *Habilitationmutter* Hamida Demirdache for her wonderful insight and support;

Brenda Laca, Cleo Condoravdi, Louise McNally, and Manfred Krifka for agreeing to lend their expertise to the defense;

Isabelle Roy and Brenda Laca for their helpful comments on a draft;

Jean-Daniel Mohier for helping with the French;

Georgie Morand and Sophie Wauquier for assistance of all kinds;

Heidi Harley, Isabelle Roy, and Phil Wolff for being my co-authors and partners in crime;

my extended family for letting me use their names in my example sentences;

my parents and brother for looking out for me;

my husband and daughter for so much.

TABLE DES MATIÈRES

I. RÉSUMÉ FRANÇAIS	11
II. RÉSUMÉ	19
1. Introduction	19
2. The paradox of future reference	25
3. Futurates as a case study	28
3.1. Four problems posed by futurates	29
3.2. The best-laid plans	36
3.3. Extending the analysis to <i>have</i> causatives	38
4. Implications for the grammatical/conceptual divide	40
4.1. Good denotational hygiene	40
4.2. Drawing the line	43
4.3. No abstentions	46
4.4. Both ends against the middle	48
5. Conditionals, eventuality type, and assertability	50
5.1. Unexpected future orientation	52
5.2. A three-way correlation	54
5.3. Causal conditionals	56
5.4. Futures, eventuality type, and assertability	57
6. How to fall off the single branch	60
6.1. Things being equal	61
6.2. Efficacy	62
7. Reifying forces	65
7.1. The case for forces	66
7.2. Force functions	70
7.3. Improving the interface with forces and degrees	72
8. Conclusion	73
9. Bibliography	75

III. ARTICLES

These articles are cited in the text using their Roman numerals.

Futurates as a case study	84
i. A conceptual and a grammatical distinction for modals (Copley 2005a)	84
ii. The plan's the thing: Deconstructing futurate meanings (Copley 2008a)	99
iii. Futurates, directors, and <i>have</i> -causatives (Copley & Harley 2009)	113
iv. Causal chains for futurates (Copley 2014)	115
v. Dispositional causation (Copley, 2018 ms.)	130
Conditionals, eventuality type, and assertability	169
vi. Temporal orientation in conditionals (Copley 2008b)	169
vii. Causal conditionals (Copley 2017 ms.)	192
viii. Aspect, scope, and future conditionals (Copley 2003)	221
ix. Aspectualized futures in Indonesian and English (Copley 2010)	237
How to fall off the single branch	261
x. So-called epistemic <i>should</i> (Copley 2004)	261
xi. What should <i>should</i> mean? (Copley 2006 ms.)	263
xii. When the actual world isn't inertial: Tohono O'odham <i>cem</i> (Copley 2005b)	284
xiii. A force-theoretic model (Copley & Harley 2013 ms.)	302
xiv. Eliminating causative entailments with the force-theoretic framework: The case of the Tohono O'odham frustrative <i>cem</i> (Copley & Harley 2014)	308
xv. Deriving the readings of French <i>être en train de</i> (Copley & Roy 2015)	340
Reifying forces	357
xvi. Theories of causation should inform linguistic theory and vice versa (Copley & Wolff 2014)	357

xvii. A force-theoretic framework for event structure (Copley & Harley 2015)	404
xviii. Force interaction in the expression of causation (Copley, Wolff, & Shepard 2016)	460
xix. Force dynamics (Copley, 2018)	479
xx. What would it take to tame the verbal hydra? (Copley & Harley 2018 ms.)	516
IV. CURRICULUM VITAE	538

I. RÉSUMÉ FRANÇAIS

Un politicien a besoin de la capacité de prédire ce qui se passe demain, la semaine prochaine, le mois prochain et l'année prochaine. Et d'avoir ensuite la capacité d'expliquer pourquoi cela ne s'est pas produit.

–Winston Churchill

Il est essentiel pour l'expérience humaine de penser à ce qui va se advenir, et à ce qui adviendra après ça et ainsi de suite, etc. Notre capacité à envisager des résultats et à s'attendre à des conséquences probables occupe une part importante de nos pensées d'un moment à l'autre (Baird et al. 2011), et a sans doute eu un impact significatif sur notre survie en tant qu'espèce (Seligman et al. 2013). Cela étant, il n'est peut-être pas surprenant que les langues évoquent ce qui va arriver de différentes façons, allant bien au-delà de *will* en anglais et allant de la morphologie future dédiée, aux modaux, aux aspects, aux constructions causales, aux verbes lexicaux.

Les multiples façons dont les langues expriment des pensées au sujet de ce qui va advenir nous donne une excellente occasion d'en explorer la sémantique, qui embrasse la grammaire et le niveau conceptuel, et de mieux comprendre où se situe la ligne de démarcation entre le langage et la pensée. Ceci, en partie, parce que de nombreux phénomènes linguistiques entrent en jeu. Mais surtout, parce que ce qui va advenir est ancré dans ce qui se passe maintenant, et ce qui est connu ou cru maintenant. Le lien entre le moment présent et ce qui va arriver ensuite est complexe, évoquant des notions telles que la causalité, l'intervention, l'intention, la possibilité et la disposition, dont aucune n'est un simple concept. En même temps, cependant, la morphologie responsable de faire référence à ces concepts complexes est souvent assez simple, voire complètement absente. Ainsi, même si les structures conceptuelles consultées peuvent être assez complexes, nos moyens morphosyntaxiques pour parler de ce qui va arriver sont souvent incroyablement simples. Ce fait nécessite une cartographie non triviale entre la morphosyntaxe

et les structures conceptuelles, dont la compréhension peut être très révélatrice quant à la nature de la faculté de langage.

Pour examiner cette cartographie, ce dossier suit plusieurs itinéraires entrelacés. C'est en premier lieu une enquête concernant plusieurs façons dont nous parlons de ce qui va se passer, en grande partie en anglais, même si d'autres langues font de brèves apparitions. Deuxièmement, il constitue une descente d'une partie particulière de l'arborescence de la phrase, des futurs modaux (j'appelle ces futurs vrais ou simplement futurs pour éviter une pétition de principe) à d'autres modaux, à l'aspect, aux verbes lexicaux et leur structures événementielles. Cet itinéraire nous part ainsi de préoccupations philosophiques éthérées au sujet de l'avenir et de l'assertabilité, pour nous amener à des questions plus granuleuses concernant les racines lexicales et les règles de composition.

Troisièmement, ce dossier trace un développement partant de la réflexion sur l'orientation future en soi—dans laquelle la question dominante est de savoir si le futur est un temps sur une seule branche, ou un modal quantifiant sur plusieurs branches, (section 2) — et nous amène à une réflexion sur la nature des événements et de la causalité. Il existe un lien simple entre ces deux domaines. Rien ne se passe qui n'ait été causé, donc la relation entre ce qui se passe (ou est connu / cru) maintenant et ce qui arrivera dans le futur (quoi que cela puisse être) peut-être comprise comme causal par nature. Ceci n'est pas nouveau. La causalité est déjà implicite dans la vision de Lewis / Stalnaker / Kratzer de la modalité et des phrases conditionnelles : pour eux, les circonstances présentes, en conjonction avec les lois de la physique ou de l'humanité ou d'un comportement rationnel, forment un ensemble de mondes possibles dans lesquels un certain nombre de possibilités se produisent dans le futur. Nous savons que ces lois de la physique contiennent beaucoup d'informations sur la causalité, et il ne fait pas de doute que l'information causale est également présente dans d'autres types de lois. Par exemple, les intentions peuvent être considérées comme provoquant une action voulue. Donc, dans l'ensemble, il y a

une relation étroite entre l'orientation future et la causalité, bien qu'elle soit implicite dans la théorie existante.

Dans ce dossier, je m'efforce de rendre la causalité plus explicite dans la dénotation des phrases qui font référence à l'avenir. Ce mouvement est initialement motivé par le cas des futurates tels que *The Red Sox play the Yankees tomorrow*, comme nous le verrons dans la section 3, et plus tard étendu aux phrases conditionnelles, dans la section 5. La différence entre la quantification dénotée explicite pour les mondes possibles et la causalité dénotée explicite ressemble à la différence, en phonologie, entre la Théorie de l'Optimalité (qui génère toutes les formes possibles et sélectionner parmi elle un ensemble particulier) et les dérivations phonologiques traditionnelles (qui transforme une forme en une autre). Dans les deux approches, il existe des formes possibles qui ne sont pas attestées, mais de telles possibilités ne sont rassemblées par le système de calcul grammatical que dans la première approche. De même, on peut soit considérer les cours possibles d'événements comme des mondes atomiques possibles qui sont explicitement quantifiés, soit construire de tels événements en allant d'un événement à l'autre. Comme c'est le cas dans l'exemple de la phonologie, les deux approches sont puissantes et peuvent traiter une grande partie des données, mais certaines données sont plus facilement traitées dans l'une que dans l'autre. Ici, je soutiendrai que, au moins pour les phénomènes en question, il vaut mieux utiliser une notion de causalité que de quantifier les mondes possibles atomiques dans la dénotation.

Cependant, nous n'abandonnons pas l'idée d'utiliser des méthodes formelles pour modéliser les possibilités ; même si les possibilités ne se ramifient pas dans la dénotation, elles peuvent certainement encore se ramifier dans le modèle, et ainsi être disponibles pour des contextes des inférences pragmatiques. C'est-à-dire qu'au lieu de quantifications explicites sur des mondes possibles dans la dénotation, nous avons un embranchement non-dénotationnel : embranchement qui a lieu en dehors de la dénotation. L'embranchement consiste de l'ensemble de possibilités alternatives à un variable contextuel auquel on évalue la dénotation. L'embranchement non-dénotationnel peut impliquer soit

la quantification, soit, tout simplement, le fait que le locuteur choisisse une alternative et pas des autres ; on peut le traiter comme condition sur le modèle, comme inhérent à l'acte d'assertion, ou comme une interaction entre les deux.

Une autre facette de la discussion qui se présente ici, et qui sera discutée plus en détail dans la section 4, est une certaine vision de la division du travail entre les ingrédients grammaticaux et conceptuels du sens. Les significations qui nous intéressent sont complexes, de sorte que la complexité doit résider quelque part, soit dans la dénotation elle-même (que nous devons comprendre au cours de la discussion comme contribution grammaticale au sens), soit dans l'interprétation conceptuelle (le modèle). Nous ne cherchons pas à évacuer la complexité mais à l'analyser à sa juste place. La discussion aboutit ici à une vue de l'ontologie grammaticale dans laquelle les critères d'individuation conceptuelle des éléments réifiés sont complexes et les dénotations sont simples plutôt que l'inverse. Cela soulage la tension entre une vue chomskienne - dans laquelle la grammaire (dénotations) devrait être simple pour que les concepts s'avèrent complexes - et une vision humienne, dans laquelle les concepts de base devraient être simples, de sorte que les dénotations s'avèreraient complexes. La vue chomskienne l'emporte au niveau de la grammaire: des éléments simples dans un système de calcul simple font référence à des concepts complexes. Cependant, ces concepts peuvent être analysés plus en profondeur dans le modèle réductionniste humien. Ce compromis nous permettra finalement de comprendre la curieuse simplicité des véhicules morphosyntaxiques utilisés pour parler de la complexité de ce qui va advenir.

Un thème supplémentaire qui sera repris dans la section 5 est celui de l'assertabilité : à quelles conditions peut-on affirmer quelque chose? Je soutiens que nous ne pouvons affirmer les événementiels parce qu'ils sont trop petits pour être des propositions, et ont un type différent (prédicats d'événements) des statifs et tout ce qui est assez grand pour inclure l'aspect. Ces derniers objets peuvent être des assertions ; je les traite donc comme des prédicats de situations. Cette position, s'elle est correcte, implique une cascade de conséquences sur

les modal flavors (genres de modaux), les phrases conditionnelles, les dénotations des phrases conditionnelles, ainsi que des aspects et la structure événementielle. En particulier, cela suggère que les phrases conditionnelles expriment une relation causale entre des événements. Si les arguments de la phrase conditionnelle sont des prédicats d'événements, les événements reliés sont ceux instantiés par ces prédicats ; si par contre les arguments de la phrase conditionnelle sont des propositions, les événements reliés sont les actes énonciatives qui ajoute ces propositions aux engagements du locuteur. Dans les deux cas, on a encore une seule branche, la chaîne causale.

Avec une seule branche s'étendant dans le futur, vient la question de savoir comment modéliser ce qui se passe quand les choses ne se déroulent pas comme prévu. Quelle est la nature de l'embranchement non dénotationnelle qui nous permet de tomber de la branche unique? Dans la section 6, nous commençons par examiner comment appliquer une condition *ceteris paribus* pour s'assurer que, dans des conditions imprévues, le résultat futur prévu ne doit pas se produire. Le concept de *efficacité* est introduit, reflétant la position du locuteur sur la question de savoir si les fondements de ses assertions au sujet de l'avenir sont tout ce qui est pertinent pour prédire ce qui va se passer.

Enfin, alors que nous en arrivons à la phrase verbale où ce qui va advenir doit être compris comme un aboutissement, nous faisons face à une gamme similaire de questions à propos ce qui s'est passé auparavant. En supprimant l'embranchement de la dénotation de la phrase verbale dans les cas de non-culmination, nous appuyons une nouvelle fois (section 7) sur la réification de la relation causale dans la dénotation. Par conséquent Davidson (1967) s'est trompé lorsqu'il affirmait que que ses arguments reflétaient la notion communément admise d' *événement*, au contraire, ses arguments—quand ils ne sont pas des situations dans le sens de Barwise and Perry (1983)—reflètent plus étroitement la notion communément admise de *force*. Les forces sont des apports d'énergie qui ont une origine à laquelle l'énergie est appliquée, une direction vers laquelle l'énergie est appliquée et une magnitude qui correspond à la quantité d'énergie appliquée. Les forces

interagissent naturellement les unes avec les autres. Nous savons que l'interaction est nécessaire quand on pense à ce qui se passe (ensuite) lorsqu'on considère comment les lois interagissent les unes avec les autres et avec les circonstances, pour les bases modales et les ordering sources (Kratzer 1981). Les forces dans le monde ont également naturellement une propriété *ceteris paribus* : elles conduisent à un certain résultat à moins que quelque chose d'autre n'intervienne et empêche ce résultat. Nous avons vu que *ceteris paribus* est une partie importante de déterminer ce qui pourrait arriver ensuite.

Alors que les forces et les interactions de forces sont facilement représentées avec des vecteurs, leur propriété *ceteris paribus* doit également être représentée. Pour cette raison, nous représenterons les forces comme une fonction qui prend une situation (l'origine) et renvoie la situation qui en résulte si les choses sont égales, c'est-à-dire, si rien d'extérieur n'intervient (une direction abstraite). La magnitude n'est pas représentée, et cela ne semble pas être nécessaire, du moins dans les phénomènes que nous examinons ici. Nous verrons que les fonctions de force sont des arguments Davidsoniens appropriés, et nous permettent de simplifier la dénotation pour les phrases verbales et l'aspect imperfectif, car en effet, la relation causale est elle-même réifiée comme un argument Davidsonien.

Un argument supplémentaire, à la suite de Michotte (1946) et Talmy (2000) entre autres, est que les causes portent en elles une des deux relations temporelles à leurs effets: soit la cause se produit entièrement avant l'effet (lancement), soit la cause et l'effet commencent plus ou moins en même temps (entraînement). L'entraînement a été malheureusement négligé dans les traitements événementiels de la structure des événements, pour des raisons qui sont bonnes quoi qu'elles soient de théories internes ; la théorie de la force étudiée ici nous permet de surmonter ces raisons et d'utiliser l'entraînement pour modéliser de façon appropriée les prédicats dynamique atélique. Ce mouvement ouvre à son tour la porte à une seule sémantique pour les prédicats verbaux : un apport d'énergie provoque un changement d'un degré à un autre le long d'une échelle graduée. Même les verbes qui impliquent un état statique

comme *rester*, qui posent des problèmes particulièrement flagrants liés à l'entraînement dans les comptes rendus de la théorie des événements, peuvent être expliqués, si nous supposons que pour ces verbes les degrés sont égaux. L'image entière est celle d'une sémantique verbale unifiée, où l'interface syntaxe-sémantique est limitée à la théorie des types, et où la variété des propriétés verbales provenant des différentes natures des racines lexicales est le statut de quantisation des nominaux, et comment ils sont tous composés les uns avec les autres et la tête verbale.

Cette approche force-théorique fournit des séquences liées de forces et de situations qui représentent des chaînes causales. Ces chaînes causales sont de bons candidats pour les chaînes causales dont nous avons besoin pour les futurs et les phrases conditionnelles; Nous revenons donc là où nous avons commencé. Nous verrons que l'idée d'une branche causale unique avec un embranchement non dénotationnel, accompagnée par une condition *ceteris paribus*, peut être le mécanisme qui nous amène à ce qui se passe ensuite, pour les futurs et les phrases conditionnelles ainsi que pour l'argument Davidsonien en lui-même. Est-ce que ce doit être le *seul* mécanisme qui nous amène à ce qui se passe ensuite? À la base, c'est une question empirique. En général, nous savons que le langage trouve souvent des mécanismes différents, à différents niveaux de la structure de phrase, pour accomplir des buts communicatifs à peu près similaires. Une analyse avec une branche unique pour la dénotation des futurates, par exemple, n'implique pas *a priori* une branche unique dans les dénotations des futurs et des modaux. Nous ne présenterons pas d'éléments de preuve particuliers pour une branche unique dans les futures et les modaux. Pourtant, il est toujours intéressant qu'une analyse d'une branche unique avec un embranchement non dénotationnel soit possible pour expliquer une référence future. Cela nous donne un outil supplémentaire pour comprendre comment nous parlons de ce qui va advenir.

Les analyses ici nous ont donné un moyen de résoudre deux pressions concurrentes sur la dénotation: l'impulsion chomskienne vers des dénotations simples et des concepts complexes, et l'impulsion humienne

vers des concepts simples et des dénnotations complexes. Si nous convenons que la dénnotation elle-même fait partie du système grammatical, alors cette dénnotation devrait être simple —aussi simple qu’une seule branche, par exemple—alors que les concepts qui interprètent les termes dans la dénnotation simple devraient être complexes—causalité, ou disposition, par exemple. Le concept complexe peut être analysé plus avant de façon humienne tant que cette analyse est cognitivement plausible. Si les dénnotations sont en effet simples, nous devrions découvrir à quel point elles peuvent être simples, pour une morphologie nulle ainsi que pour des têtes morphologiques simples. Nous devrions également poursuivre des unifications (chomskiennes) dans des choses comme les conditionnels et les phrases verbales, en même temps que nous poursuivons des analyses (humiennes) de leurs conditions de vérité. Même si ces unifications proposées sont pour l’instant très simplifiées, les prendre comme hypothèse de départ a le potentiel de nous donner une nouvelle compréhension de la division du travail entre la grammaire et la conceptuelle.

II. RÉSUMÉ

1. Introduction

A politician needs the ability to foretell what happens tomorrow, next week, next month, and next year. And to have the ability afterwards to explain why it didn't happen. —Winston Churchill

It is central to the human experience to think about what will happen next, and what will happen next after that, and so on. Planning and predicting take up quite a large proportion of our thoughts from moment to moment (Baird et al. 2011), and have arguably had a significant impact on our survival as a species (Seligman et al. 2013). This being the case, it is perhaps unsurprising that languages have a number of ways to talk about what happens next, going well beyond *will* and ranging from dedicated future morphology, to modals, to aspects, to morphemes expressing causation and culmination, to lexical verbs.

The variety of ways in which languages express thoughts about what happens next gives us a particularly good opportunity to explore meaning as it straddles grammar and the conceptual level, and to understand more about where the dividing line is between language and thought. In part this is just because so many linguistic phenomena are involved. But also, crucially, it is because what happens next is rooted in what is happening, known, or believed now. The connection between now and next is a complex one, evoking notions such as causation, intervention, intention, possibility, and disposition, none of which are simple concepts. And yet at the same time, the morphology responsible for making reference to these complex concepts is often quite simple or even absent. So even though the conceptual structures accessed can be quite complex, our morphosyntactic means for talking

about what happens next can be incredibly simple. This fact necessitates a non-trivial mapping between the morphosyntax and the conceptual structures, the understanding of which can be very revealing of the nature of the language faculty.

To examine this mapping, the collection of articles here follows several intertwining itineraries. It is in the first instance an investigation of several ways in which we talk about what happens next, largely in English, though other languages make brief appearances. Second, it constitutes a climb down a particular part of the phrase structure tree, from future modals (I call these “true futures” or simply “futures” to avoid begging the question), to other modals, to aspect, to lexical verbs and their event structure. This itinerary takes us from airy philosophical concerns about branching futures and assertability, down to grittier issues concerning lexical roots and rules of composition.

Third, these articles trace a development from thinking about future orientation *per se*—in which the dominant question has been whether “the future” is a tense along a single branch, or a modal quantifying over many branches (section 2)—to thinking about causation. There is a simple link between these two domains. Nothing happens without being caused to happen, so the relationship between what is (known or believed to be) going on now and any future eventuality can be understood as causal in nature. This point is not really news. Causation is already implicit in the Lewis/Kratzer/Stalnaker view of modals and conditionals: present circumstances, in conjunction with the laws of physics or humankind or rational behavior, together form a set of possible worlds in which various eventualities happen, some of them in the future. We know that in those laws of physics there is extensive information about causation, and surely, causal information is present in the other kinds of laws as well; for example, intentions can be viewed as causing the intended action. So in all, there is a tight relationship between future orientation and causation, albeit an implicit one on existing theory.

Over the course of this collection of articles, I move toward making causation more explicit in the denotation of certain future-referring

sentences: we will look first in some detail in section 3 at the case of futurates, such as *The Red Sox play the Yankees tomorrow* and proposal a dispositional causation analysis. The difference between a denotation that has quantification over possible worlds and one that has causation is analogous to the difference in phonology between Optimality Theory (generate all the possible forms and choose a particular set of them) and traditional phonological derivations (transform one form into another). In both approaches, there are possible forms that are unattested, but in only the first approach are such possibilities collected by the grammatical computational system. Likewise, one can either treat possible courses of events as atomic possible worlds that are explicitly quantified over, or one can construct such courses of events from one event to the next from causal relations, as a causal chain. Just as in the phonology example, while both approaches are powerful and can handle a great deal of the data, certain data is more easily treated in one than the other. Here I will argue that, at least for the phenomena in question, it is better to utilize a notion of causation than to quantify in the denotation over atomic possible worlds, even though both approaches may yield appropriate truth conditions.

I must underline here that we are not at all abandoning the idea of using formal methods to model possibilities. Even if we have “non-denotational branching,” i.e., even if the possibilities are not quantified over in the denotation, there can still be branching possibilities in the model. This branching would be accessed as set of alternative possibilities to a contextual variable at which the denotation is evaluated. These branches may be quantified over, or the speaker may simply choose one alternative among several; either of these can be done as a condition on the model, or as part of the act of assertion.

A facet of the discussion which comes up here, and which will be discussed at more length in section 4, is that the denotation has a status over and above the provision of truth conditions. This point suggests a certain view of the division of labor between the grammatical and conceptual ingredients of meaning, where the denotation is part of the grammatical system (broad syntax), while the interpretation of terms

in the denotation resides in the conceptual system (represented by the model). The meanings we are interested in are complex, so that complexity has to reside somewhere, either in the denotation itself, or in the model. This is not a matter of sweeping complexity under the rug but analyzing it where it belongs. The discussion here ends up pointing to a view of grammatical ontology in which the conceptual individuation criteria of the reified elements are complex and the denotations are simple, rather than the other way around. This relieves the tension between a Chomskyan view—in which grammar (denotations) should be simple, so concepts turn out to be complex—and a Humean view, in which basic concepts should be simple, so denotations turn out to be complex. The Chomskyan view wins out for grammar: simple elements in a simple computational system make reference to complex concepts such as causation and disposition. However, these concepts can be further analyzed in a Humean reductionistic fashion in the model. This compromise will ultimately allow us to understand the simplicity of the morphosyntactic vehicles used for talking about what happens next.

An additional theme that will be picked up in section 5 is that of assertability: under what conditions can something be asserted? I argue that eventives are unassertable because they are too small to be propositions (Chierchia 1985, Ramchand and Svenonius 2014), and have a different type (predicates of events) from statives. Anything big enough to include aspect or tense behaves similarly to statives. These latter objects can all be asserted, thus I treat them as propositions: predicates of situations. This position has a cascade of consequences for the nature of modal flavors, conditionals, future sentences, aspect, and event structure. In particular it suggests that conditionals express a causal relationship between events. If the conditional's arguments are event predicates, the events it relates are events instantiated by those predicates; if the arguments are instead propositions, the events it relates are the speech acts of adding those propositions to a common ground. Once again, we end up with a single-branch causal chain in the denotation, with non-denotational branching.

With a single branch extending into the future comes the question of how to model what happens when things do not work out as planned or predicted. What is the nature of the non-denotational branching that allows us to fall off the single branch? In section 6, we begin by investigating how to apply a *ceteris paribus* condition to ensure that in unforeseen conditions, the planned or predicted future outcome need not happen. The concept of *efficacy* is introduced, reflecting the speaker’s position on whether their grounds for an assertion about the future are all that is relevant to predict what will happen.

Finally, as we get down to the verb phrase, where “what happens next” is to be understood as culmination, we find a similar range of issues to what has come before. Removing the branching from the denotation of the verb phrase in cases of non-culmination, we double down (section 7) on the reification of the causal relation in the denotation. The upshot is that Davidson (1967) was wrong that his arguments reflected the commonsense notion of *event*; rather, his arguments—when they are not situations in the sense of Barwise and Perry (1983)—reflect more closely the commonsense notion of *force*. Forces are inputs of energy that have an origin at which the energy is applied, a direction toward which the energy is applied, and a magnitude which corresponds to the amount of energy applied. Forces naturally interact with each other. We know interaction is necessary when thinking about what happens (next) from considering how laws interact with each other and with circumstances, for modal bases and ordering sources (Kratzer 1981). Forces in the world also naturally have a *ceteris paribus* property: they lead to a certain outcome unless something else stronger intervenes and prevents that outcome. We have seen that *ceteris paribus* is an important part of figuring out what could happen next.

While forces and force interactions are easily represented with vectors, their *ceteris paribus* property must also be represented. For this reason, we will represent forces as a function that takes a situation (the origin) and returns the situation that results if things are equal, i.e., nothing external intervenes (an abstract direction). Magnitude

is not represented, and there seems to be no need for it, at least in the phenomena we examine here. We will see that force functions are appropriate Davidsonian arguments, and allow us to simplify the denotation for both verb phrases and imperfective aspect, as in effect, the causal relation is itself reified as a Davidsonian argument.

A further point, following Michotte (1946) and Talmy (2000) among others, is that causes bear one of two temporal relations to their effects: either the cause happens entirely before the effect (launching), or the cause and effect begin at more or less the same time (entrainment). The existence of entrainment, both in the world and as represented in language, prompts a further reanalysis of “what happens next”: “next” does not mean next in time, but causally next—next in the causal chain. Entrainment has been neglected in event-theoretic treatments of event structure, for good, albeit theory-internal reasons; the force-theoretic approach here allows us to overcome those reasons and use entrainment to appropriately model atelic eventive predicates as causal in nature. This move in turn opens the door to a single semantics for eventive verbal predicates: an input of energy provokes a change from one degree to another degree along a degree scale. Even verbs of maintaining like *stay*, which are problematic for event-theoretic accounts, can be explained if such verbs set the two degrees as equal. The hope is that the syntax-semantics interface can be limited to the theory of semantic composition, and the variety of verbal properties can arise from the various natures of lexical roots, the quantization status of DPs, and how all of these are composed with each other.

This force-theoretic approach provides linked sequences of forces and situations which represent causal chains. These causal chains are good candidates for the causal chains that we needed for futurates and conditionals; thus we come back around to where we started. We will now start again in earnest with future reference, beginning from the beginning.

2. The paradox of future reference

Aristotle kicked off discussion about the future with a question about sentences such as those in (1).

- (1) a. There will be a sea battle tomorrow.
 b. There will not be a sea battle tomorrow.

The problem that arises is how we are to evaluate the truth of such sentences. Are we to say that if there ends up being no sea battle tomorrow, that (1a) is false and (1b) is true today? But if we say this, then it is inevitable that there will be no sea battle, and that does not feel right. Rather, we have the sense that, from the point of view of today, any sea battle tomorrow is an outcome contingent on whatever turns out to happen, not a necessary outcome. Things may turn out differently than how we foresaw them. So, however certain we may be that there will be a sea battle tomorrow, we want to leave open somehow the possibility that there will not be a sea battle tomorrow, especially if things happen that we have not foreseen—if it is not the case that *ceteris paribus*, all things are equal. In other words, we want to consider more than one possible future, branching off from the present, to account for such eventualities. We can say that on all the normal or stereotypical branches, or those branches that are consistent with our presuppositions, that there is (or is not) a sea battle, and still allow for there to be other branches where things turn out differently.

On the other hand, we want to ensure the truth of the “Future Law of the Excluded Middle” in (2), which is a true statement:

- (2) Either there will be a sea battle tomorrow or there won’t be a sea battle tomorrow.

The Future Law of the Excluded Middle is entailed, on ordinary assumptions, by *bivalence*, or the principle that a proposition is either true or false. But if a proposition such as *There will be a sea battle tomorrow* must be either true or false, that makes the sea battle a necessary, not a contingent future outcome. Thus, to make the Future Law

of the Excluded Middle true, we are only considering a single branch into the future, rather than many branches.

The history of the treatment of future-oriented morphology is a continuous balancing act between these two demands: the *ceteris paribus* nature of future statements, and the Future Law of the Excluded Middle. This dilemma is framed in philosophy as the problem of future contingents, which is the question of the precise logical status of future events that are not historically necessary or settled. In linguistics, however, the main issue is framed as a choice between treating *will* as a tense and treating *will* as a modal.

If we treat *will* as a tense, we use it to designate a future time on a single branch so that the future is inevitable, and the Future Law of the Excluded Middle is unproblematically true. If, on the other hand, we treat *will* as a modal—where “modal” is generally taken to be synonymous with “quantification over possible worlds”—we have the opportunity to consider possibilities other than what eventually turns out to happen. In either case, we still need to account for the other demand; if we posit a single branch by treating *will* as a tense, we need to explain the *ceteris paribus* effect, and if we posit multiple branches by treating *will* as a modal, we need to explain the Future Law of the Excluded Middle.

With many branches comes the need to figure out how to make the Future Law of the Excluded Middle turn out true. The way to do this is to ensure that the set of worlds being quantified over either all make P true or all make P false. Theories of futures must find one way or another to do this. A very abbreviated list of theories and the method they use might include Thomason (1970) (supervaluations, drawing on van Fraassen (1966)); Belnap et al. (2001) (settledness, property of the model, drawing from Thomason and Gupta (1980)), Condoravdi (2003) (settledness, property of the model), Copley (2009) (homogeneity, stipulated in the denotation); Giannakidou and Mari (2012) (veridicality, property of the model, though the claim is that Greek and Italian futures are non-veridical); Del Prete (2014) (supervaluations).

Despite the near-ubiquitous use of homogeneity/settledness/veridicality as a way to relieve the tension between one and many branches, we may well have qualms about it. For one, the use of supervaluations—which involve evaluating a second kind of truth on a set of branches in addition to normal truth which is evaluated on a single branch—can be somewhat unpalatable depending on how one feels about truth. Conditions on the model are an improvement.

A alternative solution which has gained a certain foothold is to deny that future-oriented denotations quantify over branches; the denotation just refers to a single branch. In that case, there is no need for a homogeneity/settledness/veridicality requirement to make a set of branches behave as though it were a single branch, because there *is* just a single branch. However, as discussed above, we still need branches somewhere, as not everything that happens in the future is inevitable. The branching can be associated with the speech act, so that there is no quantification over branches in the denotation. This kind of solution appears in Kissine (2008), Del Prete (2014), and to some extent, Kaufmann (2005), as an option for futurates at least if not for futures. The idea is that something about making a speech act requires the consideration of different contextual alternatives to represent the speaker’s perspective, either epistemic or doxastic, and it is from this choice of starting point that the future is calculated, along a single branch, into the future.

This solution neatly sidesteps the need for supervaluations, and may even make superfluous any further conditions on the model, though this is not yet clear. Some theories, e.g. Del Prete (2014) propose *both* a single branch in the denotation *and* a version of homogeneity/settledness/veridicality for non-denotational branching. Whether this solution is a “braces and belt” kind of solution has yet to be debated in those terms as far as I know; at the least, the presence or absence of such a condition may serve to distinguish various futures cross-linguistically (cf. Giannakidou and Mari 2012, e.g.).

3. Futurates as a case study

In this section we take on the question of futurate readings as a case study. We will spend some time on them, because in their meaning and their lack of morphosyntax, they are an excellent test case for the ideas we will be discussing. I will argue that they are best analyzed as a single causal chain, with any branching occurring outside of the denotation.

Futurates (Lakoff (1971), Vetter (1973), Kaufmann (2005), Copley (2009), **ii**, **iv**, **v**, among others) are sentences that make reference to a planned, scheduled, or settled future without any obvious future morphology. So, for instance, (3a) roughly conveys that the Red Sox are scheduled to play the Yankees tomorrow, and (3b) that they are scheduled to beat the Yankees tomorrow, which can only be true if someone has the authority to schedule such an eventuality (say, the Boston Mafia).

- (3) a. The Red Sox play the Yankees tomorrow.
 b. #The Red Sox beat the Yankees tomorrow.

As I argue in **ii**, this authority boils down to the ability to make an eventuality of this type happen. Futurates presuppose that the director has this ability, and assert that they have the desire for it to happen. Unplannable eventualities such as the one in (4) are generally not possible with futurates.

- (4) #It rains tomorrow.

The idea is that (4) is not a possible futurate because it is not possible to have a plan for it to rain (this will be nuanced more later). As I argue in **v**, predictability of the eventuality is not the issue; it is perfectly possible to predict rain, just not with (4).

Futurate readings behave exactly like futures in a number of ways (**i**, Copley (2009)). They have a *ceteris paribus* effect as in (5a) and validate the Future Law of the Excluded Middle as in (5b).

Thus, we will want to make sure that any solution to the specific problems posed by futurates also does well by these more general properties of future orientation. On the other hand, there are also several problems posed specifically by futurates that require answers.

3.1. Four problems posed by futurates. The first problem particular to futurates, which I will call the morphosemantics problem, is one we have already mentioned: that a “tricky” meaning is not associated with morphology.

- (5) The morphosemantics problem: Futurates have a tricky meaning but no morphology

In the past it has been proposed (including to some extent Dowty (1979), and Copley (2009)) that futurate meaning is related to imperfective morphology. It could also be associated with a null morpheme (Copley 2008a) or a default process (Kaufmann 2005). I argue in **iv**, **v** that imperfective aspect only licenses futurate readings; futurate meaning is not located in the imperfective morphology. That leaves a null morpheme or default process. The problem is that to represent the tricky intentional meaning, the morpheme or process would have to have a complex quantificational semantics as in **ii** or (Kaufmann 2005); implausibly too complex, in fact.

The second problem posed by futurates is what we might call the model-theoretic problem. The crux of this problem is that the existence of futurate readings of imperfectives causes a problem for distinguishing such imperfectives from true futures (**i**, Copley (2009)). For imperfectives that don’t have futurate readings, this problem doesn’t arise, because one can say that the run time of the eventuality must overlap the present in imperfectives but doesn’t in true futures. However, this story is unavailable for imperfectives with futurate readings, since such imperfectives allow the eventuality not to overlap the present.

On a Kratzer-style system, it falls, then, to the sets of possible worlds chosen by ordering source or modal base to distinguish imperfectives from true futures. Condoravdi (2002, 2003), Kaufmann (2005),

Kaufmann et al. (2006) distinguish futurates from *will* sentences by using a default or normalcy ordering source. But this condition shouldn't distinguish futures from futurates either; why would the ordering source be different? Both are metaphysical in nature. In both cases, the same laws of physics and the same starting conditions apply. If any epistemic or doxastic modality is used to model speaker beliefs that are recruited when making an assertion, that should be general for any assertion, so for both futures and futurates. So there is no reason why the modal base and ordering source would be expected to be the same for both futures and futurates. This, then, is the model-theoretic problem:

- (6) The model-theoretic problem: Times, possible worlds and ordering sources don't seem to be able to distinguish futurates from futures.

Third, futurates interact with aspect similarly to lexical statives, scoping under aspect (**vi**, **iv**). For instance, as shown in (7), futurates have a flavor of permanence in the simple present and temporariness in the progressive, especially by contrast with the simple present: in (7a), the train schedule would seem to be of long standing, whereas in (7b), by comparison, the schedule has a temporary feel:

- (7) a. The train arrives at 5 tomorrow.
b. The train is arriving at 5 tomorrow.

This behavior is reminiscent of the way lexical statives behave (Dowty 1979): In (8a), the state of my living in Paris is more permanent than in (8b).

- (8) a. I live in Paris.
b. I am living in Paris.

The question is why futurates are stative.

- (9) The stativity problem: Futurates are present-oriented statives.

Finally, the animacy problem for futurates is that futurates seem to crucially require the notion of a plan made by an animate entity, as can be seen by the example in (10), where there is clearly evoked an authoritative entity such as the Boston Mafia who has both the desire (asserted) and the ability (presupposed) to ensure that the Red Sox end up beating the Yankees tomorrow. The combination of the desire and the ability (ii) comes across as a plan.

(10) #The Red Sox beat the Yankees tomorrow.

The fact that animate entities are the only entities that can make plans, and the fact that the notion of plan figures crucially in the explanation of the phenomenon of futurates, suggests that the director (the authority figure) must be animate. The trouble is, as discussed in **v**, that there exist futurates without animate directors and indeed without any plan at all, as in (11):

(11) The tide comes in at 5 tomorrow.

Thus the animacy problem is as in (12):

(12) The animacy problem: Futurates seem to require an animate director, except for some very idiosyncratic cases where they don't.

If we can solve these four problems, and ensure at the same time that the solution can also explain the *ceteris paribus* effect and the Future Law of the Excluded Middle (which as we have seen are general to future reference), we have a good chance at an adequate analysis of futurates.

3.1.1. *Solving the morphosemantic problem.* The morphosemantic problem, again, is that it is striking that there is no extra morphology compared to present-oriented version, despite the planned or settled meaning, whose truth conditions are tricky to state exactly. How do we reconcile this apparent mismatch between simple morphology and tricky semantics?

Globally speaking, we would like it to be more or less true that the more complex the meaning, the more complex the morphosyntax. But of course this is not always true in specific cases. One of the key moves of generative linguistics is to posit unpronounced elements that have a syntactic, and sometimes semantic, life. So it is possible to have a null element that has meaning. Can this be the source of the tricky meaning?

In fact I proposed in **ii** that this is the case. Here we must be careful, however. Unpronounced elements with arbitrarily complex meanings are dangerous: almost anything could be proposed. Especially, we might want to avoid quantification, which would introduce a tripartite structure that we have no evidence for.

One way that an apparently “simple” morphosyntax can be associated with complex meaning is if much of the complexity of the meaning is contributed at the conceptual level. If, as I argue in **i**, futurates and futures differ by length of causal chain from the present to the future eventuality, it makes sense to propose a null *v* head that introduces an eventuality argument which causes a *p*-eventuality. This new eventuality argument represents the plan that gives rise to the eventuality (i.e., to the agent’s action). That is the kind of meaning we want to introduce, especially given evidence **ii** that the plan can be modified by temporal adverbials, e.g. *Yesterday the Red Sox were playing the Yankees*. The length of the causal chain from plan to eventuality must be short, following from the principle of direct causation (Dowty 1979, Levin and Hovav 1994, Wolff 2003, among others).

As I have suggested in section 1 above, and as **xvi** argue, causation and possibility are closely related. We will see shortly how we get to possibilities with this causal proposal.

3.1.2. *Solving the model-theoretic problem (causation)*. Recall the model-theoretic problem: the modal base and ordering source cannot distinguish true futures from futurates (or true futures from imperfec-tives), and neither can times. The use of causation, as suggested above to solve the morphosemantic problem, is also of help here.

I argue in **i** and **iv** that the relevant distinction seems to be one of the length of causal chain. It is not clear how to distinguish long from short causal chains using possible worlds without directly modeling the difference and thereby begging the question. Again, the starting circumstances and laws of physics would be expected to be exactly the same.

But this distinction is possible with our extra *v* head, which introduces an extra causing eventuality and must express direct causation. Because of the principle of direct causation, for a futurate to be true, we need direct causation of something at a particular time tomorrow: this can happen with plans (an intention directly causes something to happen tomorrow) but not rain. This theory correctly distinguishes futurate readings of imperfectives from true futures because either true futures do involve quantification over possible worlds, or because, if they also use reference to causation, it's reasonable that they not be subject to the direct causation requirement, having different morphology.

3.1.3. *Solving the stativity problem (intentions)*. In addition to solving the model-theoretic problem, the causative approach, through intentions, sheds light on the stativity of futurates. This in turn sheds light on why only imperfectives can occur as futurates, and makes a prediction as to which imperfectives can do so.

The causing state is the plan, which I argue in **ii** is an intention; intentions are usually thought of as stative (and we will see more on this just below). As we have seen, the time over which plan holds is subject to modification by tense and aspect (**ii**), suggesting that there is a temporal or eventuality variable there. In the analysis given in **v**, it is the extra eventuality provided by the extra *v* head.

The highest causing eventuality added by the extra *v* head must be stative because the double access of the plan to both the present time and the future time is required both grammatically and conceptually. It is required grammatically because the plan must overlap present because of present tense, (with past tense instead, it would need to overlap past time); it must extend up to the eventuality because of the

direct causation requirement, which demands temporal contiguity (note that this is contra what is proposed in **iv**). It is required conceptually because the plan should be in existence up to the occurrence of the eventuality; the director should not change their mind.

This account of the stativity of futurates also provides a natural way to explain why only imperfectives can be futurates (**v**): Only imperfectives are allowed to be futurates; perfective states are not allowed to continue in this way and so would not allow double access. It is further predicted that crosslinguistically, an imperfective that allows futurate readings must also allow other stative predicates as its complement.

3.1.4. *Solving the animacy problem (dispositions)*. Recall that futurates seem to be about plans, which are necessarily held by animate entities. Yet there are idiosyncratic exceptions in which there is no plan and no animate entity (*The tide comes in at 5 tomorrow*). How can these be ruled in, while rain is ruled out? It is not plausible to have, say, an animacy feature that inexplicably has a few idiosyncratic exceptions (**v**).

Condoravdi (2002, 2003), Kaufmann (2005), Kaufmann et al. (2006) point out that futurates, whether planned or natural, are assertable only in circumstances when the occurrence of future eventuality is treated as *settled*. Recall that settledness was one of the terms for the condition on branching models which guarantees that the Future Law of the Excluded Middle is true; either p is true on all of the worlds or p is false on all of the worlds. Settledness should therefore hold of the model for both future and futurate utterances, as they indicate.

However, intentions were useful, as they were states, and we know that futurates are stative, where the highest eventuality represents the plan. Is there an analogue for cases where there is no plan? The answer is to appeal to the notion of *disposition*. Dispositions will turn out to be able to account for both the causal power of intentions and whatever causal power causes the tide to come in at a certain time. A disposition, effectively, is a state that is a causal power. This means that under certain circumstances, the dispositional state causes something to happen. For instance, a glass's fragility is a disposition that,

when the glass comes into rapid contact with a hard object, leads to the glass breaking (Choi and Fara 2016, Mumford and Anjum 2011). The dispositions we are interested in here are those that cause something *ceteris paribus*.

Intentions can be given a *ceteris paribus* dispositional analysis too (Portner (1997), **xvi**), where intentions are essentially dispositions to act. The idea of an intention fits well with the idea that futurates presuppose ability and assert “net” desire (**ii**), since intentions as well are net desires that are formed with the intender’s understanding that they can perform (or make someone perform) the eventuality. This understanding of intention closely agrees with Condoravdi & Lauer’s (2009) proposal for the kind of intention associated with imperatives; in their analysis, the ability comes from the consideration of all the circumstances.

Dispositions are states, and as we have proposed, futurates also introduce a state as the highest causing eventuality. It may be (**v**) that the only way to have a state cause another eventuality is if the state is a disposition (causal power). In any case, it seems this is the only way to have a state cause another eventuality at a particular later time; i.e., the state needs to be a disposition. If we further suppose that dispositions are conceptual structures that can be referred to, then we have a straightforward way to link the intentional meaning with the causal structure provided in the syntax of the futurate: it is through the fact that intentions, as dispositions, are states, and the fact discussed above that futurates are constrained to having their highest causing eventuality be a state.

Since this is the case, the state argument in a futurate receives reference as a disposition. This disposition is usually an intention, but not always. It is just possible in a few cases for an inanimate entity to have a disposition that causes something to happen like clockwork at a *particular* future time. These cases include natural futurates such as the one in (13a) as well as mechanical futurates such as the one in (13b), and seemingly that is all.

- (13) a. The tide comes in at 5 tomorrow.
 b. The alarm is going off at 6 tomorrow.

This understanding of futurates as having a disposition that directly causes a future eventuality, because it involves a single branch, does the job that many-branch theories do with settledness.

3.2. The best-laid plans. The four problems particular to futu- rates have been resolved by the addition of an extra causing eventuality that refers to a dispositional state. However, we still must deal with the problem general to the paradox of future reference, namely that of how to branch if there is only a single branch in the denotation. In other words, how do we account for the fact that things don't always work out; under what conditions do we fall off the denotational single branch?

Recall from section 2 above that future reference has a dual nature: in some ways it behaves as though we are talking about many branches into the future, and in some ways it behaves as though we are talking about a single branch into the future. One of the ways in which it seems like we are talking about many branches is that the speaker presupposes that nothing unexpected intervenes, that is, the outcome occurs only in the cases where *ceteris paribus*—(all) things are equal to the speaker's expectations. But of course in real life, things are not always equal, and despite this speaker presupposition that nothing unexpected will intervene, sometimes, perhaps even more often than not, such things intervene and the foreseen outcome does not in fact occur.

This is the case for a variety of modes of future reference. It is the case for futures: if I say the Red Sox *will* or *are going to* beat the Yankees, I make the claim based on certain things I believe to be now the case, and how I see them developing given the factors I feel are at play. Or maybe my grounds for this statement are relatively slim, I just have a feeling. What is presupposed when I make these statements is that I have a good grasp of which of the many things I believe are relevant to this issue, and I am confident that I have included them all, or at least, anything I have left out is not significant enough to

make a difference. If I am less than confident on this point, I will hedge by using *may* or *might*, or I will put the future sentence under an appropriate expression of attitude such as *I think*.

But however confident I am, we can agree that things may not work out in the way I foresaw them. Perhaps a pitcher is injured or the hitters by chance perform much worse than usual. In that case, although I was confident enough to use a matrix future sentence, there were other possibilities, and we have landed in one of them precisely because things were not equal, i.e., it turned out I was wrong about either the facts, or the factors at play in those facts developing into the future.¹

Interventions also happen in the case of futurates. The answer has to do with how we understand intentions and other dispositions. We have been following **ii** in saying that the way intentions are manifested in futurates can be understood as an assertion of a “net” desire and a presupposition of ability. Actually, if all desires are taken into account by taking all circumstances into account (Condoravdi and Lauer 2009), then we might get ability for free, as ability might be nothing more than being the strongest causal power, and if we take all circumstances into account, there is no way to include a stronger causal power (but see Mari and Martin (2007) for more nuance on ability).

But if this is the case, how does branching happen? One way is if the director’s desires change; another is if the director’s ability changes **ii**. If I say that the Red Sox are playing the Yankees tomorrow, I say it perhaps because I have seen the schedule and I trust the good faith of Major League Baseball to accurately represent what they have in mind and the faith to bring this about, and I have looked at the weather forecast. However, if a freak hurricane pops up and the game is cancelled, or if there is a players’ strike, or if the baseball commissioner

¹It’s useful here to forget about the philosophical conundrum having to do with the truth values of future contingents; this is a red herring. Whatever one decides the truth value of the original future-oriented sentence is, it does not affect the above discussion. “Speakers cannot have full confidence about the truth values of sentences whose truth they also believe is not objectively settled.” (Kaufmann et al. 2006, p. 99-100).

decides to cancel a game in a political protest—that is, if either the ability or the desire to hold the game changes—the game may not end up happening. The speaker when uttering a futurate sentence presupposes that neither of these will happen, and uses a single branch, in the form of a causal chain, to talk about the future; but nonetheless it could happen. In that case, the starting conditions which the speaker used are re-evaluated. We will return to this idea in section 6.

3.3. Extending the analysis to *have* causatives. The case of futurates provides us a case study of how a “tricky” future, and indeed intentional, meaning with idiosyncratic exceptions can be accounted for despite a very simple denotation. The answer is to let something in the denotation refer to a relatively complex conceptual structure, here a disposition, and then most of the semantic work is done by the conceptual structure.

This answer can be extended to other cases where intentions are crucial to the meaning but morphology is simple. For instance, *have* causatives, in contrast to e.g. *make* causatives, have intentional meaning that evokes an authority. The *make* causative in (14a) could be about my daughter, for example, while the *have* causative in (14b) could only be about my boss, not my daughter. The key intuition is that my daughter does not have authority over me.

- (14) a. Madeleine made me wake up early.
 b. Madeleine had me wake up early.

Even when someone has authority over someone else, this authority does not normally cover eventualities that cannot really be controlled, such as collapsing (**iii**). So, while Obama can certainly make Clinton collapse, he cannot really have her collapse (unless, oddly, he indeed does have control over such an eventuality), as shown in (15):

- (15) a. Obama made Clinton collapse last Tuesday.
 b. #Obama had Clinton collapse last Tuesday.

I argue in **v** that authority is just the ability to directly cause someone else to do something by virtue of one's intention. So, the authority's intention in effect replaces the intention of the subordinate. Thus eventualities that cannot be caused by the direct result of someone's intention are excluded, just as they are with futurates.

Similarly to futurates, as well, *have* causatives have idiosyncratic inanimate exceptions, as in (16):

(16) The book had me on the floor.

So, we have a tricky meaning related to intentions, with idiosyncratic inanimate exceptions. We also have simple morphosemantics; *have* has been argued to have an underspecified meaning, introducing merely a relation between its specifier and complement. One of the ways this relation can get reference is to be equated with a dispositional relationship between the disposer (which resides in the specifier of *have*) and the eventuality description to which it is disposed (which is the complement of *have*). When the disposer is animate, the disposition is an intention, and when the disposer is inanimate, the disposition is a physical disposition. Effectively the whole conceptual dispositional structure comes along for free, although the morphosemantics only picks out the one relation.

These are not the only cases where dispositions are relevant. In general, we should look for cases that despite being morphologically simple, are sensitive to intentionality with the possibility for idiosyncratic inanimate exceptions. As I point out (**i**), generic/habitual readings fall into this category; dispositional *will* (**viii**) does as well. Cases of non-culmination which involve agent intentionality or the lack thereof (Demirdache and Martin 2015, Paul et al. 2017) and out-of-control forms (Demirdache 1997) are also good candidates for a dispositional causation analysis.

4. Implications for the grammatical/conceptual divide

Let us take a step back to take stock of where we are. The paradox of future reference, as we have seen, consists in the fact that a number of diagnostics indicate that future reference uses a single branch extending into the future, while other diagnostics indicate that it uses multiple branches. We have seen how futurates provide evidence that a single branch can be what is referred to in the denotation, while the branching has to do with the speaker’s choice of initial starting conditions and is not represented in the denotation by explicit quantification over possibilities. Such a configuration resolves the conflict between many branches and one branch, allowing us to have both.

In this section, I would like to consider what such proposals of non-denotational branching mean for the relationship between grammar and the conceptual level. I take the term “grammar” to refer to the digital computational system which includes both narrow syntax and compositional semantics; so, broad syntax. The term “conceptual level” refers to the system of concepts which includes, but is not limited to, the lexicon, and which interacts with grammar. We will get a little more precise about what it is along the way.

4.1. Good denotational hygiene. In pointing out that it is possible to accomplish branching in the model but without a quantifier in the denotation, it raises the question immediately of what it means to be in the denotation versus not being in the denotation. For this distinction to have teeth (and clean teeth at that), I suggest a habit of “good denotational hygiene”: namely, we should make sure that the terms, relations, functions, etc. that are in the denotation are understood to be visible to the grammatical system.

Before we begin, we must first agree on how to identify grammatical material and grammatical manipulations, as opposed to conceptual material that is not visible to grammatical manipulations. It may be tempting to think that in formal denotations, the operations, relations, etc. automatically correspond to the grammatical manipulations that are associated with functional heads by the grammar. But this is not

necessarily the case. It's true that, as we have said, non-lexical concepts can be dealt with in the model itself, as interpretations of the terms used in denotations. But denotations can also themselves be used to spell out non-lexical concepts, and do not ordinarily come with the distinction between these and truly grammatical elements labeled.

Because of this, there is currently a lot of leeway in writing denotations, both as to how much complexity there should be in the denotation, and as to which level the complexity in a denotation is meant to reside at. Some denotations have more complexity, some less, and there's usually little to say which part should correspond to grammatically-contributed meaning and which to conceptually-contributed meaning.

Wherever the line is drawn, however, good denotational hygiene helps make clear what is being proposed. To see how this works, we can compare two classic accounts of the English progressive. Parsons (1990) takes the denotation of the progressive to include a term $Hold(e,t)$, which conveys that a possibly incomplete event e holds at time t .

- (17) Parsons: *Mary is building a house* is true at time t iff *Mary is building a house* is true of e and $Hold(e,t)$

The work here is done by the concept of *event* and what it means for an event to hold at a time; it is not explicitly spelled out in the denotation. $Hold$ is a formally rather simple 2-place relation whose interpretation is necessarily somewhat complex, so here most of the complexity is at the level of conceptual interpretation.

On the other hand, consider Dowty's (1979) denotation of the progressive in (18). Here Dowty specifies in the formal denotation what it means to be an incomplete event, in terms of inertia worlds. More work is done within the denotation itself, as can be seen from the fact that the denotation, shown in (18), is more complex than Parson's denotation in (17).

- (18) Dowty: *Mary is building a house* is true in a world w at an interval i iff in every inertia world v for w at i this interval i is

a subinterval of a larger interval where *Mary build a house* is true.

This contrast may make it seem as though Dowty, as compared to Parsons, is proposing a greater role for grammar (more complexity) and a lesser one for concepts (less complexity). However, it is not clear whether all the material in Dowty's denotation should be thought of as grammatically-contributed. To see this, note that there is nothing stopping us from defining a new predicate *Hold-Dowty* and interpreting it with a formally-defined concept as in (19a). Then one could use the new predicate in a restatement of (18) as in (19b), as a kind of abbreviation. Now Dowty's new denotation does not look that much more complicated than Parsons'; it merely has a 3-place relation instead of a 2-place relation. Like the Parsons denotation, much of the complexity would appear to be at the conceptual level, in that the definition of the new predicate is the interpretation of a term.

- (19) a. *Hold-Dowty*(w, i, p) is true in a world w at an interval i iff in every inertia world v for w at i this interval i is a subinterval of a larger interval where p is true.
- b. (new statement of (18)): *Mary is building a house* is true in a world w at an interval i iff *Hold-Dowty*(w, i, *Mary is building a house*)

Since (19b), given the definition in (19a), is equivalent to (18), Dowty could say that nothing has really changed. In particular, he can say that he meant for (18) to be taken as involving concepts all along.

This exercise demonstrates that the formal complexity of a denotation is not necessarily so informative about the division of labor between grammatical and conceptual. But it would be good to be able to get information about the grammatical-conceptual division of labor from inspecting the form of the denotation. Good denotational hygiene ensures that a denotation can be understood as a claim about the grammatically-contributed meaning, while the interpretations of the terms used in the denotation can be understood as a claim about

the conceptually-interpreted meaning. The grammatical level is that which is visible to grammatical operations. Terms in a denotation can in principle be manipulated through (grammatical) operations on that term (notably including semantic composition). The conceptual level, on the other hand, is by hypothesis invisible to these grammatical operations. Formal methods, however, can be used on both levels.

4.2. Drawing the line. The need to draw a line between the grammatical and the conceptual brings up two pressures which are at odds: the Humean impulse, which demands simple concepts and hence entails complex denotations and the Chomskyan impulse, which demands simple denotations and hence entails complex concepts.

The Humean impulse is to ensure that individuation criteria for entities are as simple as possible. This heuristic reflects a reductionist worldview, often associated with David Hume. The prize is an easy-to-understand ontology—one where, ideally, the entities are so well-understood that their individuation criteria are positively boring. A Humean point of view thus permits us to construct a model on a trustworthy ontology, with some confidence that there will be agreement about what the entities are. On the other hand there is no guide in this worldview as to how complicated the denotation should be. So in a reductionist approach, while the concepts are simple, the denotations are complex.

The Chomskyan impulse, on the other hand, is to simplify grammar. Since, with our good denotational hygiene, denotations are in the grammar, this entails simple denotations. Since the complexity has to be somewhere, simple denotations entail complex concepts, which is anti-Humean.

To resolve this tension between the Humean impulse and the Chomskyan impulse, we need simplicity in the denotation, which the grammar sees, and any further complexity to be clearly consigned to the conceptual level.

A clear way to decide between the two extremes as to how much complexity should go in the denotation has been elusive. More Humean

proposals can be very precise in their complexity, but there is disagreement and sometimes even inconsistency about where the complexity resides: it can be written into the individuation criteria of the model, which should be conceptual, but can also be written into the denotation itself, while nonetheless supposed to be conceptual in nature, as in our made-up example; or else nothing is claimed about where it resides, and whether it is visible to the grammar. On the other hand, anti-Humean proposals are generally clear on the point that the grammar does not see the complexity, but often they only deal with the simple operations that the grammar does see, leaving aside the details of the complex concepts that the grammar does not see. There is no general rule that I know of as to how much of the intricacy of meaning should go in the grammatical system and how much should go in the conceptual system. Chomsky's (1965) distinction between explanatory and descriptive adequacy suggests that, however descriptively adequate both kinds of theories can be, there is a right answer about where to draw the line.

For further inspiration we might turn to a more familiar debate about the division of labor between the grammatical and the conceptual, namely the lexicalist/structuralist debate. This debate asks how much of a particular meaning that is associated with a lexical item is due to the interpretation of roots in the lexicon and how much is due to its participation in a syntactic structure. Lexical items are thus responsible for a certain amount of what we may call "conceptual material": the part of the meaning of a sentence that does not come from grammar, but rather arises from how terms in the denotation are interpreted at the conceptual level. The conceptual material that is contributed by lexical items can be called "lexical conceptual material". The lexicalist/structuralist debate is about how much of meaning is contributed by the lexical conceptual material.

Now, consider the semantic denotation in (20):

(20) $\lambda s.$ John smoke in s

To understand (20), one needs to understand how the lambda calculus works, as well as something about the concepts accessed by the lexical items *John* and *smoke*. The lambda calculus is part of grammar, while the concepts accessed by the lexical items are part of the conceptual system.

Lexical items are thus responsible for a certain amount of what we may call “conceptual material”: the part of the meaning of a sentence that does not come from grammar, but rather arises from how terms in the denotation are interpreted at the conceptual level. The conceptual meaning that is contributed by lexical items can be called “lexical conceptual material”.

There is also “non-lexical conceptual material,” of two different kinds in (20). One is what it means for something (e.g. smoking) to occur “in” a situation. This can be thought of as a question of the semantics of the insertion of roots in the Distributed Morphology sense (Marantz 1997, Embick and Noyer 2007); specifically, the way in which properties corresponding to the concepts represented by roots are mapped to linguistic predicates, using relations such as *in*.

The second is what it means to be, e.g., a situation *s*. This is an ontological question, which shows up on the technical level as a matter of variable interpretation. Elements in the ontology are represented by variables and these variables must be interpreted at the conceptual level, i.e., the model; to do so we need to know what it means to be an *x* for any variable *x*.

Normally the relationship between variables on either side of the divide is pretty simple; we might even be lulled into thinking that it is the identity relation. But sometimes this relationship can be more interesting, as with the relationship between forces and force functions that we will consider below (**xii**, **xiii**, **xiv**, **xvii**, **xix**). Strictly speaking, although we are not used to seeing it, there is a dual ontology: linguistic variables in the evaluation function’s domain and conceptual variables in its range. This raises the possibility that they will have different formal properties, a possibility that should be investigated.

So the debate we have not been having, but should be having, concerns the division of labor between the grammar and the conceptual level, just as the traditional lexicalist/constructivist debate does, but instead of being about lexical conceptual material, it is about non-lexical conceptual material. The traditional debate asks how much of a particular meaning that is associated with a lexical item is due to the interpretation of roots in the lexicon and how much is due to its participation in a syntactic structure. The analogous debate here is to ask how much of a particular meaning that is associated with *non-lexical* material really comes from the functional heads (grammar), and how much comes from how classes of properties are mapped to predicates and how variables are interpreted.

4.3. No abstentions. This perspective allows us to take a stand on the question of whether doing semantics forces one to make claims about cognition. The answer is that one is always making either claims about cognition (the conceptual level), about syntactic composition (the grammatical level), or about the mapping between them (and cf. Jackendoff (1972, 1990)). There is nothing else. It is not legitimate to say that one is doing semantics but nonetheless not making a claim about any of these.

Much of model-theoretic semantics has always treated models as making claims about the conceptual level. But not everyone doing model-theoretic semantics explicitly intends to make claims about the conceptual level; sometimes an abstention is given as a response to a question about a complex denotation. I think there are a couple of reasons for this. One is simply that the use of formal tools may give the impression that we are always in the realm of grammar. Another reason is the assumption of a rather direct one-to-one correspondence between a variable as manipulated in the grammar and a conceptual entity. Often there's no reason to assume that this correspondence is anything other than identity, or as close as makes no practical difference, in which case there is no additional substantive discussion to be had about the

conceptual level. But as we do have a dual ontology, the picture is more interesting.

Apparently complex meanings, or paradigms of meanings, can be associated with simple morphosyntax when the complexity has to do with the mapping between the grammatical and conceptual levels. This can occur in two ways: either the very fact of mapping makes the meaning look complex, because the grammatical and conceptual elements being mapped to each other have different properties; or the mapping itself is more complex than would initially be expected.

For an example of the first case, Roy and Soare (2013), noting that simple event nominals (*party*, *meeting*) have long been thought to have an event argument in them (Grimshaw 1990), nonetheless argue that all the tests to detect such an event argument are lexical-conceptual in nature, not strictly grammatical. Simple event nominals simply do not pass grammatical tests for the presence of an event argument the way that derived nominals such as *destruction* do. Consequently, they propose that simple event nominals have a grammatical individual argument that is mapped to a conceptual—i.e., non-syntactically-visible—event. This non-identity mapping makes simple sense of what would otherwise be a relatively complex pattern.

States may provide another such example. There are arguably only a few cross-linguistically valid tests for stativity (e.g., triggering epistemic readings in modal contexts), but many language-particular tests. This complexity may well stem from a system that recognizes different kinds of states (“Davidsonian” and “Kimian”) in a single grammatically-visible ontology (e.g. Maienborn (2005)). However, it could also reflect a single grammatically-visible state variable with certain formal properties mapped to different conceptual variables that have (possibly different) formal properties. This would be reminiscent of the Roy & Soare proposal for simple event nominals in which an entity variable at the grammatical level corresponds to a conceptual event.

4.4. Both ends against the middle. How do we actually do semantic research, on this view of the architecture of semantics?

Let’s characterize two extremes. One way to go about research is to look at some data and create a model using entities with precise individuation criteria. Any interactions between entities can be precisely modeled. This is the familiar Humean approach: we can also call it the “model-first” approach.

If on the other hand we decide to take an anti-Humean approach, however, there is not much point in starting by creating a model. The reason is that we would have no faith in the entities, functions, or relations in it—the whole point of an anti-Humean approach is to discover the properties of entities with relatively complex individuation criteria, so we cannot start with these at the beginning. Instead we take our cue from the morphology to get a sense of how complex our denotations are allowed to be, and come up with provisional entities, functions, or relations that fit the bill, with their precise inventory of properties to be discovered. We can also call this anti-Humean approach the “grammar-first” approach. Both the Humean, model-first approach and the anti-Humean, grammar-first approach have their strengths and weaknesses.

A Humean, model-first approach is nice because it has precise individuation criteria, so it is easy to calculate truth conditions as well as entailments and other predictions. A weakness of this approach, however, is that it can generate implausibly complex denotations that risk being only descriptions, not explanations, of truth conditions—assuming that Chomsky is right and the grammar is minimal, and recalling that denotations are part of the grammar. Thus the relationship between arbitrarily complex denotations and (often simple) morphosyntax is complicated. To be sure, descriptive adequacy in semantics is often more than challenging enough, and the precision of the model-first approach inspires confidence that it will get there in the end. But the lack of a constraint on the complexity of denotations is a problem and arguably slows progress.

In an anti-Humean, grammar-first approach, starting with provisional entities particular to the phenomenon and language in question, and presuming a close relationship between morphosyntactic and denotational complexity, the aim is for simplest explanation of interactions. We can make progress without entirely understanding the individuation criteria and constructing a full model. If we cannot be fully precise, we can at least identify a class of models Kamp (2015) that would be appropriate. Such an approach has a better chance at explanatory adequacy since it is anchored to grammar. (This chance would increase if a principle of relating morphological and denotational complexity can be agreed upon.) It also places us in a good position to determine whether complexity is in grammar (the denotation), the conceptual level, or the mapping between them. A natural criticism of the grammar-first approach, of course, is that without precise individuation criteria it can be difficult to make precise predictions. It is not *impossible* to make predictions; though rather than being about entailments, they will tend to be about grammar (as in **v**, e.g., the prediction that only imperfectives that take statives allow futurate readings). But the criticism is well taken.

In sum, the model-first approach guarantees semantic precision but does not necessarily prioritize accuracy with respect to morphosyntactic theory; the grammar-first approach provides a certain level of accuracy with respect to morphosyntactic theory but does not necessarily aim first for semantic precision. Thus it makes sense to adopt a both-ends-against-the-middle strategy: attack the problem of meaning from both sides, with grammar-first theory providing proposals for plausible grammatical and conceptual entities (functions, relations) and the division of labor between them, and with model-first theory providing proposals with precise truth conditions. If we can make these approaches meet somewhat in the middle, we will know we are on the right track. For example, an obvious next move for futurates will be to construct a model that allows dispositional causation as it is proposed in **v**.

There is a further check available on semantic theory: Any conceptual interpretation, as I have mentioned, is necessarily a proposal about cognition, and is subject to evaluation by cognitive psychological methods. So, the proposal in **v** entails a claim that the notions of disposition and direct causation both have a psychological reality. Claims from cognitive psychology therefore become relevant; for example, a finding by Wolff and Barbey (2009) that subjects find long causal chains to involve more indeterminacy than short causal chains. In **(xviii)**, as well, we argue on the basis of experimental data for a distinction between force interaction on the conceptual level and force interaction on the grammatical level. The testing of the conceptual part of semantics according to principles of psychological theory is exactly parallel to work at the syntax-semantics interface, which tests the grammatical part of semantics according to principles of syntactic theory. One goal here, then, is to refine formal proposals to reflect a plausible grammatical/conceptual interaction, as well as to propose hypotheses that can be tested using psycholinguistic and other methods of cognitive psychology.

5. Conditionals, eventuality type, and assertability

We turn now to another way in which language talks about what happens next, namely, indicative conditionals. In keeping with our anti-Humean, grammar-first approach, we will zero in on the difference between stative and eventive predicates in English to see what we can conclude about the nature of their arguments (**vi**, **vii**).

I will adopt several assumptions about the difference between the arguments of stative predicates and the arguments of eventive predicates, in particular having to do with their assertability. By following the logic of these assumptions, we will, I argue, learn something about the nature of epistemic and metaphysical modality, supporting broadly dynamic (semantics) views of both. It will further suggest something counterintuitive (and yet perhaps intuitive after all) about conditionals: namely, that they ultimately express a causal relation between two events, with the option that either or both events can be a speech

act. This analysis resembles an analysis that Krifka (2014) gives for Austinian/“biscuit” conditionals.

The first assumption is (following Katz (2003) among many others) that there is a type difference between stative and eventive predicates. This is not the only possible position and it is not, for instance, one that I assume in **v** (the argumentation in that paper would, though, be consistent with a cover type for both states and events being used). One could instead eschew eventualities altogether (e.g. Beaver and Condoravdi 2007, Hallman 2009); another possible move is to have more than two basic types (Maienborn 2005, 2007). Nonetheless I will assume two types.

The second assumption we will make is that this type difference between statives and eventives corresponds, by its nature, to a difference in assertability. Only stative predicates are of the type that can be asserted. Eventive predicates in English are not, except on the generic/habitual or futurate readings, both of which we know now are stative, so they do not count as eventive.

- (21) a. I am in the room.
 b. I eat.

Nonetheless, it’s possible to have bare eventives in a kind of oddly performative, play-by-play account, as in a sportscast (Leech 1971, Comrie 1976, Smith 1991).

- (22) He shoots, he scores!

(22) is not performative in the sense of performing the act of shooting, e.g., with the utterance, but it still feels quite immediate.

How might this work formally? Another assumption is in order, namely that assertions are in some sense about situations, in more or less the sense meant by Barwise and Perry (1983) or Kratzer (1989). This would mean that statives are situation predicates. Eventives are something else; the easiest thought here is that they are predicates of events. Let’s assume, given the bareness of the eventives and their

performative flavor, the play-by-play account is describing events rather than making assertions.

A final word before we turn to the task at hand: The job of aspect, on this picture, is to turn unassertable things—event predicates—into assertable things—propositions. This is in line with a longstanding, though not unanimous, tradition on aspect (e.g. Klein 1997) often involving times rather than situations, with the idea being that assertions locate events in time. This is also the picture of aspect in a more recent cartographic proposal Ramchand and Svenonius (2014).

5.1. Unexpected future orientation. As we have seen above in section 3, English matrix present tense sentences can have future orientation. They get only a futurate reading, however, not a true future reading: “unplannable” or “non-settleable” eventualities are excluded. Such eventualities, we saw, are those that cannot be directly caused by a current disposition. In contrast to futurate readings, true future sentences, on the other hand, can talk about any eventuality.

In modal contexts, including in conditionals, English bare verbs have future orientation and are not required to be futurates. In **vi**, **vii** I referred to these as Unexpected Future Orientation. How unexpected these UFOs are depends on one’s point of view. What is really surprising, though, from the point of view of section 3, is that these are not necessarily futurates. That is, true future readings, which put no constraints on the eventuality, are apparently possible at least with some modals, as shown by the examples in (23), which have unplannable eventualities²

- (23) Real future readings under modals
- a. Madeleine might/may/could get sick tomorrow.
 - b. It might/may/could rain tomorrow.
 - c. The Red Sox might/may/could beat the Yankees tomorrow.

²Some modals don’t permit these though: *Madeleine #must/#should get sick tomorrow.*

Unplannable eventualities are also possible with bare verbs in conditionals, both antecedent and consequent, regardless of whether there is a future such as *will* in the consequent, as shown in (24).

- (24) a. If Madeleine gets sick, the Red Sox (will) beat the Yankees.
 b. If it rains tomorrow, the Red Sox (will) beat the Yankees.

Of course, futurate readings are possible too (Condoravdi 2002), (vi):

- (25) a. He may see the dean tomorrow.
 b. If Madeleine leaves tomorrow, I'll call her today.

But why do (many) English modal contexts permit non-furate future reference, while matrix contexts do not? This is the real problem.

The move we will make here is to take advantage of the hypothesized type distinction, and concomitant assertability distinction, between statives (situation predicates/descriptions) and eventives (event predicates/descriptions). So, as we have hypothesized above, matrix sentences in English cannot be event descriptions, simply because in the matrix, one is making an assertion, and an event description by its nature cannot be used to make an assertion; one needs to use a situation description instead. As we saw, futurates are necessarily stative. Statives are by assumption situation descriptions. So this would be the reason why matrix contexts do not permit non-furate readings and permit futurate readings.

On this story, we need to answer two questions: why event descriptions are felicitous in these modal contexts when they are not futurate or generic/habitual, and why they get a true future reading.

The answer to the first question would have to be that in modal contexts one need not make an assertion of the prejacent: event descriptions are possible under some modals. This means must say how modality would be possible without propositions; yet, since event descriptions are large enough to have plenty of content in them, this should not be in principle a deal-breaker. We will follow this line of inquiry further below.

For now we will try to answer the second question: why do UFOs get a *true* future reading?

5.2. A three-way correlation. To answer this question we must note the association between modal flavor, eventuality type, and temporal orientation in conditionals. Excluding deontic readings, I argue in (vi) that modal flavor, eventuality type, and temporal orientation have a three-way correlation. That is, metaphysical modality, eventivity, and future orientation go together; and epistemic modality, stativity, and present orientation go together as well.

One part of this argument is that there are no truly future-oriented statives in modal contexts; where they appear to be future-oriented, it is really that they are present-oriented with respect to a temporal argument which is itself future-shifted.

The argument also depends crucially on the absence of epistemic readings of eventives. This in turn depends on the analysis of futurates developed in ii, iv, v and discussed above in section 3, where futurates are statives. In effect they behave like present-oriented statives, just as generic/habituals do. This being the case, no exception need be made for what looks like epistemic readings of eventives; there is no such thing.

Heeding our assumption that the difference between states and events is a type-driven difference in assertability, we can recast this three-way correlation as follows: Epistemic modality takes $\langle s, t \rangle$ arguments and orients them in the present, while metaphysical modality takes type $\langle v, t \rangle$ arguments and orients them in the future.

This proposed type difference between modal flavors is a departure from the common assumption that modals have uniform semantics (cf. Skibra 2017). It is not a large departure, however; it has precedent in previous treatments that take certain inherently-future-oriented propositions to be of a different type (Portner 1997, Ginzburg and Sag 2000, Laca 2010). If a type difference of the kind I am suggesting holds for modals in general, it would provide a certain advantage in answering

the question why epistemic modals scope high and root modals (including metaphysical modals) scope low in phrase structure, as proposed by Hacquard (2006). The answer given to this question in Hacquard (2010) is that the eventuality argument in epistemic modals must have associated informational content, so it must either be relativized to a speech event (as by default in a matrix context), or to an attitude event. However, this constraint is not needed (or rather, is already packaged into the distinction between situations and events), if we have our type difference between epistemic and metaphysical modals and we assume along with Ramchand and Svenonius (2014) that situation arguments, or something like them, occur higher in the tree than event arguments.

So, a type difference between epistemic and metaphysical modal flavors is plausible. But we are still trying to answer the question of why eventives in modal contexts are future-oriented while statives are not; does relating eventuality type to modal flavor help us? Given the three-way correlation, the answer should hinge on the difference between the modal flavors. The idea that asserted propositions are context change potentials which alter the information state finds an analogue in a view of events as “world change potentials” in which their occurrence alters the state of affairs in the world. Yet information and the world do not quite behave the same way. We are aiming at something like (26), where (26a) is familiar but (26b) is less so:

- (26)
- a. epistemic modality and assertion concern a relationship between a proposition p_{st} and an information state/common ground/set of speaker commitments
 - b. metaphysical modality and play-by-play commentating concern a relationship between an event instantiated by p_{vt} and a history of events

But now we can finally get a hint of a difference between statives and eventives: it should be something like the following. Adding assertions to a common ground or set of speaker commitments doesn't take time (Krifka 2014), so the next assertion is added instantaneously, but

events in the world do not behave this way, so the “next” event is truly, temporally next. While this idea obviously glosses over the existence of instantaneous events, such as *reach the summit*, and cases of entrainment, where one event causes a simultaneous result, the

A couple of points arise with this characterization. First, it’s interesting that though we know events and states are happening at all times all around us, the play-by-play perspective where one thing at a time is described, something like a multi-sentential version of Croft’s (1991) observation that sentences present causal chains, not causal networks. This may well be relevant to metaphysical modality. Secondly, the idea that metaphysical modality involves addition of an event to a history brings metaphysical modality in line with perspectives where illocutionary force is update of a set, either something like a common ground or in the case of imperatives, a to-do list (e.g. Portner 2004).

5.3. Causal conditionals. So: let us suppose that play-by-play commentary, and metaphysical modality are dealing with histories or sequences. Now consider what happens in a bare (no futures or modals) English indicative conditional. The temporal relationship between antecedent and consequent is the causally-mediated temporal relation: the consequent eventuality cannot begin before the antecedent eventuality (**vi**). This suggests that the sequence or history is a causal chain (**vii**); it is hard to imagine another explanation for it, and spelling it out explicitly entails a bit of denotational complexity. If on the other hand we want a causal relation, we put a causal relation in the denotation, and interpret it at the conceptual level as causal, and there is no need for times in our denotation.

But of course there are immediate counterexamples to the idea that conditionals are causal, as in (27). The interlocutor’s thirst certainly does not cause there to be a beer in the fridge. If the creature under discussion has a heart, that does not cause it to have a liver.

- (27) a. If you’re thirsty, there’s beer in the fridge.
 b. If this creature has a heart, it has a liver.

Following an analysis by Krifka (2014) of Austinian or “biscuit” conditionals as in (27b), I argue in **vii** that in these cases that do not seem to involve causation between the events described, what is really going on is a causal relation between speech acts that are similar to assertions. To do this, we need a type-shifting operation that shifts situation predicates to event predicates, as in (28). This ensures that any propositions are shifted to events of adding such propositions to the set of speaker commitments.

$$(28) \quad \text{ADD}(e) = \lambda C \lambda p_{st} . e \text{ is an event of adding } p \text{ to } SC_C$$

Conditionals then uniformly take event descriptions as their arguments, as in (29), and express a causal relation between them.

$$(29) \quad \text{conditionals: } \lambda p_{vt} \lambda q_{vt} . \text{ all causally accessible courses of events from } e_C \text{ that include an } e' \text{ such that } p(e') \text{ are such that: all causally accessible courses of events from } e' \text{ include an } e'' \text{ such that } q(e'')$$

However, a proposition can be type-shifted to an event description using ADD, and then it can be an argument of a conditional.

This analysis lines up with syntactic evidence from Haegeman (2003, 2006) who distinguishes *if*-clauses which modify the main clause event from *if*-clauses which structure the discourse. Similarly to Haegeman’s theory, this difference here is mediated by a larger element for the more discourse-related conditionals (merging at CP for her, adding ADD for me). Unlike Haegeman’s theory, however, the current theory entails that antecedents and consequents each have their own modal flavor, a proposal that decidedly contrasts with accepted theory, but which I do not find evidence against.

5.4. Futures, eventuality type, and assertability. We have seen that eventuality type can have an impact on modality. This point has implications for another phenomenon, namely in futures that behave as though they have an aspect scoping over them: as if they themselves are stative (in which case I proposed (Copley 2009) an aspect

scoping over a future modal) or eventive (no aspect). These distinctions engender entailments that, I argued, result from the interaction of aspect and modality. In **viii**, I argue that future morphology can be associated with an aspectual head over a future modal. The argument comes in part from the analysis of the contrast shown below in (30). While it is felicitous to use *will* for an offer, as shown in (30a), it is infelicitous to use *be going to* as an offer, as shown in (30b).

- (30) a. We'll change your oil in Madera. ✓offer
 b. We're going to change your oil in Madera. #offer

The reason for this has to do with the intuition that (30b) seems to contradict part of the pragmatic condition on felicitous offering, namely the part in (31b) (where q is “we change your oil in Madera”).

- (31) Offering condition (two parts)
 a. If the hearer wants q , q .
 b. If the hearer wants *not- q* , *not- q* .

The question, then, is why (30b) and (31b) are contradictory, or in other words, why *be going to q* seems to preclude the idea that a q -eventuality might not happen. For it certainly seems as though, when *be going to q* is true, a q -eventuality is *already* or *anyway* going to happen, i.e., regardless of anything else that may occur.

The answer presented here is that while *will* is just the future modal WOLL (Abusch 1985, Condoravdi 2003), *be going to* decomposes to a temporal progressive in the style of Bennett and Partee (1978), Klein (1997), plus the future modal WOLL. So, *be going to* quantifies over not just the worlds that branch off from the present instant, but also over some worlds that branch off before the present instant. It follows that in a *be going to* conditional (30b), what is ongoing is the *futurity* of q ; that is, the fact that a q -eventuality will happen. By contrast, this is not the case in a *will* conditional as in (30a), because *will* only quantifies over worlds that branch off from the present instant.

The primary appeal of the story given in **viii** and **ix** is that it provides a completely compositional interaction between temporality and modality, using a branching time model to explain why the (proposed) presence of progressive aspect yields modal effects. Since on a branching time model, different worlds branch off at different times, and since an aspectual operator above the modal affects the temporal argument of the modal, aspect ultimately has an impact on which worlds are quantified over. In an *if p, q* conditional, this generates what I call the “anyway entailment”: some *not-p* worlds are *q* worlds. Offering contexts are “anyway-conflicting” in that they conflict with the anyway entailment, which is why they conflict with anyway-entailing *be going to*.

Similar facts suggest that certain readings of *will* have an aspectualized reading, though rather than a progressive aspect, they feel more like a generic/habitual aspect, as in (32), as they need more or better or more general evidence, or more strongly inevitable conclusions.

(32) Oh, she’ll show up, all right.

The argument relies again on the idea that assertability differs between stative and eventive i.e., between aspectualized WOLL and non-aspectualized WOLL, In the terms of section 5, the aspectless WOLL would have to be type *vt*, i.e. the reason it cannot be asserted is because it is about an event. Conversely, *be going to* and generic *will* would have to be type *st*, i.e. they can be asserted because they are about a situation. If we think that the morphology in *be going to* indicates two heads, we can retain a progressive + WOLL analysis for *be going to*. This kind of analysis is implausible however for generic *will*, which like verbal generics shows no morphology; the aspect should be “baked in” to the denotation. Either way, there would be an aspectual difference (progressive vs. generic vs. no aspect) between *be going to* and both forms of *will*, namely bare *will* and generic *will*.

A different idea for the distinction between *be going to* and *will* is presented by Klecha (2011). The idea is one of modal subordination:

be going to and *will* differ in assertability because the world argument *be going to* need not be bound while the world argument in *will* needs to be bound. The main problem with this account is that it does not capture the difference between generic *will* and *be going to* (noting that generic *will* and bare *will* seem to each have analogues in Indonesian that are distinguished, **ix**). However, there is something attractive about linking aspect to assertability through modality, which after all is what I was trying to do above as well. We can join these approaches if we think of the situation argument in the stative predicate to be analogous to Klecha's world argument; it does not need binding. Events, on the other hand, would end up needing to be bound (unless in a play-by-play account or a performative), exactly because they are not something at which an assertion can be evaluated.

The aspectualized future facts bear on the question of how to treat the branching futures for true futures. At the time, I saw the argument for aspectualized futures as part of an argument that branching is a necessary part of the denotation of futures. If the denotation is the only game in town for where to put the branching, this follows. For the current discussion, though, the need for branching is not in dispute. The question instead is where the branching resides, as we now have two options: either in the grammar, i.e. in the denotation (using good denotational hygiene), or at the conceptual level, i.e., as non-denotational branching. If the latter, however, the question arises as to how aspect interacts with it. Because of this, any argument that (these) aspectualized futures have a single branch in their denotation, with branching being non-denotational, would have to treat (these) aspects as non-denotational themselves, i.e., affecting the contextual variable. I will not offer an opinion on this issue here.

6. How to fall off the single branch

We have so far seen some examples of how to do what happens next with a single branch: futurates, eventives in modal contexts, conditionals, and (briefly) WOLL and friends. But a single branch theory is only as good as how it manages branching: We need to characterize

what it's like to fall off the single branch. Remember, despite there being a single branch in the denotation, there is still plenty of room to fall off it, because although there is no quantification over possibilia in the denotation, there are still going to be possibilia in the model. And these possibilia should be the ones the speaker views as not normal or stereotypical.

6.1. Things being equal. It is understood from much previous work, stemming largely from the work of David Lewis, that in metaphysical modality, normalcy or stereotypicality or inertia is involved: we fall off the single branch precisely when things are not normal or stereotypical or continuing on inertially. These we can collect as *ceteris paribus* conditions—conditions that, regardless of their exact technical implementation, ensure that things are equal. On theories with quantification over branches in the denotation, we would normally use an ordering source pick out best (according to plausibility, normalcy, stereotypicality, highest entropy, etc.) worlds consistent with facts (modal base). Then one needs to ensure that a homogenized/settled/veridical set of histories is a subset of such a set.

But how do we do a *ceteris paribus* condition with a single branch? The way to do this that would be most similar to the many-branch theories is to say that the single branch is in such a set. This could be done. However, if our single branch is a causal chain, as in the case of futurates, there is another opportunity here that is perhaps more conceptually plausible—provided one believes that reasoning through a causal chain of events does not involve constructing all possibilities and taking a normal subset of them, but rather, running one or more simulations of causal chains in one's mind. (This is the analogy to phonological theory mentioned in the introduction, with the first option similar to Optimality Theory and the second option similar to transformations.) In the simulation scenario, one imagines a situation that includes particular facts as well as various laws and dispositions,

and runs the simulation forward, assuming that nothing arising external to the imagined situation intervenes. This last assumption is a so-called “closed-world assumption”.

In this scenario, there is no need to construct a set of most normal worlds. Instead, the knowledge that would have gone into calculating a set of normal worlds is instead used to construct one or more simulations of a normal causal chain of events. One knows that at any causal link in the chain something *could* happen contrary to what one has imagined: something could intervene that one has not taken account of in one’s imaginings. But one presupposes that it won’t, i.e., one makes a closed-world assumption.

In this way, with just the particular starting conditions, the general laws of physics, and the closed-world assumption, we should be able to get the same result for metaphysical normalcy—namely, an appropriate *ceteris paribus* condition—as we would if we constructed a set of most normal worlds given the starting conditions.

This train of thought represents a reorganization, not a repudiation, of the knowledge that would otherwise go into constructing modal bases and ordering sources. If we pursue this reorganization, it makes it clear that something extra is needed. When one constructs a set of the most normal worlds, it may go without saying that normally, the actual world is or turns out to be one of these worlds. On the analogous mechanism in the new perspective, however, we have to explicitly say whether the circumstances and laws the speaker has in mind are in fact all one needs to determine what happens next, or if something else intervenes. In fact, as we will see now, there seem to be cases where the speaker conveys that something might or does intervene, so we need to account for such cases.

6.2. Efficacy. In **xi**, **xiii**, **xiv**, **xvii**, a notion of *efficacy* is proposed to fill this gap. Informally, efficacy is “when the actual world turns out to be one of the best worlds” (**xi**, p. 11). That is, for a metaphysical modal, what is supposed to happen, actually manages to

happen. The original proposal in **xi** for metaphysical *should* (**x**) characterizes efficacy with relations between sets of worlds. Louie (2015) instead treats efficacy as more along the lines of the informal definition in order to relativize it to times, proposing that efficacy that the world of evaluation is identical to one of the worlds in the modal’s domain of quantification, for the duration of the time of evaluation t . In the single branch proposal pursued in **xiii**, **xiv**, and **xvii**, a situation is efficacious if it gets to determine what happens next without anything intervening that arises from factors external to that situation. The definition in **xiii** defines a situation as efficacious iff any enlargement (supersituation) of that situation would lead to the same successor situation. While it is not clear that updates of accepted situations are always supersituations of the accepted situations—i.e., one can be wrong about the contents of a situation, not just learn something new—this definition is on the right track.

Efficacy bears a resemblance to a few other principles or properties in the literature. Louie points out a similarity to Kratzer’s strict counterpart relation, used for deriving actuality entailments (Kratzer 2011). In both, there is identity between particulars for a certain duration. Indeed, Louie finds this similarity to be non-accidental; she uses her version of efficacy to account for actuality entailments as well.

Second, and continuing with the theme of actuality entailments, efficacy seems to replace the idea that there is a presupposition of ability in futurates (**ii**), (Copley 2009) and futures (Copley 2009). This however would end up as an “action-dependent ability” (Mari and Martin 2007) rather than a general ability, as efficacy is the claim that in actuality, nothing perturbing intervened, rather than the claim that, *ceteris paribus*, nothing would ever be able to intervene. This point ought to be clarified empirically as to which kind of ability is involved in different kinds of future reference.

A third principle comes into play with the situation-based construal of efficacy understood in **xiv**, **xvii** and defined in **xiii**. We propose a historical efficacy requirement for situations which are anterior to the

reference situation s_0 ensures that there are no supersituation alternatives to the previous situation s_{-1} that would lead to an alternative to s_0 . In this, historical efficacy, as a condition on the model, plays a similar role to the role that historical necessity plays in a multi-world approach, where the model is constrained such that a proposition evaluated at a past time has the same truth value no matter on which world it is evaluated.

However, there is work to do here if historical efficacy is to truly do the job of historical necessity. First, for situations causally prior to s_{-1} , it must be spelled out explicitly that the speaker's acceptance of $\llbracket s_0 \rrbracket$ and the lack of alternatives for s_{-1} would result in the speaker's acceptance of $\llbracket s_0 \rrbracket$; then historical efficacy can be applied recursively as far back as needed. Second, we must have in mind at least a way to model speaker's epistemic or doxastic alternatives about the past; should these be accounted for only through the use of situations that are silent on various points where the speaker has no knowledge/belief, or should there be alternative situations represented?³ Third, efficacy should be further examined in the context of Condoravdi's and Kaufmann's proposal that historical necessity/settledness can, depending on circumstances, partially extend into the future for some outcomes and thereby guarantee homogeneity for future reference. For example, for futurates, in the causal single branch theory of **v**, we must be able to represent a notion of dispositional causation. Dispositional causation is an example of stative causation; it might even be the only method by which states can cause. As Darteni (2017) points out, stative causation cannot be accounted for in the informal framework of **xvii**; accordingly, futurates, which rely on dispositional causation, which is (at least) a species of stative causation, cannot be represented using the model in **xiii**.

The model-theoretic details of efficacy are therefore still to be explored. However, there has been some progress in determining where efficacy requirements reside in the language architecture. In the initial

³In general, too, the behavior of possibility modals, metaphysical as well as epistemic, is not accounted for.

proposal in **xi**, efficacy is located in the denotation. This is also true in the case of **xii**, which investigates a particle *cem* in Tohono O’odham that seems to require negative efficacy, that is, a requirement that the actual world *not* be one of the inertia worlds. However, by **xiii**, **xiv**, **xvii**, efficacy is presupposed (or not), and historical efficacy as sketched in **xiii** is a condition on the model. Louie (2015) argues that efficacy is a default for Blackfoot modals, though lexically specified for certain English modals. An advance here also comes from Cable (2017), though he does not refer to a notion of efficacy. The Tlingit decessive that he is looking at is similar to Tohono O’odham *cem*. He analyzes the Tlingit decessive as a simple past tense that competes with the bare form non-future. Due to this competition, a negative efficacy effect arises from the use of the marked past tense, from pragmatic principles. This non-denotational branching analysis, which in line with **xiv**, looks to be viable for Tohono O’odham as well, is another analysis to add to the list of non-denotational treatments of metaphysical branching.

I anticipate that such an approach will also be useful for the French periphrastic progressive *être en train de*. In **xv**, on a many-branch approach, we argue that *être en train de* involves a relationship between what is in progress (modeled using propositions and an stereotypical ordering source) and something else either in progress (stereotypical ordering source) or desired (bouletic ordering source). Not only does this meaning have a flavor very similar to that of the negative efficacy cases, but *être en train de* is also in competition with the unmarked French *présent* for an ongoing meaning, just as the Tlingit and Tohono O’odham cases are in competition with an unmarked form for past meaning. Such an analysis has the potential to deepen our understanding of the ingredients of efficacy and efficacy-like effects.

7. Reifying forces

Several of the themes that have arisen for future reference in general, such as causation, *ceteris paribus* conditions, and non-denotational branching, also come into play at the level of the Davidsonian argument. As we argue in **xvii** and **xix**, if some Davidsonian arguments

represent the commonsense idea of *force* rather than the commonsense idea of *event*, we can account for much of the complexity inherent in the aforementioned themes at the conceptual level, without overburdening the denotation. Here, I present some of the advantages that arise from representing forces.

7.1. The case for forces.

7.1.1. *What is a force?* We can understand the commonsense notion of force (\mathbf{xx}) as an input of energy that has an origin at which the energy is applied, a direction toward which the energy is applied, and a magnitude which corresponds to the amount of energy applied. These characteristics of forces can be represented by construing forces as vectors. This is a natural way to think of physical forces, and it only then takes a small step to represent other, more abstract forces, namely as an impetus or tendency toward some result (direction) having some intensity (magnitude).

Elements of this definition of force have also been claimed for the commonsense notion of event. Energy, for instance, is routinely claimed for events, although change is a competing notion, and perhaps direction is possible in events, in the form of a path. Magnitude is harder to claim for events, though perhaps intensity is the appropriate notion. So at first glance it seems that event talk and force talk are quite similar. However, force talk allows us to do more than event talk in two ways.

The first has to do with modeling force interaction: vectors can be summed with each other to represent the interaction of two forces, whereas events cannot really be summed (without further analysis) to represent the interaction of two events. Significantly, configurations of force interactions are often important to lexical distinctions, and the notion of efficacy as discussed in 6 above hinges crucially on the notion of intervention, which is just interaction with something that arises from outside of a situation. The second advantage of force talk over event talk is the *ceteris paribus* property of forces: the fact that a force has a result that happens only when “(all) things are equal”. If I push

on a cup, all else being equal, the result is that it moves in a certain way or moves to a certain location. All else is not equal when something external to the force intervenes through force interaction—so, for example, if the cup is stuck to the table, the force I apply may not result in any change in location of the cup. Note as well that it is analytically clear how a force, modeled as a vector (perhaps a quite abstract one), has a *ceteris paribus* result—it is the vector’s direction. In contrast, although truth conditions for continuations of events can certainly be detailed in a Humean fashion (see, for instance, Landman (1992)), it is not at all *analytically* clear how an event has a *ceteris paribus* result.

Where such interaction and *ceteris paribus* characteristics are seen, it is thus a reasonable hypothesis that force dynamics is being recruited at some level, regardless of whether the Davidsonian argument manipulated by the grammar is called an event or a force.

7.1.2. *Telicity and the imperfective paradox.* The understanding of Davidsonian arguments as similar to commonsense forces also brings together two strands of thought about telic predicates. A pervasive distinction between theories of telicity is between those that recruit one or more causal relations between subevents (e.g. Pustejovsky 1995, Higginbotham 2000, Ramchand 2008) and those that recruit the idea of a distinction between maximal and non-maximal events (Bach 1986, Parsons 1990, Krifka 1998, Rothstein 2008, Filip 2008).

As we argue in **xvii**, the choice of which kind of theory to use has much to do with how one views Dowty’s (1979) imperfective paradox. The imperfective paradox is the fact that is perfectly possible to say that Mary was painting the dresser (a telic predicate) without entailing that the result state occurred:

- (33) a. Mary painted the dresser black, but she didn’t finish.
 b. Mary was painting the dresser black, but she didn’t finish.

The main problem the contrast in (33) raises for Dowty, who uses a causal relation in his telic predicates, is how to achieve the contrast given that (A) his accomplishments have a causal relation, and that

(B) the causal relation (here based on Lewis (1986)) entails that the result occurs. To solve the problem, Dowty famously accepts the idea of inertia worlds, which allows him to maintain both (A) and (B). The use of inertia has since been taken up by many of the theories of telicity that rely on a causal relation between subevents.

A different strategy is employed by the maximal/non-maximal event theories: that is, they get out of the imperfective paradox by denying (A). Instead of being organized around a causal relation between subevents, the relation between the non-maximal and the maximal event is central. Some of the researchers espousing such theories are skeptical of the idea that all telic predicates involve causation; for example, *Mary went to the store* is not universally accepted to have a paraphrase where an event of which Mary is the agent *causes* her to go to the store; normally we would think of, e.g., Mary's intention as causing her to go to the store in that case (Chris Piñon, p.c.).

Instead of evoking quantification over inertia worlds or denying (A), a good compromise between these two positions would be to deny (B), a strategy which is rarely or never invoked. As we point out in **xvi**, however, there are plenty of theories of causation in which the result is not entailed by a causal relation; these include force dynamic theories.

Understanding Davidsonian arguments as representing forces allow us to maintain many of the key intuitions behind both existing approaches to telicity. For those researchers that prefer a causal approach, the link is quite direct given that causation can be understood to be based on force dynamics: there is still a causal element in the denotation. Moreover, the *ceteris paribus* property of forces is a kind of baked-in inertia. On the other hand, those who eschew causal relations may also find something to like in a theory that treats Davidsonian arguments as forces. Although forces can be the foundation of a theory of causation, a single force is not equivalent to a paraphrase with main verb CAUSE. Furthermore, a force, in the abstract sense we advocate in **xvii** and Copley and Harley (2018), is a good commonsense interpretation of what is intended by “non-maximal event”.

7.1.3. *A physical parallel to information.* As discussed in **xi**, **xvii**, and **xx**, there is a parallel between events themselves and the subset of dynamic approaches that hinge on “default” or “defeasible” inferences (Lascarides and Asher 1991, Veltman 1996, Asher and Lascarides 2003). This is the *ceteris paribus* property again: just as forces lead defeasibly to a situation in the world (as other, stronger forces can block this from happening), so too utterances can lead to default information states, but default conclusions are defeated if there is information to the contrary.

However, if we were to treat the verb phrase as exactly the same as information and inferences, we give up the advantages of Davidsonian modification, as facts do not strictly have spatiotemporal locations, and we lose the useful distinction between things in the world (or in our conceptual model of it) and inferences we make about things in the world (or in our conceptual model of it). We think forces are a good compromise between the Davidsonian evidence that make us want to anchor our ontological entity in the physical world (i.e., what events are good at), and the ability of these entities to interact with each other; and to construct different possibilities that proceed from a present situation selected by the speaker.

7.1.4. *Atelicity and entrainment.* Another benefit to treating Davidsonian arguments as forces is that it has the potential to clarify the treatment of atelic predicates. It has long been noted in both psychology (Michotte 1946) and the cognitive linguistic tradition (e.g. Shibatani 1973, Talmy 1976, Croft 1991), that causes can have either of two temporal relationships to their effects. More recently this fact has been modeled in artificial intelligence-inspired treatments of events (Fernando 2005, van Lambalgen & Hamm 2008). We use Michotte’s terms, translated from French, for the two relationships, given in (34):

- (34) a. launching: the cause precedes the effect
 b. entrainment: the cause and the effect happen at the same time

To illustrate these two relationships, we can think of pushing a cup along a table. If you *push a cup to the edge of the table* (a telic predicate), the result that is described is the cup's being at the edge of the table, which happens as you finish applying the energy to the cup. However, if you simply *push the cup* (an atelic predicate), the result that is described is the cup's moving; this result obtains as soon as you impart the pushing force to the cup. That is, there a result that happens at the same time as the causing input of energy. So results are not constrained to occur after their cause—and moreover, they need not be states.

Entrainment poses problems for Davidsonian events as typically understood, due to individuation concerns and the oddity of having a result happening at the same time as an event. What we need is for the Davidsonian argument to be able to cause a non-stative result that holds at the same time as the run time of the Davidsonian argument. Intuitively the Davidsonian argument should then represent the energy that provokes that result. This again corresponds to the commonsense notion of force. We thus propose (**xvii**, **xix**) that telicity and atelicity represent these two temporal relationships for causation: telicity is launching and atelicity is entrainment.

7.1.5. *Verbs of maintaining.* Finally, a problem is posed for Davidsonian event arguments by the existence of verbs of maintaining such as *keep*, *stay*, *preserve*, and indeed *maintain*. They are difficult to analyze with standard Davidsonian event arguments (**xvii**): they all seem causative, but *keep* and *stay* seem to have a standard Voice / no Voice relationship. So the question is in what sense *stay* is causative, given that it is neither CAUSE to BE nor CAUSE to BECOME. If, however, Davidsonian arguments represent energy, it is much easier to characterize these verbs: they represent a state of affairs where there is an input of energy that does not result in a change.

7.2. Force functions. In reifying forces, essentially we reify the causal relation: the Davidsonian argument itself *is* the causal element. But if it is to be worth it to make our Davidsonian arguments represent

forces instead of events, we must integrate into the representation both their possibility for interactions and their *ceteris paribus* property.

A vector analysis is possible, but as pointed out in **xx**, we want to distinguish between modeling directedness toward a culmination, which will be done for every verb, and modeling other kinds of directedness toward, e.g. the speaker for a very particular class of verbs such as *pull* (Zwarts 2010, Goldschmidt and Zwarts 2016). What we want for the Davidsonian argument of verbs in general is thus quite abstract, a kind of bleached vector, with an origin in the initial situation and a direction in the final situation, and without magnitude represented at all. Moreover, it will be useful to be able to refer to the final situation without entailing its existence.

We will thus view forces as very simple functions with a single (“initial”) situation in the domain and a single (“final”) situation in the range. Both situations can be referred to in terms of the force itself (i.e., *init(f)*, *fin(f)*), so we can talk about the final situation without entailing its existence. It should be underlined that “initial” and “final” situation are to be understood in terms of causation, not in terms of time, which is not represented here. Thus, there is no problem with having a final situation that is cotemporal with the initial situation.

Confounding the issue of how to formalize force functions is the fact that there seems to be a dual role for the initial situation: Forces seem to arise *from* or *in* an initial situation, via the individuals and their property attributions that make up the situation, but if we view forces as a function, they take the initial situation *as an argument*. As explained in **xix**, the dual role is accounted for with the dual ontology, similar to the proposal in Barwise and Perry (1983) and what is argued in **xviii**. Where a conceptual force φ is equal to $\llbracket f \rrbracket$ and the (initial) conceptual situation that φ arises in, σ , is equal to $\llbracket s \rrbracket$, f (the linguistic force function) takes s (the initial linguistic situation) as an argument.

A force-theoretic model is given in **xiii**, but it does not go down to the level of the contents of conceptual situations. Here is the reason why: a complete model would need to be a model of our conceptual level, according to the principle of no abstentions, section 4.3 above.

But then the model ought to properly represent how conceptual forces arise from conceptual situations, and this is orthogonal to the goals here; we only need to know, and have intuitions, that they do, not how they do. To elide the question of how they do is perfectly legitimate, just as there is nothing amiss in doing chemistry without studying particle physics. Whatever the correct way to represent how conceptual forces arise from conceptual situations will end up being—vector representations along the lines of Zwarts and Winter (2000), primitive relations such as SUPPORT, ATTACH, and OPPOSE Talmy (2000), Zwarts (2010), some combination of both, or something else entirely—it is an empirical question, just not one we are in a position to answer here.

We can briefly touch on how force functions relate to some of the other issues we have discussed. First, as desired, branching is non-denotational in this picture, since it arises from consideration of a different initial situation, which would be fed to the denotation by a contextual variable. Second, a sequence of force functions makes a causal chain, which is a good candidate for the causal chains provisionally proposed above in section 5 for metaphysical modality; this will have to be further explored.

7.3. Improving the interface with forces and degrees. In the verb phrase both energy and change, or the lack thereof, need to be represented. In **xvii** we proposed to reify energy, but we did not reify change—instead we represented change with the Dowty-style transition between $\neg p$ and p . However, there is a way to reify change, namely with degree arguments (Kennedy and McNally 1999, Hay et al. 1999, Kennedy and Levin 2008, a.o.). The degree argument, whatever its actual ontology (Anderson and Morzycki 2012), seems a much cleaner way to represent change than an event argument, and in particular they do well explaining cases of variable telicity with and without homomorphism.

If one were going to try to unify the analysis of eventive or dynamic verbal meanings for languages like English, one could do worse than the idea that a force (an input of energy) provokes a change on a degree

scale. Modulo the difference between event-talk and force-talk, this is in fact what Kennedy, McNally, Hay, and Levin are interested in developing (“We propose that the adjectival core of a degree achievement is a special kind of derived measure function that measures the degree to which an object changes along a scalar dimension as the result of participating in an event,” Kennedy and Levin (2008, p. 17)).

In **xix** we raise the question whether such a unification can be realized for English verb phrases with a framework that combines force functions to represent energy with degree arguments to represent change. This framework marries the benefits of forces discussed above in section 7.1 to the benefits of degrees on understanding cases of variable telicity. These pictures make sense together: we argue that launching corresponds to telicity as understood with a maximum value for the degree argument, and entrainment corresponds to atelicity as understood with the minimum value for the degree argument. The success of this project would obviate the need for multiple interchangeable *v* heads (Folli and Harley 2005), or multiple sets of verbal heads that select different roots (Ramchand 2008, 2017). Thus, by removing the need for such selection it would remove a duplication of labor on both sides of the grammatical-conceptual divide.

8. Conclusion

For a moment, nothing happened. Then, after a second or so, nothing continued to happen.

–Douglas Adams

We have seen that the idea of a single causal branch with *ceteris paribus* non-denotational branching can be the mechanism that takes us to what happens next, from futurates and conditionals down to the Davidsonian argument itself. Must that be the *only* mechanism that takes us to what happens next? At base, this is an empirical question. In general we know that language often finds different mechanisms, at different levels of phrase structure, to accomplish roughly similar

communicative goals, so a single branch analysis of futurates, say, has no *a priori* implications for whether, say, futures should be analyzed using a single branch. What we have argued here is that a single-branch analysis with non-denotational branching is in some cases a viable account of how we talk about what happens next.

The analyses here pointed the way toward resolving two competing pressures on the denotation: the Chomskyan impulse toward simple denotations and complex concepts, and the Humean impulse toward simple concepts and complex denotations. If we agree that the denotation itself is part of the grammatical system, then that denotation should be simple—as simple as a single branch, for instance—while the concepts that interpret the terms in the simple denotation should be complex—causation, or disposition, for example. The complex concept can be analyzed further in a Humean fashion as long as such analysis is cognitively plausible. If denotations are indeed simple, we should find out how simple they are allowed to be, for null morphology as well as single morphologically overt heads. We can also pursue (Chomskyan) unifications in phenomena like conditionals and verb phrases, at the same time as we pursue (Humean) analyses of their truth conditions. Such a strategy has the potential to give us a new understanding on the division of labor between the grammatical and the conceptual.

9. Bibliography

- Abusch, D. (1985). *On Verbs and Time*. Ph. D. thesis, University of Massachusetts.
- Anderson, C. and M. Morzycki (2012). Degrees as kinds. Ms., Michigan State University.
- Aristotle (1996). *Physics*. Oxford: Oxford University Press. Translated by Robin Waterfield.
- Asher, N. and A. Lascarides (2003). *Logics of conversation*. Cambridge University Press.
- Bach, E. (1986). The algebra of events. *Linguistics and philosophy* 9(1), 5–16.
- Baird, B., J. Smallwood, and J. W. Schooler (2011). Back to the future: autobiographical planning and the functionality of mind-wandering. *Consciousness and cognition* 20(4), 1604–1611.
- Barwise, J. and J. Perry (1983). *Situations and Attitudes*. Cambridge, Mass.: MIT Press.
- Beaver, D. and C. Condoravdi (2007). On the logic of verbal modification. In *Proceedings of the 16th Amsterdam Colloquium*, pp. 3–9. University of Amsterdam Amsterdam.
- Belnap, N., M. Perloff, and M. Xu (2001). *Facing the future: Agents and choices in our indeterminist world*. Oxford: Oxford University Press.
- Bennett, M. and B. Partee (1978). *Toward the Logic of Tense and Aspect in English*. Bloomington, Ill.: Indiana University Linguistics Club.
- Cable, S. (2017). The implicatures of optional past tense in Tlingit and the implications for ‘discontinuous past’. *Natural Language & Linguistic Theory* 35(3), 635–681.
- Chierchia, G. (1985). Formal semantics and the grammar of predication. *Linguistic Inquiry* 16(3), 417–443.
- Choi, S. and M. G. Fara (2016). Dispositions. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Spring 2016 ed.). Metaphysics Research Lab, Stanford University.

- Chomsky, N. (1965). *Aspects of the Theory of Syntax*. MIT Press.
- Comrie, B. (1976). *Aspect*. Cambridge University Press.
- Condoravdi, C. (2002). Temporal interpretation of modals. In D. Beaver, S. Kaufmann, B. Clark, and L. Casillas (Eds.), *Stanford Papers on Semantics*. Palo Alto: CSLI Publications.
- Condoravdi, C. (2003). Moods and modalities for *will* and *would*. Hand-out of talk given at the 2003 Amsterdam Colloquium.
- Condoravdi, C. and S. Lauer (2009). Performing a wish: Desiderative assertions and performativity. Talk given at California Universities Semantics and Pragmatics 2.
- Copley, B. (2003). Aspect, scope, and future conditionals. In C. ecile Maier and M. Weisgerber (Eds.), *Proceedings of Sinn und Bedeutung*, Volume 117, pp. 67–82. Fachbereich Sprachwissenschaft der Universität Konstanz.
- Copley, B. (2004a). A grammatical and a conceptual distinction for modals. In *NELS 35*.
- Copley, B. (2004b). On so-called epistemic *should*. *Snippets 9*.
- Copley, B. (2005). O’odham *cem*: when the actual world isn’t inertial. In M. Becker and A. McKenzie (Eds.), *The proceedings of the third meeting of Semantics of Underrepresented Languages of the Americas (SULA 3)*, Amherst, Mass. University of Massachusetts Occasional Papers in Linguistics.
- Copley, B. (2006). What should *should* mean?
- Copley, B. (2008a). The plan’s the thing: Deconstructing futurate meaning. *Linguistic Inquiry 39*(2), 261–274.
- Copley, B. (2008b). Temporal orientation in conditionals. In J. Guéron and J. Lecarme (Eds.), *Time and Modality*, pp. 59–77. Springer.
- Copley, B. (2009). *The Semantics of the Future*. Routledge. *Outstanding Dissertations in Linguistics*, Routledge.
- Copley, B. (2010). Aspectualized futures in Indonesian and English. In B. Laca and P. C. Hoffherr (Eds.), *Layers of Aspect*. CSLI.
- Copley, B. (2014). Causal chains for futurates. In P. de Brabanter, M. Kissine, and S. Sharifzadeh (Eds.), *Future Times, Future Tenses*, Oxford Studies of Time in Language and Thought, pp. 72–86. OUP.

- Copley, B. (2017). Causal conditionals. CNRS/Paris 8 ms.
- Copley, B. (2018a). Dispositional causation. CNRS/Paris 8 ms.
- Copley, B. (2018b). Force dynamics. In R. Truswell (Ed.), *Oxford Handbook of Event Structure*, pp. 103–149. Oxford.
- Copley, B. and H. Harley (2009). Futurates, directors, and have-causatives. *Snippets*, 5–6.
- Copley, B. and H. Harley (2013). A force-theoretic model. CNRS/Paris 8 and University of Arizona ms.
- Copley, B. and H. Harley (2014). Eliminating causative entailments with the force-theoretic framework: The case of the Tohono O’odham frustrative *cem*. In B. Copley and e. F. Martin (Eds.), *Causation in Grammatical Structures*, pp. 120–151. Oxford University Press.
- Copley, B. and H. Harley (2015). A force-theoretic framework for event structure. *Linguistics and Philosophy* 38, 103–158.
- Copley, B. and H. Harley (2018). What would it take to tame the verbal hydra? CNRS/Paris 8 and University of Arizona ms.
- Copley, B. and I. Roy (2015). Deriving the readings of french *être en train de*. In E. O. Aboh, J. C. Schaeffer, and P. Sleeman (Eds.), *Romance Languages and Linguistic Theory 2013: Selected papers from "Going Romance" 2013*, pp. 103–118. John Benjamins Pub. Co.
- Copley, B. and P. Wolff (2014). Theories of causation should inform linguistic theory and vice versa. In B. Copley and F. Martin (Eds.), *Causation in Grammatical Structures*, pp. 11–57. Oxford University Press.
- Copley, B., P. Wolff, and J. Shepard (2015). Force interaction in the expression of causation. In S. D’Antonio, M. Moroney, and C. R. Little (Eds.), *Proceedings of SALT 25*, pp. 433–451.
- Croft, W. (1991). *Syntactic categories and grammatical relations: The cognitive organization of information*. University of Chicago Press.
- Darteni, S. (2017). *Italian Parasynthetic Verbs: Argument Structure*. Ph. D. thesis, Université Paris 8.
- Davidson, D. (1967). The logical form of action sentences. In N. Rescher (Ed.), *The Logic of Decision and Action*. University of Pittsburgh

Press.

- Del Prete, F. (2014). The interpretation of indefinites in future tense sentences: A novel argument for the modality of will? *Future Times, Future Tenses*, 320.
- Demirdache, H. (1997). Out of control in St'á'imcets salish and event (de) composition. *Theoretical Issues on the Morphology Syntax Interface. (Supplements of the International Journal of Basque Linguistics and Philology (ASJU) Vol XXVIII)*.
- Demirdache, H. and F. Martin (2015). Agent control over non-culminating events. pp. 185–217.
- Dowty, D. (1979). *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Embick, D. and R. Noyer (2007). Distributed morphology and the syntax/morphology interface. *The Oxford handbook of linguistic interfaces*, 289–324.
- Filip, H. (2008). Events and maximalization. In S. Rothstein (Ed.), *Theoretical and crosslinguistic approaches to the semantics of aspect*, pp. 217–256. John Benjamins.
- Folli, R. and H. Harley (2005). Flavors of v. In *Aspectual inquiries*, pp. 95–120. Springer.
- van Fraassen, B. (1966). Singular terms, truth-value gaps, and free logic. *Journal of Philosophy* 63, 481–495.
- Giannakidou, A. and A. Mari (2012). Italian and Greek futures as epistemic operators. In *Proceedings of the Chicago Linguistics Society* 48.
- Ginzburg, J. and I. Sag (2000). *Interrogative Investigations: The Form, Meaning and Use of Interrogative Investigations: The Form, Meaning and Use of English Interrogatives*. CSLI.
- Goldschmidt, A. and J. Zwarts (2016). Hitting the nail on the head: Force vectors in verb semantics. In *Proceedings of SALT 26*, pp. 433–450.
- Grimshaw, J. (1990). *Argument structure*. MIT Press.
- Hacquard, V. (2006). *Aspects of Modality*. Ph. D. thesis, MIT.

- Hacquard, V. (2010). On the event relativity of modal auxiliaries. *Natural language semantics* 18(1), 79–114.
- Haegeman, L. (2003). Conditional clauses: External and internal syntax. *Mind & Language* 18(4), 317–339.
- Haegeman, L. (2006). Conditionals, factives and the left periphery. *Lingua* 116(10), 1651–1669.
- Hallman, P. (2009). Instants and intervals in the event/state distinction.
- Hay, J., C. Kennedy, and B. Levin (1999). Scalar structure underlies telicity in degree achievements. In *Proceedings of SALT*, Volume 9, pp. 127–144. Citeseer.
- Higginbotham, J. (2000). Accomplishments. In *Proceedings of GLOW in Asia II*.
- Jackendoff, R. (1972). *Semantic Interpretation in Generative Grammar*. Cambridge, Mass.: MIT Press.
- Jackendoff, R. (1990). *Semantic structures*, Volume 18. MIT press.
- Kamp, H. (2015). Dispositional or generic: How much should there be in a logical form? Presentation given at the Workshop on the Morphological, Syntactic and Semantic Aspects of Dispositions, University of Stuttgart, 27 June 2015.
- Katz, G. (2003). Event arguments, adverb selection, and the stative adverb gap. In E. Lang, C. Maienborn, and C. Fabricus-Hansen (Eds.), *Modifying adjuncts*, Interface Explorations. Mouton de Gruyter.
- Kaufmann, S. (2005). Conditional truth and future reference. *Journal of Semantics* 22, 231–280.
- Kaufmann, S., C. Condoravdi, and V. Harizanov (2006). Formal approaches to modality. *The expression of modality*, 71–106.
- Kennedy, C. and B. Levin (2008). Measure of change: The adjectival core of degree achievements. *Adjectives and adverbs: Syntax, semantics and discourse*, 156–182.
- Kennedy, C. and L. McNally (1999). From event structure to scale structure: Degree modification in deverbal adjectives. In *Proceedings of SALT*, Volume 9, pp. 163–180.

- Kissine, M. (2008). Why *will* is not a modal. *Natural Language Semantics* 16, 129–155.
- Klecha, P. (2011). Optional and obligatory modal subordination. In *Proceedings of Sinn und Bedeutung*, Volume 15, pp. 365–379.
- Klein, W. (1997). *Time in Language*. New York: Routledge.
- Kratzer, A. (1981). The notional category of modality. In H.-J. Eikmeyer and H. Rieser (Eds.), *Words, Worlds, and Contexts*, pp. 38–74. Berlin: de Gruyter.
- Kratzer, A. (1989). An investigation of the lumps of thought. *Linguistics and Philosophy* 12, 607–653.
- Kratzer, A. (2011). What “can” can mean. In *Proceedings of SALT*, Volume 21.
- Krifka, M. (1998). The origins of telicity. In S. Rothstein (Ed.), *Events and Grammar*, pp. 197–235. Dordrecht: Kluwer.
- Krifka, M. (2014). Embedding illocutionary acts. In *Recursion: Complexity in cognition*, pp. 59–87. Springer.
- Laca, B. (2010). On the temporal orientation of intensional subjunctives in spanish. In J. Guéron (Ed.), *Sentence and Discourse*, pp. 23–44. Oxford University Press.
- Lakoff, G. (1971). Presupposition and relative well-formedness. In L. A. J. Danny D. Steinberg (Ed.), *Semantics: An Interdisciplinary Reader in Philosophy, Linguistics, and Psychology*, pp. 329–340. Cambridge, UK: Cambridge University Press.
- Landman, F. (1992). The progressive. *Natural Language Semantics* 1(1), 1–32.
- Lascarides, A. and N. Asher (1991). Discourse relations and defeasible knowledge. In *Proceedings of the 29th annual meeting on Association for Computational Linguistics*, pp. 55–62. Association for Computational Linguistics.
- Leech, G. N. (1971). *Meaning and the English Verb*. Essex, U.K.: Longman Group Limited.
- Levin, B. and M. R. Hovav (1994). A preliminary analysis of causative verbs in English. *Lingua* 92, 35–77.
- Lewis, D. (1986). *On the Plurality of Worlds*. Oxford: Blackwell.

- Louie, M. (2015). *The temporal semantics of actions and circumstance in Blackfoot*. Ph. D. thesis, University of British Columbia.
- Maienborn, C. (2005). On the limits of the Davidsonian approach: The case of copula sentences. *Theoretical Linguistics* 31(3), 275–316.
- Maienborn, C. (2007). On Davidsonian and Kimian states. In I. Comorovski and K. Von Heusinger (Eds.), *Existence: Semantics and Syntax*, Volume 84 of *Springer Science and Business Media*, pp. 107–130. Springer.
- Marantz, A. (1997). No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. *University of Pennsylvania working papers in linguistics* 4(2), 14.
- Mari, A. and F. Martin (2007). Tense, abilities and actuality entailment. In *Proceedings of the sixteenth Amsterdam Colloquium*, pp. 151–156.
- Michotte, A. (1946). *La perception de la causalité* (English translation: *The perception of causality*, Methuen, London, 1963 ed.). Louvain: Éditions de l'Institut Supérieur de Philosophie.
- Mumford, S. and R. L. Anjum (2011). *Getting causes from powers*. Oxford University Press.
- Parsons, T. (1990). *Events in the Semantics of English: A Study in Subatomic Semantics*. Cambridge, Mass.: MIT Press.
- Paul, I., B. S. Ralalaoherivony, and H. de Swart (2017). Culminating and non-culminating accomplishments in Malagasy.
- Portner, P. (1997). The semantics of mood, complementation, and conversational force. *Natural language semantics* 5(2), 167–212.
- Portner, P. (2004). The semantics of imperatives within a theory of clause types. In *Semantics and linguistic theory*, Volume 14, pp. 235–252.
- Pustejovsky, J. (1995). *The Generative Lexicon*. MIT Press.
- Ramchand, G. (2008). *Verb meaning and the lexicon: A first-phase syntax*. Cambridge Univ Pr.
- Ramchand, G. (2017). *Situations and Syntactic Structure*. MIT Press.
- Ramchand, G. and P. Svenonius (2014). Deriving the functional hierarchy. *Language Sciences* 46, 152–174.

- Rothstein, S. (2008). Telicity, atomicity and the vendler classification of verbs. In S. Rothstein (Ed.), *Theoretical and Crosslinguistic Approaches to Aspect*, pp. 43–77.
- Roy, I. and E. Soare (2013). Event-related nominals. *Categorization and category change*, 123–152.
- Seligman, M. E. P., P. Railton, R. F. Baumeister, and C. Sripada (2013, March). Navigating Into the Future or Driven by the Past. *Perspectives on Psychological Science* 8(2), 119–141.
- Shibatani, M. (1973). *A linguistics study of causative constructions*. Ph. D. thesis, University of California, Berkeley.
- Skibra, D. (2017). Modals, contextual parameters, and the modal uniformity hypothesis. Northwestern University ms.
- Smith, C. (1991). *The parameter of aspect*. Dordrecht: Kluwer.
- Talmy, L. (1976). Semantic causative types. In M. Shibatani (Ed.), *Syntax and semantics*, Volume 6, pp. 43–116. Academic Press.
- Talmy, L. (2000). *Towards a Cognitive Semantics*. Cambridge, Mass.: MIT Press.
- Thomason, R. (1970). Indeterminist time and truth-value gaps. *Theoria* 36, 264–281.
- Thomason, R. H. and A. Gupta (1980). A theory of conditionals in the context of branching time. *Ifs: Conditionals, Belief, Decision, Chance and Time*, 299–322.
- Veltman, F. (1996). Defaults in update semantics. *Journal of philosophical logic* 25(3), 221–261.
- Vetter, D. C. (1973). Someone solves this problem tomorrow. *Linguistic Inquiry* 4:1, 104–108.
- Wolff, P. (2003). Direct causation in the linguistic coding and individuation of causal events. *Cognition* 88(1), 1–48.
- Wolff, P. and A. Barbey (2009). Composing causal relations in force dynamics. Under revision.
- Zwarts, J. (2010). Forceful prepositions. In V. Evans and P. Chilton (Eds.), *Language, Cognition and Space: The State of the Art and New Directions*, pp. 193–214. Equinox Publishing.

Zwarts, J. and Y. Winter (2000). Vector space semantics: A model-theoretic analysis of locative prepositions. *Journal of logic, language and information* 9(2), 169–211.

A conceptual and a grammatical distinction for modals

Bridget Copley

University of Southern California

1. Two kinds of modals, two kinds of forces

The progressive and generic/habitual uses of imperfectives have long been claimed to be modal, with universal quantification over “normal” or “inertial” worlds or situations (Cipria and Roberts 2000, e.g.). Futures such as *be going to* and *will* have also been claimed to be modal in the same sense (Copley 2002b, e.g.). Assuming that both claims are correct, an account of the obvious differences between modal aspects and modal futures is needed. In this paper I will propose a general outline for such an account, with a view towards an eventual full formal implementation.

1.1. Initial data

We might at first assume that modal imperfectives place an event overlapping with the local evaluation time, while modal futures place it following the local evaluation time (where the local evaluation time is determined by tense). Contrasts such as the one in (1), for example, support such a generalization.

- (1) a. #John is getting sick tomorrow. imperfective, physical¹
b. John is going to get sick tomorrow. future, physical

Many thanks to Barry Schein, Jim Higginbotham, Sabine Iatridou, several anonymous reviewers, and audiences at NELS 35, Kyushu University, MIT, UCLA, and USC.

¹The reasons for this annotation will become clear shortly.

Here, although both the progressive and *be going to* share some sort of “ongoingness” in their meaning,² they differ in their compatibility with the future temporal adverbial *tomorrow*. The sentence *John is getting sick* can only refer to an event that is ongoing at the local evaluation time, which in this case is the utterance time. The generalization seems fairly straightforward: the progressive talks about the local evaluation time, and *be going to* talks about some time that is in the future with respect to the local evaluation time. Let’s call this generalization “G1”:

- (2) G1: Progressives place their event overlapping the local evaluation time; future modals place their event after the local evaluation time.

Yet in many languages, English included, G1 is not valid. It is well known that some progressives can be used to talk about the future when the event under discussion is something that is planned or scheduled, as in (3a), and indeed the modal future *be going to* in (3b) seems to make a similar reference to an ongoing intention for John to make pizza.

- (3) a. John is making pizza tomorrow. aspect, intentional
b. John is going to make pizza tomorrow. future, intentional

So although in some cases, namely those that are non-intentional as in (1), the initial generalization holds, it does not hold for all cases. When intentions (schedules, plans) are considered, as in (3), the generalization is simply wrong, and we are left without an idea of the difference between aspectual modals and future modals.

The kind of progressive exemplified in (3a) is often called a *futurate* reading. One may object here that futurate readings are entirely different animals from other readings of imperfectives, and so do not properly belong in a discussion of “normal” imperfectives. But as I will argue, this different animal – a more future-like behavior when it comes to intentional cases – shows up elsewhere, and therefore is deserving of inclusion in this initial collection of facts.

Another objection is that futurates are too normal for consideration; it has become common, since Dowty (1979), to treat the intention stage as a preparatory stage to the event, and then this event is what the progressive operates on. But it seems very strange to consider it as an early stage of the event. For example, the planning stage can have an independent temporal adverbial, and participate in anaphora:

- (4) a. **When I talked to the baseball commissioner last week**, the Red Sox were playing the Yankees three times in the first week in May.
b. **That** made me think I should get some tickets.

Thus, while the intention or plan is required to include the local evaluation time in futurates, it is implausible to consider it an early stage of the event itself. Later we will see that this impulse to make the intention part of the event is really unnecessary.

²Elsewhere (Copley 2001, 2002a,b, 2004) I have argued that this “ongoingness” corresponds to sharing a Kleinian (Klein 1997) imperfective component, i.e., inclusion of the topic interval within a larger interval over which branching takes place.

A conceptual and a grammatical distinction for modals

A similar pattern to the one we have just seen for progressives and *be going to* can also be observed in generic/habitual sentences and dispositional *will* sentences, both of which assert a lawlike connection between the subject and the event. The difference, at least initially, appears to be that habituais, as in (5a), require the event to have been instantiated at least once. We may conclude this because the continuation *though thankfully it's never come to that* induces a contradiction. On the other hand, the dispositional in (5b)³ does not contradict the continuation, and therefore does not seem to require instantiation of the event.

- (5) a. #Our grad students are so tough, they even eat
cardboard, though thankfully it's never come to that. aspect, physical
b. Our grad students are so tough, they will even eat
cardboard, though thankfully it's never come to that. future, physical

Thus, our initial generalization concerning the difference between habituais and dispositionals is G2:

- (6) G2: Habituais require the event to have been instantiated at least once before the local evaluation time; dispositionals do not require the event to have been instantiated before the local evaluation time.

However, G2 turns out to be as untenable as G1 – and in a suspiciously similar way. As pointed out by Carlson (1995), some habituais do not require instantiation. One such habitual is given in (7a); as with the dispositional in (7b), the continuation does not induce a contradiction.

- (7) a. Our grad students answer the mail from Antarctica,
though there hasn't been any so far. imperfective, intentional
b. Our grad students will answer the mail from Antarctica,
though there hasn't been any so far. future, intentional

Crucially, the event there is intended by (we assume) the faculty; the exceptionality to G2 must stem from the fact that the lawlike connection between the subject and the event is manmade rather than physical. What is interesting about the fact that the law is manmade is that it should remind us of the exception to G1, which also involved a manmade law of a sort, in the form of a schedule or plan. So perhaps G1 and G2 are somehow analogous, in a manner yet to be explicated.

Before offering an explication, I would like to forestall a possible objection to this analogy. In what sense (the objection goes) is (6a) not intentional? Surely the students are agents of eating-cardboard events, and being agents, have intentions to carry out these events. Therefore, the difference between (6a) and (7a) is not one of physical laws versus intentional laws. Therefore, G2 is not analogous to G1.

³There is of course another reading of (4b), placed in better context as: 'There's nothing you can do about it, the students will just keep on eating cardboard.' We will ignore this reading here. The idea that these are different readings is supported by the fact that in at least one language (some varieties of Indonesian) these readings are expressed by different morphemes (Copley 2004).

This objection is not valid, however. Mere agenthood does not entail intentionality of the agent to carry out the event; agents can certainly do things accidentally. But let us suppose that the agents in question in (6a) do actually intend to eat cardboard. Their intentions to eat cardboard have nothing to do with the analogy between G1 and G2, because the intentionality of the agent to carry out the event is not where the distinction lies between (6a) and (7a). Rather, the distinction is in the source of the lawlike connection between the agent and the event. The connection is physical in (6a) in that it has to do with properties of the students that dispose them to eat cardboard. The connection is manmade in (7a), to the extent that it results from an obligation, rather than a disposition. This is the reason why the objection is not valid. Yes, agents may very well intend to carry out events, but this kind of intention is not the kind of intention under discussion.

With that objection out of the way, let us consider how to unify G1 and G2 (and their exceptions). What does overlapping the local evaluation time (as in G1) have to do with having at least one instantiation before the local evaluation time (as in G2)? Here it will be useful to think a little about the difference between the meaning of progressives and habituals, to subtract that difference from the equation, and hopefully to be left with equals on either side. Progressives involving physical forces, on any account, predicate a single occurrence of the event, ongoing at the local evaluation time, while habituals involving physical forces say of an event that in any of a contextually supplied kind of situation, the event holds, as result of an ongoing lawlike connection between the subject and the event. What these have in common, though, is the requirement that at least part of the event be before the local evaluation time. The exceptions to G1 and G2, the intentional cases, are exceptions precisely in that this requirement is not obeyed.

The table in (8) sums up this new generalization; the imperfective “no!”’s are the exceptions to G1 and G2.

(8) Must the event be at least partly before the local evaluation time?

		physical	intentional
imperfective	progressive	yes	no!
future	<i>be going to</i>	no	no
imperfective	habitual	yes	no!
future	dispositional	no	no

It so happens that this initial pattern is supported further by examples in which these modals in certain kinds of conditionals. We turn now to these cases.

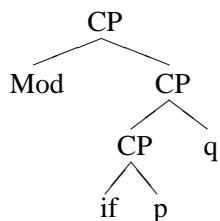
1.2. Modals in conditionals

The generalization noted for imperfectives and futures applies to conditionals as well, as demonstrated in (10) through (13) below. A sidebar: We are only considering conditionals in which the modal takes wide scope. I have argued elsewhere (Copley 2002b, 2004) that

A conceptual and a grammatical distinction for modals

in conditionals like those in (10) through (13), the aspectual or future modal takes scope over the entire conditional, as in (9).

(9)



While conditionals can have other structures, this structure is the one we are interested in, as it guarantees that the modal will take the local evaluation time as its temporal argument.

These wide scope conditionals exhibit the same pattern of judgments observed above: intentional cases of imperfectives are allowed to be somewhat “looser” than physical cases of imperfectives, and behave more like the futures do.

If you drop that vase:

- | | | |
|------|--------------------------------|---------------------------|
| (10) | a. #it’s breaking. | imperfective, physical |
| | b. it’s going to break. | future, physical |
| (11) | a. you’re picking it up. | imperfective, intentional |
| | b. you’re going to pick it up. | modal future, intentional |
| (12) | a. #it breaks. | imperfective, physical |
| | b. it will break. | future, physical |
| (13) | a. you pick it up. | imperfective, intentional |
| | b. you will pick it up. | modal future, intentional |

The contrast in (10) shows that in physical cases, progressives are not grammatical the way *be going to* is. However, in an intentional case as in (11a), the progressive is possible. This looks very similar to what we have seen before. Likewise, the contrast in (12) demonstrates that physical habituals are not as permissive as dispositional *will*. Actually, not all physical habituals are bad; those in (14) are fine.

- (14) a. If you drop a vase, it breaks.
 b. If you drop this kind of vase, it breaks.

But this is exactly the point: the examples in (14) are fine just to the extent that these kinds of events have already been instantiated. The example in (12a) presumably, if true, describes a non-repeatable event, so it can’t already have happened. And it is exactly in this case that the physical habitual is bad. The intentional habitual, in (13a), however, is fine. Thus we can see that the same patterns hold here as with the other data.

So: While the futures are apparently insensitive to any variation between physical facts and intentions, the aspects are sensitive to them, behaving more like futures in the

intentional cases. What could account for this pattern?

2. Ordering

First let us look at the imperfective modals, as they are more discriminating, and hence (with any luck) more informative, than the future modals.

2.1. Unasking the question

The pattern of the imperfective data is still rather unsatisfying at the moment; there are glaring exceptions to our generalizations. So let us try to look at the pattern from another perspective. Instead of asking what requirements are placed on the event time in all four cases of imperfectives, let us ask instead what it is (call it “X”) that is required to overlap the local evaluation time in all four cases.

It seems clear that X cannot be the event time. Of the four kinds of imperfective sentences, only the physical progressive cases seem to require the event time to overlap the local evaluation time. In the intentional progressive (i.e., the futurate) cases, the event time does not overlap the local evaluation time; it is in the future. And certainly no one has ever suggested of habituals that an instantiation of the event needs to overlap the local evaluation time. This is a prominent property of generics and habituals, that an instantiation of the event need not be taking place at the local evaluation time. In generics and habituals, rather, what overlaps the local evaluation time is the lawlike connection between the subject and the event. For physical habituals, this amounts to the combination of properties that engenders the lawlike connection (so this combination of properties would be X). In intentional habituals, it is the manmade law or rule. Likewise, in intentional progressives (furate readings), it is the manmade plan or schedule that must overlap the local evaluation time.

We have then three plausible candidates for X, and one mystery. The three plausible candidates are: plans in intentional progressives (furates), manmade laws in intentional habituals, and physical properties in physical habituals. The mystery is what X would be in physical progressives. If this story is correct, the fact that the event time overlaps the local evaluation time in physical progressives is actually a red herring. *There is no such requirement in the grammar.* It is, rather, always X that must overlap the local evaluation time. X is obviously not an intention in the physical cases, but it is something else, and it just so happens that X in the physical cases either corresponds to the event, or is something that in progressives has the same run time as the event.

Perhaps we can shed light on the mystery X by considering what role the other Xs play. Since two of the Xs deal with intention, shading into obligation, let us turn to the semantics of intention and obligation. Fortunately, intention and obligation are known to have formally similar meanings, and there is no need to start from scratch in understanding them.

2.2. Intentions and forces

Intention and obligation are both treated formally as ordering sources; the concept of the ordering source was created in order to solve a problem having to do with modality in a possible worlds framework (see, e.g., Lewis 1986, Kratzer 1991).

As background to this problem, note that a modal such as *must* is taken to quantify universally over possible worlds that satisfy some particular propositions. In the case of epistemic *must*, the propositions are those that the speaker knows to be true. Epistemic *must* thus quantifies over the set of worlds that satisfy those propositions that the speaker knows to be true. Since knowledge cannot be contradictory, there will always be such a set. (If it were mere belief that were involved, this might not be the case, as beliefs might be contradictory.)

Now consider deontic *must*. At first glance it looks as though deontic *must* quantifies over the set of worlds that satisfy those propositions that represent (manmade) laws or ideals⁴ Suppose that I only have enough clean clothes to make it through tomorrow. Suppose also that the propositions in (15) are true.

- (15) a. I want to have clean clothes.
b. I don't want (= want not) to do my laundry. , I don't want to (= want to not) have someone else do my laundry.
c. I don't want to (= want to not) buy new clothes.

Assuming that the only ways I am going to get clean clothing are by washing my clothes myself, having someone else do it for me, or buying something new to wear, then there is no world in which all of the desires expressed in (15) are true, because taken together they are contradictory. And yet the desires in (15) are perfectly natural simultaneous desires, and it is perfectly natural to say in this situation that I must (or *have to*) do my laundry.

One solution is to weight the desires and have *must* quantify over the worlds that come closest to being ideal, by satisfying the most important desires. The desires thus provide an ordering source for the possible worlds: based on the weighting of the desires, the worlds will be ordered according to how well they satisfy these desires. In this case, on the most natural weighting of the desires in (15), the most ideal worlds would be those in which I give in and do my laundry, because presumably my desire to avoid doing my laundry is not as strong as the other desires.

Returning to the argument at hand: recall that we are trying to determine a general rule for what X is, where X is the thing that must overlap the local evaluation time in imperfectives. We have three plausible Xs, two of which have to do with intentions (i.e., plans, manmade laws and the like). Since intentions provide ordering sources, we may assume that in these intentional cases, X provides the ordering source.⁵

⁴Of the speaker, or of someone else?

⁵Carlson also pointed out other habituals that do not require instantiation. These are habituals that involve machines of some kind.

- (i) a. This car goes 180 miles per hour.
b. This machine crushes oranges.

Bridget Copley

Now, what about the physical cases? Recall that X for physical habituals was whatever properties of the subject cause the lawlike connection between subject and event. We had no good idea about X for physical progressives. However, now that we know we are looking for an ordering source, there is a good candidate, namely *inertia*. This idea of an inertial ordering source looks appropriate as well for physical generics and habituals. “Normal cases according to some law” are like “inertia worlds”: If nothing disturbs the lawlike connection, the connection actually holds. This would then be why generics and habituals admit exceptions: The habitual in (16), for instance, can be true even though some exceptional dogs have three legs.

(16) Dogs have four legs.

The existence of exceptions does not affect the truth of (16), because (16) is only about the normal situations. All the cases in which dogs have three legs are in fact non-normal situations, those in which some mutation or accident has taken place. Thus we can justify a hypothesis that treats X in the physical cases, both progressive and habitual, as being inertia.

Furthermore we should note that inertia, like intention, can be treated as an ordering source (see for instance Portner 1998). For just as there may be desires of varying strengths, that may oppose each other, so too there may be physical forces or dispositions of varying strengths, that oppose each other. In general, physical forces have an underlying conceptual similarity with intentions. An intention or desire is an impetus towards worlds of the maximum possible contentment; a physical force is an impetus towards worlds of the maximum possible entropy (we might think of this as maximum contentment of the physical universe).

One question that arises is whether intentional forces and physical forces are involved in the same ordering source, or whether a modal can have only one or the other. It seems that the former is true; they actually compete to form a net force, and it is the net force that is X. If they didn't compete, it would be possible to felicitously say (17) simply on the basis of wanting it to be so.

(17) I am winning the election tomorrow.

But these are not the felicity conditions for (17). The only way in which (17) could be uttered felicitously is if the speaker had knowledge of forces that ensured his or her winning. Wanting is not enough, unless the speaker actually has the ability to turn their wants into reality. That is, the modal doesn't just use the net desire, it has to take other forces into account. So it seems that there are not two ordering sources, just one, an inertial one, that considers both intentional and physical forces.

But intentional and physical forces do seem to have a major difference. Intentional forces such as plans and laws can have local application but spatiotemporally distant ef-

What is the nature of the laws in these examples, that allow the lack of instantiation? I suggest the fact that there is a designer means there is a manmade law, and therefore the designer could have in mind situations that haven't arisen yet.

fects. That is, one can place an obligation on someone else to carry something out later.⁶ But physical forces are typically limited to the here and now. One apparent exception might be gravity, which seems to act at a distance. But of course, we don't expect even Newtonian physics to necessarily interact with grammar. Rather, we expect some sort of naïve physics, part of our cognitive birthright, to have some sort of interaction with the grammar. And equally, some sort of naïve psychology, with which to understand intentions.

Returning to the main argument, here then is a plausible reason why X was so hard to see in physical progressives, but so easy to see in intentional progressives. Physical forces disappear into their effects, as it were, while intentional forces have a life of their own. But both are apparently treated similarly in the modal semantics.

So far, we have only discussed forces with respect to aspectual modals; this afforded us a different understanding of why our original generalizations about the difference between aspectual and future modals failed. However, we still have to say what the correct difference is between aspectual and future modals.

3. Reasoning

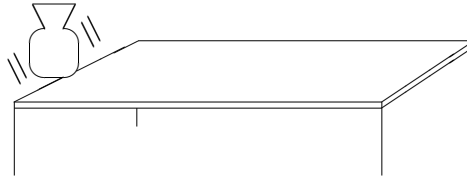
I have argued that imperfectives require X to overlap the local evaluation time. X was the net force, composed out of intentions (“forces of will”) and physical forces alike. Now we turn to future modals, and the difference between them. The proposal is that future modals require X, the net force, to be future with respect to the local time of evaluation. (Of course the local time of evaluation for futures such as *will* and *is going to* is present.) It is this grammatical difference that is the semantic distinction promised in the title of this paper by the term “reasoning.”

To argue for this idea, let us consider the case of a vase sitting on a table. When the vase is sitting on the edge of the table, teetering, as depicted below, it is possible to use felicitously either the aspectual modal in (18a) or the future modal in (18b).

⁶Also, intentional forces necessarily involve an animate entity to carry out plan, since inanimate objects don't listen to our plans.

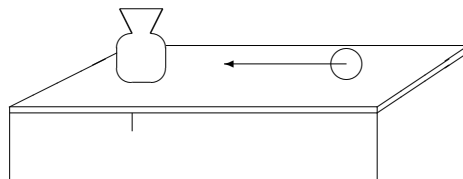
Bridget Copley

- (18) a. The vase is falling.
b. The vase is going to fall.



However, in the following situation, where the vase is sitting solidly in the center of the table, with a ball rolling towards it, it is only possible to felicitously use the future modal.

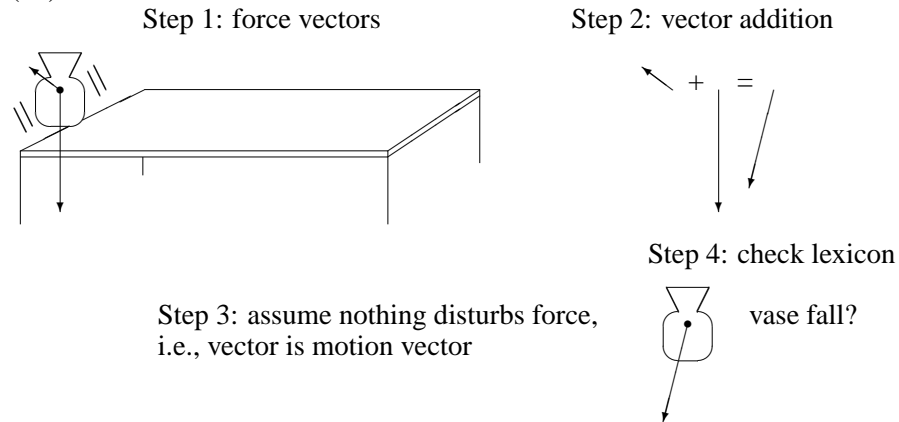
- (19) a. #The vase is falling.
b. The vase is going to fall.



This minimal pair of physical cases (progressive and *be going to*) will help us determine the distinction between imperfectives and futures in general. As I have proposed, the progressive requires there to be a force overlapping the local evaluation time (here the utterance time) that is a vase-falling kind of force. To determine if there is such a force in this situation, we use vector addition to add up the force vectors. Then we look in the lexicon to see if the effect caused by the force counts as a vase-falling motion. Note that we are only interested in what would happen in the absence of other disrupting forces; this is inertia. This process is diagrammed below in (20).

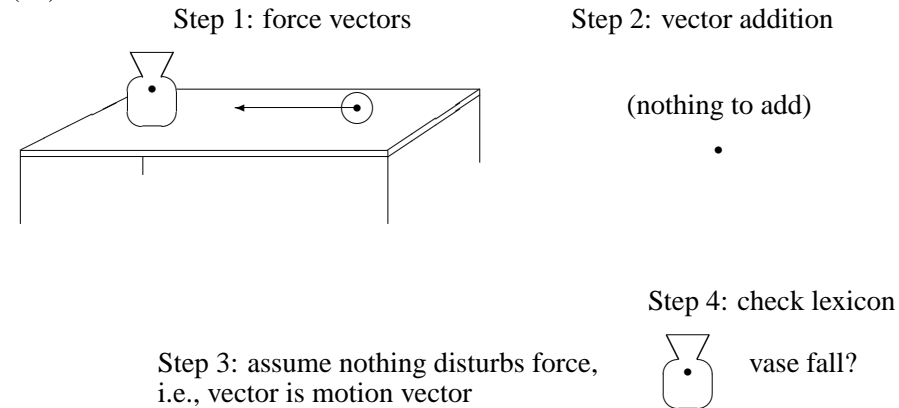
A conceptual and a grammatical distinction for modals

(20)



Because in this situation we do end up with a vase-falling vector, the progressive is possible. But in the situation where the vase is not moving, if we apply the same process (shown below), the vase vector is zero, and does not count as a vase-falling vector; so the progressive is not possible.

(21)



However, in the same situation, *be going to* is possible, even though the progressive is not. This suggests that *be going to* must be able to consider all of the forces in the following diagram, not just the current forces on the vase, and work out how they will eventually affect the vase. That is, in evaluating future modals, we calculate from forces in the current situation to future forces, which have a future effect.

How might intention come into this discussion? In fact, it is possible to use *be going to* even in a situation where the vase is sitting on the table. You could still say felicitously that it's going to fall if you had an intention to knock it over or knew someone else to have such an intention. You could only use the progressive if there was a current schedule for such a thing to happen. The basic idea is still the same; the future modal requires only

that there be a future intention (calculated to follow from current conditions) while the progressive requires that there be a current intention, i.e., a plan.

Likewise, in more familiar cases, the progressive seems to be about plans or obligations, as in (22a), while the future leaves room for one to not have made up one's mind yet, as in (22b):

- (22) a. I think I'm teaching tomorrow.
b. I think I'm going to teach tomorrow.

This is exactly the same as what we saw in the physical cases: the progressive requires current forces (where in this case the current forces, being intentions, can have effects in the future). *Be going to*, as before, can talk about future developments; future forces that follow causally from current forces.⁷

So far, then, we have a story about the difference between progressives and *be going to*. But recall, the larger project is to explicate the difference between aspectual modals and future modals in general. Is the difference between habituais and dispositionals the same kind of difference as that between progressives and *be going to*? Consider, for instance, the pair in (23).

- (23) a. Norvin eats doughnuts.
b. Norvin will eat doughnuts.

Our theory predicts that habituais require the force that results in the Norvin-eating-doughnuts action – that is, Norvin's properties that cause him to eat doughnuts – to overlap the local evaluation time. In the dispositional, we predict that it should be true just in case the current situation will develop into one with such a force. Indeed that seems to reflect the contrast in (23). And similarly, in cases that involve manmade laws, as in (24), the contrast is as expected.

- (24) a. Mary answers the mail from Antarctica.
b. Mary will answer the mail from Antarctica.

The example in (24a) feels like a current law, while the example in (24b) seems to express a more distant law.

All of these contrasts are difficult to tease apart. However, this fact should not deter us. There are two choices in the face of such subtle (though real) contrasts. We could of course abdicate, and give up trying to come up with a more precise characterization of these contrasts, because we cannot find truth-functional contrasts. The other choice is to find easier cases, where the contrast *is* truth-functional, and which are closely related to the more difficult cases. Then that analysis can be justifiably exported to account for the more subtle cases. This is the route we have taken here. It is predicated on the idea

⁷For reasons of space, I will have to omit discussion of two apparently problematic kinds of progressives: progressive achievements, as in *The penny is hitting the ground*, and "clockwork" futurates, as in *The sun rises/is rising at 5 tomorrow*. But see Copley (to appear) for discussion.

that progressives are to *be going to* sentences exactly in the same way that habituais are to dispositionals; the same distinction is at work in both domains.

From here on, I will refer to this distinction as a distinction of *reasoning*. The idea behind this name is simply that depending on whether the modal is aspectual or future, the chain of reasoning one is allowed to use to get to the net force. In both cases you begin with a current situation (a situation overlapping the local evaluation time). Aspectual modals can only look at forces within the local evaluation time; these modals, let us say, have “direct” reasoning, as all you are allowed to do is to look at the current situation. For future modals, the net force is determined through a causal chain from the current situation to a later one; let us say that these modals have “extrapolative” reasoning.

Before moving on to consider whether this distinction will be a useful one, I would like to step back a bit and consider how this proposed distinction is different from a more familiar distinction, that of tense.

Tense helps determine what situation is used to calculate the net force, by telling us what time is the local evaluation time, that the situation must overlap.⁸ Tense is oblivious to whether the net force that the modal is interested in is a current force or a future force. In either case the same situation – a current one – is used.⁹

4. Conclusions and further directions

The preceding discussion provides merely a sketch of both the grammatical and cognitive elements that would need to be marshalled in order to account for the judgments under discussion. I will have to leave a more detailed investigation of both of these components, and therefore more detailed predictions, to later work. However, it is possible to outline the impact of this general line of inquiry both on typology – i.e., what ought to be possible grammatically – and on ontology – i.e., what ought to be possible conceptually.

One typological expectation is that distinctions in reasoning should occur with other modals besides the ones we have discussed (just as tense occurs with other modals, e.g.). This expectation seems to be borne out. Cross-linguistically, root modals can be realized with either aspectual or future morphology. The Tagalog abilitative, which expresses physical ability, is one such modal (as shown in (25) below). Compositionally, such forms are obscure; e.g., a future-marked abilitative does not mean ‘will be able to.’ But the imperfective-marked form requires instantiation, while the future-marked form does not, as expected if the contrast is the grammatical distinction of reasoning argued for above.

⁸I have outlined a role for aspect elsewhere (Copley 2004); in this discussion, aspect would also have a role constraining the situation.

⁹Aspect is also different from this new distinction. I take aspect to provide both a binder for a temporal variable, and a relation between that variable and the local evaluation time. Like tense, it has the effect of modifying the time of the local situation used to determine the net force (or ordering source). The “ongoingness” that progressives and *be going to* share, I have argued in (Copley 2004, etc.) is a kind of aspect; namely, an operator that introduces a superinterval of the temporal argument.

Bridget Copley

- (25) Dell (1987) (physical forces only)
- a. Nakakainom siya ng sampung bote nang sunod-sunod.
abil-impf-drink he-nom gen ten bottle nang follow-follow
'He can drink ten bottles in a row.' (must have at least started to do so)
 - b. Makakainom siya ng sampung bote nang sunod-sunod.
abil-future-drink he-nom gen ten bottle nang follow-follow
'He can drink ten bottles in a row.' (need not ever have done so)

Interestingly, Tagalog is a so-called “tenseless” language, which has been taken not to mark tense morphologically, but instead to mark “aspect”: perfective, imperfective, and future (what Schachter and Otones (1972) call “contemplative”). Note that this is a bit strange, as we are not used to thinking of futures as “aspects”. But with the new distinction of reasoning, we have another option: perhaps what Tagalog marks is values of reasoning, not values of aspect, and perhaps the perfective is a third value of reasoning, one in which a past force causes the local situation. Then we would have three values of reasoning:

- (26) Values of reasoning (speculative!)
- a. retrospective: local situation follows from past forces (perfectives? resultatives?)
 - b. direct: local situation includes forces (imperfectives) , extrapolative: future forces follow from local situation (futures)

As yet we have no precise prediction for the meanings of “retrospective reasoning” forms, but we expect something like a perfective or resultative.

As far as ontological issues, this line of inquiry raises intriguing issues. First, it promises a framework under which “forces of will” and physical forces have a connection both to modality and to events. It does this by recognizing that forces have a double role: They are used in the calculation of the ordering source, but they also intuitively have effects (resulting events). Whatever formal mechanism is ultimately used to model forces (functions from situations to properties of situations, perhaps), I expect that taking forces seriously will allow us to revisit problems that have in the past not yielded cleanly to an event-based analysis: “accidental” action, for instance (e.g. Dell 1987, for Tagalog), or indeed the problem of whether statives have an event argument, the key notion about (many) states being that there is no associated net force.

Secondly, this way of looking at modals rests on the idea that there may be conceptual distinctions (like the distinction between intentions and physical forces) that are not necessarily grammatical distinctions, but are part of our general cognitive model of the world. The study of semantics, then, may have something to say about this cognitive model; and research on cognitive models may have something to say about semantics.

References

- Bennett, M., and Barbara Partee. 1978. *Toward the logic of tense and aspect in English*. Indiana University Linguistics Club.
- Carlson, Gregory. 1995. Truth conditions of generic sentences: Two contrasting views. In *The generic book*, ed. Gregory Carlson and Francis Jeffrey Pelletier, 224–237. University of Chicago Press.
- Cipria, Alicia, and Craige Roberts. 2000. Spanish *imperfecto* and *pretérito*: Truth conditions and aktionsart effects in a Situation Semantics. *Natural Language Semantics* 8:297–347.
- Copley, Bridget. 2001. *Be going to* as a case of high aspect. In *Proceedings of SALT XI*. Ithaca, NY: Cornell Linguistics Circle.
- Copley, Bridget. 2002a. A linguistic argument for indeterministic futures. In *Proceedings of NELS 32*.
- Copley, Bridget. 2002b. The semantics of the future. Doctoral Dissertation, MIT; In press, Routledge: *Outstanding Dissertations in Linguistics* series.
- Copley, Bridget. 2004. Aspect and scope in future conditionals. URL www-rcf.usc.edu/copley/, USC ms.
- Copley, Bridget. To appear. Ordering and reasoning. In *Modality*, ed. Jon Gajewski et al. MITWPL.
- Dell, François. 1987. An aspectual distinction in Tagalog. *Oceanic Linguistics* 22-23:175–206.
- Dowty, David. 1979. *Word meaning and montague grammar*. Dordrecht: Reidel.
- Klein, Wolfgang. 1997. *Time in language*. New York: Routledge.
- Kratzer, Angelika. 1991. Modality. In *Semantics: An international handbook of contemporary research*, ed. A von Stechow and D. Wunderlich. Berlin: de Gruyter.
- Lewis, David. 1986. *On the plurality of worlds*. Oxford: Blackwell.
- Portner, Paul. 1998. The progressive in modal semantics. *Language* 74:760–87.
- Schachter, Paul, and Fe Otones. 1972. *Tagalog reference grammar*. Berkeley, Calif.: University of California Press.

Remarks and Replies

The Plan's the Thing: Deconstructing Futurate Meanings

Bridget Copley

A *futurate* is a sentence with no obvious means of future reference, which conveys that a future-oriented eventuality is planned or scheduled. I argue that the component of planning found in the meaning of futurates should be derived from the more familiar modal concepts of abilities and desires. A futurate statement presupposes that some contextually salient entity *d*, the *director*, has the ability to bring it about that *p*, and asserts that *d* is committed to bringing it about that *p*.

Keywords: future, futurates, present tense, ability, modality

A *futurate* is a sentence with no obvious means of future reference, which nonetheless conveys that a future-oriented eventuality is planned, scheduled, or otherwise determined.¹ The sentences in (1) and (2) are examples of futurates. The (a) examples, which discuss a plannable event (a baseball game), are far more acceptable than the (b) examples, which refer to a presumably unplannable event (the Red Sox winning).

- (1) a. The Red Sox play the Yankees tomorrow.
b. #The Red Sox defeat the Yankees tomorrow.
- (2) a. The Red Sox are playing the Yankees tomorrow.
b. #The Red Sox are defeating the Yankees tomorrow.

The (a) examples convey, roughly, that there exists a plan for the Red Sox and the Yankees to play tomorrow; the (b) examples, however, are decidedly odd. By comparison, there is nothing odd about (3).

- (3) The Red Sox will defeat the Yankees tomorrow.

The oddness of (1b) and (2b), as compared with (3), seems to stem from the fact that the winner of a baseball game is (usually) not decided ahead of time. The sentences in (1b) and (2b) improve markedly in a context where it is presupposed that the winner *can* be decided ahead of time—for instance, if we are allowed to consider the possibility that someone has fixed the game.

¹ Early works on futurates include Lakoff 1971, Prince 1971, Vetter 1973, Huddleston 1977, and Dowty 1979. See Binnick 1991 for an overview. More recent efforts are found in Landman 1992, Portner 1998, Cipria and Roberts 2000, and Copley 2008.

Futurate readings are not universal. In some languages, “present” tense verbs might be better understood as “nonpast,” in that they do not have this plannability restriction when used to talk about the future. This can be true even when additional future morphology is available, as in German. For the purposes of this article, I leave aside the question of the correct analysis of the German present tense. My central concern here will be to investigate the origin of the flavor of planning that arises in English.²

As can be seen in (1) and (2), in English both simple and progressive present forms can have futurate construals.³ Crosslinguistically, not all progressive forms have futurate construals. For example, the progressive in Italian does not have a futurate reading.

- (4) *I Red Sox stanno giocondo gli Yankees domani.
 the.PL Red Sox be.3PL play.PROG the.PL Yankees tomorrow

Presumably the difference between (2a) and (4) lies in some difference between the meaning of the English progressive and that of the Italian progressive. What can be said is that most if not all forms with futurate construals seem to be imperfective or progressive forms. It has been proposed, understandably under the circumstances, that imperfective semantics are responsible for futurate meaning (e.g., Dowty 1979, Cipria and Roberts 2000). What these proposals have in common is the idea that a plan for an event can constitute an early stage of the event, and thus that an imperfective sentence about the event can be true before the event has begun, while the event is only a gleam in someone’s eye. This idea is an interesting one, but it raises the question of why exactly a plan can count as an early stage of an event. To understand this, more must be known about how plans are involved in the meanings of futurates, and how they might be assimilated to more general semantic concepts. The evidence presented below will suggest that plans can be reduced to desires and abilities, bringing them into the realm of more familiar modal concepts and making it easier to draw parallels to nonfuturate construals of imperfectives.

1 An Initial Hypothesis and Its Problems

Consider again the futurate contrast in (2), repeated here as (5).

- (5) a. The Red Sox are playing the Yankees tomorrow.
 b. #The Red Sox are defeating the Yankees tomorrow.

² An anonymous reviewer points out that future-oriented bare verbs also appear in English in certain embedded contexts, as in (i) and (ii).

(i) If/When it rains tomorrow . . .

(ii) I hope it rains tomorrow.

I wish to exclude such uses of the bare verb from the current discussion, as they do not exhibit the plannability constraint. Given that languages differ with respect to which morphology they use in such embedded contexts, I assume that these uses of the bare verb need not be explained in the same breath as the futurate uses of the bare verb.

³ While there are differences between the meanings of these forms, they share a great deal (Copley 2008). Here, I will concentrate on the meaning of progressive futurates.

As noted above, the sentence in (5a) seems to say that there is a plan for the Red Sox to play the Yankees tomorrow. It seems that the existence of a plan in futurates matters, at the very least, to temporal predicates; the time over which the plan is asserted to hold is constrained by tense and can also be constrained by a temporal adverbial. The utterance in (6) seems to convey that at some time in the past, for a period of two weeks, there was a plan for the Red Sox to play the Yankees today.

(6) For two weeks, the Red Sox were playing the Yankees today.

The semantics of futurates will thus need to refer to at least the duration of the aforementioned plan. But what is the nature of the reference to the plan?⁴ Let us suppose, as an initial hypothesis, that a plan, as far as the grammar is concerned, is simply the conjunction of future-oriented propositions. For now, I will not venture to say what might make any old conjunction of future-oriented propositions a plan. At least the propositions ought to be consistent with each other, for example. But let us suppose, for now, that whatever else makes a plan a plan, it is not manipulated by the semantics. (This supposition will, incidentally, turn out to be incorrect.)

If propositions are sets of worlds, we can define a plan as the joint intersection of a set of type $\langle w, t \rangle$ propositions p , where each of these propositions is equal to a type $\langle i, \langle w, t \rangle \rangle$ proposition q applied to a future time.

(7) *Definition of planhood (initial try)*

$X_{w,t}$ is a plan in w at t if

$$X_{w,t} = \bigcap \{p : p \in D_{\langle w, t \rangle} \ \& \ \exists q \in D_{\langle i, \langle w, t \rangle \rangle} : [\exists t' > t : [p = q(t')]]\}$$

A plan then provides for p just in case all worlds in the plan are also in p .

(8) $\forall p \in D_{\langle w, t \rangle}, X_{w,t}$ provides for p iff $\forall w'$ such that $w' \in X_{w,t} : [p(w')]$

We then define a futurate operator Op , as in (9), that takes a proposition, a world, and a time, and asserts that at that world and time there is a plan that provides for p .

(9) $Op = \lambda p \lambda w \lambda t . \exists X_{w,t} : X_{w,t}$ provides for p

This, then, is our initial hypothesis for the meaning of futurates:

(10) *Initial hypothesis*

Futurates assert that there is a plan that provides for p .

Of course, as with most initial hypotheses, the story is not this simple. There are two major problems.

⁴ Note that the nature of the reference to the plan is not the same as the nature of the plan. The field of artificial intelligence planning is concerned with the latter (see Weld 1994 for an introduction and Geffner 2002 for an overview); we are concerned with the former.

1.1 Problem 1: The Status of the Plan

The first problem is that futurates do not really seem to *assert* the existence of a plan that provides for p. If they did, we would expect (11a) to mean that there does not exist a plan for the Red Sox to play the Yankees tomorrow. But this meaning is not quite right. Suppose that Major League Baseball has not yet decided who plays whom tomorrow. Then neither (11a) nor (11b) is true.

- (11) a. The Red Sox aren't playing the Yankees tomorrow.
 b. The Red Sox are playing the Yankees tomorrow.

So futurates apparently exclude the middle: in the case where there is no particular plan with anything to say about the Red Sox playing the Yankees, neither (11a) nor (11b) is true.⁵ This is in conflict with the proposed meaning for futurates, in which the negation ('There does not exist a plan that provides for the Red Sox to play the Yankees tomorrow') would be expected to be true in exactly this middle case.⁶

One possible solution to the problem posed by (11) would be to interpret negation below the futurate operator Op. Then (11a) would be predicted to mean something like 'There is a plan that provides for the Red Sox to not play the Yankees tomorrow'. But while this solution works for (11a), it is unavailable for biclausal cases such as (12), which have exactly the same problem.

- (12) I doubt that the Red Sox are playing the Yankees tomorrow.

What (12) seems to mean is that the speaker doubts that the plan provides for the Red Sox to play the Yankees tomorrow. That is, the speaker is of the opinion that the plan provides for the Red Sox to not play the Yankees tomorrow. So again, the middle is excluded, but the option of interpreting the proposed embedded-clause futurate operator over the matrix-clause *doubt* is unavailable.

So p is either entailed by the plan or inconsistent with the plan, but it cannot be merely consistent with it. And indeed, in a case where the matter is still under consideration by the relevant parties, it is neither true to say that the Red Sox play the Yankees tomorrow, nor true to say that they do not play the Yankees tomorrow; we can only say that it has not yet been decided whether they do or not.

These facts suggest that futurates have a certain presupposition. The presupposition is that the plan provides either for p or for not-p; that is, a p-eventuality is the sort of thing that is either planned to happen or planned to not happen. Call this the *excluded-middle presupposition*.

⁵ An anonymous reviewer asks whether (i) indicates that no plans have been made either way.

(i) The Red Sox aren't playing the Yankees tomorrow, or at least not yet.

If that is what (i) indicates, then the middle can after all be included, making the exclusion of the middle an implicature, perhaps, rather than an entailment. It seems, however, that (i) does not indicate that no plans have been made. Rather, there is at the time of utterance a plan for the Red Sox not to play the Yankees. By uttering (i), the speaker conveys that she or he expects the powers that be to change their minds about the plan. See section 3.3 for more on changing plans.

⁶ For more on the future version of the Law of the Excluded Middle, see, for example, Van Fraassen 1966, Thomason 1970.

(13) *Excluded-middle presupposition*

The plan provides either for p or for not-p.

This idea makes sense of the judgments in (14) in terms of a presupposition failure (a failure that, again, is ameliorated if we can suppose that the eventualities in question are in fact part of someone's plan).

- (14) a. #The Red Sox are defeating the Yankees tomorrow.
 b. #It's raining tomorrow.

It is not yet clear where this presupposition would fit in compositionally. I will raise this question again below, since the solution to the second problem will prove relevant to this issue.

1.2 *Problem 2: Speaker Confidence*

Recall the initial hypothesis for futurate meaning: that futurates assert the existence of a plan that provides for p. The second problem with this hypothesis is that futurates commit the speaker to the belief that the eventuality in question will in fact occur, as shown in (15a).⁷ This would be surprising under the initial hypothesis, as there is no problem with asserting, as in (15b), that there is a plan that provides for p but you don't think it will happen.

- (15) a. #The Red Sox are playing the Yankees tomorrow, but they won't/might not.
 b. There is a plan for the Red Sox to play the Yankees tomorrow, but they won't/might not.

If the assertion of the futurate in (15a) really is just that the plan exists, it is not clear why spelling it out that there is a plan, as in (15b), should be any different. Yet the futurate shows a conflict with denying that the eventuality will happen, while the explicit assertion that there is a plan does not. Our initial hypothesis cannot account for this difference.

Could this problem be solved by adding, as part of the assertion contributed by the future operator, an assertion reflecting speaker confidence that the plan will be realized? It turns out that this move will not work. In past tense futurates, the realization of the plan does not seem to be part of the assertion, as shown in (16). Past tense futurates do not commit the speaker to the belief that the plan was or will be realized.⁸

- (16) The Red Sox were playing the Yankees tomorrow, but now they won't.

⁷ This fact seems not to have been discussed in the literature prior to Copley 2008, and indeed I know of no other analyses that can account for it. Thanks to Sabine Iatridou (pers. comm.) for originally bringing this kind of example to my attention.

⁸ Incidentally, past tense is one environment where progressive and simple futurates differ; simple futurates are extremely marked, if not impossible, in the past tense.

- (i) #The Red Sox played the Yankees tomorrow.

These past simple futurates do improve under sequence of tense and in narrative contexts, but the contrast is very striking. This fact has long been noted but remains unexplained.

So assertion of the realization of the plan is apparently not an option for explaining the contrast in (15).

2 Getting Smarter about Plans

What went wrong with the idea that futurates assert the existence of a plan that provides for *p*? Consider the problematic examples again.

- (17) a. I doubt that the Red Sox are playing the Yankees tomorrow.
 b. #The Red Sox are playing the Yankees tomorrow, but they might not.

The first problem is that (17a) appears to have a presupposition that the eventuality be of a kind that could, in principle, be planned. The second problem, the unacceptability of (17b), seems to indicate that the speaker of a futurate has some high level of confidence that the future eventuality will happen.

To solve these problems, we will need to know something more about plans than merely that they are sets of future-oriented propositions. This is clearest in the case of the first problem; we apparently need to care whether or not a *p*-eventuality is something that *could* be planned. Some eventualities can be planned, it seems, and some can't, and this is relevant. Since any future-oriented proposition trivially *could* be included in a set of future-oriented propositions, we must have a more restrictive definition of what it is to be a plan.

In the second problem, too, this issue arises. Above, I have argued that the speaker confidence cannot be part of the assertion of a futurate. Suppose instead that the confidence is expressed in a presupposition, that the speaker of a futurate presupposes that the eventuality will actually happen, and that there is some sort of context shift that allows the past tense futurate to be truly asserted even when the speaker goes on to deny that the event will actually happen. But this attempt does not provide satisfactory results either, as Vetter (1973) argues. If there were such a presupposition, (17b) would deny its own presupposition, because the presupposition of the embedded clause would also be a presupposition of the matrix. Consider (18), for example.

- (18) I doubt that John has quit smoking.

The matrix clause, like the embedded clause, presupposes that John smoked at one time; this property is a general property of attitude sentences (Karttunen 1974, Heim 1992). Vetter argues that the same kind of presupposition projection is at work in (12), repeated here as (19).

- (19) I doubt that the Red Sox are playing the Yankees tomorrow.

Thus, the sincere utterer of (19) would doubt whether the Red Sox would play, but would presuppose that he or she was sure that they would play. Likewise, a putative presupposition of speaker confidence would be totally inappropriate for futurate questions, as in (20). We certainly would not want the speaker of (20) to be presupposing that the Red Sox are playing the Yankees tomorrow.

- (20) Are the Red Sox playing the Yankees tomorrow?

Therefore, following Vetter, I conclude that a presupposition of speaker confidence is not the correct presupposition for futurates.

The appropriate presupposition, rather, seems to be a conditional one: the speaker is certain that *if* the plan says the Red Sox play the Yankees tomorrow, they will. This can be a presupposition of both the embedded clause and the matrix clause without contradiction, and it would yield the correct judgments. A conditional presupposition of this sort would also solve the first problem, by providing a source for the excluded-middle presupposition. Recall that there seemed to be a presupposition that either *p* is planned or not-*p* is planned. As long as plans are assumed to be exhaustive, the excluded-middle presupposition would be subsumed under this conditional presupposition; a *p*-eventuality must be the sort of thing that can be planned. A conditional presupposition therefore seems appropriate.

(21) *Conditional presupposition*

If *p* is planned, *p* will happen.

However, if that is so, again we must specify more about the plan than we have so far. If a plan is just a set of future-oriented propositions, then futurates should be able to vary with respect to whether their plans consist only of propositions describing eventualities that will actually turn out to happen, or only of those that will not turn out to happen, or of a combination of both. Thus, there should be no conditional presupposition and no excluded middle. But this conclusion contradicts the observed facts. Therefore, once again, we need a more restrictive definition of a plan than merely an arbitrary set of future-oriented propositions; ideally, this definition should be expressed in terms of more primitive semantic concepts. To that end, let us consider in more detail our intuitions about plans.

3 Intuitions about Plans

If we consider what we know about plans aside from their being sets of future-oriented propositions, we might come up with the following initial intuitions:

1. A certain entity has a desire for the plan to be realized.
2. The entity has the ability to see that the plan is realized.
3. Plans can change, since desires and abilities can change.

I take these intuitions, without argument, to be a reasonably good starting point. Unpacking them will motivate a theory of plans in more familiar semantic terms.

3.1 *On Being Committed*

The first intuition on the list is that the person making the plan for *p* must somehow want *p* to happen. However, an entity can have a plan and intend to carry it out, seemingly without actually wanting to, as in (22).

(22) I'm doing laundry tomorrow, even though I don't want to.

Is there a problem, then, with the naive intuition?

I think we can safely say that there is no substantive problem here, on the strength of Kratzer's (1991) discussion of a parallel issue. Here is a version of Kratzer's point. Suppose that I only have enough clean clothes to make it through tomorrow. Suppose also that the propositions in (23) are true.

- (23) a. I want to have clean clothes.
 b. I don't want (= want not) to do my laundry.
 c. I don't want to (= want to not) have someone else do my laundry.
 d. I don't want to (= want to not) buy new clothes.

Assuming that the only ways I am going to get clean clothes are by washing my clothes myself, having someone else do it for me, or buying something new to wear, there is no world in which all of the desires expressed in (23) are true, because taken together they are contradictory. And yet the desires in (23) are perfectly natural simultaneous desires.

The introduction of gradable modality into the modal framework allows us to model contradictory desires such as those in (23). The idea is that my desires in (23)—and desires in general—do not all have equal weight. In the present instance, suppose that above all else I would like to avoid buying new clothes. Next most important to me is to avoid having someone else do my laundry. Having clean clothes is my next priority, and avoiding doing the laundry myself is least important. In such a scenario, it is obvious that my best course of action is to resign myself to doing my laundry. Thus, the utterance in (24) expresses a true proposition.

- (24) I should do laundry tomorrow, even though I don't want to.

Now we alter the theory of modals to get (24) to turn out true. In Kratzer's terminology, the conversational background consisting of the propositions expressed in (23) provides an ordering source on the accessible worlds being quantified over. The ordering source partitions the worlds into sets and ranks them according to how well they agree with the conversational background. In our case, for instance, worlds in which I do my own laundry are the best possible worlds; worlds in which I buy new clothes so I can have something to wear tomorrow are the worst.

The modal *should* is approximated by universal quantification over, not the set of accessible worlds, but the set of best accessible worlds. In all those worlds, I do my laundry. Thus, the reason that (24) comes out true is not that my desires are not involved in the evaluation of the *should*-clause, but that *should* takes into account my "net" desires, while *want* does not.

This mechanism works equally well to explain why (22), repeated here as (25), is true, not contradictory.

- (25) I'm doing laundry tomorrow, even though I don't want to.

We might therefore revise the statement of the intuition to say that the following is true of an entity making a plan for *p*: *p* is true in all the worlds that are optimal according to an ordering source given by the entity's desires. Then a fact about an entity's plan for *p* is that *p* is true in all the worlds consistent with the entity's net desires, which we might also term commitments.

3.2 *On Ability*

The second intuition about plans is that the entity making the plan, if it is a valid plan, has the ability to see that the plan is realized. To demonstrate the role of this claim, suppose that five-year-old Max utters the sentence in (26a) and his mother Chelsea utters the one in (26b).

- (26) a. We're seeing *Spiderman* tomorrow.
 b. We are not seeing *Spiderman* tomorrow.

Max is clearly mistaken in uttering (26a). He could in fact be mistaken in either of two ways. He could be making a mistake about his mother's commitments, still accepting that she is the one with the ability to determine which movie the family will see. In that case, he will probably correct his belief upon hearing what his mother has to say on the subject.

On the other hand, being a five-year-old, he could equally be under the misapprehension that he has the authority to make plans for the family. On that scenario, he wants to see *Spiderman* (that is, he is committed to it), and he believes that he has the ability to make that happen, so that his mother's comment may well not change his belief.

But it is Chelsea and not Max, of course, who really has the ability to say what the family does. For a certain class of eventualities, if she wants an eventuality to happen, it happens. And equally, if she doesn't want an eventuality to happen, it doesn't happen. What Mom says, goes—or at least, is presupposed to go.

3.3 *On Changes*

But plans do not always get realized. One way they might fail to be realized is that the person doing the planning changes his or her mind. The other way is that the person's abilities change; that is, the best-laid schemes of mice and men might go, as they so often do, awry. We may presuppose that Mom has the ability to say what goes, but it can happen that somewhere along the way, something unexpected, and more powerful, disrupts her plans. Chelsea may, for example, utter the sentence in (27), but if there are flash floods and the family cannot get to the theater the next day, what she ordained does not end up happening.

- (27) We're seeing *Scooby Doo* tomorrow.

This kind of thing happens now and then. It does not shake our belief in Chelsea's authority as a mother if there happens to be a flash flood just as the family starts out for the movie theater.⁹

⁹ It is interesting that (ia) and (ib), which are roughly equivalent to each other, are possible (brought to my attention by an anonymous reviewer).

- (i) a. We're seeing *Scooby Doo* tomorrow, unless it rains.
 b. We're seeing *Scooby Doo* tomorrow, if it doesn't rain.

Does the possibility of adding an *unless*- or *if*-clause conflict with our hypothesis that the speaker of a futurate has confidence that the plan will be realized? It seems not. There are two ways to understand these utterances. The first, available especially if the pause for the comma is not long, is that the plan itself is a plan for a conditional proposition,

We still want to presuppose that what Mom and Dad say about certain events, goes, all else being equal.¹⁰ This kind of *ceteris paribus* restriction on the possible worlds being considered is a familiar one, seen throughout the modal literature (e.g., Stalnaker 1968, Lewis 1986, Kratzer 1991). Dowty (1979) invokes it for progressives by delimiting a set of ‘‘inertia worlds,’’ which is roughly the set of worlds in which things proceed normally. This restriction also applies to commitments: we assume that they will not change, even though we recognize that they could.

4 Proposal

Having unpacked plans in terms of desires and abilities and the fact that either of these can change, I will now incorporate these intuitions into the semantics of futurates.

The initial hypothesis was that futurates assert the existence of a plan that provides for *p*. Recall once more the examples that are problematic for this hypothesis, repeated here from (17).

- (28) a. #I doubt that the Red Sox are playing the Yankees tomorrow.
 b. #The Red Sox are playing the Yankees tomorrow, but they might not.

The example in (28a) mysteriously excludes the middle, and the example in (28b) is mysteriously contradictory. I attributed these problems to an inadequate understanding of plans. If the presupposition in (29) (= (21)) could be added, however, all would be well.

- (29) *Conditional presupposition*
 If *p* is planned, *p* will happen.

(29), of course, could be stipulated, but we wanted to know whether it followed from some more basic properties of plans.

The intuitions fleshed out above regarding the entities behind the plans will now prove to be of use in augmenting our representation of plans to account for (28a) and (28b). Before we start, let us agree to call the entity who makes a plan a *director*. As we have seen, the director need not be the subject of the sentence; for now, let’s suppose that a director is supplied contextually, or at least that the existence of a director is accommodated. Directors must be animate; they may also be plural individuals (e.g., Major League Baseball and Max’s parents both qualify as possible directors).

A director for a proposition *p*, according to the intuitions detailed above, has at least two properties: the ability to ensure that *p* happens, and the commitment, or ‘‘net desire,’’ to seeing that it does happen. I would like to propose that, in futurates, the former property is attributed

namely, the proposition that we see *Scooby Doo* tomorrow if it’s not raining then. In that case, we still have confidence in the plan, even though the plan itself has a contingency built into it. The second way to understand the sentences in (i), available if there is a substantial intonational break between the clauses, is to treat the *unless*- or *if*-clause as an afterthought, representing a change of context. That is, the speaker at first is not considering the possibility that it will rain (in which case the futurate is true), and then does consider it. At that point, it would be true to assert a plan for a conditional proposition, as in the first case.

¹⁰ What if Mom and Dad disagree? If they are really sharing control, they probably won’t talk about the possible options using futurates. The reader can verify this by trying some futurates on his or her significant other.

to the director in a presupposition, and the latter property is attributed to the director in the assertion, as stated informally in (30).

(30) a. *Direction presupposition*

The director has the ability to ensure that a p-eventuality happens.

b. *Commitment assertion*

The director is committed to a p-eventuality happening.

In effect, the presupposition in (30a) is a restatement of what I called the conditional presupposition, given in (29). Like the conditional presupposition, this direction presupposition accounts for the fact that the middle is excluded. If it is presupposed that the contextually supplied director has the ability to see that the eventuality is carried out, presupposition failure will rule out utterances such as #*The Red Sox are defeating the Yankees tomorrow*, cases where we assume there could not be such a plan. This is as desired.

The second problem is also solved. The reason (28b) is a contradiction, on this proposal, is that the second conjunct contradicts an entailment of the first conjunct. The utterer of *The Red Sox are playing the Yankees tomorrow* presupposes that the plan for them to do so is made by someone who has the ability to see that such a plan is carried out (Major League Baseball, in this case). When this presupposition is combined with the assertion that there is such a plan, it is entailed that the plan will come to fruition. Thus, it feels like a contradiction for the speaker to continue on to assert that it might not. However, if past tense affects the temporal location of both the director's commitments and the director's abilities, we still correctly predict it is not contradictory to say (31).

(31) The Red Sox were playing the Yankees tomorrow, but then Major League Baseball changed its mind.

This is because we are only making a statement about what an entity's commitments and abilities were at some time in the past. Since either of these could have changed since then, the speaker is not committed to the belief that the eventuality did or will happen.

At this point, we have a hypothesis about both the assertion and the presupposition of futurates. To formalize it, let us define *d directs p in w at t* to capture the notion of the ability to make a valid plan, for use in presuppositions of futurates. This ability is the ability to ensure that, if d is committed to p's happening, p will happen. (Note that this formulation is quite similar to the conditional presupposition in (29).) The antecedent includes all cases where p is true in all the worlds in which d's commitments are satisfied; we discussed this earlier. The consequent, however, we have not discussed. How to express what will actually turn out to happen is not clear. It could be a metaphysical modal base with an empty ordering source, or a single future. We do not have any way to decide between these alternatives here, so I will just use the former option. Here, then, is a formal definition of direction:¹¹

¹¹ For reasons of space, not to mention complexity, I will not further formalize the notions of commitment and ability, but I take the abilities in the definition of direction to be substantive abilities—that is, abilities that supervene on physical and social facts about the director.

- (32) An entity *d* *directs* a proposition *p* in *w* at *t* iff:
 $\forall w'$, *d* has the same abilities in *w'* as in *w*:
 $[\forall w''$ metaphysically accessible from *w'* at *t* and consistent
with *d*'s commitments in *w'* at *t*:
 $[\forall w'''$ metaphysically accessible from *w* at *t*:
 $[\exists t' > t: [p(w'')(t')] \Leftrightarrow [\exists t'' > t: [p(w''')(t'')]]]]]$

What this definition does is to take a set of worlds and say that there is a subset of that set, such that all the worlds in the subset agree with all the worlds in the larger set on a certain property.¹² The larger set is the entire set of metaphysically possible worlds, while the subset is the set of worlds consistent with the director's commitments (but still metaphysically accessible). The property is the property of there being some—possibly nonspecific—future time at which *p* is true in the world in question. Thus, whether the director's commitment-worlds have the property determines whether the entire set of metaphysically possible worlds has that property or not.¹³ That is, what the director says, goes (or at least, is presupposed to go).

The presupposition of futrates is then simply the presupposition in (33).

- (33) *Direction presupposition*
d directs *p* in *w* at *t*.

The assertion is, still, that the future-oriented proposition *p* is consistent with *d*'s commitments (i.e., maximally consistent with *d*'s desires) in *w* at *t*.

- (34) *Commitment assertion*
d is committed to *p* in *w* at *t*.

And the meaning we want for the futrate operator is as follows:¹⁴

- (35) $Op(d)(p)(w)(t)$ is defined iff *d* directs *p* in *w* at *t*. If defined,
 $Op(d)(p)(w)(t) = 1$ iff *d* is committed to *p* in *w* at *t*.

To summarize: I have presented a denotation for a futrate operator that solves two problems of futrate meaning. The problems, I argued, indicated that we needed more information about what constitutes a plan. This information needed to be derived from more familiar semantic concepts, in order to facilitate the assimilation of futrate meanings to other imperfective meanings. On the basis of intuitions about plans, I employed the concept of a *director*, the entity who is able to make a *p*-eventuality come about. I argued that futrates presuppose that an entity *d* directs a proposition *p*, and that they assert that *d* is committed to *p*.

¹² The double restriction to metaphysically accessible worlds is not redundant. Suppose, for instance, that *d* wants *p* and also wants not-*p*, and only *p* is metaphysically possible. If we were considering all of *d*'s desire-worlds, *d* would not have an opinion about *p*. But intuitively, *d* does have an opinion about *p* in such a case.

¹³ It is here that the Law of the Excluded Middle is incorporated: the worlds must all agree, whether on *p* or on not-*p*.

¹⁴ Ideally, there would be a better theory of the syntax-semantics interface in futrates; this operator is not intended as a serious candidate for a morphologically real null operator. Rather, its meaning is expected to be part of the meaning of the imperfective operator. For some further discussion, see Copley 2005.

5 Further Questions

One facet of the approach taken here is that much of the meaning of futurates follows from our real-world intuitions about plans. Since these intuitions led us to a modal semantics, complete with ordering sources and *ceteris paribus* conditions, we are now in a position to ask how the modality in futurate progressives can be assimilated to the modality in nonfuturate progressives (and how both, perhaps, can be assimilated to the modality in other imperfectives, assuming that imperfectives and progressives trigger the imperfective paradox because of a modal component to their meaning; Dowty 1979).

A question that will need to be addressed by a more complete theory of futurate meaning is how future orientation without an overt modal can ever be possible in the absence of a flavor of planning. In (36a), for example, future reference is possible even though (presumably) nobody plans for the sun to rise.¹⁵ This kind of example contrasts with the kind of unplannable events we have been considering up to this point, such as a raining event, as in (36b).

(36) *Achievements*

- a. The sun rises at five tomorrow.
- b. #It rains at five tomorrow.

This fact should not, however, cause us to abandon the preceding discussion of plans in futurates. Instead, it should make us wonder what the differences and similarities are between plans, which have to do with an animate entity's force of will, and natural forces, which cause the sun to rise or rain to fall. This kind of discussion is beyond the scope of this article; however, recently a number of papers in the generative tradition have taken up the idea that physical forces and intentions are represented similarly in both the grammar and cognitive representations (e.g., Wolff 2007, Guéron, to appear, Harley and Folli, to appear), an idea championed much earlier by Talmy (1975, 1988). Then the question is what allows intentions to have results in the future, while some but not all physical forces (as shown in (36)) can act in the future. We might note that gravity (or, because our explanation should depend only on naive physics, whatever it is that makes the sun rise) acts on the sun both now and throughout the rising process, while there is no single force happening now that makes it rain later. A greater understanding of the contrast in (36) will no doubt rely on finding out how we conceive of physical forces as different from intentions.

References

- Binnick, Robert I. 1991. *Time and the verb*. Oxford: Oxford University Press.
 Cipria, Alicia, and Craige Roberts. 2000. Spanish *imperfecto* and *pretérito*: Truth conditions and aktionsart effects in a Situation Semantics. *Natural Language Semantics* 8:297–347.

¹⁵ While *The sun rises at five tomorrow* is felicitous, as in (36), *?The sun is rising at five tomorrow* is often judged to be slightly degraded by comparison (Leech 1971).

- Copley, Bridget. 2005. Ordering and reasoning. In *New work on modality*, ed. by Jon Gajewski, Valentine Hacquard, Bernard Nickel, and Seth Yalcin, 7–34. MIT Working Papers in Linguistics 51. Cambridge, MA: MIT, MIT Working Papers in Linguistics.
- Copley, Bridget. 2008. *Semantics of the future*. London: Routledge.
- Dowty, David. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Fraassen, Bas van. 1966. Singular terms, truth-value gaps, and free logic. *Journal of Philosophy* 63:481–495.
- Geffner, Héctor. 2002. Perspectives on artificial intelligence planning. In *Proceedings of the Eighteenth National Conference on Artificial Intelligence*, 1013–1023. Menlo Park, CA: AAAI.
- Guéron, Jacqueline. To appear. On the temporal function of modal verbs. In *Time and modality*, ed. by Jacqueline Lecarme and Jacqueline Guéron. Dordrecht: Springer.
- Harley, Heidi, and Raffaella Folli. To appear. Teleology and animacy in external events. *Lingua*.
- Heim, Irene. 1992. Presupposition projection and the semantics of attitude verbs. *Journal of Semantics* 9: 183–221.
- Huddleston, Rodney. 1977. The futurate construction. *Linguistic Inquiry* 8:730–736.
- Karttunen, Lauri. 1974. Presupposition and linguistic context. *Theoretical Linguistics* 1:181–194.
- Kratzer, Angelika. 1991. Modality. In *Semantics: An international handbook of contemporary research*, ed. by Arnim von Stechow and Dieter Wunderlich, 639–650. Berlin: Mouton de Gruyter.
- Lakoff, George. 1971. Presupposition and relative well-formedness. In *Semantics: An interdisciplinary reader in philosophy, linguistics and psychology*, ed. by Danny D. Steinberg and Leon A. Jacobovits, 329–340. Cambridge: Cambridge University Press.
- Landman, Fred. 1992. The progressive. *Natural Language Semantics* 1:1–32.
- Leech, Geoffrey N. 1971. *Meaning and the English verb*. London: Longman.
- Lewis, David. 1986. *On the plurality of worlds*. Oxford: Blackwell.
- Portner, Paul. 1998. The progressive in modal semantics. *Language* 74:760–787.
- Prince, Ellen. 1971. Futurate be-ing, or Why Yesterday morning, I was leaving tomorrow on the Midnight Special is OK. Ms., University of Pennsylvania, Philadelphia. Presented at the 1973 summer meeting of the Linguistic Society of America.
- Stalnaker, Robert. 1968. A theory of conditionals. *Philosophia* 5:269–286.
- Talmy, Leonard. 1975. Semantics and syntax of motion. In *Syntax and semantics 4*, ed. by John P. Kimball, 181–238. New York: Academic Press.
- Talmy, Leonard. 1988. Force dynamics in language and cognition. *Cognitive Science* 12:49–100.
- Thomason, Richmond. 1970. Indeterminist time and truth-value gaps. *Theoria* 36:264–281.
- Vetter, David C. 1973. Someone solves this problem tomorrow. *Linguistic Inquiry* 4:104–108.
- Weld, Daniel S. 1994. An introduction to least commitment planning. *AI Magazine* 15:27–61.
- Wolff, Phillip. 2007. Representing causation. *Journal of Experimental Psychology: General* 136:82–111.

CNRS UMR 7023
 Université Paris 8
 59-61, rue Pouchet
 75017 Paris
 France

bridget.copley@univ-paris8.fr

1.

Bridget Copley - CNRS
Heidi Harley - University of Arizona
Futurates, directors, and have-causatives

bridget.copley@sfl.cnrs.fr, hharley@email.arizona.edu

Copley (2008, 2009) proposes a treatment of futurate sentences like that in (1a) according to which an existentially quantified, presupposed-capable 'director' entity *d* is asserted to be committed to the realization of the proposition expressed in the sentence. On this account, (1a) ends up entailing the event's occurrence because the director (whoever has the ability to tell Clinton where to go, perhaps Clinton herself) is presupposed to be able to bring it about. By contrast, (1b) is unacceptable insofar as no animate director has the ability to make it rain tomorrow. It is acceptable, however, if there is someone who has the ability to make the rain event happen (God, or a screenplay writer, e.g.).

- (1) a. Clinton travels to France tomorrow.
b. #It rains tomorrow.

We argue that the English *have*-causative exemplified in (2) has the same properties as the futurate. In particular, we claim that the subject of *have* is the director.

- (2) Obama had Clinton travel to France last Tuesday.

In a *have*-causative, the embedded subject must normally be animate, in independent control of the event denoted by the embedded verb. It has long been observed (Ritter and Rosen 1993, 1997, Belvin 1993, 1996, Harley 1998) that causative *have* is ill-formed with uncontrollable embedded events in a way that more mundane causatives are not:

- (3) #Obama had it rain last Tuesday.
(4) Obama made it rain last Tuesday.
(5) #Obama had Clinton collapse last Tuesday.
(6) Obama made Clinton collapse last Tuesday.

Causative *have* with such uncontrollable events is not ungrammatical, precisely. Rather, what is often termed the 'director's reading' emerges. On this reading, the subject of *have* is an omnipotent being with respect to the universe of the embedded predicate, arranging the dispositions and behaviors of entities in it at will. If Mary is an author of a book or the director of a movie in which the embedded subjects are characters, for example, these are good readings:

- (7) a. (In the opening scene), Sorkin had Barlett collapse.
 b. (During Josh's big confession to Toby,) Sorkin had CJ asleep.
 c. Sorkin had it rain (to give his protagonists a reason to go in the shop).

In other words, there's nothing wrong with *have*-causatives of normally unplannable events. It's just that to interpret them, Mary's powers must be extended from mere authority-over-actions-of-other-humans (i.e. planning-for-humans authority) to authority-over-everything-in-the-universe (planning-for-everything authority). The same effect emerges in futurates, as shown in (1) above. The contrast between regular and 'director's' readings of a *have*-causative thus stems from the fact that the embedded event has to be plannable (or, we might say, directable) by the subject of *have*, in the exact same sense that a futurate requires plannability/directability. The similarity of these constructions suggests that Copley's futurate operator and causative *have* are the same entity.

References

- Belvin, R. (1993) "The two causative *haves* are the two possessive *haves*." In *Papers from the Fifth Student Conference in Linguistics, MITWPL 20*, ed. V. Lindblad and M. Gamon. Cambridge: MITWPL, 19-34.
- Belvin, R. (1996) *Inside Events: The Non-Possessive Meanings of Possession Predicates and the Semantic Conceptualization of Events*. PhD. dissertation, University of Southern California.
- Copley, B. (2008) "The plan's the thing: deconstructing futurate meanings." *Linguistic Inquiry* 39: 2.
- Copley, B. (2009) *The Semantics of the Future*. New York: Routledge.
- Harley, H. (1998) "You're having me on: aspects of *have*", in *La grammaire de la possession*, ed. J. Guéron and A. Zribi-Hertz. Paris: Université Paris X - Nanterre, 195-226.
- Ritter, E. and S.T. Rosen (1993) "Deriving causation." *Natural Language and Linguistic Theory* 11: 519-555.
- Ritter, E. and S.T. Rosen (1997) "The function of *have*." *Lingua* 101: 295-321.

Causal chains for futurates

BRIDGET COPLEY

Cross-linguistically, certain imperfectives can be used to refer to planned future outcomes. When they are used in this way, the readings that result are said to be ‘furate’ readings—as for example the progressive in (1a) and the simple present form in (1b). For the most part, only plannable eventualities, as in (1), can occur; unplannable ones, as in (2), are prohibited.¹

- (1) a. John is getting married tomorrow.
b. John gets married tomorrow.
- (2) a. #John is getting sick tomorrow.
b. #John gets sick tomorrow.

The author or ‘director’ (Copley 2008) of the plan is either the subject of the sentence or someone presupposed to have the ability to decide whether the eventuality occurs. For instance, in (1), the director would normally be John, because we suppose John to have the ability to decide whether he gets married tomorrow. However, the sentences in (1) could also be true with someone else as the director—that is, if a plan for John to get married tomorrow is held by someone else who has the ability to decide whether John gets married tomorrow.

We can see that the director’s ability to decide whether the plan is realized or not is a presupposition by the fact that the sentences in (2) are not false but infelicitous.

¹ Early work on futurates includes Lakoff (1971) (from whom the famous baseball examples, though his have the Yankees winning); Vetter (1973); Huddleston (1977); Dowty (1979). Very many languages allow real future readings with what seems to be present (or more accurately, non-past) tense. Only the imperfectives that allow plannable eventualities as in (1) but prohibit unplannable ones as in (2) are considered to have furate readings. I assume that simple futurates have their furate reading by virtue of being imperfectives, since cross-linguistically perfectives do not have furate readings. I assume as well that English simple present futurates (as in (1b)) have much the same meaning as progressive futurates (as in (1a)), the differences again being aspectual in the sense of e.g. Deo (2009); the contrast between simple and progressive futurates is discussed at length in Copley (2009a).⁵

These are exactly cases where it is supposed that no one has the ability to see to it that the eventuality occurs.²

The plan itself in futurates is tantamount to the director's *commitment* that the plan be realized. This commitment is similar to volition, but is not 'mere' volition; rather, commitment is something that takes into account all of the director's desires.³

In this chapter, I argue that futurates are best understood by means of a causal chain analysis in which the plan directly causes the eventuality described by the sentence. The first section is dedicated to a better understanding of the plan and how it is represented. Following the spirit of Dowty (1979), as well as Copley (2008), I argue that the plan for the eventuality is represented as a stative Davidsonian eventuality argument in the semantics, and further propose that the plan argument *directly* causes the eventuality described in the sentence, even though the latter eventuality takes place in the temporally distant future. Apparent counterexamples to the idea that the eventuality has to be plannable ('natural futurates') are argued to also involve a stative eventuality argument that directly causes the described eventuality. In the second section I present an account of the syntax–semantics interface for this causal chain account of futurates. The unpronounced director in futurates is introduced as the external argument of an extra little vP that also introduces the extra stative argument. This proposal is shown to successfully account for two properties that make futurates different from futures: the fact that not all preparatory events can be plans (the 'bowling ball problem') and the fact that futurates, but not futures, have a presupposition of plannability (the 'presupposition problem'). The third section favourably compares the present proposal to existing theories that explicitly put possible worlds into the denotation of futurates. I argue that possible world theories that lack Kaufmann's (2005) presumption of settledness/decidedness are inadequate, but that the current proposal goes farther than Kaufmann's in determining how futurate meaning is related to both syntax and world knowledge.

4.1 REPRESENTATION OF THE PLAN

4.1.1 PLANS ARE STATIVE EVENTUALITIES

A first move must be to ask where the future orientation in futurates comes from. There are two ways to do this compositionally. Since imperfectives and progressives are

² See Copley (2008) for a more detailed argument that the ability to see that the plan is realized is presupposed in futurates.

³ The combination of presupposed director ability and asserted director commitment is very similar to the version of *want* used by Condoravdi and Lauer (2009) in their account of imperatives.

generally taken to locate the time of the eventuality overlapping or including the reference time, one way to solve this problem is to simply have the imperfective/progressive allow the eventuality to either overlap or follow the reference time (Cipria and Roberts 2000; Copley 2009a). Another solution (Dowty 1979; Copley 2008) is to reify the plan: to say that in the case of futurate readings, what overlaps the reference time is not the run time of the eventuality itself, but rather, the time of the plan for the eventuality. The plan is defined in such a way that the eventuality has to happen later than it.

While the first solution is simpler on its face, reification of the plan is supported by the fact that plans seem to have at least something of a Davidsonian reality. They can be, for instance, modified by temporal adverbials, as in (3):

- (3) a. Yesterday, John was getting married tomorrow.
b. John has been getting married tomorrow for six weeks.

Futurates also support certain manner adverbials. We can see that manner adverbials can describe the plan, rather than the eventuality, because it is possible to have a manner adverbial that is contradictory with the manner of the eventuality: in the sentence in (4a), the higher adverbial modifies the plan, while the lower one seems to modify the event. Compare this with the ongoing progressive sentence in (4b), where it seems that *secretly* and *in public* both have to modify the same eventuality argument.

- (4) a. Secretly, John is getting married in public tomorrow.
b. #Secretly, John is getting married in public right now.

Thus plans seem to have some of the properties proposed by Davidson to diagnose eventuality arguments. On the other hand, futurates do not seem to support locative or instrumental modification of the plan. The sentence in (5a) cannot readily be used to convey that John (or an unexpressed director of the plan) has the plan in the room, nor can the sentence in (5b) be used to say that John or another director is holding his plan with the help of a calculator.

- (5) a. #In the room, John is getting married in church tomorrow.
b. #With a calculator, John is getting married tomorrow.

Plans, therefore, may share some properties with events, but at the very least are not stereotypical events.⁴ In that case, the question arises as to what they are. One might wonder whether they are states, since states of various kinds are known to fail Davidso-

⁴ Another one of Davidson's tests is anaphora; we might test whether, e.g., *John is getting married tomorrow. It bothers Mary.* is coherent. Unfortunately the judgements do not seem clear with respect to whether the pronoun is anaphoric to the plan or the eventuality, so this test is inconclusive.

nian tests (Maienborn 2005, 2007). It would also make sense for the plan to be a state, in that having a volition is taken to be a state, and as far as eventuality type is concerned, holding a plan is just holding a volition (albeit one that takes all of the director's volitions into account); the presupposed ability to see that the content of the plan is carried out should have no effect on the eventuality type of the plan.

Some further evidence that we are dealing with a state comes from the fact that futurates, like habituais and some lexical statives, can take the progressive in English, with a certain meaning contrast between the simple form and the progressive form. In the examples in (1)–8 below, the simple present in the (a) sentences conveys that the plan, the habit, or the state is rather permanent or of long standing; in the (b) sentences, the plan, habit, or state is more temporary or episodic (cf. also Deo 2009).⁵

- (6) a. John gets married tomorrow.
 b. John is getting married tomorrow.
- (7) a. Juliet takes sugar in her tea.
 b. Juliet is taking sugar in her tea.
- (8) a. Mary lives in Paris.
 b. Mary is living in Paris.

The analogy to habituais and lexical statives allows us also to make sense of the fact that, unlike progressive futurates, simple futurates with modified plans are slightly odd. Simple present habituais and simple present lexical statives share that oddness.

- (9) a. ?Secretly, John gets married in public tomorrow.
 b. Secretly, John is getting married in public tomorrow.
- (10) a. ?Secretly, Juliet takes sugar in her tea.
 b. Secretly, Juliet is taking sugar in her tea (these days).
- (11) a. ?Secretly, Mary lives in Paris.
 b. Secretly, Mary is living in Paris.

We can surmise that plans are states,⁶ then, and in futurates the time of the plan overlaps the reference time. Imperfectives, as desired, thus do still have something overlapping the reference time; it is just that in the case of futurates, this something is the plan rather than the event.

⁵ This predicts that, cross-linguistically, futurates should only be possible under aspectual forms that accept stative predicates as their complement.

⁶ An additional argument that futurates are derived statives, based on their temporal behaviour in indicative conditionals, can be found in Copley (2009b).

4.1.2 NATURAL FUTURATES AND TEMPORALLY
DISTANT DIRECT EFFECTS

We have spoken of futurates as presupposing a plannable eventuality. While this is generally true, there is a small class of apparent exceptions to this generalization: what we might call ‘natural futurates’—sentences that look like futurates, using a linguistic form that normally triggers the plannability contrast, but which do not themselves involve plans. English natural futurates are not available in the progressive, but only in the simple present tense, as in (12) and (13) (Leech 1971):

- (12) a. The sun rises tomorrow at 6:30.
b. ?The sun is rising tomorrow at 6:30.
- (13) a. The tide comes in at noon today.
b. ?The tide is coming in at noon today.

We can think of these as also involving a state argument in the position where the plan is in ordinary futurates; it is exactly the temporary nature of the progressive example in (12b) and (13b), that is problematic, much like the examples in (6b), (7b), and (8b) (though in (6b), (7b), and (8b), the temporary nature is not a problem). The state in question in (12) and (13) is, however, obviously not a plan, since there is no director available who has the ability to see to it that the sun rises or the tide comes in at a certain time (unless God is invoked). On the other hand, the sun and the tide do have various physical properties, and it is among these that we must find the state we are looking for. I propose to understand such states as *tendencies*, more or less in the sense of Talmy (2000), but with the understanding that these tendencies towards a certain effect include a temporal specification on the effect.

This kind of argument is not without precedent. In effect it says that neither volitionality nor animacy are required in order for an entity to qualify as a director. Rather, what is required is a more general condition that the entity have stative properties which directly causes a certain kind of effect. Note the similarity of this kind of argument to that of Harley and Folli (2008) for activities, who argue that an apparent animacy or volitionality requirement on the external argument of activities is really a requirement (‘teleological capability’) that the properties of the entity allow it to input energy into the caused eventuality throughout the run time of the eventuality. The similarity to Harley and Folli’s theory is more than coincidental if, as I will propose, the projection that introduces the plan eventuality and the director is a kind of vP; then both the present proposal and Harley and Folli’s theory fall under the category of vP-related constraints on what kinds of eventualities can cause other eventualities.

This kind of temporal specification is rare among natural tendencies. There is no tendency for it to rain tomorrow at 6:30, for instance, so (14a,b) are impossible.⁷

⁷ Some English speakers can say things like *%It is raining tomorrow*. But even they do not accept *#It rains tomorrow* or (14a,b). Their judgement on *%It is raining tomorrow* can be accounted for if we

- (14) a. #It is raining tomorrow at 6:30.
 b. #It rains tomorrow at 6:30.
 c. It is going to rain tomorrow at 6:30.
 d. It will rain tomorrow at 6:30.

I propose that temporally-specified tendencies and plans are both states that directly cause a temporally distant future result. This proposal makes temporally-specified tendencies and plans slightly unusual, compared to more normal physical tendencies, for two reasons. The first reason is that physical states do not cause anything on their own; even if a state is involved in causing an effect, there must be an event also involved somewhere. In short, states are normally the end of the causal line in the absence of other causing events (see also Copley and Harley forthcoming for this point).

Secondly, it is also slightly unusual for anything to *directly* cause a temporally distant eventuality. Following much work on the syntax–semantic interface of causatives, I take direct causation to be the term for a causal chain which has only two eventualities in it, namely, the causing eventuality and the caused eventuality. Indirect causation, on the other hand, occurs when the causing eventuality causes one or more intermediate eventualities in a causal chain, the last of which stands in a causal relation to the caused eventuality in question. It seems obvious that, in order to reach a temporally distant effect, a typical causing eventuality must cause intermediate eventualities whose run times span the temporal gap between the original causing eventuality and the distant effect. Normally we would think of all the causal links in such a chain as strictly temporally local; the proposal here is that certain causing eventualities, namely volitions and other temporally-specified tendencies, exceptionally can have temporally distant effects.⁸

In the next section, I will articulate how this idea plays out at the syntax–semantics interface, and show that this account explains certain differences between futures and futurates.

4.2 A CAUSAL CHAIN ACCOUNT OF FUTURATES

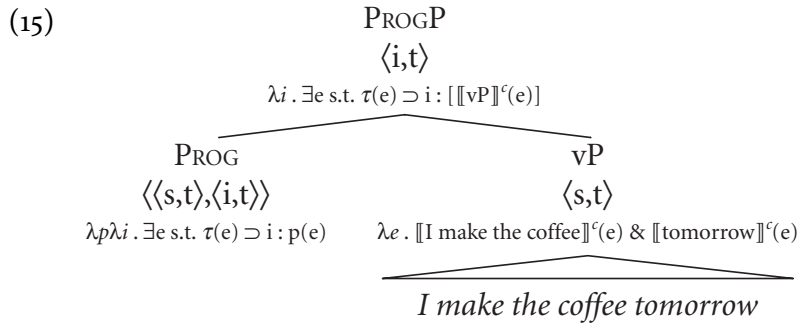
We will now see how the assumption proposed above—that plans and other temporally-specified tendencies are states that directly cause temporally distant future results—is represented at the syntax–semantics interface.

Consider first what would happen with a very simple denotation of PROG and a normal vP as its complement. The temporal adverbial is assumed to be adjoined at

assume that for these speakers, there can be a (temporary) state now that directly causes it to rain tomorrow.

⁸ On a situation semantic theory, the idea that a plan directly causes a temporally distant effect is compatible with the idea that the effect is caused via a causal chain of eventualities. All that needs to be true is that the plan holds during the supersituation that includes the sequence of actions that bring about the realization of the plan.

the vP-level. This structure crashes as e is required to both overlap i (evaluated at the present) and to be in the extension of $\llbracket \text{tomorrow} \rrbracket$, where c is a contextual variable referring to a set containing the situation of utterance, the speaker, the variable assignment function, etc.

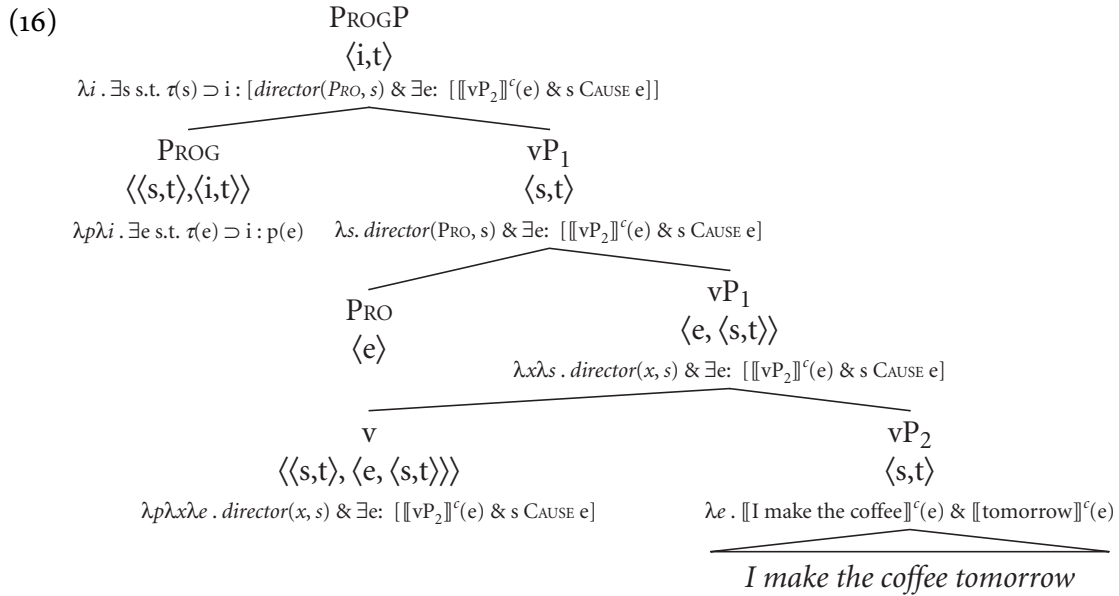


This kind of crash is why we need Dowty's notion that the plan is a kind of preparatory eventuality, so that the temporal relation in the progressive applies to the plan. We can imagine a head with causal meaning that introduces the director as an external argument. This description makes it look very much like agency does at the syntax–semantics interface. Along these lines, I propose that the director and the causal relation are introduced by a 'little v' head (Kratzer 1996), but with a state predicate and a director as arguments instead of an event predicate and an agent. The unpronounced director's commitment state s is such that $s \text{ CAUSE } e$, where the content of the plan holds of e . CAUSE here indicates direct cause as usual. But there is no temporal relation between s and e given in the logical form; e can be temporally distant, that is, there can be a temporal gap between s and e .

Recall that directors are asserted to be committed to p , and presupposed to have the ability to see to it that p . Where does ability come in in the logical form? This is an interesting question, as the statement 'director(x, s)' says nothing about x 's ability to see to it that a p -eventuality happens—it can't, because p is not mentioned. That would make 'director(x, s)' something of a misnomer. However, a kind of ability is involved in agency too, namely the ability, under the very circumstances that obtain in that moment, to make the event happen, in the sense of Mari and Martin's (2007) 'action-dependent ability'—a very constrained property that is not the same as 'real' ability, but an ability nonetheless. So although it is somewhat inaccurate to write 'director(x, s)', it is no more inaccurate than writing 'agent(x, e)'.

What about natural futurates? In the case of natural futurates, we saw that there is no director and no plan; instead, there is a natural tendency, belonging to the external argument, for a p -eventuality to occur at a certain time. The tendency, I proposed, filled the same slot as the plan; the external argument could be doubled in the director slot. For now, I will suppose that a broad enough definition of the 'director' theta-role would account for both kinds of futurates, recognizing that more investigation is warranted to confirm such a move.

Assuming, then, for now, that ‘director(x,s)’ is an acceptable way to express the relationship between the director and the causing state, the structure of the futurate *I am making the coffee tomorrow* is given in (16). States (s) and events (e) are both type s (in fact both could be represented by the same kind of variable, though here I’ve chosen not to). Note that PROG takes a type ⟨s,t⟩ argument, that is, a predicate of either eventive or stative eventualities. Here, of course, since the plan is referred to by a stative argument, the complement of PROG is a predicate of stative eventualities.



The denotation of the structure in (16) says that there is an ongoing state of which PRO is the director. This state directly causes an event e, such that *I make the coffee* and *tomorrow* are both true of e. This is the desired meaning for progressive futurates. Simple present futurates would be the same but with an imperfective operator instead of a progressive operator. With this proposal in mind, we can now make sense of two otherwise puzzling facts about futurates: the fact that other preparatory events are not possible in futurates, and the fact that futurates, but not futures, are sensitive to plannability (modulo the natural futurates).

4.2.1 THE BOWLING BALL PROBLEM

One question for accounts that treat the plan as a ‘preparatory event’ as Dowty does is why preparatory events other than plans (and temporally-specific tendencies) are not possible in futurates. For example, in the situation where a bowling ball is rolling toward a pin, the rolling apparently does not count as a preparatory event in the same sense that plans do for the pin falling, as evidenced by the fact that (17), below, is not true in such a situation. If the rolling of the ball could count as a preparatory event in

the relevant sense, then it should be true on a futurate reading, as the rolling is ongoing and directly causes the falling.⁹

(17) The pin is falling over.

The sentence in (17) is to be compared with the sentence in (18). If Mary has previously and reliably been able to knock down pins in similar situations in the past, she has the ability to do so, and if she is committed to doing so, then she is a director and we can use the proposed analysis.

(18) Mary is knocking over the pin.

What is interesting is that even in this situation, (17) is still not felicitous on a futurate reading.¹⁰ The reason for this would seem to be that in the absence of a director such as Mary, there would have to be a property of the pin to serve as the causing property, analogous to the temporally-specific tendencies in the case of the sun and the tide. However, the pin has no such property, so the addition of the extra vP is unlicensed. Since the extra vP is not licensed, then the temporal relation of the progressive must apply to the run time of the falling event, that is, the normal ongoing progressive reading.¹¹

4.2.2 THE PRESUPPOSITION PROBLEM

Another fact that is explained by the current proposal is the fact that while futures, like futurates, can involve plans, only futurates presuppose plannability of the eventuality. Consider the difference between the futurates in (19a) and (19b) on the one hand, and the futures in (20a) and (20b) on the other hand.¹²

- (19) a. I am getting married tomorrow.
b. I get married tomorrow.

⁹ It is true that there seem to be some preparatory events that are not plans that license progressives in English, namely those that occur before achievements where the achievement seems to name the final state. So *Mary is arriving at the station* is true as Mary reaches the station, and *The plant is dying* is true in a situation where the causes of the plant's death are already in force. Following Hay et al. (1999) and Bohne-meyer (2005), I will assume that achievements represent eventive state changes to non-gradable states, so that what seems to be an unrelated preparatory event is really part of the eventive change of state.

¹⁰ A conference participant once pointed out to me that *That pin is totally falling over* is better than (19) in the context where the ball is rolling. I'm not sure why this is. It seems to have a special intonation similar to that of taunts such as *You're dead/You're going down*.

¹¹ This would tend to suggest that the proposal that the causing event is represented in unaccusatives/anticausatives (see e.g. Alexiadou et al. 2006) is not correct for English. However, it admits the possibility that the anticausative proposal is true in languages such as German where sentences such as (17) are true in the context when the ball is rolling. In that case the causing event would be able to be accessed by the progressive in exactly the correct manner.

¹² Both the difference between (19a) and (19b) and the difference between (20a) and (20b) are aspectual in nature, I have argued elsewhere (Copley 2009a). These differences will not concern us here.

- (20) a. I am going to get married tomorrow.
 b. I will get married tomorrow.

The futurates in (19) necessarily make reference to a plan made by a director. The futures in (20) can either be simply predictions (in which case they sound slightly odd, as it is bizarre to make predictions about one's own behaviour), or they can be seen as volitional futures—statements of an intention or plan held either by the speaker or by someone who has authority over the speaker, that is, a director. These plans in futures, as in (21a), (22a), clearly have a temporal existence, similarly to plans in futurate readings, as in (21b) and (22b).

- (21) a. Yesterday, John was going to get married tomorrow, but then his fiancé dumped him.
 b. Yesterday, John was getting married tomorrow, but then his fiancé dumped him.
- (22) a. John has been going to get married tomorrow for six weeks.
 b. John has been getting married tomorrow for six weeks.

It is evident therefore that futures can, and futurates must, involve a plan eventuality that overlaps the reference time.¹³ But if both volitional futures and futurates have an reference time-overlapping plan and a future-oriented event, it remains to be seen why futurates also carry a presupposition that the event is plannable, while futures do not.

With causal chains, it is possible to make sense of this fact. If there are only two eventualities in the causal chain, as I have proposed for futurates, the single causal relation has to 'leap' into the future over a temporal gap. In other words, the fact that there are only two events means that the caused eventuality must be directly caused, so the second can only be temporally distant if it can be both directly caused and temporally distant. By assumption, the only possible causing eventualities that allow a directly caused, temporally distant effect are plans and temporally-specific tendencies. The latter are very particular to things like the sun and the tide, so they are not assumed to be involved in most futurates. Therefore, in futurates there is assumed to be a plan, and there is consequently a presupposition that the eventuality is the sort of thing that can be planned.

Futures, on the other hand, evidently do not necessarily involve a two-link causal chain. If they do specify a causal chain, it would have to be one that allows many links. However, in general, futures are not given analyses in terms of causal chains; instead all that matters in existing analyses (e.g. Abusch 1997; Condoravdi 2001; Kaufmann 2005; Copley 2009a; Kissine 2008a) is a temporal subsequence relation and/or a restriction

¹³ The reference time is the time provided by tense; tense in *will* and *am/is/are going to* is present, tense in *would* and *was/were going to* is past, and therefore the reference time. What all of these futures have in common is a future element *woll* or FUT (Abusch 1998; Condoravdi 2003; Copley 2009a: among others).

to certain possible worlds. In any case, there is no reason to expect sensitivity to the length of a causal chain for futures. So the temporal leap required in futurates is not required in futures. At the same time, it is perfectly possible for the present eventuality, that is, the eventuality argument of the modal accessibility relation (Hacquard 2006), to be an intention, that is, a plan eventuality.

4.3 FUTURATES AND POSSIBLE WORLDS

The account of futurates just presented relies on the causal relation, presented in a familiar way at the syntax–semantics interface, as well as on constraints on which eventualities can directly cause which other eventualities. Notable by its absence is the mechanism of possible worlds. Yet all other formal proposals for the semantics of futurates (e.g. Dowty 1979; Cipria and Roberts 2000; Kaufmann 2005) include possible worlds in the logical form.

The primary reason that possible worlds have been proposed as explanations for futurates is that they are good at accounting for two seemingly contradictory characteristics of futurates, shared with futures, that we will call the *ceteris paribus* condition and the homogeneity requirement. However, I will argue below that the ways these characteristics play out in futures and futurates are different. The two problems we looked at above will be relevant here: the bowling ball problem demonstrates that the *ceteris paribus* condition is not the same in futurates as it is in futures, and the presupposition problem demonstrates that non-homogeneous cases are not the same in futurates as in futures. This is not to say that possible worlds could not be used to account for futurates; as we will see, as long as something like Kaufmann's (2005) notion of settledness/decidedness is used, futurates can be adequately described. Where such a possible worlds account of futurates falls down, however, is in explaining *why* a settledness/decidedness condition applies to futurates and not to futures. Ultimately this question should be answered by appeals to both the syntax of futurates and our conception of the world, the two interfaces with logical form. The current proposal achieves both aims.

4.3.1 *CETERIS PARIBUS* AND HOMOGENEITY IN FUTURES AND FUTURATES

The *ceteris paribus* condition refers to the fact that a future or futurate can be asserted even if it turns out that the eventuality is not, in the end, realized. So, for example, a speaker can in good faith assert (23a), but it may well turn out that something unforeseen occurs and the Red Sox do not play the Yankees tomorrow. The same holds for futurates as in (23b).

- (23) a. The Red Sox will/are going to play the Yankees tomorrow.
 b. The Red Sox play/are playing the Yankees tomorrow.

The *ceteris paribus* condition is the presupposition that ‘all things are equal’: there is wiggle room for things to turn out differently if it so happens that not all things are equal.

The homogeneity condition is in opposition to the *ceteris paribus* condition in the following way. At the same time that the *ceteris paribus* condition holds in that there is a possibility that the eventuality will not happen, the speaker must still apparently believe at the moment of utterance, that the eventuality will happen. The assertions in (23) for instance, will entail—all else being equal—that the Red Sox will in fact beat the Yankees, as shown in (24), though of course all else may not be equal.¹⁴

- (24) a. #The Red Sox will play the Yankees tomorrow, but (all else being equal) they won’t.
 b. #The Red Sox are playing the Yankees tomorrow, but (all else being equal) they won’t.

With the future as well, negation ‘excludes the middle’—that is, (25a) is not used to convey that the speaker is unsure as to whether there will or will not be a sea battle tomorrow. Likewise, the negation of a futurate in (25b) does not convey that the Red Sox may or may not play the Yankees tomorrow.

- (25) a. There won’t be a sea battle tomorrow.
 b. The Red Sox don’t play the Yankees tomorrow.

Call this requirement that all the worlds agree on the truth value of p ‘homogeneity’, following von Stechow (1997).

The *ceteris paribus* condition and homogeneity are in apparent conflict with each other: the former requires there to be a possibility that the eventuality will not happen, while the latter requires there to be a kind of speaker certainty that the eventuality will happen. Possible worlds have been recruited quite successfully to account for both of these conditions at the same time.

On a possible worlds account of futures, there is a universal quantifier over possible worlds, and the restriction on this quantifier restricts the worlds to those that meet a certain criterion—either worlds where things work out normally, or worlds consistent with (the speaker’s beliefs about) current facts. This restriction ensures that there is the possibility that something may go wrong and the eventuality does not happen. Then, a homogeneity principle must be applied to these worlds; either p is true on all

¹⁴ Kaufmann (2005) finds similar sentences good (cf. (27a) in Kaufmann (2005): *The plane leaves at 4pm but I doubt that it will.*). Such a judgement is the result of a change of context (in Kaufmann’s system, different modal bases for each clause). The point in (24b) is to keep the context (modal base) the same. In that case the judgement is as I have given. 126

the worlds or p is true on none of the worlds. This ensures speaker certainty as well as homogeneity, and is essentially Kaufmann's (2005) settledness/decidedness condition. Without getting into formal details here, the idea behind Kaufmann's settledness/decidedness is that an individual considers a proposition *settled* just in case they believe that it has a truth-value; that is, that it is either true or false. As Kaufmann says, 'sentences whose truth value depends on facts no later than the time of evaluation are necessarily presumed decided in any admissible belief state, whereas sentences about the future may fail to be.' (Kaufmann 2005: 240). Homogeneity is also written into the denotations of futures and futurates in Thomason (1970) and Copley (2009a). It is missing in certain other possible world treatments of futures and futurates (Condoravdi 2001; Cipria and Roberts 2000).

It should be noted that possible worlds are not the only way to reconcile these two apparently contradictory conditions. For example, in the current proposal, the *ceteris paribus* condition stems from a presupposition that the director is able to cause a temporally distant effect; this presupposition can turn out to be wrong. The source of the presupposition will ultimately be a theory of world knowledge about which eventualities can cause temporally distant effects. Homogeneity is achieved trivially, by the fact that either p or not- p holds of the single future eventuality. And in general, to the extent that single branch accounts such as the one in this chapter for futurates (and those of Kissine 2008a and Copley and Harley forthcoming for futures) can deal with the *ceteris paribus* condition as efficiently as do the possible world proposals for futures, they represent real competition to the possible world theories. The reason is that the single branch accounts get homogeneity trivially, from the fact that either p or not- p holds on a single branch, while possible world accounts need to either stipulate homogeneity as they currently do, or find some way in which to derive it. Both perspectives are in principle legitimate and powerful enough to account for the data, though in formal semantics we are used to seeing only the first perspective.¹⁵

Still, possible worlds have been very successful in dealing with the conflict between *ceteris paribus* and homogeneity for futures and futurates. Now we will see that these conditions for futurates are not exactly the same as for futures. Kaufmann's settledness/decidedness can account for these facts, but only if a theory of causation of the kind proposed here is added to answer the question as to why futurates differ from futures. In that case it is not clear why a semantics that explicitly quantifies over possible worlds would be needed.

¹⁵ If the *ceteris paribus* condition is really part of the causal relation, as argued in Copley and Harley (2014), it need not be represented in the logical form by a semantics with explicit quantification over possible worlds. Since futurates display a lack of extra morphology cross-linguistically, it is more reasonable to suppose that the logical form should not be complicated. Since the current proposal, with an extra vP that introduces a cause relation, results in a logical form that requires less special pleading than does one with a special modal projection, the current proposal should be preferred.

4.3.2 *CETERIS PARIBUS* IS NOT THE SAME FOR FUTURES AND FUTURATES

The bowling ball problem illustrates that the *ceteris paribus* condition is not the same for futures and futurates. Recall that in this scenario, the bowling ball is thrown by Mary, who has an extremely good record of hitting the pin. Still, although one can say (26a) and (26b) while the ball is rolling, one cannot say (26c).

- (26) a. Mary is hitting the pin.
b. The pin will/is going to fall down.
c. #The pin is falling down.

If the theory of possible worlds being used lacks a homogeneity stipulation, this difference cannot be explained at all; if all else is equal and (27a)–(27c) are evaluated in the same context (=modal base), why would (27a)–(27b) be felicitous and (27c) infelicitous? Furthermore, even with the homogeneity stipulation, why would Mary's hitting the pin be settled, but the pin's falling not be settled, when (presumably) one entails the other? I am not saying that this question could not be answered in a possible worlds theory; merely that to answer it, we need something like the current theory, which says that there is a causing event represented in (27a) but not in (27b), and that something about this fact allows it to be settled (*ceteris paribus*) that Mary hits the pin, but not that the pin falls down. But if this is to be added, there is no need for a possible worlds analysis at all.

4.3.3 NON-HOMOGENEOUS CASES ARE NOT THE SAME FOR FUTURES AND FUTURATES

The presupposition problem, discussed above, illustrates that the homogeneity requirement is not the same for futures and futurates. While homogeneity holds for both futures and futurates—that is, neither (27a) nor (27b) convey that the Red Sox may or may not play the Yankees tomorrow—there is a difference when there is a non-plannable/settled/decided eventuality. Future sentences with such an eventuality are felicitous, while those without such an eventuality are infelicitous.

- (27) a. The Red Sox won't play the Yankees tomorrow.
b. The Red Sox don't play the Yankees tomorrow.
- (28) a. It will rain tomorrow.
b. #It rains tomorrow.

In the current proposal for futurates, the idea that there is a single causal branch fulfills the need for homogeneity, since on such a branch, either the eventuality hap-

pens or it does not happen. But this way of accounting for homogeneity does not need to be the explanation for the sensitivity to the plannability of futurates. Instead, I accounted for the presupposition of plannability by a world-knowledge restriction as to which eventualities can directly cause temporally distant effects. Since only plans and temporally-specific tendencies fall into this category, and temporally-specific tendencies are usually implausible, plannability of the described eventuality is presupposed.

These data are addressed differently in possible world theories; as discussed just above, something like Kaufmann's settledness/decidedness principle is needed for futurates. Homogeneity in futures can then be dealt with by treating the negation as lower than the future morpheme.¹⁶ However, what is missing from Kaufmann's theory is *why* there is a settledness/decidedness constraint for futurates but not futures. The idea is perhaps that futurates are present tense and futures are not. But if both involve quantification over possible worlds, and if futures involve present tense (as is universally assumed for *woll*), why is one different from the other in just this way? Could it have been the other way around? Seemingly not, in which case we need a theory of why not.

A question like this should ultimately be answered both with reference to syntax on the one hand and the conception of the world that the semantics models on the other. The current proposal can be thought of as an answer to this question of why plannability/settledness/decidedness goes with futurates and not futures. The syntactic part of the answer is that futurates have an extra vP projection, whose semantics are similar to what we are used to seeing in vPs, except that the causing eventuality is stative and the external argument is a director rather than an agent. The caused eventuality is directly caused as we would expect in such a structure. The world knowledge part of the answer proposes that it is possible for certain stative causing eventualities to directly cause temporally distant effects. This part of the answer thereby points out something that is required from an adequate theory of how we conceive of causation: namely, an understanding of why certain eventualities can or cannot cause other eventualities.

4.4 ACKNOWLEDGEMENTS

Thanks to Philippe De Brabanter, Mikhail Kissine, and Saghie Sharifzadeh for their engaging workshop, and the workshop participants and anonymous reviewers for helpful comments. This research has been supported in part by the project 'La causalité dans le langage et la cognition' financed by the Fédération Typologie et Universaux Linguistiques of the Centre National de la Recherche Scientifique.

¹⁶ This option is not available for futurates; see Copley (2002, 2008).

Dispositional causation

Bridget Copley, SFL (CNRS/Paris 8)

Abstract There are a number of phenomena where an apparent animacy requirement exceptionally admits some inanimate causers as felicitous. In this paper I argue that these should be explained not by an syntactically visible animacy feature but rather by a “what-can-cause-what” approach. In this kind of approach, judgments of felicity occur exactly when the cause is conceptually able to cause the effect. I show how a what-can-cause-what approach for futurates and *have* causatives explains their felicitous inanimate causer exceptions and other behavior, via a novel notion of “dispositional causation”, where the dispositions in question include both intentions of animate entities and physical tendencies of both animate and inanimate entities. Both dispositions and disposers can either be explicitly present in the syntactic structure, or merely implicitly available through the accommodation of a conceptual model of dispositional structure.

Keywords: causation, animacy, intentions, dispositions, futurates, *have* causatives

1 Introduction

This paper investigates two phenomena—futurates and *have* causatives—which seem to generally require an animate subject, but which permit certain idiosyncratic exceptions to this generalization. I will argue that an animacy feature with exceptions is not the best way to account for these phenomena; a better way is a causal structure that makes reference to a notion of dispositional causation. Futurates and *have* causatives both make reference to a conceptual dispositional structure, but to different parts of it, with the remaining parts in each case accommodated. This mechanism allows quite complex meanings to be accessed by quite simple morphosyntactic structures.

The first phenomenon we will investigate is futurates. Futurates (Lakoff 1971; Prince 1971; Vetter 1973; Dowty 1979; Kaufmann 2005; Copley 2008a; 2009; 2014) have future reference in the absence of future-oriented morphology, with a “planned” or “settled” flavor. A future-oriented adverbial, or at least a contextual understanding of a future time, is required. In most examples, an unexpressed animate “director,” which may or may not be the same entity as the subject, controls or has authority

over whether the eventuality happens or not; it is their intention or plan for the eventuality to happen.

So, for example, the speaker would be understood as the director in (1a) on the assumption that the speaker controls (has the ability to decide) whether they make the coffee or not, while Major League Baseball is understood to be the director in (1b). Other eventualities yield infelicity to the extent that they cannot be controlled by an animate director, as in (2a) and (2b); (2b) improves on a reading where the mafia is fixing the game. So it seems at first glance that an animate director is required.

- (1) a. I make the coffee tomorrow.
- b. The Red Sox play the Yankees tomorrow.
- (2) a. #I get sick tomorrow.
- b. #The Red Sox beat the Yankees tomorrow.

However, on this way of looking at futurates there are felicitous inanimate exceptions. The examples in (3), which Copley (2014) calls "natural" futurates, seem to have no possible director, since no one controls, plans, or has authority over the behavior of the sun or the tide.

- (3) a. The sun rises #(at 6:00) tomorrow.
- b. The tide is high #(at 6:00) tomorrow.

So, futurates seem to have to be an (unexpressed) animate director, except for certain idiosyncratic exceptions involving inanimate entities.¹

The other case of apparent animacy requirement that we will look at is *have* causatives as in (4) (Ritter & Rosen, 1993, 1997; Bjorkman & Cowper, 2013).

- (4) Mary had John laugh.

There are a number of similarities between *have* causatives and futurates. For instance, a similar sense of an authority is apparent for the matrix subject of *have* causatives as is visible in the unexpressed director of futurates. In (5a), with *make*, Madeleine could be, e.g., the speaker's daughter, but in (5b), with *have*, she has to be the speaker's boss.

- (5) a. Madeleine made me wake up early.

¹ Condoravdi (2003) and Kaufmann (2005) offer the notion of "settledness" as a criterion for futurate readings, a notion which does not mention directors or animacy and which therefore avoids the characterization of natural futurates as exceptional. In a similar vein, an anonymous reviewer questions whether predictability might not better characterize the difference between futures and futurates, again without the need for a mention of animacy. I discuss these in section 2.5 below.

- b. Madeleine had me wake up early.

Have causatives also have a plannability constraint. Copley & Harley 2009 point out the generalization that *have* causatives require a plannable or controllable eventuality, just as futurates do. As shown in (6a), if Obama is Clinton's boss, Obama can make her collapse but it is infelicitous to say that he had her collapse. He can even make it rain, if he happens to have that ability, but he cannot *have* it rain, unless counterfactually there is some sort of precise weather control mechanism that he has access to.

- (6) a. Obama made/#had Clinton collapse last Tuesday.
b. Obama made/#had it rain.

These facts prompt Copley & Harley to propose that whatever head contributes futurate meaning is the same as the *have* in *have* causatives.

In the existing literature *have* causatives are discussed as though they have an animacy requirement on the causer, on the basis of facts such as in (7a). However, cases such as those in (7b) and (8) also exist, indicating that there are inanimate causer exceptions to the apparent animacy requirement.

- (7) a. #The book had John laugh.
b. The book had John laughing/on the floor/in tears.

These phenomena show a similarity to certain other phenomena which have apparent animacy requirements for an agent (as shown by the a and b examples), but nonetheless admit idiosyncratic inanimate causer exceptions (the c examples). Two of the most prominent cases where this has been noticed are activities (Higginbotham 1997; Folli & Harley 2005a; b; 2008) and nominalizations (Grimshaw 1990; Pesetsky 1995; Marantz 1997; Harley & Noyer 2000; Sichel 2010; Alexiadou et al. 2013). Generics, as in (10) (Carlson 1995), could also be included though they are not as well discussed in this vein.

- (8) a. John ate the apple.
b. #The sea ate the beach.
c. The washing machine ate the laundry.
- (9) a. The authorities' justification of the evacuation
b. #The hurricane's justification of the evacuation
c. The sun's illumination of the room
- (10) a. Sally handles the mail from Antartica (but none has ever come).
b. #Bears eat meat (but they never have).
c. This machine crushes oranges and removes the seeds (but it never has).

It is certainly possible to tell a story about such cases with a head that selects for +/-animate; this has especially been done for nominalization (e.g. Alexiadou et al. 2013). One could then posit a +animate-selecting version of *v* for the (a) and (b) cases and a –animate-selecting head for the (c) cases. However, such an analysis would necessarily be incomplete, in that it does not provide an analysis for the following characteristics of the phenomena in question:

- (11) a. The exceptions are idiosyncratic to each particular phenomenon
 b. There are no morphological consequences of the animacy distinction
 c. Only agent/causer arguments are involved; i.e., no patients

Such a state of affairs clearly contrasts with phenomena where there is a solid case for an animacy feature, such as in Blackfoot (Ritter & Rosen 2010; Wiltschko & Ritter 2014). In Blackfoot, there are morphological consequences of the animate/inanimate contrast. For instance, plural nouns are obligatorily marked for animacy, as shown in (12) (animate) and (13) (inanimate; Frantz & Russell (1995)):

- (12) a. **nina-iksi** 'men'
 b. **áinakai-iksi** 'wagons'
 c. **iihtáisinaakio-iksi** 'cameras'
 d. **misiníttsiim-iksi** 'buffalo berries'
- (13) a. **miistak-istsi** 'mountains'
 b. **ipapoktsimaan-istsi** 'favorite activities'
 c. **iihtáisinaakio-istsi** 'pencils'
 d. **otohtoksiin-istsi** 'raspberries'

While there are cases of conceptually inanimate exceptions like (12b), (12c), and (12d), they are treated by the morphology as animate both in the plural morphology and in their participation as arguments of verb classes, which are themselves distinguished on the basis of animacy of the subject and the object (Bloomfield 1946):

Verb Class	Classifying Argument	Animacy
transitive animate (TA)	object	[+animate]
transitive inanimate (TI)	object	[-animate]
intransitive animate (AI)	subject	[+animate]
intransitive inanimate (II)	subject	[-animate]

(14) provides some examples of these verb classes (Frantz & Russell 1995):

(14)

Gloss	Transitive		Intransitive	
	Animate	Inanimate	Animate	Inanimate
'eat'	oowat	oowatoo	ooyi	
'laugh (at)'	ikkahsimm	ikkahsi'tsi	ikkahsi'takiwa	
'be complete'			sapanistsimm	sapanistso
'rain'				sootaa

Thus, what we see in the case of Blackfoot is the opposite of the characterization in (11) of the cases in (8) - (10). Namely:

- (15)
- a. Exceptions are systematic across phenomena
 - b. There are morphological consequences to the animacy distinction
 - c. Patients participate in the same way as do agents/causers

Based on the contrast between the characteristics in (11) and those in (15), I suggest a high bar for positing an animacy feature: The criteria in (15) should be satisfied in order for us to be confident that there is a morphosyntactically-visible animacy feature.

If animacy features are off the table as an explanation of the animacy not-quite-requirements in (8) - (10), what other explanation could there be? An alternative kind of analysis for facts such as in (8) - (10) relates the possibility of a particular external argument's occurring to its being able to be the agent or causer of a causing event that causes the result event. That is, the reason for felicity or infelicity in (8) and (9) has to do with conceptual criteria of what can cause what, together with constraints on the cause and effect that are provided by the particular phenomenon. Folli and Harley's *teleological capability*, for (8), Sichel's *direct participation*, for (9), and Carlson's *rules and regulations*, for (10), are examples of this kind. An agent or causer is teleologically capable relative to a predicate if it can "participate in the eventuality denoted by the predicate," notably causally, by virtue of the "inherent qualities and abilities of the entity" which allow it to do so (Higginbotham 1997; Folli & Harley 2008); different entities have different teleological capabilities. Direct participation is "the relationship between the event denoted by the nominal and some property which is inherent to the entity denoted by the genitive" (Sichel 2010), and crucially, this property causes the effect, licensing some effects with inanimate entities but not others. Rules and regulations (Carlson 1995) entail effects, and we can surmise that manmade rules and regulations can have different effects than natural laws.

I will call such theories "what-can-cause-what" theories. The key to a what-can-cause-what theory is the constraints on the agent/causer, causing eventuality and/or the effect eventuality that are provided by the compositional semantics. To ensure

that the agent/causer, causing eventuality and the effect eventuality can be interpreted in a conceptual model of the world, any constraints on them must be satisfied in such a way that the causing eventuality is able to cause the effect eventuality, according to the interlocutor's world knowledge. This can very well include the animacy status of the external argument, as animate entities can cause many things that inanimate entities can't, though some inanimate entities can cause certain things. In this way, the animacy possibilities for the external argument can be explained. Note that the syntactic structure of the particular phenomenon is as important for what-can-cause-what theories as it is for feature-based theories.

In this paper, I present a what-can-cause-what theory of two phenomena, namely futurates and *have* causatives, which fail to clear the high bar in (15) and which are therefore poor candidates for an animacy feature analysis. I propose that the conceptual knowledge relevant to what can cause what in these phenomena crucially makes use of a novel notion of "dispositional causation".

The methodology used is to first separate the logical form on the one hand versus meaning arising from the conceptual interpretation of the logical form on the other hand. Both futurates and *have* causatives, I argue, have a simple causal logical form even though complex notions such as intention, authority, control, ability, and settledness arise. In cases with animate entities the causing eventuality is typically an intention. Taking into account what we know about intentions, I generalize intentions to include the inanimate exceptions by generalizing them to *ceteris paribus* (cp) dispositions—dispositions that cause their outcome to occur if (all) "things are equal", i.e., if nothing intervenes that is external to the speaker's representation of the current situation.

While the relevant cp dispositions for animate entities are intentions, those for inanimate entities are physical tendencies. Intentions are very good at causing a variety of eventualities through the action of the person doing the intending or their entourage; physical tendencies are rather less so. But even the latter can cause things to happen, and this is why certain inanimate exceptions are permitted in dispositional causation, according to the constraints that the logical form places on each particular phenomenon. The appearance of the notions of authority, control, ability, and settledness is argued to follow from reference to such dispositions. Finally, differences in whether the disposition, the disposer, or both are explicit in structure or left implicit, will account for the full range of facts in futurates and *have* causatives.

Both logical form and dispositional conceptual structure are argued to contribute to the meanings of these phenomena. Thus, we will not only be able to explain the inanimate exceptions in both futurates and *have* causatives, but also to sharpen a view of meaning as straddling the divide between grammar (compositional semantics,

logical form) and the interpretation of such grammatical expressions in a conceptual model of the world.

2 Futurates as dispositional causation

2.1 Properties of futurates

We saw above that futurates seem to make reference to an eventuality planned by a possibly unexpressed director, as in (16), and are infelicitous when the eventuality is not of the sort that can be planned. Exceptions to this are “natural” futurates as in (18a), in which there is no director.

- (16) a. I make the coffee tomorrow. = (1)
 b. The Red Sox play the Yankees tomorrow.
- (17) a. #I get sick tomorrow. = (2)
 b. #The Red Sox beat the Yankees tomorrow.
- (18) a. The sun rises #(at 6:00) tomorrow. = (3)
 b. The tide is high #(at 6:00) tomorrow.

Two other properties of futurates are worth mentioning here before we move on to an analysis. First, futurates permit an extra adverbial modifying the intention or plan of the director, particularly in the past progressive. (Natural futurates don’t permit this, presumably because they are odd with progressives: *#Yesterday, the sun was rising at 6:00 tomorrow.*)

- (19) Yesterday, the Red Sox were playing the Yankees tomorrow (but I don’t know if the plan has changed since then).

Secondly, in a number of ways futurates behave like present-oriented derived statives [Copley \(2008b\)](#). For instance, the only epistemic readings of (20a) and (20b) are futurate readings or generic/habitual readings. Since statives are compatible with epistemic readings of modals but eventives are not, this is evidence that the futurate is behaving like a stative.

- (20) a. The Red Sox must play the Yankees.
 b. The tide must come in at 6:00.

Likewise, futurates in the antecedents of conditionals allow the consequent eventuality to take place before the antecedent eventuality, as shown in (21a) and (21b) (see also [Crouch \(1994\)](#) for a similar point). This behavior is like present statives, as in (22a), not like future-oriented (non-futurate) eventives, as in (22b).

- (21) a. If Mary leaves on Monday, I'll give her a call (today/then).
 b. If the sun rises at 6:00 tomorrow, I'll give Mary a call (now/then).
- (22) a. If Mary is here, I'll give her a call (today/tomorrow).
 b. If Mary gets sick tomorrow, I'll give Mary a call (#today/then).

Another way in which futurates behave like present statives is the fact that the simple present version has a feeling of being somehow permanent while the progressive version has a feeling of being temporary, as in (23) and (24). This is the same as present statives, as in (25). In fact the very temporariness of (24b) rules the sentence out, as it is not a temporarily true fact that the sun is to rise at that particular time tomorrow, it is a fact of long standing.

- (23) a. The Red Sox play the Yankees tomorrow.
 b. The Red Sox are playing the Yankees tomorrow.
- (24) a. The sun rises at 6:00 tomorrow.
 b. #The sun is rising at 6:00 tomorrow.
- (25) a. I live in Paris.
 b. I'm living in Paris.

Together these facts suggest that there are (at least) two eventualities represented in the structure of futurates, and the higher one is stative, representing the director's plan or intention.

The claim that futurates are themselves stative, interacting with progressive or imperfective aspect in the way that lexical statives do, also suggests that progressive or imperfective aspect is not responsible for their meaning. So, contra Dowty (1977; 1979); Kaufmann (2005); Copley (2008a; 2009), but following Copley (2014), their meaning is not associated with any overt morphology. The lack of morphology is a clue that the logical form of futurates is actually quite simple. If there is to be an unpronounced head carrying the futurate meaning, it should be a relatively simple one.

The idea that futurates are themselves statives further suggests that futurate readings should only be possible with imperfective forms that take can take statives as their argument. As far as I know this is true, though I have not done an exhaustive study so it could still turn out to be false.

2.2 The structure of futurates

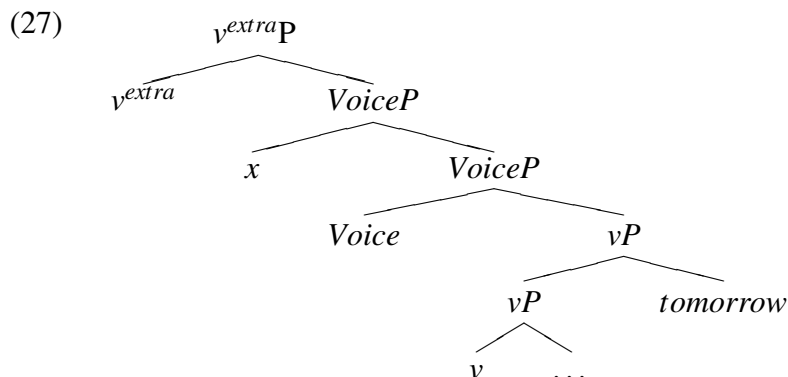
We have seen that futurates require a future adverbial (at least contextually); they seem to have a non-expressed animate director or in the case of natural futurates an inanimate or no director; and they are themselves stative. Given these facts, what

then is the structure of futurates? Remember that we need to know what the structure is in order to have a what-can-cause-what theory to explain the inanimate exceptions to the apparent animacy requirement.

I adopt a modified version of the analysis for futurates given in Copley (2014). Copley argues that a basic structure with two subevents leads to a contradiction because $[[\text{tomorrow}]^c(e')$ is not compatible with a present run time for e' .

- (26) Basic structure (contradictory temporal constraints on e'):
- | | |
|----------------------------|---------------|
| NOW(e') | present tense |
| AGENT(x, e') | Voice |
| e' CAUSE e | v |
| $[[\text{tomorrow}]^c(e')$ | adverbial |

Following the idea that any null head must be a semantically simple one, and noting that v heads introduce eventualities (typically a causing sub-event representing what the agent does to cause the result sub-event), Copley proposes an extra causal head, here notated v_{extra} above *VoiceP*, as in (27), to introduce an extra eventuality argument. This allows a higher causing eventuality (e'') to hold now, even though the effect (the agent-caused event e') is to occur tomorrow.



- (28)
- | | |
|----------------------------|---------------|
| NOW(e'') | present tense |
| e'' CAUSE e' | v_{extra} |
| AGENT(x, e') | Voice |
| e' CAUSE e | v |
| $[[\text{tomorrow}]^c(e')$ | adverbial |
| $[[\dots]^c(e)$ | ... |

The constraints on the causal structure, then, are as in (28): there is a cause and an effect, where *p* is true of the effect; the cause occurs now² while the effect occurs at a future time such as tomorrow. This reanalysis, which is not to be understood as a true reanalysis in a derivational sense, is in its effect an implementation of the idea in Kaufmann (2005: p. 21) that there is a reinterpretation or remedy of such sentences to be about the schedule or plan.

The structure in (28) differs from the structure proposed in Copley (2014) in one respect: the addition of Voice to the syntax (Kratzer 1996; Pykkänen 2008; Harley 2013). In Copley (2014), the vP projection introduces both the causal semantics (in the head *v*) and a null director (in the specifier of vP). However, since the director is always unpronounced, and in natural futurates there seems to be no director at all; and in the context of proposals which have Voice introducing the external argument rather than *v*, it is simpler to say that futurates have no syntactic realization of the director; we only get an implicit sense of a director because an intention is (almost) the only thing that *e''* can be, and intentions must be held by someone animate.

We can say that directors are merely implicit in futurates despite an argument in Copley (2009: p. 54) that directors of futurates are visible in the syntax. That argument goes as follows. Although futurates are possible with animate and inanimate subjects, as shown in (29), there are certain subject-oriented adverbials that seem to force the subject to be the director, as shown in (30a), where Andrea must be in charge of her singing tomorrow, and the impossibility of (30b), where the inanimate subject cannot be the director. This Copley takes as evidence that the director is visible to the syntax, because it seems to be visible to the adverbial, as the adverbial apparently places a requirement on the director.

- (29) a. Andrea is singing tomorrow.
 b. The concert is happening tomorrow.
- (30) a. Andrea is magnanimously/reluctantly/egotistically singing tomorrow.
 b. #The concert is magnanimously/reluctantly/egotistically happening tomorrow.

However, on this account, since both (30a) and (30b) have an (animate) director, it is not clear why (30b) would be ruled out. So we must retrace our steps, and in fact there is a relatively simple answer. If we understand the adverbial to require its argument to be syntactically provided, i.e., it has to be the subject rather than contextually provided, the contrast in (30) is entirely expected. Noting that the adverbials in (30) require the subject to control whether and/or how the eventuality occurs, and that the unexpressed director is the one who controls the occurrence of

² The example we are looking at is in the present tense; any tense and aspect would of course place further conditions on *e''*.

the eventuality in futurates, it follows that the subject must be the director. Therefore there is still no evidence that the director in futurates has a syntactically-visible realization. This is good news, since the existence of natural futurates indicates that there need not be a director *per se*.

We turn now to the interpretation of (28). The only way to have referents for the Davidsonian arguments is if the higher causing eventuality e'' can *directly* cause the effect eventuality e' despite the temporal gap between them. We know that the direct/indirect distinction is important to language (Shibatani 1973; Dowty 1979; Comrie 1985; Croft 1991; Levin & Hovav 1994), and in particular direct causation, understood as causation with only enabling conditions, not another causing condition, between the cause and effect is a condition on verbal semantics (Wolff 2003), which for us is associated with the *v* head. Moreover, if indirect causation were allowed for the *v* head unplannable eventualities would be possible; there could, for instance, certainly be something true today that indirectly caused it to rain tomorrow. So the causation here must be direct causation.

The requirement for direct causation also helps us understand why e'' must be stative. Copley 2014 concludes from (28) that there is a temporal gap between a cause today and its effect tomorrow, and therefore that the kind of direct causation involved must be a novel one, not limited to spatiotemporal contiguity. But actually, if e'' is stative, there is no need for a temporal gap between e'' and e' . Instead the state e'' can hold both now and at the time when e happens tomorrow, in a kind of double access. And, given that e' is interpreted as an intention, it makes sense that there is double access of the state to the two times, as the director has to not have changed their mind in order for e' to happen. So there is no reason to posit a different kind of causation.

One further question about the interpretation of (28) is where the sense of authority or ability to control whether the eventuality happens comes from, as well as the sense of settledness in futurates. While the usual course of events is for the agent's own intention to directly cause the actions of which they are an agent, the futurate cases differ only in that it is not specified whose intention directly causes the actions of the agent; it could be either the agent themselves or another entity. I would like to suggest that it is exactly this case where someone else's intention is treated as directly causing an agent's actions, that we interpret as someone having authority over the agent. The sense of ability and control then comes from whatever it is about intentions that gives an intender the ability to control, to a certain extent, the outcome of their own action (see, e.g. Farkas (1988)).³ This sense of control or ability is

³ Following Wolff's (2003) treatment of the direct causation condition, the agent of futurates then does not count as an additional causing condition, but merely as an enabling condition. This has the curious effect of making the subject of futurates a kind of instrument, conceptually at least, though not grammatically. But this seems correct, as the director is in control of the outcome, rather than the

thus presupposed, and it in turn gives us the sense of settledness (Condoravdi 2002; Kaufmann 2005; Kaufmann et al. 2006) or plannability (Copley 2008, 2009): since the intender is presupposed to control whether the eventuality happens or not, and they intend for it to happen, then in the absence of unforeseen events, it will.

2.3 Inanimate “exceptions”: generalizing from intentions to dispositions

Working from this analysis of ordinary futurates, we must then find a way to generalize this analysis to account for the idiosyncratic inanimate exceptions, i.e. natural futurates. Strictly speaking, then, what we have been calling inanimate exceptions will not be exceptions at all. Since intentions are crucially involved in ordinary futurates, let’s start from the notion of intention, with the aim of generalizing it to something that does not require an animate or sentient entity.

Intention involves, at the very least, an intender y who holds an intentional state e'' bearing some intentional relation toward an eventuality description p , such that an eventuality e' of that description occurs. The nature of the intentional relation could be one of two things: either a *bouletic* relation, where the state is some kind of preference for p , as in Heim (e.g. 1992); Condoravdi & Lauer (e.g. 2009); Grano (e.g. 2016); or a *dispositional* relation, where the intentional state is seen as some kind of disposition to cause an eventuality that meets the eventuality description (e.g. Portner 1997).

The existence of natural futurates suggests a dispositional rather than a bouletic analysis of intention for futurates. As Copley & Wolff 2014 point out, such cases suggest that the intentionality implicated here does not involve preferences. If it did, then it would be mysterious why some inanimate exceptions are allowed to occur, as inanimate entities do not have preferences. If instead, we view intentions as a kind of disposition (which is implicit to a certain extent in Condoravdi & Lauer (2009) and Grano (2016)), the inanimate exceptions can be those which have a relevant disposition that under certain circumstances causes the eventuality.⁴

agent who is merely (Copley & Harley 2015) the source of the energy that brings about the outcome. Relevantly, note that the event of communication of the authority’s intention, if any, would also not count as an intervening cause but at most an intervening enabling condition.

⁴ The dispositional structure in (31) includes the notion of causation. There is no consensus in philosophy as to whether intentions involve causation (Setiya 2015). Neither is there consensus as to whether dispositions involve causation (McKittrick 2005; Choi & Fara 2016). From a linguistic perspective we have no such scruples about causation, since an extra causal v head seems to be the most minimal proposal that can work, especially with the restriction to direct causation that drives the double access and hence the stativity of the argument introduced by v . However, as we will see below in section 4, relations in the conceptual structure could well be more underspecified than those given in (31); there is work to be done on the precise nature of these relations.

I will follow Fara (2001) in thinking of dispositions as essentially habitual or generic in nature. For Fara, “N is disposed to M when C is true just in case N has some intrinsic property in virtue of which N Ms when C.” While intentional states are clearly not intrinsic properties, we can still use this idea to sketch the structure of a dispositional intention as in (31):

- (31) Structure of a (dispositional) intention:
- a. an intender y , who is the holder of ...
 - b. an intentional state e'' , which in certain circumstances directly causes ...
 - c. an eventuality e' ...
 - d. that instantiates the eventuality description p intended by y

Of course it would be good to know more about the “certain circumstances”, corresponding to Fara’s “when C”. There is much to be said here about intentions which we will not be able to delve into, but for now we can informally say that someone with an intention toward p acts to cause an eventuality which instantiates p as long as, taking everything relevant they know into account, they expect that this action will cause such an eventuality (see Portner (1997); Kamp (1999/2007); Condoravdi & Lauer (2009; 2016); Grano (2016))). So, in a very informal sense, and without relativizing it to the intender or the speaker, we can say that the certain circumstances are *ceteris paribus* (“(all) things are equal”) circumstances—nothing unforeseen arises.

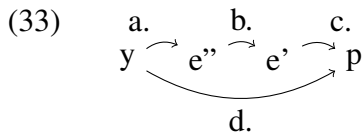
With this definition of intention in mind, we can generalize intentions to a category of *ceteris paribus* dispositions, which includes physical *ceteris paribus* tendencies, by not requiring the holder of the state to be animate, nor the disposition to be an intention. So the *intender* y is generalized to *disposer*, to include also inanimate holders of dispositions, and *intention* is generalized to (*ceteris paribus*) *disposition*, to include also physical tendencies.⁵

Ceteris paribus dispositional structure is characterized by the relations in (32) between the disposer y , the dispositional state e'' , the manifestation e' , and the description p . These relations are also represented in the graph in (33). There is some redundancy in this set of relations: y being the holder of the state e'' which causes the eventuality e' instantiated by p is effectively what it means for y to be disposed toward p . As we will see, however, when we discuss *have* causatives below

⁵ Another point regarding the characterization of causation associated with intention is that it is *robust* or *insensitive* causation, where small changes in the environment do not perturb the outcome (Lewis 1986; Woodward 2006; Lombrozo 2010; Gerstenberg et al. 2015). This seems intuitively correct, as an intender can overcome changes in the environment to still achieve the intended outcome.

in section 3, it will be useful to have a relation between y and p made explicitly available, as in (32d).

- (32) Dispositional structure
- a. y is the holder of e''
 - b. e'' is a state that directly causes e' , *ceteris paribus*
 - c. e' instantiates p
 - d. y is disposed toward p



The causal relation in (32b) is the “dispositional causation” of the title of this paper; it is “dispositional” merely because the causing relatum is a dispositional state. The “directly” part will not be motivated in this discussion on futurates.⁶ But how do *ceteris paribus* dispositions (or any dispositions) cause their outcomes? This we cannot say. We can only say that they do. For example, in the case of intentions, Copley & Harley (2015) treat it as a law of rational behavior that intentions, if nothing prevents them from causing the intended thing to happen (this is the *ceteris paribus* condition), cause the intended outcome. A similar law should operate for physical tendencies to cause their manifestations.

We can now turn back to the structure of futurates to see how *ceteris paribus* dispositions help us account for natural futurates. This is summarized in the table (34). From the structure in (27) comes the constraint that e'' must be a state (because double access is needed to ensure direct causation), and v^{extra} provides the constraints that e'' CAUSE e' and $p(e')$. I assume that dispositional causation is generally the way in which states cause things, so the fact that e'' is a causal state evokes the conceptual disposition structure (this evocation is indicated by boldface). The dispositional structure in turn provides its own constraints.

⁶ The reason is that direct causation is already guaranteed by the proposed structure of futurates itself, as we will see just below. In fact, as far as futurates are concerned, the relation in (32b) could even be an entirely underspecified relation between e'' and e' . The case for direct causation as the relation between e'' and e' , however, will be motivated below in the discussion on *have* causatives.

(34) Futurates:

	from structure in (27)	from dispositional structure
y		is the holder of e'' , disposed toward p
e''	is a state , directly causes e'	is a state held by y , directly causes e' <i>ceteris paribus</i>
e'	is directly caused by e''	is directly caused by e'' <i>ceteris paribus</i> , instantiates p
p	is instantiated by e'	is what y is disposed toward, is instantiated by e'

While the what-can-cause-what theory does not make use of syntactically-visible animacy features, the syntax is still important. It tells us which inanimate exceptions to the apparent animacy requirement will be possible. In the case of futurates, the outcome occurs at a particular future time, so for natural futurates we are constrained to physical dispositions that can directly cause something to happen at this later time (although not all dispositions themselves are limited in this way). So we see how the causal structure in (28), constructed in the syntax, combines with world knowledge about what can cause what to result in what looks like an animacy requirement, but which has idiosyncratic inanimate exceptions. Since the causing eventuality needs to be a state which causes, it needs to be a dispositional state, so the question becomes about what kind of dispositions meet the requirements in (34). For natural futurates, what we are looking for is something that fits the causal structure, where e'' is not an intention but rather whatever disposition that causes the sun to rise at a certain time tomorrow, or the tide to come in at a particular time tomorrow. Since such physical dispositions are rare, so too are natural futurates. On this account, natural futurates are no longer truly exceptions; they are cases of dispositional causation just like the intentional futurates.

2.4 Heading off an objection

Two anonymous reviewers point out that (35) is unexpectedly odd, which poses a *prima facie* problem. The problem is that a disposition for the sun to rise at a particular precise time tomorrow can also be described as a disposition for the sun to rise at any time tomorrow, so a plausible reason for the infelicity of (35) must be found in order for us to have confidence in the proposed analysis.

(35) The sun rises tomorrow

The sun of course rises every day, so (35) is not very informative. However, as the reviewers point out, we cannot rely on the unformativeness of (35) to explain its infelicity, because (36) is equally uninformative, but felicitous.

(36) The sun will rise tomorrow.

To explain the infelicity of (35), we will slightly but reasonably elaborate the analysis, turning to the fact that simple present futurates as in (36) are sensitive to focus alternatives (Copley 2009), while true future statements such as those in (36) are not. The utterer of (35), but not the utterer of (36), evokes a disposition toward a proposition that includes focus marking. This proposition will thus be one of the following:

- (37) a. [the sun]_F rise tomorrow
 b. the sun [rise]_F tomorrow
 c. the sun rise [tomorrow]_F

So, (35) feels odd because it raises either an alternative where it is not the sun that rises tomorrow but something else; an alternative where the sun does not rise, but rather, does something else tomorrow; or an alternative where the sun rises (only) on a different day than tomorrow. All of these are absurd alternatives, and that is why (35) feels odd. On the other hand, (36) does not deal in dispositions; it only says that there is a future time tomorrow at which the sun rises.

A wrinkle here is that Copley (2009) finds only simple futurates to be focus-sensitive, not progressive futurates. Progressives are not very good with natural futurates anyway, so there is no test to be run here, but it suggests that the focus-sensitivity comes from the simple present, not the disposition. How this could be done is something to be further investigated, but the lack of a theory for this is no argument against the proposed analysis.

2.5 Prediction, certainty, and probability vs. settledness

An anonymous reviewer asks whether the notion of predictability might not better characterize the difference between futures and futurates. The idea would be that intended actions, sunrises, and tides, are all highly predictable while, e.g., rain at a certain time tomorrow is not, and it would be this difference that distinguishes futurate-friendly eventuality descriptions from those that are not possible to have in futurates. The issue with this story is how to derive infelicity rather than mere falsity from having a low-predictible eventuality described by a futurate. So whatever the

nature of futurates, it should require that a low-predictible eventuality described by a futurate is a kind of category mistake, thus deriving infelicity.

The problem is that it not possible to do this with prediction. Low-probability eventualities are perfectly easy to predict even if one has few grounds on which to reasonably make such a prediction. Not having reasonable grounds on which to predict something does not make it impossible to assert such a prediction; one can have “just a feeling”.

To see this, note first that true futures are all possible to embed under *predict*. I assume that we can take the possibility of being embedded under *predict* as a diagnostic for whether something can conceptually be predicted. In fact what we see is that despite any conceptual difference between high or low predictability eventuality descriptions, cases without *will* behave the same, whether they are acceptable futurates or not. If there were a conceptual conflict between prediction and low-probability eventualities, we might expect low-probability eventualities to be incompatible with prediction. But of course it is possible to predict even things with a low probability. This suggests right away that there is no inherent conceptual conflict between prediction and the eventuality description that would be expected to result in infelicity of a category mistake kind. At worst, in asserting a prediction of a low-probability eventuality, one risks losing the bet, as it were.

- (38) I predict that ...
- a. ... Madeleine will sing at 6 tomorrow.
 - b. ... the sun will rise at 6 tomorrow.
 - c. ... Madeleine will get sick at 6 tomorrow.
 - d. ... it will rain at 6 tomorrow.

Furthermore, while it true that there is a difference in how easy it is to predict intended actions, sunrises, and tides on the one hand, and precise times of rain and onset of illness on the other hand, this difference does not correspond to the difference between true futures and futurates. The cases without *will* show us that prediction using a present is marginally possible whether the embedded clause is good as a futurate ((39) and (40)) or not ((41) and (42)). In the futurate cases, the first reading is that it is a prediction about whether we will find out that the futurate itself is true. The second is a prediction about what actually happens. The aspectual contrast between the (a) and (b) examples underlines this, as the progressive applies to the time of the event, not the plan time as in futurate readings.

- (39) a. ?I predict that Madeleine sings at 6 tomorrow.
 → I win if it the schedule says so (furate).
 → I win Madeleine actually sings at 6 tomorrow.

- b. ?I predict that Madeleine is singing at 6 tomorrow.
 → I win if the schedule says so (furate).
 → I win if Madeleine actually is in the midst of singing at 6 tomorrow.
- (40) a. ?I predict that the sun rises at 6 tomorrow.
 → I win if the almanac says so (furate).
 → I win if it actually does.
- b. ??I predict that the sun is rising at 6 tomorrow.
 → I win if the almanac says so (furate).
 → I win if it actually is in the midst of rising at 6 tomorrow.
- (41) a. ?I predict that Madeleine gets sick tomorrow.
 (nothing to check)
 → I win if she actually does.
- b. ?I predict that Madeleine is getting sick tomorrow.
 (nothing to check)
 → I win if she actually is in the midst of getting sick tomorrow.
- (42) a. ?I predict that it rains at 6 tomorrow.
 (nothing to check)
 → I win if it actually does.
- b. ?I predict that it raining at 6 tomorrow.
 (nothing to check)
 → I win if it is actually raining at 6 tomorrow.

We can go through a similar exercise with certainty and probability, though it is more difficult to distinguish whether the certainty or probability with the felicitous furate in(43b) is about the plan or the eventuality than it is with predict.

- (43) It is probable/certain/I am certain that ...
- a. ... #Madeleine gets sick at 6 tomorrow.
- b. ... Madeleine leaves at 6 tomorrow.

The reason is that the speaker of a present furate normally has confidence that the plan will lead to the outcome; (44) is odd unless one is explicitly contrasting one's own view of the world with Madeleine's and one views her as unreliable. An exchange such as (45) facilitates this change of context.

- (44) #Madeleine leaves at 6 tomorrow but she won't.
- (45) A: Does Madeleine leave at 5 tomorrow?
 B: No, she leaves at 6 tomorrow, but you know she won't.

It's possible to do the context-change trick under *it's certain*, etc., as in (46):

- (46) a. Doesn't Madeleine leave at 5 tomorrow?
I'm certain/it's certain/it's probable she leaves at 6 tomorrow, but you know she won't.

This indicates that the certainty, etc. is indeed about the content of Madeleine's plan, not about the outcome happening. So, as with predictability, if infelicitous futurates are infelicitous because there is a category X such that their low-X eventualities represent a category mistake, the category in question (X) is not certainty or probability.

In a similar vein, Condoravdi (2002); Kaufmann (2005); Kaufmann et al. (2006) say that futurate utterances are felicitous because the truth of the outcome is presupposed *settled*. Settledness (or settleability) however, is a slightly different commonsense notion from predictability, certainty, and probability. To see this, note that for (47a) to be true, the speaker has to have more than "just a feeling"; they have to have causal grounds. Either someone controls the rain, or there is a persistent weather pattern such as a monsoon. And in either of those cases, (47b) is also acceptable.

- (47) a. It is settled that it will rain tomorrow.
b. It is settled that it rains tomorrow.

A proposition p is settled with respect to an equivalence class of worlds when that class is homogeneous with respect to p: either p or not-p is true on all the worlds in a class. The key relevance of settledness to futurates is that an issue described by a futurate is presupposed to be settled on the model the speaker is using.

I agree with Condoravdi (2002); Kaufmann (2005); Kaufmann et al. (2006) that settledness arises in futurates—only eventualities that the speaker considers settleable in their sense are possible. However, we need to go beyond settledness; it is a descriptive generalization rather than an explanation.

First, note that the dispositional causation account can derive settleability. Asserting that a disposition e'' causes, *ceteris paribus*, a manifestation e' such that $p(e')$ is to assert that if all is equal, such an e' occurs. The *ceteris paribus* presupposition is related to the speech act: speakers assume that they are including all relevant facts. Together these create a presupposition that the manifestation is of the sort that can be directly caused by a current disposition. Given that a current disposition is asserted to cause it, this would be expected to entail (all else being equal) that the manifestation happens, which is just what we need for settleability.

The dispositional causation account also explains more than the settledness account. First, the settledness account does not explain the stativity of futurates. This is itself a problem, and it also means that no prediction is made about which imperfectives allow futurate readings. In the current analysis, by contrast, futurates

are stative because their highest causing eventuality is a disposition, and dispositions are known to be states (as are intentions, which are here a subset of dispositions). This, as we saw, makes the prediction that imperfective forms that allow futurate readings should also allow other statives.

Second, the implementation of settledness for matrix futurates given in Kaufmann (2005); Kaufmann et al. (2006) raises a further problem for settledness as it is stated there: that of complexity that does not seem to have an appropriate home.

Kaufmann proposes that bare tensed sentences are associated with a modal meaning as in (48), where T and R are temporal and modal relations respectively. It is important for the settledness proposal that there be a modal operator in futurates, because there have to be branching histories over which settledness of a proposition holds or does not hold.

$$(48) \quad \llbracket \emptyset \rrbracket = \lambda \varphi \lambda T \lambda R \lambda i \lambda s . \square (\lambda j . i R j) (\lambda j . \varphi (. j T k) (s))$$

This implementation of the settledness proposal for matrix futurates seems to run afoul of a broad minimalist heuristic that simple morphology should correspond to simple denotations. In the current proposal, futurates introduce an extra causing eventuality. The element that does this is a null v head. Whatever the merits or demerits of null heads, we know that v heads, in theories that use them, frequently correspond to null morphology. So, there is some theoretical consistency there. On this implementation of the settledness proposal, however, a complex quantificational denotation is proposed which prompts the question of why such a complex meaning is represented with no morphology, and whether similar meanings appear elsewhere with no morphology.

Actually, despite the notation in (48), Kaufmann denies that he is forced to a view where the meaning of (48) corresponds to a null morpheme:

In my view, this analysis does not entail a commitment to a syntactic analysis of the bare Present which actually includes a morpheme meaning \emptyset . Perhaps the universal modal force is simply a default way of interpreting non-modalized sentences. On the other hand, phenomena like emphatic do-support do lend some support to the idea that there might be some syntactic motivation for this analysis.

The current dispositional causation analysis of futurates is in agreement with Kaufmann's idea here that the futurate meaning may arise in some part from the default interpretation. But on the current analysis, the default interpretation is just the *ceteris paribus* condition—something like the closed-world hypothesis. This seems quite natural. Kaufmann's meaning is considerably more complex. So whether his

meaning is attributed to a default interpretation or a null head, it is more complex and correspondingly, less plausible than what is proposed here.

For these reasons, the dispositional causation proposal does better than the settledness proposals. At the same time, the current analysis accords with the essence of the important insight behind the settledness proposal, namely that some future eventualities are treated as though it is settled that they will happen, even though it may turn out that they don't.

3 *Have* causatives as dispositional causation

3.1 *Have* causatives are similar to futurates

As we saw in the introduction, *have* causatives are similar to futurates in several ways. First, they contribute a kind of authority to their matrix subject, which is along the same lines as the director in futurates; this was shown in the contrast between (49a) and (49b), where Madeleine could be the speaker's daughter in (49a) but could only be the speaker's boss in (49b).

- (49) a. Madeleine made me wake up early. = (5)
 b. Madeleine had me wake up early.

We also saw that *have* causatives have a plannability constraint, requiring a plannable or controllable eventuality, just as futurates do. This was shown in the contrasts in (50).

- (50) a. Obama made/#had Clinton collapse last Tuesday. = (6)
 b. Obama made/#had it rain.

Finally, we saw that similarly to futurates, there are idiosyncratic inanimate causer exceptions to the apparent animacy requirement.

- (51) a. #The book had John laugh.
 b. The book had John laughing/on the floor/in tears.

Further examples of inanimate causer *have* causatives are shown in (52):

- (52) a. **This had me laughing** for a straight minute.
https://www.reddit.com/r/allthingsprotoss/comments/60dim3/this_had_me_laughing_for_a_straight_minute/
 b. Birmingham boss Harry Redknapp admits **emergency surgery had him worried**.

<http://www.tribalfootball.com/articles/birmingham-boss-harry-redknapp-admits-emergency-surgery-had-him-worried-4189375>

- c. While **my teammate Monica Noda unbridled optimism had her believing this prize was ours to win**, I was happy to be along for the ride with four of my most driven and intelligent classmates.
<http://blogs.ft.com/mba-blog/2013/09/23/the-end-or-the-start-of-the-hult-prize-rollercoaster/?mhq5j=e1>
- d. **It had him seeing stars.**
<https://twitter.com/WeedHumor/status/872922539852521472>
- e. This kiddo opened her snack pack and **it had her in awe!**
<http://liketodiscover.com/this-kiddo-opened-her-snack-pack-and-it-had-her-in-awe-this-is-creative/>

Inanimate matrix subjects apparently can occur in *have* causatives when the lower subject is animate and the caused eventuality is either a psychological state or a physical state that is indicative of a certain psychological state.⁷ The cause in these cases is a true cause as opposed to Pesetsky's (1995) "Target of emotion/subject matter", since in (55a), as in a reading of (55b), Bill is angry at something other than the article itself; in fact he is angry at something that the content of the article causes him to be angry at.

- (55) a. The article had Bill angry.
 b. The article in the *Times* angered Bill.

The idiosyncratic inanimate exceptions here again point to a what-can-cause-what theory rather than an animacy feature. Note that the inanimate exceptions are not the same as those for futurates; they are idiosyncratic to the particular structure of the *have* causative in question, which we will now address.

⁷ This is not an exhaustive characterisation of idiosyncratic inanimate exceptions for *have* causatives. For example, property transfer as in (53) and (54) could be seen as stemming from a disposition to transfer the property. The need for a scalar marker such as *all* complicates the question, however, and we will not consider these further here.

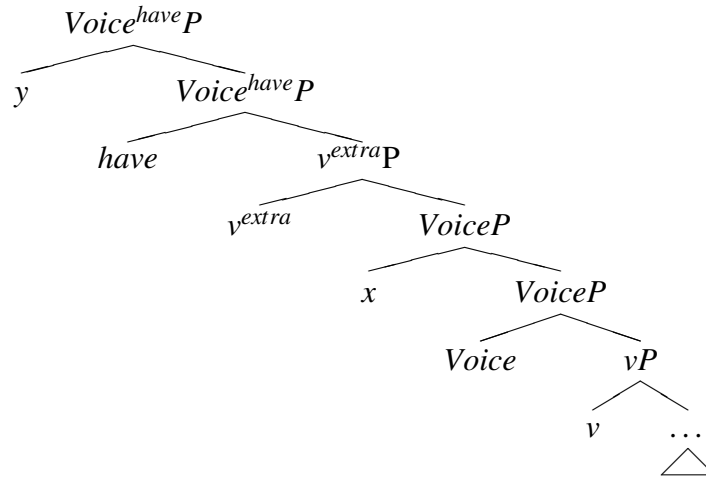
- (53) a. The square is white from the hailstones. (Maienborn & Herdtfelder 2015)
 b. The flyers had the square #(all, completely, quite ...) white.
- (54) a. The flowers brightened the room. (Darteni 2017)
 b. The flowers had the room #(all, completely, quite ...) bright.

3.2 *Have* causatives on the model of futurates

In conjunction with Copley's (2014) analysis that we adapted above, Copley & Harley's (2009) idea that the futurate operator is the same as *have* would mean that *have* causatives have an extra *v*, as well as an extra Voice above it which introduces an argument.

Like futurates, *have* causatives would have an extra causal *v* head on top of the usual active Voice projection (if it has the usual active Voice and *v* projections to begin with; the inanimate exception cases in (51) and (52) do not). A second Voice head on top of the second *v* head introduces the matrix argument and is realized morphologically by *have*.

(56) *Have* causatives with an extra *v* head (to be revised)



The advantage of this analysis is that it straightforwardly accounts for the similarity to futurates, explaining the data in the previous section. As we will see now, however, there are several arguments that point against extra *v* head for *have* causatives. Some of these arguments do not go through, but those that do ultimately disqualify the analysis in (56). Despite this, a dispositional causation account of *have* causatives will still be possible, just with a different structure from the one in (56), and with different ingredients of dispositional structure left implicit.

3.3 Existing arguments against an extra *v* head for *have* causatives

The analysis in (56) conflicts with that of Ritter & Rosen (1993; 1997) and Bjorkman & Cowper (2013). In all of these the position is that *have* causatives, unlike *make*

causatives, have a single eventuality rather than two eventualities. For example, Bjorkman & Cowper take the impossibility of passivization of a *have* causative as in (57a) as evidence that the *have* causative is too small to passivize. Likewise, they take the impossibility of the two adverbials (57b) as evidence that there cannot be two eventualities.

- (57) a. The children were made/*had to clean up the playroom.
 b. They made/*had the team throw the game on Monday by threatening them on Sunday night.

However, the problem with (57b) seems not to be only the two adverbials but rather the *by* phrase, as shown by the infelicity of (58a). The felicitous two-adverbial case in (58b) is parallel to futurate examples as in (58c); both are in the progressive.

- (58) a. *Mary had John pick up her dry cleaning by threatening him.
 b. On Sunday night, they were having the team throw the game on Monday.
 c. On Sunday night, the team was throwing the game on Monday.

As shown in (59), both futurates and *have* causatives become infelicitous in the perfective:

- (59) a. #On Sunday night, the team threw the game on Monday.
 b. #On Sunday night, the coach had the team throw the game on Monday.

While on Copley's 2014 account there is no explanation offered for (59b), the double access modification of her account does provide one. Assuming that perfective aspect as in (59) bounds a state, the perfective does not allow the double access of the intention needed for futurates. So a contradiction ensues: the throwing of the game has to be directly caused by whatever the coach did on Sunday night, so the game must take place on Sunday night, but it also happened on Monday. This explanation can apply equally to *have* causatives.

In sum, *have* causatives look exactly like futurates with respect to double temporal adverbials, as would be expected if they had the futurate-like structure in (59). So we must reinterpret what is responsible for the infelicity of (57a) and (57b). But of course *by* is not unrelated to the passive. Whatever is responsible for the problem with passivization in (57a) may also be responsible for the problem with *by* in (57b). Therefore, if we can specify that there is no passive Voice that can replace *Voice^{have}*, and that *by* cannot introduce a haver, these are not substantive problems for the structure in (56).

3.4 New arguments for the lack of v^{extra} in *have* causatives

There are, however, other arguments against the extra v analysis (56) for *have* causatives.

3.4.1 Stativity



One argument has to do with the eventuality type of *have* conditionals, in particular whether they are stative or not. Dispositions are states. Futurates are uniformly stative, which supports the idea that their highest eventuality argument is a disposition (which in the analysis above is introduced by an extra v head). We have seen that *have* causatives are similar to futurates in having a dispositional causation meaning (due to the sense of authority and inanimate exceptions). The question, however, is whether they are uniformly stative.

Certainly some *have* causatives are stative. For example, the inanimate exception cases are stative, as shown in (60). In (60a), the felicity of a simple present, non-generic/habitual reading diagnoses stativity, and in (60b), the possibility of an epistemic reading also indicates the possibility for a stative reading.

- (60) a. The book has John laughing.
b. The book must have John laughing.

Another reading that is apparently stative is the “director reading” (Ritter & Rosen 1993). As Copley & Harley 2009 point out, the eventuality does not have to be plannable, and contra Ritter & Rosen 1993, the lower subject need not control the eventuality.


Let’s use a director’s chair icon⁸ to mark cases that are felicitous only when the matrix causer is a director, novelist, playwright, etc., and therefore omnipotent within the fictional world being presented.

- (61) a.  Sorkin had it rain (to give his protagonists a reason to go in the shop).
b.  (In the opening scene), Sorkin had Barlett collapse.

It’s telling that both Copley, writing about futurates, and Ritter and Rosen, writing about *have* causatives, use the word “director”. While the general idea is similar, it turns out they are not used for exactly the same things. Copley uses the word “director” for the unexpressed animate causer in all except natural futurates. This causer does not have to be a director, novelist, playwright, etc. but could be. Ritter and Rosen, on the other hand use “director” only for these curious *have* causative cases as in (61) where the matrix causer has to be an omnipotent director, novelist,

⁸ Director’s chair icon by Nikita Kozin, The Noun Project.

playwright, and so forth. Copley & Harley 2009 point out that the analogous futurate cases to (61) would be the way in which (62), e.g., normally marked pragmatically infelicitous, would be ok, namely, in the case where there is someone omnipotent doing the planning. So it can be marked with a director's chair.

(62)  It rains the next day/tomorrow (we are in a book/God is doing the planning)

The director's reading of *have* causatives is stative, as shown by the fact that it can occur in the simple present without a generic/habitual reading as in (63a); it can have an epistemic reading under *must* as in (63b); and it shows a permanent/temporary contrast when comparing the simple present to the present progressive as in (63c).

- (63) a. Sorkin has it rain in the first act. (not a gen/hab reading)
 b. Sorkin must have it rain in the first act. (epistemic reading)
 c. Sorkin has/is having it rain in the first act. (permanent/temporary contrast)

However, it is not the case that all *have* causatives are stative. The authority-related cases of *have* causatives are eventive, as is shown in (64a) and (65a).

- (64) a. Mary has John laugh. (gen/hab or director reading only)
 b. Mary must have John laugh. (no epistemic reading)

So, to sum up this section, the core "authority" cases of *have* causatives are eventive, while the inanimate exceptions and director readings are apparently stative. The eventivity of the authority cases is problematic for the structure in (56), since the eventuality e'' introduced by v^{extra} , is a (dispositional) state. This, then, is evidence that there is no extra v head in *have* causatives.

3.4.2 Eventuality type inheritance and the director reading


A lack of an extra v head in *have* causatives could also explain why *have* causatives display what looks like an "inheritance" of eventuality type: in non-director reading cases, when the complement of *have* is eventive, the whole *have* causative sentence is eventive, and when the complement of *have* is a small clause as in (65b) and arguably (cf. Harley & Noyer 1997) (65c), the whole *have* causative is stative.

- (65) a. Madeleine had/#has John wake up early today.
 b. Madeleine had/has [_{SC} John up early] today.
 c. Madeleine had/has [_{SC} John waking up early] today.

This is easily explainable by the lack of a v_{extra} : since no higher eventuality is introduced, the eventuality type of the whole sentence should be that of the eventuality

type of the *have* complement, because it would have the highest lambda-bound eventuality.


At first glance, this pattern seems to be broken by director readings, which allow eventive complements though they themselves have a non-director, non-generic/habitual simple present reading, as in (66):

(66)  Madeleine has John wake up early in the second act.

However, even though it looks like (66) breaks the pattern of eventuality type inheritance, it actually shows that the pattern holds, and moreover, allows us to accurately characterize the conditions under which only the director reading is possible. The key insight (B. Bjorkman & E. Cowper, p.c.) is that in narrative contexts such as plays and books, present tense eventives are possible, as in (67).

(67) John wakes up early in the second act.

So, the fact that (66) has a felicitous simple present stems directly from the fact that (67) has a felicitous simple present. They are in fact both stative, as shown by the epistemic readings available in (68).

- (68) a.  Madeleine must have John wake up early in the second act. (epistemic reading ok)
 b. John must wake up early in the second act. (epistemic reading ok)

The restriction of present eventives to narrative contexts, in conjunction with the fact that the eventive complement provides the eventuality type of the whole sentence, explains why examples like (66) force us to accommodate a narrative context. The important thing is the narrative context, not that the haver is the creator of the narrative context. Of course it can be, and when it is, that constitutes the director reading. But note that although (66) lacks a real-world authority reading, it does (despite the director's chair notation) have a reading distinct from the director reading, where Madeleine is not the director or playwright, but is a character in the play who has authority over John. This indicates that the director reading arises just because there is an intention that causes something in a narrative context, and the creator of the narrative context is an entity that can have such an intention.

In all, the inheritance of eventuality type is further evidence that *have* causatives do not have an extra *v* head.

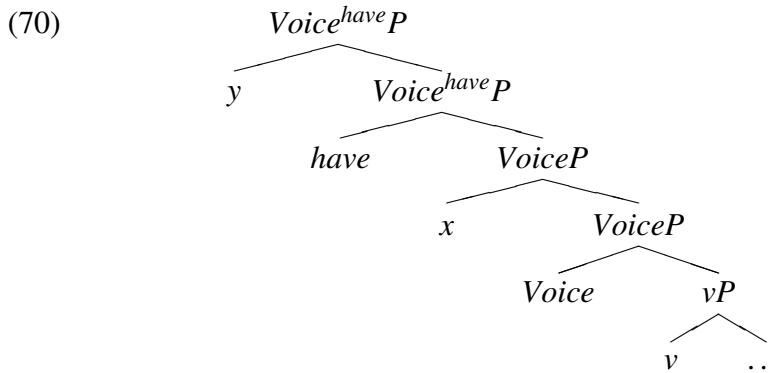
3.4.3 Underspecification of *have* and dispositions

There is further reason to doubt the existence of an extra *v* head in any readings of *have* causatives if we follow the literature on *have* in adopting a highly underspecified

meaning for *have* (Freeze 1992; Belvin & Den Dikken 1997; Ritter & Rosen 1993; Harley 1998; McIntyre 2006: among others). Let's use the implementation of this underspecified meaning as in McIntyre (2006: p. 191).⁹

(69) HAVE(*y*, *z*) asserts of *y* that it is in some relationship to *z*

If there is no extra *v* head, as for example in (70), interpreted as in (71), *have* sets up a relationship between the haver *y* and the predicate as in (72):



(71)

HAVER(<i>y</i> , [[VoiceP]] ^c)		Voice ^{have}
AGENT(<i>x</i> , <i>e'</i>)		Voice
<i>e'</i> CAUSE <i>e</i>		v
[[...]] ^c (<i>e</i>)		...

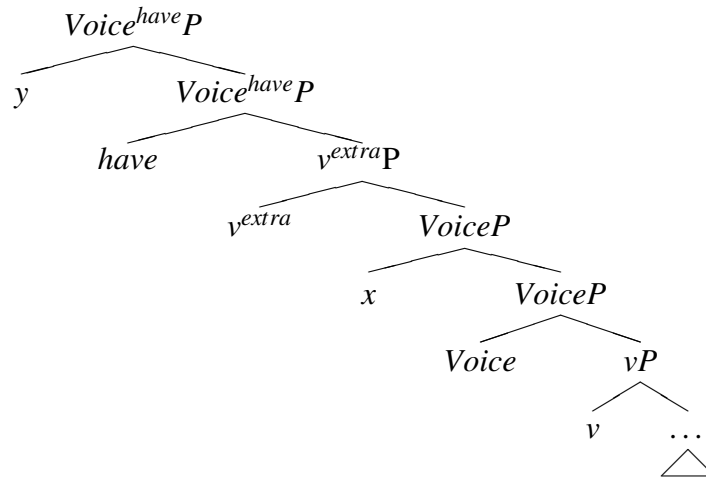
(72) [[VoiceP]]^c = λ*e'* . AGENT(*x*, *e'*) & *e'* CAUSE *e* & [[...]]^c(*e*)

This relationship is exactly the relation in (32d) between the individual and the eventuality description, i.e., *y* intends for an eventuality of the description to happen.

If, however, *have* causatives are supposed to have an extra *v* head, *have* sets up a relationship between the haver *y* and the predicate as in (75):

⁹ One question is why *have* doesn't do this in all languages; see also Folli & Harley (2008).

(73) (= (56))



(74) HAVER(y , $[[v^{extra}P]]^c$) Voice^{have}
 e'' CAUSE e' v^{extra}
 e' CAUSE e v
 $[[\dots]]^c(e)$...

(75) $[[v^{extra}P]]^c = \lambda e'' . e'' \text{ CAUSE } e' \ \& \ e' \text{ CAUSE } e \ \& \ [[\dots]]^c(e)$

The relationship *have* sets up between y and (75) does not have the right meaning. For the director reading, this would mean that y intends for there to be an intention for x to be the agent. This would in turn entail that the director reading requires an intentional lower agent. Although Ritter & Rosen make this claim, leading them then to try to explain why exceptional cases exist where there is no agent at all, it is easier not to treat agentless cases as exceptions to the rule. It is also more intuitively accurate, since a creator can make anything happen in their creation by fiat, regardless of whether there is an agent to carry out their instructions. So (75) is not appropriate as the second relatum of *have*. Any attempt to change the relatum from (75) to something else within the denotation of (75) (e'' , for instance) runs afoul of our underspecified denotation for *have*. Moreover, if it *were* possible to use *have* to relate the haver to an eventuality which instantiates p (which would also require adding a relation between y and e' to the dispositional structure), one would expect, e.g., an agent reading to be possible, because the agent role is exactly a relation between an entity and an event; and it is not possible.

3.4.4 Revisiting an assumption

Given all of the evidence against an extra v for *have* causatives, it behooves us to revisit the one assumption above that suggested an extra v , namely, the assumption that the felicity of two adverbials diagnoses two eventuality arguments. If this assumption is dropped, the rest of the evidence above militates in favor of Bjorkman & Cowper's structure for *have* causatives, with no extra v , inspired by Ritter & Rosen's analysis.

Parenthetically, a question that arises here is that of whether *futurates* can still be argued to have an extra v head as in Copley 2014, if we drop the assumption that the felicity of two temporal adverbials diagnoses two eventuality arguments. *Futurates*, though, really are always stative despite any eventivity of their verbal predicates, and seemingly the only way to account for this is, still, to add it in via an extra v head.

3.5 Explicit and implicit ingredients of dispositions

Having decided on a structure for *have* causatives, we still need to interpret it to account for the facts, including the similarities between *futurates* and *have* causatives discussed in section 3.1. The hope is that the facts can be accounted for by appealing to what-can-cause-what knowledge, resting again on the notion of dispositional causation, and indeed this hope will be borne out. But first we need to understand how *have* causatives can have a disposition without explicitly representing a dispositional state as *futurates* do.

Recall the ingredients of dispositions: a disposer y , a (dispositional) state e'' , a description p , and a manifestation e' . As we saw earlier, these are related variously by several relations: y holds of e'' , e'' causes e' *ceteris paribus*, e' instantiates p , and y is disposed toward p . Together the ingredients, related in this way, constitute a dispositional structure.

Futurates and *have* causatives both evoke dispositions, yet with a difference which will still allow for the similarities between *futurates* and *have* causatives. The difference between *futurates* and *have* causatives has to do with which of the ingredients of dispositions are explicit—in the sense of 'represented in the logical form', not in the sense of 'pronounced'—and which are left implicit. The possibility to evoke ingredients that are left implicit comes, again, from the proposal that the dispositional structure is part of our model of the world, so that if one or two ingredients are missing, they are still accommodated.

In the case of *futurates*, the logical form provides, via v_{extra} , an extra causing eventuality that directly causes a temporally distant result. This extra eventuality must be stative, because the only way to fulfill the direct causation requirement and still hold of the present time is by double access, which is only available for states.

So, of the ingredients of the dispositional structure, we get e'' , p , and e' from the logical form; specifically, from the denotation of v_{extra} . The disposer is left implicit, but given that we have evoked a dispositional structure, we fill in the disposer, as the intender (Copley's "director") in the case of regular futurates, and the subject in the case of natural futurates.

(76) Futurates (= (34)):

	from structure in (27)	from dispositional structure
y		is the holder of e'' , disposed toward p
e''	is a state, directly causes e'	is a state held by y , directly causes e' <i>ceteris paribus</i>
e'	is directly caused by e''	is directly caused by e'' <i>ceteris paribus</i> , instantiates p
p	is instantiated by e'	is what y is disposed toward, is instantiated by e'

For *have* causatives, on the other hand, *have* relates y to the description p . Disposition is one of the possible specifications of this underspecified relation contributed by *have*. When in this way a dispositional structure is evoked, the dispositional state e'' corresponds to the authority or relevant property; and a p eventuality e' is caused to occur, *ceteris paribus*.

(77) *Have* causatives:

	from structure in (70)	from dispositional structure
y	bears a relation to p	is the holder of e'' , disposed toward p
e''		is a state held by y , directly causes e' <i>ceteris paribus</i>
e'		is directly caused by e'' <i>ceteris paribus</i> , instantiates p
p	is what y bears a relation to	is what y is disposed toward , is instantiated by e'

3.6 What-can-cause-what for *have* causatives

Now we can ask what role dispositions play in the what-can-cause-what calculus for *have* causatives. They play a role in ruling out examples such as (78a) and (78b) as cases of mere authority (i.e., putting aside the director reading where John or the teacher is the creator of a fictional course of events).

- (78) a. ☞ John had the branch break the window. (Folli & Harley 2005a)
 b. ☞ The teacher had the plastic wrap cover the food. (Bjorkman & Cowper 2013)

An intention (which, again, is a kind of disposition) can apparently directly cause an animate entity to be an agent of another event. This, we said, is what authority is. The example in (77a) shows us that, outside of the director reading, an intention cannot directly cause an eventuality that does not have an animate agent, presumably because the only way intentions are causally powerful in the real world are through the actions of animate agents (Folli & Harley 2005a). On the director reading, on the other hand, we are in a narrative context that could be anything its creator wants it to be, by fiat of the creator. Therefore, there are no such sentience restrictions on the director reading. Note that the infelicity of the examples in (78) also support the case for the causation in dispositional structure to be direct; if it were not, this explanation of their infelicity would not go through, and it's not clear what other explanation could replace it.

- (79) What-can-cause-what constraint #1
 For any e'' such that e'' is an intention, if e'' CAUSE e' , $\exists x : \text{AGENT}(x, e')$
 UNLESS e'' is the intention of a director/playwright/author/creator toward
 their fictional creation

One kind of example that might give us pause regarding the constraint in (79) is that in (80), where John is an agent but not a volitional one:

- (80) ☞ Madeleine had John sneeze.

Does the infelicity of (80) mean we need to change (79) to include a notion of volitionality of the lower agent? In fact, it does not. Just like examples where there is no lower agent at all, such as ☞ *Madeleine had it rain*, this is a case of a description that cannot be part of an intention of Madeleine's outside of the director reading, since by definition intentions cause, *ceteris paribus*, a manifestation of the eventuality description. The possible eventualities are limited to those that can be caused, *ceteris paribus*, by the intention. So all of these cases are ruled out together by that.

The other main example we need to explain is that of inanimate exceptions such as (81a) and (82a), which can be compared with the minimally different (81b) and (82b).

- (81) a. The book had John laughing.
 b. #The book had John laugh.
- (82) a. The pepper had John sneezing.
 b. #The pepper had John sneeze.

The contrast within each minimal pair in (81) and (82) is instructive because they are lexically not different at all, though they *are* different syntactically. *John* in (82a) bears the AGENT role. But on the assumption that (82a) has a small clause complement, *John* does not bear an AGENT role.¹⁰ Yet in both, conceptually, John is the source of the energy that causes the laugh(ing). What this underlines is that this “intuitive” notion that only intentions can directly cause agentive events really holds at logical form—so not on whatever lexical-conceptual elements are common to both (82a) and (82b), but only when they are in the particular syntactic structures. So the what-can-cause-what constraint that rules out (82a) is as follows.

- (83) What-can-cause-what constraint #2
 For any e' such that $\exists x : \text{AGENT}(x, e')$, if $e'' \text{ CAUSE } e'$, then e'' is an intention.

What-can-cause-what constraints underline the fact that what-can-cause-what theories depend critically on what the syntactic structure in question is. But it also leaves the door slightly open for features. For the AGENT there is no need for an additional animacy feature. But for the distinction between intention and physical tendency, something is needed. It is not an animacy feature, as animate entities can have dispositions that are not intentions (for example, as in *Madeleine had me laughing* where she is not intentionally causing me to laugh). But the grammar needs to at least be able to see whether eventualities are intentions or not. Thus to distinguish intentions from other dispositions perhaps a feature such as +MENTAL will ultimately be needed on the state e'' .

4 Predictions and possible extensions

An objection brought up in review is that the nature of this analysis makes it difficult to make predictions, since the nature of a physical *ceteris paribus* disposition is not

¹⁰ Somehow small clause results go along with inanimate causers: cf. the point made in Folli & Harley (2005a; b), referenced above in (8), that the sea can only eat [_{SC} the beach away], but it cannot eat the beach.

well-understood, by linguists at least. Nonetheless, the theory does make predictions. One prediction, already made, is that futurate readings should only be possible with imperfective forms that can take stative arguments. Another is that the senses of authority evident in futurates and *have* causatives ought to have similarities to each other, on behavioral and neurological measures. Another is that stative dispositional readings ought to be possible but not obligatory in cases like futurates but where there is no temporally-induced restriction that the highest eventuality be a state; it should be investigated whether generic/habitual or characterizing readings fit this bill.

The dispositional causation analysis could also be extended to additional phenomena with simple morphology and dispositional meanings. In general, the methodology will be to identify which relation or relations are expressed in the morphology and to find out whether the other relations are expressed by other morphological distinctions in the sentence, or if they come “for free”, in which case they would be understood to be in the dispositional conceptual structure. We can start from the conceptual structure presented here, but the actual relations may turn out to be more underspecified. Furthermore, we cannot assume that even a more accurate version of the conceptual structure is cross-linguistically present; perhaps different languages reference different, though similar, conceptual structures.

Cross-linguistic work on such phenomena will clarify the picture. One obvious candidate for investigation is the middle (e.g., *This bread cuts easily*), which has been argued (Lekakou 2004; 2005) to have the semantics of a dispositional ascription in which the generalization expressed by the middle sentence is true by virtue of the disposition of the patient (subject). Another is the abilitative head that (e.g.) deMena Travis (2010) and Paul et al. (2017) find in Austronesian, associated with non-agentive and unintentional causation, and explicitly likened to English *have* causatives by Paul et al. There are undoubtedly many more forms with dispositional meanings and simple morphology that are susceptible to investigation along these lines, and which will provide further insight as to the conceptual structure of dispositions.

5 Conclusion

In this paper we have seen that the different causal structures of futurates and *have* causatives yield different requirements for the agent/causer argument. This, plus a new notion of dispositional structure helps us explain their apparent animacy requirements. An extra *v* introduces an explicit disposition, whereas an extra Voice (Voice^{*have*}) introduces an explicit disposer, through a specification of the underspecified *have* relation. If there is an extra *v*, and therefore an explicit disposition, there

can be an implicit disposer, as in futurates. If there is an extra Voice but no extra *v*, as in *have* causatives, Voice is spelled out as *have*, the disposer is introduced explicitly as having a relationship to an eventuality description, and from that a disposition is accommodated. With the framework presented here, in which denotations can evoke dispositions in different ways and dispositional conceptual structure can contribute to meaning, we have a new tool with which to investigate the variety of phenomena in which dispositional meanings occur.

Acknowledgements

Originally presented at the Dispositions Workshop 2015: Workshop on the Morphological, Syntactic and Semantic Aspects of Dispositions Universität Stuttgart, 25-27 June 2015. Thanks to Fabienne Martin and Tillmann Pross for organizing the fantastic workshop. Thanks too to the audience at the Workshop on the Nature, Representation, and Composition of States, Northwestern University, May 5-6 2017, and audiences at the Dog Days Workshop at the University of Toronto, August 2015 and August 2017. Finally, thanks to several anonymous reviewers for their extremely helpful comments.

Competing Interests

The author has no competing interests to declare.

References

- Alexiadou, Artemis, Mariangeles Cano, Gianina Iordăchioaia, Fabienne Martin & Florian Schäfer. 2013. Direct participation and agent exclusivity effects in derived nominals and beyond. *Gianina Iordăchioaia, Isabelle Roy & Kaori Takamine (eds.), Categorization and Category Change in Morphology. Cambridge: CSP*.
- Belvin, Robert & Marcel Den Dikken. 1997. There, happens, to, be, have. *Lingua* 101(3). 151–183.
- Bjorkman, Bronwyn M. & Elizabeth Cowper. 2013. Inflectional shells and the syntax of causative have. *Proceedings of the 2013 CLA, ed. Shan Luo. Canadian Linguistic Association*.
- Bloomfield, Leonard. 1946. *Algonquian*.
- Carlson, Greg. 1995. Truth conditions of generic sentences: Two contrasting views. In Gregory N. Carlson & Francis Jeffrey Pelletier (eds.), *The generic book*. 265–299. Chicago: University of Chicago Press.

- Choi, Sungho & Michael Graff Fara. 2016. Dispositions. In Edward N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University spring 2016 edn.
- Comrie, Bernard. 1985. *Tense*. Cambridge University Press.
- Condoravdi, C. & S. Lauer. 2009. Performing a wish: Desiderative assertions and performativity. Talk given at California Universities Semantics and Pragmatics 2.
- Condoravdi, Cleo. 2002. Temporal interpretation of modals. In David Beaver, Stefan Kaufmann, Brady Clark & Luis Casillas (eds.), *Stanford papers on semantics*. Palo Alto: CSLI Publications.
- Condoravdi, Cleo & Sven Lauer. 2016. Anankastic conditionals are just conditionals. *Semantics & Pragmatics* 9.
- Copley, B. 2014. Causal chains for futurates. In Philippe de Brabanter, Mikhail Kissine & Saghie Sharifzadeh (eds.), *Future times, future tenses* Oxford Studies of Time in Language and Thought. 72–86. OUP.
- Copley, B. & H. Harley. 2015. A force-theoretic framework for event structure. *Linguistics and Philosophy* 38. 103–158.
- Copley, Bridget. 2008a. The plan's the thing: Deconstructing futurate meaning. *Linguistic Inquiry* 39(2). 261–274.
- Copley, Bridget. 2008b. Temporal orientation in conditionals. In Jacqueline Guéron & Jacqueline Lecarme (eds.), *Time and modality*. 59–77. Springer.
- Copley, Bridget. 2009. *The semantics of the future*. Routledge. *Outstanding Dissertations in Linguistics*, Routledge.
- Croft, William. 1991. *Syntactic categories and grammatical relations: The cognitive organization of information*. University of Chicago Press.
- Crouch, Richard. 1994. *The temporal properties of English conditionals and modals*: University of Cambridge, Computer Laboratory dissertation.
- Darteni, Silvia. 2017. *Italian parasynthetic verbs: Argument structure*: Université Paris 8 dissertation.
- deMena Travis, Lisa. 2010. *Inner aspect*. Springer.
- Dowty, David. 1977. Towards a semantic analysis of verb aspect and the English 'imperfective' progressive. *Linguistics and Philosophy* 1. 45–77.
- Dowty, David. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Fara, Michael Graff. 2001. *Dispositions and their ascriptions*: Princeton University dissertation.
- Farkas, Donka F. 1988. On obligatory control. *Linguistics and Philosophy* 11(1). 27–58.
- Folli, Raffaella & Heidi Harley. 2005a. Consuming results in Italian and English: Flavors of v. *Aspectual inquiries* 95–120.

- Folli, Raffaella & Heidi Harley. 2005b. Flavors of v. In *Aspectual inquiries*. 95–120. Springer.
- Folli, Raffaella & Heidi Harley. 2008. Teleology and animacy in external events. *Lingua* 118.
- Frantz, DG & Norma Jean Russell. 1995. Blackfoot dictionary of stems, affixes and roots.
- Freeze, Ray. 1992. Existentials and other locatives. *Language* 553–595.
- Gerstenberg, Tobias, Noah D Goodman, David A Lagnado & Joshua B Tenenbaum. 2015. How, whether, why: Causal judgments as counterfactual contrasts. In *Proceedings of the 37th annual conference of the cognitive science society*. 782–787.
- Grano, Thomas. 2016. The logic of intention reports. *unpublished ms* .
- Grimshaw, Jane. 1990. *Argument structure*. MIT Press.
- Harley, Heidi. 1998. You're having me on: Aspects of have. *La grammaire de la possession* 195–226.
- Harley, Heidi. 2013. External arguments and the mirror principle: On the distinctness of voice and v. *Lingua* 125. 34–57.
- Harley, Heidi & Rolf Noyer. 2000. Formal versus encyclopedic properties of vocabulary: Evidence from nominalizations. *The lexicon-encyclopedia interface* 349374.
- Heim, I. 1992. Presupposition projection and the semantics of attitude verbs. *Journal of Semantics* 9. 183–221.
- Higginbotham, James. 1997. Location and causation. Ms., Oxford University.
- Kamp, Hans. 1999/2007. Intentions, plans and their execution: Turning objects of thought into entities of the external world. Unpublished manuscript, Universität Stuttgart.
- Kaufmann, Stefan. 2005. Conditional truth and future reference. *Journal of Semantics* 22. 231–280.
- Kaufmann, Stefan, Cleo Condoravdi & Valentina Harizanov. 2006. Formal approaches to modality. *The expression of modality* 71–106.
- Kratzer, Angelika. 1996. Severing the external argument from its verb. In John Rooryck & Laurie Zaring (eds.), *Phrase structure and the lexicon*. 109–137. Dordrecht: Kluwer.
- Lakoff, George. 1971. Presupposition and relative well-formedness. In Leon A. Jacobvits Danny D. Steinberg (ed.), *Semantics: An interdisciplinary reader in philosophy, linguistics, and psychology*. 329–340. Cambridge, UK: Cambridge University Press.
- Lekakou, Maria. 2005. *In the middle, somewhat elevated: The semantics of middles and its crosslinguistic realizations.*: University of London dissertation.

- Lekakou, Marika. 2004. Middles as disposition ascriptions. *Arbeitspapier Nr. 117* 181.
- Levin, Beth & Malka Rappaport Hovav. 1994. A preliminary analysis of causative verbs in English. *Lingua* 92. 35–77.
- Lewis, David. 1986. *Postscript C to "causation"*.
- Lombrozo, Tania. 2010. Causal–explanatory pluralism: How intentions, functions, and mechanisms influence causal ascriptions. *Cognitive Psychology* 61(4). 303–332.
- Maienborn, Claudia & Johanna Herdtfelder. 2015. A compositional account of the eventive/stative ambiguity of German causal *von*-modifiers. In *Semantics and linguistic theory*, vol. 25. 163–183.
- Marantz, Alec. 1997. No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. In L. Siegel & A. Dimitriadis (eds.), *Upenn working papers in linguistics*, vol. 4 2. 201–225. University of Pennsylvania.
- McIntyre, Andrew. 2006. The interpretation of German datives and English *have*. In Daniel Hole, André Meinunger & Werner Abraham (eds.), *Datives and other cases: Between argument structure and event structure*. 185–211.
- McKittrick, Jennifer. 2005. Are dispositions causally relevant? *Synthese* 144(3). 357–371.
- Paul, Ileana, Baholisoa Simone Ralalaoherivony & Henriëtte de Swart. 2017. Culminating and non-culminating accomplishments in Malagasy.
- Pesetsky, David. 1995. *Zero syntax: Experiencers and cascades*. MIT Press.
- Portner, Paul. 1997. The semantics of mood, complementation, and conversational force. *Natural language semantics* 5(2). 167–212.
- Prince, Ellen. 1971. Futurate *be-ing*, or Why Yesterday morning, I was leaving tomorrow on the Midnight Special is OK. Unpublished ms. read at the 1973 Summer Meeting of the Linguistic Society of America.
- Pylkkänen, Liina. 2008. *Introducing arguments*. Palo Alto, CA: CLSI.
- Ritter, Elizabeth & Sara Thomas Rosen. 1993. Deriving causation. *Natural Language & Linguistic Theory* 11(3). 519–555.
- Ritter, Elizabeth & Sara Thomas Rosen. 1997. The function of *have*. *Lingua* 101(3). 295–321.
- Ritter, Elizabeth & Sara Thomas Rosen. 2010. Animacy in Blackfoot: Implications for event structure and clause structure. *Syntax, lexical semantics and event structure* 124–152.
- Setiya, Kieran. 2015. Intention. In Edward N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University summer 2015 edn.
- Shibatani, Masayoshi. 1973. *A linguistics study of causative constructions*: University of California, Berkeley dissertation.

- Sichel, Ivy. 2010. Event-structure constraints on nominalization. *The syntax of nominalizations across languages and frameworks* 23. 151–190.
- Vetter, David C. 1973. Someone solves this problem tomorrow. *Linguistic Inquiry* 4:1. 104–108.
- Wiltschko, Martina & Elizabeth Ritter. 2014. Animating the narrow syntax. *Talk given at GLOW* 37.
- Wolff, Phillip. 2003. Direct causation in the linguistic coding and individuation of causal events. *Cognition* 88(1). 1–48.
- Woodward, James. 2006. Sensitive and insensitive causation. *The Philosophical Review* 115(1). 1–50.

Temporal orientation in conditionals*

(Or, How I learned to stop worrying and love UFOs)

Bridget Copley
CNRS UMR 7023/Université Paris 8

November 1, 2007

Abstract

This paper argues for a modal explanation for temporal orientation facts in both antecedents and consequents of conditionals. Future-oriented statives are shown to get their future orientation by means of a different mechanism from future-oriented eventives. Thus, eventuality type and temporal orientation turn out to be correlated more closely than previously thought, and the “present eventive constraint” is not useful in accounting for the temporal orientation facts. Thus we must look for a new kind of explanation. I argue that temporal orientation, and therefore also eventuality type, are correlated with modal flavor, so that the most promising way to explain the temporal orientation facts will be through appealing to the modal facts. Two apparent objections to this kind of account are removed: the proposed existence of epistemic eventives (I argue that these examples are actually derived statives), and the assumption that antecedents and consequents share the same modal flavor (they do not, despite traditional assumptions).

*I would like to thank the Jacqueline Lecarme and Guéron, Jean-Daniel Mohier, various English speakers, and the participants at the roundtable.

The goal of this paper is to argue for a certain way of explaining temporal orientation in conditionals. We will limit ourselves to indicative English *will* conditionals, such as the one in (1).

- (1) If Zoe gets cranky, Tasha will get cranky.

By “temporal orientation,” I mean the temporal location of the antecedent eventuality (here, the Zoe-get-cranky event) with respect to the utterance time, and similarly the temporal location of the consequent eventuality (here, the Tasha-get-cranky event) with respect to the utterance time. We will also be interested in how these eventualities are situated with respect to each other.

We can articulate this goal a little more precisely. In the above example, let’s agree that *Zoe get cranky* is the “antecedent” (rather than *if Zoe gets cranky*), and that *Tasha get cranky* is the “consequent” (rather than *Tasha will get cranky*; the reasons for scoping out *will* will become clear later). Now, let us assume that the antecedent and consequent each take a temporal argument. Let t^*_{ant} be the temporal argument of the antecedent – it will normally be equal to t_u , the utterance time – and let t^*_{cons} be the temporal argument of the consequent. Finally, we define $t\text{-sit}_{ant}$ as the run time of the eventuality in the antecedent (cf. Klein’s “situation time”), and similarly define $t\text{-sit}_{cons}$. Then the goal of this paper is to explain how to relate $t\text{-sit}_{ant}$ to t^*_{ant} and $t\text{-sit}_{cons}$ to t^*_{cons} , and furthermore, to determine how the antecedent is temporally related to the consequent. We must be coy about this latter point until we know more, since at the outset, it is not immediately clear which antecedent time might be related to which consequent time, though it is clear enough that the antecedent and consequent are somehow temporally related. In the end, we will not have much to say about this issue, though we will need to say something in order to determine what t^*_{cons} is.

We will see that eventuality type – whether something is eventive or stative – correlates with temporal orientation – whether a $t\text{-sit}$ is future-oriented or present-oriented with respect to its t^* (i.e., the temporal argument of its clause). This result will render inadequate the “present eventive constraint,” which is the accepted way to explain temporal orientation in modal contexts. We will instead justify (though not provide) a different kind of explanation, based on a correlation with modal flavor. It turns out that metaphysical modal flavor correlates with eventivity, and epistemic modal flavor correlates

with stativity. This result also makes the prediction that antecedents have a modal flavor independently of their consequent, which is true, though such judgments have been oddly overlooked in earlier literature.

1 UFOs and other oddities

In this section we will see what the apparent temporal relations are between each t^* and its corresponding t -sit, and also give a description of how the antecedent and consequent are temporally related.

We begin with antecedents. Our starting point is a phenomenon that I will be calling “unexpected future orientation,” or “UFO” for short. The antecedent in (2a) below is considered to have a UFO because it has future orientation of t -sit_{ant} with respect to t_u (and since we presume t^*_{ant} to be equated with t_u , there is also future orientation of t -sit_{ant} with respect to t^*_{ant}) – but there is no obvious morphology to mark the futurity. Indeed it is impossible¹ to assert the material in the antecedent by saying (2b).

- (2) a. If it rains tomorrow, Max will get sick.
b. #It rains tomorrow.

This contrast does not appear in languages universally. The morphological equivalent of (2b) in many languages is perfectly acceptable; (3), for instance, is acceptable in German.

- (3) Es regnet morgen.
it rains tomorrow
'It's going to rain tomorrow.'

Thus in a language like German, one would never be surprised by future orientation in antecedents using the same morphology. But in English, (2a)

¹It is true that a future event time is possible with a simple present verb in English, if the verb phrase describes an event that is scheduled ahead of time or otherwise predetermined.

- (i) Zoe plays chess with Xander tomorrow.

The status of these “futate” readings will become relevant once we have a theory of the type proposed in this paper. For now, we will not attempt an explanation of these readings (but for the classic treatment see Dowty (1979), and more recently Cipria and Roberts (2000), Copley (2002), and ?). We will, however, make reference to futurates again below, in the discussion about “settled eventives”.

is good and (2b) is bad, and that fact requires explanation.²

The UFO we have just seen in (3a) has an eventive predicate. Eventive predicates in antecedents must be future-oriented (FO), and cannot be present-oriented (PO), as shown in (4):

- (4) If it rains, Max will get sick. *PO reading
≠ ‘If it’s raining right now, Max will get sick.’

The situation is a little different when the antecedent has a stative verb phrase as in (5).

- (5) a. If John is sick tomorrow, Celeste will get sick. ant. FO
b. If John is sick right now, Celeste will get sick. ant. PO

The example in (5a) shows that statives in the antecedent can have UFOs; the example in (5b) shows that they need not. This behavior contrasts with that of eventives, which as we have seen necessarily have UFOs.

This pattern of judgments is familiar from the behavior of complements of (certain) modals (see Condoravdi (2001), Werner (2002), Werner (2006)), as in (6). Similarly to the antecedent cases, eventives under modals can only be FO, while statives under modals can be either PO or FO.³

- (6) a. Morgan may go. (eventive, only FO; ≠ ‘may be going’)
b. Morgan may be here right now. (stative, PO)
c. Morgan may be here tomorrow. (stative, FO)

It is not so surprising that these environments should behave similarly to antecedents of conditionals, considering that these are both modal contexts as well. (This common element of modality should also make us wonder what the temporal facts have to do with the modal facts, a question that we will take up again later.)

Consequents of conditionals, which of course are in a modal context as much as antecedents and complements of modals are, behave similarly when

²Actually, it is something of a matter of opinion *which* of (2a) and (2b) requires the explanation. If, based on the facts in other languages, one expects verbs with present (null) morphology to be able to refer to the future, one could instead speak of (2b) as having an “unexpected *lack of* future orientation.”

³There is another wrinkle here, that of modal flavor, e.g. the examples in (5) have differing possibilities for epistemic, deontic, etc. readings. These will be considered below; for now, we are just interested in the temporal possibilities.

it comes to temporal orientation.

To ascertain the temporal orientation of $t\text{-sit}_{cons}$ with respect to t^*_{cons} , we will need to know what t^*_{cons} is, i.e., the temporal argument of the consequent. I have mentioned above that the question of how to calculate t^*_{cons} from a time in the antecedent is a tricky one. The answer is different depending on the eventuality type of the antecedent. To begin with, we will hold the eventuality type of the antecedent constant, using only eventive antecedents.

Consider the sentence with in (7), for example. The antecedent and consequent are both eventive. What can be said about the temporal relationship between the antecedent and the consequent?

(7) If it rains, Max will get sick.

It appears that the start of the consequent event must begin at least a little bit after the start of the event of the antecedent.⁴ In uttering (7), one conveys that Max gets sick at least a little bit after the rain begins. Indeed, the inference that the rain *causes* Max to get sick is (at least) difficult to escape, and may well be inescapable. The need for a causal interpretation would definitely explain the temporal observation; for the contextually salient causal mechanism, the rain should indeed start before the illness starts, in order for the rain to cause the illness. For our purposes at the moment, it is enough to note the temporal fact: there must be at least a little rain before the illness begins.⁵

When the consequent is stative, it can be either FO or PO with respect to the start of the antecedent event. Consider the examples in (8), which

⁴There are cases where the same event is described in both antecedent and consequent, as in (i):

(i) If Marissa leaves, she will leave quickly.

In such cases, the above generalization does not apply. It is not clear to me when reference to the same event is permitted.

⁵Suppose to the contrary, that one wished to convey that the onset of Max's illness coincides exactly with the onset of the rain. One could say, for example, (ia) or (ib), using *when*, to convey this.

(i) a. It will start raining exactly when Max gets sick.
b. Exactly when it starts raining, Max will get sick.

But one could not truly say (7). For (7) to be true, Max's illness has to start at least a bit after the start of the raining.

have a stative in the consequent.

- (8) a. If John gets mad, Celeste will be mad (afterwards). cons. FO
 b. If John gets mad, Celeste will be mad (then). cons. PO

In (8a), where the consequent is future-oriented, John gets mad and then Celeste is mad at some later point. In the reading where the consequent is present-oriented, John gets mad during the time that Celeste is already mad. (These readings have different modal “flavors,” which will be considered later.) Thus statives in consequents can be either FO or PO with respect to the relevant time in the antecedent.

This pattern is enough to cause us to posit that t^*_{cons} in (7) through (8) begins at the same time as the start of $t\text{-sit}_{ant}$. With that assumption, we get the expected relation between t^*_{cons} and $t\text{-sit}_{cons}$: when the consequent is eventive, $t\text{-sit}_{cons}$ must be future-oriented with respect to t^*_{cons} (i.e., it must start at least a little after the beginning of t^*_{cons}), and when the consequent is stative, $t\text{-sit}_{cons}$ can be either present-oriented or future-oriented with respect to t^*_{cons} .

The situation is similar when the antecedent is stative and PO, as in (9).

- (9) a. If Xander is cranky now, Zoe will get cranky. eventive cons., FO
 b. If Xander is cranky now, Zoe will be cranky (now).stative cons., PO
 c. If Xander is cranky now, Zoe will be cranky (the next day).stative cons., FO

The familiar pattern is there: eventive consequents must be future-oriented, and stative consequents can be either present-oriented or future-oriented. The data in (9) are also compatible with the idea that t^*_{cons} is constrained to start when $t\text{-sit}_{ant}$ starts. But in fact there would be another possible hypothesis if we were just to look at the data in (9) on its own, since in stative PO antecedents, $t\text{-sit}_{ant}$ has to overlap t^*_{ant} . So the data in (9) are also compatible with a hypothesis that t^*_{ant} (not $t\text{-sit}_{ant}$) is what constrains t^*_{cons} .

This alternative hypothesis turns out to be appropriate when the antecedent has additional tense-aspect morphology (that is, it is what Condoravdi calls a “temporal” predicate), as in (10).

- (10) If Xander was cranky yesterday, Zoe will be cranky now/#then/the

day after tomorrow.

The time in the antecedent that constrains the temporal location of t^*_{cons} cannot be $t\text{-sit}_{ant}$. If it were, we would expect Zoe's crankiness to be either overlapping $t\text{-sit}_{ant}$ or later than it. But it cannot do this (as shown by the non-acceptability of *then*); instead, it either overlaps or is later than t_u – which we assume has the same value as t^*_{ant} . So the alternative hypothesis, namely that t^*_{ant} is the antecedent time that matters, works here, and the original hypothesis is not appropriate.

On the other hand, the original hypothesis *is* appropriate when the antecedent is a future-oriented stative, again on the assumption that t^*_{ant} is t_u :

- (11) If Xander is cranky tomorrow, Zoe will be cranky #now/then/the next day.

Here, by parallel argumentation to (10), t^*_{cons} cannot have the same value as t_u , but rather, has to be in the future.

The two hypotheses about the relationship between t^*_{cons} and the antecedent are summarized in (12):

- (12) a. Original hypothesis: t^*_{cons} begins when $t\text{-sit}_{ant}$ begins.
Accounts for eventive antecedents and future-oriented stative antecedents.
Compatible with present-oriented stative antecedents.
b. Alternative hypothesis: t^*_{cons} begins when t^*_{ant} begins.
Accounts for temporal antecedents.
Compatible with present-oriented stative antecedents.

It is important to remember that even with this complex picture, there is one clear result: Consequents behave just like antecedents (and like the complements of modals) in relating their t^* to their $t\text{-sit}$: With eventive consequents, $t\text{-sit}_{cons}$ is future-oriented with respect to t^*_{cons} , and with stative consequents, $t\text{-sit}_{cons}$ can be either present-oriented or future-oriented with respect to t^*_{cons} .⁶

Incidentally, the existence of this pattern for both the antecedent and consequent of *will* conditionals suggests that *will* contributes no extra future or non-past tense meaning of any kind to the relationship between t^* and

⁶Temporal predicates, of course, further alter the relationship between t^* and $t\text{-sit}$.

t-sit in the consequent – at least, none that it does not also contribute to the antecedent. There are at least two ways we might account for this fact: *will* might take wide scope, or it might mark agreement with a null modal that takes wide scope. Either way is fine; I will assume the first.

We now have the basic facts about the relation between t^* and t-sit in both antecedents and consequents. We also know that these facts hinge on the eventuality type of the antecedent and consequent: eventives must be FO, while statives can be either FO or PO. Our next move is not to explain these facts, but first, to dismantle a popular type of explanation for these facts. After that, we will interest ourselves in the possibility of a different kind of explanation for temporal orientation within the antecedent and consequent, one that makes reference to modal flavor.

2 Away from an explanation

Given that we see the same relationship between t^* and t-sit in antecedents, complements of modals, and consequents – i.e., in modal contexts – it is reasonable to think that it is all for the same reason. The most reasonable reason to propose, and one that has often been proposed for such situations, is what we will be calling the “present eventive constraint” (PEC). It says that both FO and PO readings are in principle possible, but that eventive FO readings are alone in being ruled out. However, we will see that the PEC is not in fact the right way to deal with these environments, since a key assumption motivating the PEC is not valid. This development will make us rethink it as an explanation for this pattern.

We have just seen that t-sit in a modal context can apparently be either PO or FO with respect to the t^* . Consider the matrix *will* sentences below in (13). It is clear that t-sit can be PO with respect to t_u , as in (13a), or FO with respect to t_u , as in (13b).⁷

- (13) a. Zoe will be cranky (right now). “epistemic *will*,” PO
 b. Zoe will be cranky at 4 tomorrow. FO

⁷Some readers may see a modal, epistemic *will* (13a), and a non-modal, future tense *will* in (13b). Instead of treating (13b) as having a future tense, we are treating it as having a modal with metaphysical modal flavor. See Condoravdi (2003) for arguments motivating a unitary modal analysis of *will*. In any case, at the moment we are concerned with the difference in the temporal orientation of the eventualities in (13a) and (13b), though the difference in modal flavor will come to be relevant towards the end of the paper.

Note that (14), which lacks a temporal adverbial, sounds somewhat incomplete when it has an intended future orientation, or as if the temporal specification must be somehow understood from the context.

(14) Zoe will be cranky.

This need for a temporal adverbial is commonly referred to as “anchoring.” Anchoring can be accomplished in a number of ways: with a temporal adverbial as in (15a), with a *when* clause as in (15b), or with an *if* clause, as in (15c). (The *if* clause does something else modal in addition to providing a temporal anchor, of course, but the point here is that it does provide the temporal anchoring.)

- (15) a. At 4, Zoe will be cranky.
b. When you see Zoe, she will be cranky.
c. If you see Zoe, she will be cranky.

So anchoring must do what (we decided in the last section) the eventive antecedent does: It shifts forward the t^* of *Zoe be cranky*. (For reasons discussed above, we can assume in all cases that *will* takes wide scope.)

We can confirm that it is t^* and not t -sit that is shifted forward by considering a temporal predicate, that is, one with temporal-aspectual morphology, as in (16):

(16) (At 4/When you see Zoe/If you see Zoe), she will have been cranky.

In the sentence in (16), what is shifted forward is the time that is the argument of *Zoe have been cranky*, not the time of the crankiness itself (which, according to the meaning of the future perfect, could take place before the anchor). This is additional evidence that the time being anchored is not t -sit, but is rather t^* .

So t -sit in (14) is FO with respect to t_u exactly when t^* is shifted forward by an anchor: It can be shifted forward contextually, or with a temporal adverbial, or with a *when*-clause, or with an *if* clause. But if these “anchors,” essentially reference time shifters, are absent, t -sit must be PO with respect to t_u .

This need for anchoring has two important corollaries for us. The first is that t^* is not always the same as t_u ; it can be shifted forward into the future. The second is that t -sit is always PO with respect to t^* . Because if it were allowed to be FO with respect to its t^* , the sentence in (16) could

have a FO reading in the absence of an anchor, as eventives do. To see the contrast, compare the sentence in (14) (repeated below as (17a)) with that in (17b):

- (17) a. Zoe will be cranky.
 b. Zoe will leave.

In (17a), there is a strong feeling that a contextually-specified time is needed (i.e., an anchor) if the sentence is to be read with future orientation of t-sit with respect to t_u . In (17b), on the other hand, there is future orientation of t-sit with respect to t_u even though there is no anchoring. This indicates that t-sit in (17b) really is FO with respect to t^* , and t^* is to be identified with t_u .

We have seen that it is possible to shift the t^* of an eventive clause forward in at least one case. The t^*_{cons} is shifted forward by an eventive antecedent, as in (18) below.

- (18) If it rains, Max will get cranky.

So there is one future shift for t^*_{cons} with respect to t_u , accomplished by the antecedent, and a second one for t-sit_{cons} with respect to t^*_{cons} , accomplished by the eventive itself. This second shift is exactly what statives cannot do.

Interestingly, it's quite difficult to shift the reference time for eventives with temporal adverbials. There seems only to be one shift into the future in (19); the getting cranky seems to have to be at 4.

- (19) At 4, Max will get cranky.

So in (19), t^* apparently shares the same value with t_u , and *at 4* characterizes t-sit, even though it is pronounced at the beginning of the sentence.⁸ For now, it is puzzling why this should be so; we will return to this case later.

We have so far considered stative predicates in complements of *will* and in consequents of *will* conditionals. We have seen in these cases that when the t-sit is FO with respect to t_u , it cannot be because t-sit is FO with respect to t^* , but must be because t^* is FO with respect to t_u ; t-sit is always PO with respect to t^* . This behavior contrasts with that of eventives, in which t-sit is always FO with respect to t^* (but as with statives, t^* may or may

⁸Syntactically, what this would mean is that the temporal adverbial *at 4* in (19) is interpreted in the *vP*, and cannot be interpreted up high.

not be PO with respect to t_u .) We can represent these generalizations as in (20) and (21), borrowing the neo-Reichenbachian notation in which “ t_1, t_2 ” denotes present orientation of t_2 with respect to t_1 (or equivalently, of t_1 with respect to t_2), and “ $t_1 - t_2$ ” denotes future orientation of t_2 with respect to t_1 .

- (20) Statives:
- a. $t_u, t^*, t\text{-sit}$ e.g., *Zoe will be cranky now.*
 - b. $t_u - t^*, t\text{-sit}$ e.g., *Zoe will be cranky at 4.*
 - c. NOT POSSIBLE: $t_u, t^* - t\text{-sit}$
- (21) Eventives:
- a. $t_u, t^* - t\text{-sit}$ e.g., *Zoe will leave.*
 - b. $t_u - t^* - t\text{-sit}$ e.g., *If Max shows up, Zoe will leave*
(only possible with *when* or *if* anchors)

For further evidence for these generalizations, let us consider the behavior of antecedents. Stative antecedents behave as expected. Without an (overt or contextual) adverbial to anchor the stative, $t\text{-sit}_{ant}$ is PO with respect to t_u , but with an adverbial to fix a time in the future, $t\text{-sit}_{ant}$ is FO with respect to t_u .

- (22)
- a. If Zoe is cranky, ... PO (FO with context)
 - b. If Zoe is cranky at 4 tomorrow, ... FO
 - c. If, when you see her, Zoe is cranky, ... FO

As before, the need for the anchor to shift t^* forward is evidence that $t\text{-sit}$ is not allowed to shift forward on its own.⁹

For eventive antecedents, as before, $t\text{-sit}_{ant}$ is normally FO with respect

⁹Under what conditions is t^* allowed to shift forward? The examples in (i) seem to indicate that *will* (or presumably, another modal) must be in the consequent:

- (i)
- a. If John is cranky tomorrow at 4, Mary will be happy.
 - b. #If John is cranky tomorrow at 4, Mary is happy.

This is further evidence that *will* has to take wide scope in all the conditionals we have been looking at. It is also reminiscent of theories in which *will* is a non-past tense, since *will* here shifts t^* (as we might expect of a tense) rather than $t\text{-sit}$ (as we would expect of aspect). Of course some modal element is required too in order to get the conditional semantics; I assume that *will* contains the modal element, though nothing in particular hangs on that assumption here.

to t_u even without an *as* in (23a), and this does not change with a temporal adverbial, as in (23b). But, with a *when* clause, we get the double future orientation; the onset of the crankiness in (23c) must be after the onset of your seeing Zoe.

- (23) a. If Zoe gets cranky, ...
b. If Zoe gets cranky at 4 tomorrow, ...
c. If, when you see her, Zoe gets cranky, ...

This behavior is exactly what we expect.

So both stative and eventive predicates can have a t^* that is PO or FO with respect to t_u . But eventives always have a t -sit that is FO with respect to t^* , and statives always have a t -sit that is PO with respect to the reference time. But if this is always true, then we have no “real” FO statives – that is, no statives that can shift forward by themselves. They only shift forward because of an independent mechanism that allows a future shifting of t^* , a process that is common to eventives as well.

What do these facts mean for the present eventive constraint?

We began by noting that it was possible to have future orientation of t -sit with respect to t_u in antecedents (these were the “UFOs”), and more generally under modals and in consequents, without any obvious future-orienting morphology. Since it is obligatory for eventives, and optional for statives, the traditional response to this fact has been to generally rule in both present and future orientation of t -sit with respect to t_u . Then it is just PO eventives that need to be ruled out. These were ruled out by some version of a “present eventive constraint”.

But now we see that, if more attention is paid to t^* – which can be either present- or future-oriented itself with respect to the t_u – it is clear that the relationship between t -sit and t_u should be broken down into two relationships, one between t_u and t^* , and one between t^* and t -sit. Once we do that, we can conclude that eventives always have a t -sit that is FO with respect to t^* , and statives always have a t -sit that is PO with respect to t^* . But now it is unsatisfactory to have one constraint to rule out PO eventives and another constraint just to rule out FO statives; two constraints to rule out two of four possibilities is arguably too much theoretical machinery.

Moreover, it is not even clear how we would justify a “future stative constraint.” The usual explanation for the PEC goes like this: Eventives can not be evaluated at the present moment because the present moment is

homogenous, and cannot have an event take place during it.¹⁰ Can such an explanation be extended to account for a putative FSC, i.e., to explain why statives might not be evaluated except at their input time? At this point, it is hard to think of how it could be.

Thus the PEC is really not worth pursuing further as an explanation for UFOs and other temporal orientation facts in conditionals and other modal contexts; it cannot explain the unexpected lack of future orientation for statives. But fortunately, there is something associated with present orientation and future orientation that we can mine for an explanation: namely, modal flavor. We now, therefore, turn our expectant hopes towards the possibility of a modal explanation for the temporal facts.

3 Towards an explanation

In (24a) below, a prediction is made that has the flavor of being about how the world turns out, whether we get to check and see it or not. We will refer to this as a “metaphysical flavor;” Zoe’s actually getting cranky is FO with respect to the utterance time. In (24b), however, the prediction has the flavor of being about what is true now (PO), and there is a suggestion, perhaps, that we are about to check whether that is so. If anything about the situation in (24b) is in the future, it is the finding out, rather than Zoe’s being cranky. We will refer to this flavor as an “epistemic flavor.”

- | | | | |
|------|----|--------------------------------|------------------|
| (24) | a. | Mary will get cranky tomorrow. | metaphysical; FO |
| | b. | Mary will be cranky right now. | epistemic; PO |

In this case, the present orientation of t-sit with respect to t^* is associated with the epistemic flavor, while the future orientation of t-sit with respect to t^* is associated with the metaphysical flavor.

The question now is whether we can connect the temporal orientation facts to something modal. That is, can we say that statives, in addition to always having a t-sit that is PO with respect to t^* , are also always epistemic? And that eventives, in addition to always having a t-sit that is FO with respect to t^* , are always metaphysical? And having demonstrated both of

¹⁰At any rate, such an explanation needs special pleading to account for the PEC-like effects with future-shifted t^* , since the future t^* is not the present moment, but eventives still must have their t-sit shifted into the future with respect to the t^* . At the very least, it must be made clear how a future t^* might be treated as though it were t_u .

these, can we give an explanation for the temporal facts that is based on the modal facts?

Condoravdi proposes (for independent reasons) an argument that, if valid, would vitiate such a line of reasoning. She argues that there are epistemic eventives. If she is correct, we cannot appeal to modal flavor to explain the correlation between temporal orientation and eventuality type. I will argue now, however, that epistemic eventives do not actually exist. It is not that Condoravdi's examples are not actually epistemic; it is that they are derived statives, and therefore not actually eventive.

3.1 No real epistemic eventives

To argue for the existence of epistemic eventives in modal contexts, Condoravdi considers a context where we know that a certain professor will meet with one senior administrator. Then both the discourse in (25) and the discourse in (26) are coherent.

- (25) a. It hasn't been decided yet who he will meet with.
b. He may see the dean. He may see the provost.
- (26) a. It has been decided who he will meet with but I don't know who it is.
b. He may see the dean. He may see the provost.

Condoravdi's idea is that the sentences in (25b) and (26b) are assertable whether the future-oriented event is not yet settled, as in the context provided by (25a), or already settled, as in the context provided by (26a). I find that the settled reading can be a bit difficult to get, but the dialogue in (27) highlights that reading.

- (27) a. Who does he see tomorrow?
b. Someone. Let's see. Darn, I can't find the book. He may see the dean, he may see the provost. I don't know. Go ask him.

When something is assumed settled, like the identity of the person being seen tomorrow, one can check now to see whether it is true or not (at least, that is what the sentences in question presuppose). That is, what we get when something is settled is epistemic modal flavor. For Condoravdi, it is settledness itself that makes metaphysical modality impossible. However, to stop there is to miss a generalization. Settledness is linked to another

phenomenon aside from modal flavor, namely the ability to be predicated of the present time, as we will see now. This ability makes “settled eventives” look more like statives.

The sentence in (28a), which has a stative, can describe something that is currently taking place. But (28b) cannot be used to describe something taking place at the present moment.

- (28) a. Toby likes the dean. (does describe a current Toby-like-the-dean state)
 b. #Toby sees the dean. (cannot describe a current Toby-see-the-dean event)

In English, if you want to use an eventive verb phrase to refer to current goings on, you can, but the meaning is either habitual, as in (29a), or something very much like Condoravdi’s settled case, but without a modal (a simple present futurate), as in (29b).

- (29) a. Right now, Toby sees the dean on Mondays. habitual
 b. Right now, Toby sees the dean tomorrow. simple futurate
 (like Condoravdi’s “settled” case)

The important point here is that the “settled” futurate case in (29b) is fine, just like the habitual in (29a). Also like the habitual, it seems to say something about the utterance time t_u , even though t -sit is different (i.e., for the habitual, today need not be a Monday for (29a) to be true).¹¹ In the habitual case, if it is truly asserted, what is true right now is that Toby has the habit of seeing the dean on Mondays (or perhaps, what is true right now is that

¹¹In fact, if we consider other things we can do to eventive predicates to form sentences that describe a current state, we can construct parallel examples with *may* that are also fine.

- (i) a. Toby sees the dean on Mondays. habitual
 b. Toby is seeing the dean right now. ongoing progressive
 c. Toby is seeing the dean tomorrow. futurate progressive
- (ii) Everyone has a special administrator who they see for advice. He may see the dean, he may see the provost, I don’t know. habitual
- (iii) He may be seeing the dean. He may be seeing the provost. ongoing or futurate progressive

there is a rule that compels him to do so). In the futurate case, if it is truly asserted, what is true at t_u is that there is a schedule or plan for Toby to see the dean tomorrow.¹²

Both habitual sentences and futurate sentences, then, behave like stative sentences in that they can both be asserted of the present moment.

Now, the work of the PEC in distinguishing eventives and statives is done in Condoravdi’s theory by her AT function, given below in (30).

$$\begin{aligned}
 (30) \quad \text{AT}(t, w, P) &= \exists e[P(w)(e) \ \& \ \tau(e, w) \subseteq t] \text{ if } P \text{ is eventive} \\
 &= \exists e[P(w)(e) \ \& \ \tau(e, w) \circ t] \text{ if } P \text{ is stative} \\
 &= P(w)(t) \text{ if } P \text{ is temporal}
 \end{aligned}$$

Eventives, treated in the first clause of the definition, are given a run time τ (i.e., t-sit) that is included in the interval t . Statives, treated in the second clause, have a run time overlapping the interval t . In a matrix clause, the interval t will have the value *now*, which for these purposes is an interval that begins at the moment of utterance and extends infinitely into the future.¹³

Based on Condoravdi’s treatment of the “settled” cases under modals, as in (26b) and (27b) above, how would her theory handle the difference in judgments between (31a), a “settled” or futurate case, and (31b), an ordinary eventive case?

- (31) a. Toby sees the dean tomorrow.
 b. #It rains tomorrow.

Both have present tense, which for Condoravdi is as in (32).

$$(32) \quad \text{PRES: } \lambda P \lambda w [\text{AT}(\text{now}, w, P)]$$

The AT function guarantees that the eventive in both cases is shifted to the future. But what rules out (31b)? Presumably it is that (31b) does not describe a settled event – since we don’t normally presuppose it to be settled that it is going to rain tomorrow – while (31a) does describe a settled event. Condoravdi doesn’t discuss these cases, and treats settledness as a property that only applies to complements of modals. But let’s try to extend

¹²See also Copley (2002) and ? for how the schedule or plan interacts with the rest of the denotation, as well as Copley (2005) for thoughts on the nature of the schedule or plan.

¹³This function incorporates a version of the PEC, and thus does not address the remarks above about the non-existence of “real” FO statives.

her theory by expanding the notion of settledness to include the non-modal cases, and adding the constraint that assertions can only be about things that are already settled:

- (33) For any P, w, t: “P” can be asserted at w, t only if P is settled at w, t.

This addition may be the simplest one to make to account for the difference between (32a) and (32b). But it is also problematic. We will need to extend the definition of settledness to include temporal predicates, because one does not assert just “P” in this account, but rather “PRES P.” There shouldn’t be a problem with that. But what about extending the notion of settledness to something with a modal, like *will P*? Surely we want to say that sentence such as that in (34) can be asserted.

- (34) It will rain tomorrow.

In that case, then, according to the requirement in (33), it should be settled that “will P.” But do we really want to say that in order to assert (34), it should be settled that it will rain tomorrow? And that if it is not settled that it will rain tomorrow, that (34) is just as bad as (31b)? One alternative is to define the settledness of *will P* in some other way to entail that it is assertable even when it is not settled whether P will happen or not. Another alternative is to relax the requirement in (33) in such a way as to exclude the sentence in (34). But each of these alternatives seems to be quite inconvenient.

This line of inquiry having hit an obstacle, we should wonder if there is anything else we could try, to explain the difference between (31a) and (31b), and account for the future orientation of settled eventives. We noted above that futurate readings and habitual readings do not predicate the event of their reference time (the present time, when the sentences are in the present tense). Habituals predicate of the reference time something like lawlike behavior, while futurates predicate of the reference time a current rule or schedule. Thus it makes sense to say that the futurate cases, like the habituals, are really derived statives. It is whatever the futurate semantics is, presumably something¹⁴ in the semantics of the imperfective, that pushes

¹⁴If this something is a modal, which seems plausible, then we can return to Condoravdi’s idea of settledness as being a property that is only relevant to complements of modals. But this modal would not be an epistemic one, rather one having to do with natural laws/current schedules, so there would still be no epistemic eventives.

the occurrence of the event into the future. So when it combines with a modal, as far as the modal is concerned, it is just combining with a stative. And when we assert a futurate, we are asserting a stative of the present, not asserting an eventive of the future.

Additional evidence for this idea comes from the fact that futurate eventive antecedents do not behave like ordinary (non-futurate) eventive antecedents, but rather like stative antecedents, in that the time that enters into a temporal relationship with the consequent is t^* , not $t\text{-sit}$. Consider the conditional in (35). The antecedent could have a non-futurate reading, in which the speaker will give Mary a call after she actually leaves (and nothing is implied about Mary's current plans), as well as a futurate reading, in which case the speaker is saying she'll give Mary a call as soon as she finds out that she has plans to leave on Monday.

(35) If Mary leaves on Monday, I'll give her a call.

The dialogue in (36) further demonstrates the existence of the futurate reading for the antecedent *If Mary leaves on Monday*; the addition of *today* to the consequent in fact rules out the non-futurate reading:

(36) a. I thought Mary was already out of town.
 b. No, she leaves on Monday.
 c. Oh, well, if Mary leaves on Monday, I'll give her a call today.

The difference between the non-futurate and futurate readings is this. As we saw earlier, with the non-futurate eventive antecedent, the t^*_{cons} begins when $t\text{-sit}_{ant}$ begins. Here, this means that the speaker calls Mary a little bit after the time when she actually leaves. But with the futurate case, the reference time of the consequent does not start when $t\text{-sit}_{ant}$ starts, but rather, with t^* (or equivalently, with t_u) starts. In this, it behaves similarly to stative antecedents, discussed above.

If settled eventives are really to be treated as PO statives, the way habituals are treated, there is no more justification for the existence of eventive FO epistemics, and in fact, there is no justification for the existence of any eventive epistemics at all, as eventive PO epistemics clearly do not exist, and so were never at issue. Therefore, all epistemic cases are stative.¹⁵

¹⁵It is not true, however, that all statives under modals are epistemic. Modals can have deontic flavor with either statives or eventives. For example, either (ia) (eventive) or (ib) (progressive, i.e. derived stative) are possible as injunctions for what Mary is supposed to

3.2 Antecedents have their own modal flavors

The way is almost clear for us to make the case that the correlation between eventuality type and temporal orientation should be explained in terms of a correlation with modal flavor. Statives have a t-sit that is PO with respect to their t*, and they are epistemic in modal flavor; eventives have a t-sit that is FO with respect to their t*, and they are metaphysical in modal flavor. One obstacle remains: if modal flavor correlates with eventuality type and temporal orientation in both antecedents and consequents, we would expect an antecedent and a consequent in the same conditional to be able to have different modal flavors from each other. This question is not addressed by Kratzer-style (Kratzer, 1986) possible worlds treatments of conditionals, which assume that a conditional has a single modal flavor (in the absence of overt embedded modals in either clause).

Yet this traditional assumption, surprisingly, is not warranted. As it turns out, antecedents have their own modal flavor, and this modal flavor correlates, as we now expect, with eventuality type and temporal orientation.

How do we test a sentence (or an utterance) for modal flavor? In general, it is necessary to take a native speaker's word for it, as for judgments of felicity or truth. There is, however, a straightforward test for antecedents.¹⁶ Adding *it's true that* to the antecedent is good with stative antecedents (which have an epistemic flavor) but bad with eventive antecedents (which

do:

- (i) a. Mary will sing when the queen walks in.
- b. Mary will be singing when the queen walks in.

Under deontic *must*, as in (iia) and (iib), these possibilities have been called “obligation to do” and “obligation to be” respectively. In (iia) Mary has an obligation to sing, while in (iib) there is a requirement that she be singing at that point.

- (ii) a. Mary must sing when the queen walks in.
- b. Mary must be singing when the queen walks in.

Even imperatives can occur both with eventives and statives:

- (iii) a. Sing when the queen walks in!
- b. Be singing when the queen walks in!

I will not consider such cases further here.

¹⁶Recall that I also argued for a correlation between epistemic modal flavor and the ability to occur on its own without the modal, so that would constitute a test as well.

have a metaphysical flavor).¹⁷ The stative antecedent in (37a), even before the consequent is heard, has an epistemic flavor, and is fine with *it's true that*, as shown in (37b).

- (37) stative
- a. If it's cold out right now, ...
 - b. If it's true that it's cold out right now, ...

The eventive antecedent in (38a), on the other hand, has a metaphysical flavor, and is not good with *it's true that*, as in (38b).

- (38) eventive
- a. If it rains tomorrow, ...
 - b. #If it's true that it rains tomorrow, ...

(38b) may be good for certain speakers of philosophical English, but for most speakers it is terrible. Why is (38b) so bad? Let us suppose that *#it rains tomorrow* does not express a proposition; therefore it can't be true or false, and can't be asserted.

Anchored stative antecedents (i.e, those with a future-oriented t^*) seem at first blush to behave like eventives, in that they are not possible with "it's true that":

- (39) anchored "FO" stative
- a. If it's raining at 4 tomorrow, ...
 - b. #If it's true (now) that it's raining at 4 tomorrow ...

There is however a variant of (39b) that is acceptable, namely (40).

- (40) If at 4 tomorrow it's true that it's raining (at that time) ...

This has an epistemic flavor as well. These data show that anchored statives are possible, but they are not propositions evaluated at the present moment (because if they were, (39b) would be good). Rather, they are propositions evaluated at the future time provided by the temporal adverbial. This explains why (40) is acceptable, and is exactly the result that was obtained in the earlier discussion of the status of these future-oriented statives: t^*_{ant} ,

¹⁷It's unlikely that I am the first person to notice this, so I would be grateful to hear about any earlier statements of this fact.

the argument of the antecedent proposition, is FO with respect to t_u , and $t\text{-sit}_{ant}$ is interpreted as PO with respect to t^*_{ant} .

Note that the anchored stative in (39b) is ruled out for a different reason than the FO eventive in (38b), which is (we suspect) itself ruled out for not being a proposition. This difference is confirmed by the fact that the eventive remains unacceptable in (41), unlike the stative in (40).

(41) #If at 4 tomorrow it's true that it rains (at that time) ...

So the stative antecedents are things that can be true, either now or at some future t^* . The FO eventives cannot be true, now or ever, and we thus surmise that they are not propositions at all.

It makes sense that stative antecedents, always PO with respect to t^*_{ant} , would have an epistemic flavor. The reason is that what one knows has to do (presumably) with which propositions one has added to a set of known propositions as of t^* . It's not clear yet what the eventive antecedents are – perhaps they are predicates of events – but if they are not propositions, as we suspect, we should not be surprised that they invoke a different flavor of modality, one that does not have to do with adding propositions to a set of known propositions.

It is worth confirming that an antecedent and consequent in the same conditional can have different modal flavors, based on their eventuality type. That is, if we look at conditionals of the forms in (42a) and (43a), will they correspond to modal flavors as in (42b) and (43b) respectively?

- (42) a. *If stative, will eventive =?*
 b. *If epistemic, will metaphysical*
- (43) a. *If eventive, will stative =?*
 b. *If metaphysical, will epistemic*

We exemplify the combinations we want with the stative predicate *be sick* and the eventive predicate *get sick*. (We will stay away from the tricky anchored statives.)

- (44) a. If John gets sick tomorrow, Mary will be sick then. FO + PO
 b. If John is sick right now, Mary will get sick tomorrow. PO + FO

Now, the question is for each of these readings, what modal flavor is pos-

sible in the antecedent, and what modal flavor is possible in the consequent? Speakers' judgments are as follows. In (44a), the antecedent supposes that something happens (metaphysical flavor), while the consequent conveys that in such a situation, we will find something out that is already the case (epistemic flavor). Conversely, in (44b), the antecedent supposes that we find something out now that is already the case (epistemic flavor), and the consequent then discusses what we are entitled to conclude will happen. In other words: the conditionals in (44) behave as hoped.

Thus, it is official that we need a theory that can specify a different modal flavor for both the antecedent and the consequent; this is the expected result, since the correlation between eventuality type and modal flavor predicts that the antecedent and consequent modal flavors are entirely independent of each other.

More urgently, we need a theory of modality that can actually account for the correlations between modal flavor, eventuality type, and temporal orientation. Moreover, this theory must be able to account for the fact that both kinds of modal flavor can occur in a single conditional, even though epistemic modality apparently has to do with propositions, and metaphysical modality apparently does not.

4 Conclusion

At this point we have, I hope, some “proof of concept” that a certain kind of modal theory of temporal orientation in conditionals is an attractive one. To reach this conclusion, I argued that there is a stronger correlation than previously thought between eventuality type and temporal orientation in conditionals, and between both of these and modal flavor. Stativity, present orientation with respect to t^* , and epistemic modality are correlated; likewise, eventivity, future orientation with respect to the t^* , and metaphysical modality are correlated. (We set aside deontic modality, which can occur with both eventives and statives.)

These correlations make the traditional “present eventive constraint” less attractive as a way to explain temporal orientation in conditionals and other modal contexts, since it is not just present-oriented eventives that need to be ruled out, but also future-oriented statives. An explanation of the temporal facts based on the correlation with modal flavor is more attractive, once the objections to this kind of explanation are removed.

An interesting result of this investigation was the finding that antecedents have their own modal flavor, independently from that of the consequent. One upshot is that we can no longer talk about “epistemic conditionals,” for instance, unless by that we mean a conditional whose antecedent and consequent are both epistemic. The modal independence of antecedents is predicted to be true by the viewpoint presented here, because the modal flavor is correlated with the eventuality type of the predicate. The judgments on modal flavor in antecedents corroborate this prediction quite clearly, though oddly, in the mainstream generative linguistic literature, the modal flavor of the antecedent has largely passed unnoticed.

References

- Cipria, A. and C. Roberts (2000). Spanish *imperfecto* and *pretérito*: Truth conditions and aktionsart effects in a Situation Semantics. *Natural Language Semantics* 8, 297–347.
- Condoravdi, C. (2001). Temporal interpretation of modals. In D. Beaver, S. Kaufmann, B. Clark, and L. Casillas (Eds.), *Stanford Papers on Semantics*. Palo Alto: CSLI Publications.
- Condoravdi, C. (2003). Moods and modalities for *will* and *would*. Handout of talk given at the 2003 Amsterdam Colloquium.
- Copley, B. (2002). *The Semantics of the Future*. Ph. D. thesis, MIT. To appear, *Outstanding Dissertations in Linguistics*, Routledge.
- Copley, B. (2005). Ordering and reasoning. In J. Gajewski, V. Hacquard, B. Nickel, and S. Yalcin (Eds.), *New Work on Modality*, Number 51, pp. 7–34. MIT Working Papers in Linguistics.
- Copley, B. (2008). The plan’s the thing: Deconstructing futurates. *Linguistic Inquiry* 39(2). ms.
- Dowty, D. (1979). *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Klein, W. (1997). *Time in Language*. New York: Routledge.
- Kratzer, A. (1986). Conditionals. In *Papers from the Regional Meetings, Chicago Linguistic Society*, pp. 1–15.
- Werner, T. (2002). Deducing the future. In M. Kadowaki and S. Kawahara (Eds.), *Proceedings of NELS 33*.
- Werner, T. (2006, December). Future and non-future modal sentences. *Natural Language Semantics* 14(3), 235–255.

Causal conditionals

Bridget Copley, SFL (CNRS/Paris 8)

Abstract

Copley (2008) has argued for a three-way correlation between eventuality type, temporal orientation, and modal flavor in English non-deontic indicative conditionals. The proposal hinges on a type-theoretic difference between eventive and stative predicates: eventive predicates are treated as event descriptions, i.e. predicates of event arguments, whereas stative predicates are treated as propositions, which for Copley are predicates of situation arguments. Drawing on Copley’s proposal, I further explore here the idea of metaphysical modality using event descriptions, arguing that a unified analysis of conditionals is possible if conditionals express causal relations between events, with any propositions type-shifted to event descriptions by an embedded discourse operator in the spirit of Krifka (2014).

This paper examines some consequences for the meaning of conditionals from the proposal (Copley, 2008) that there is a three-way correlation between eventuality type, temporal orientation, and modal flavor in English indicative conditionals. If we exclude from the discussion deontic modal readings (which occur with both eventives and statives) this three-way correlation breaks down as follows:

(1)	<u>eventuality type</u>		<u>temporal orientation</u>		<u>modal flavor</u>
	stative	\leftrightarrow	present orientation	\leftrightarrow	epistemic modal flavor
	eventive	\leftrightarrow	future orientation	\leftrightarrow	metaphysical ¹ modal flavor

In the first section of this paper, I present Copley’s argument for the three-way correlation in (1), first taking the two-way correlation between eventuality type and

temporal orientation, and then adding modal flavor for the three-way correlation. The purpose of this presentation is to be able to argue, in sections 2 and 3, for a proposal that makes sense of the picture in (1), at the same time retaining a unified theory of conditionals. This proposal is that metaphysical modality is based on event descriptions rather than on propositions, and that all conditional sentences at base have metaphysical modal flavor, thereby expressing a causal relation between events. When this seems *prima facie* not to be the case—for instance, in the example *If this creature has a heart, it has a liver*—I argue that that is because one or more of the events in the conditional is actually an event “spawned” by a certain discourse operation on a proposition, along the lines of a proposal in Krifka (2014).

1 Copley 2008

1.1 Temporal orientation varies with eventuality type

Copley argues that eventuality type and temporal orientation vary together in conditionals: all and only eventives are future-oriented, and all and only statives are present-oriented. English bare eventives, of course, cannot express an ongoing present reading, and can express a future-oriented reading, as shown in (2a). But the idea that all statives are present-oriented seems false, as it has long been observed that future-oriented statives occur, as in (2b) (where “=” denotes a present-oriented ongoing reading and “>” a future-oriented reading).

- | | | | |
|-----|----|----------------------------|---------------------|
| (2) | a. | Juliet dances (tomorrow). | eventive: *=, > ok |
| | b. | Juliet is home (tomorrow). | stative: = ok, > ok |

Such facts have been noted many times in the literature. We will call this effect the present perfective eventive (PPE) effect.² Treatments of this effect in the literature vary slightly. In many cases (e.g. Parsons, 1990; Smith, 1991; Kamp and Reyle, 1993), it is understood as following directly from the nature of a present perfective eventive predicate, in that events cannot culminate or be entirely included within the present moment. Alternatively, sometimes the PPE effect is attributed to a special dedicated operator (Kaufmann, 2005; Matthewson, 2012), which in English is unpronounced.

Relevantly for the case of conditionals, Enç (1996) and Condoravdi (2002), among others, show that there is a PPE effect under modals: eventives can only be future-oriented, while statives can apparently be either present-oriented or future-oriented:

- (3) a. Juliet will/should/may dance (tomorrow). eventive: *=, > ok
 b. Juliet will/should/may be sick (tomorrow). stative: = ok, > ok

As the antecedents of conditionals are also a modal context, it is not surprising that a similar effect is seen there:

- (4) a. If Juliet leaves (tomorrow) ... eventive: *=, > ok
 b. If Juliet is sick (tomorrow) ... stative: = ok, > ok

As (4a) shows, PPE facts at first glance falsify the proposal of a correlation between eventuality type and temporal orientation in indicative conditionals: one eventuality type (statives) can apparently occur with both temporal orientations.

However, Copley (2008) argues that appearances are misleading: while statives can be future-oriented, the way in which they are is fundamentally different from the way in which eventives are future-oriented. Ultimately, she argues, it is correct to say that temporal orientation *on a particular understanding* does vary with eventuality

type.

The relevant difference between future-oriented eventives and future-oriented statives is that eventives seem to get into the future inherently, as it were, while future-oriented statives need to be temporally anchored by another element, even under *will*. For example, the *will*-sentence with an eventive complement in (5b) is complete as it is, while the *will*-sentence with a stative complement in (5a) lacks a temporal anchor. The anchoring for the stative in (5b) can be provided by a temporal adverbial, a *when*-clause, or an *if*-clause, as in (6).

- (5) a. Juliet will dance. eventive: “sometime”
b. Juliet will be at home. stative: “when?”
- (6) a. At 4 o’clock, Juliet will be at home.
b. When you next see Juliet, she will be at home.
c. If it’s 4 o’clock, Juliet will be at home.

Copley takes such facts to indicate that the eventuality time of an eventive is inherently future-oriented with respect to the eventive predicate’s temporal perspective (in the sense of Condoravdi (2002)) t^* , while the eventuality time of a stative is inherently present-oriented with respect to the stative predicate’s temporal perspective t^* . This means that t^* itself must be both shifted forward and bound by the anchor if a stative ends up being future-oriented. *Will* permits, but does not require this forward-shifting of t^* , as indicated in (7).

- (7) a. Juliet will leave at 4 o’clock. eventive: $t^* = \text{now}$
b. Juliet will be at home at 4 o’clock. stative: $t^* = 4 \text{ o’clock}$

The same facts hold for other modal contexts, e.g. within antecedents of conditionals. Compare, for instance, (8a) to (5a), (8b) to (5b), and (8c) to (6a):

- (8) a. If Juliet dances in her office ... eventive: *=, > ok, “sometime”
 b. If Juliet is home ... stative: = ok, > ok, “when?”
 c. If Juliet is home at 4 o'clock ... stative: > ok with anchor

So the apparently future-oriented statives in conditionals are not future-oriented in the relevant sense, i.e., future-oriented with respect to their temporal perspective t^* . This, then, is the particular understanding of “temporal orientation” on which the proposed correlation holds between eventuality type and temporal orientation: statives are inherently present-oriented with respect to their temporal perspective, and eventives are inherently future-oriented with respect to theirs.

Copley presents a further test that allows us to see a forward shifting of t^* within antecedents of conditionals, namely, the embedding of the antecedent under *it's true that*. The temporal perspective t^* is the time at which truth of the prejacent should be evaluated, so the acceptability of *it's true that* with a present or future temporal adverbial reveals whether t^* is shifted forward or not. A present temporal adverbial such as *now* is possible with a present-oriented stative. But if the stative is future-oriented, it is not compatible with a present temporal adverbial, as in (9a). However, it is compatible with a future temporal adverbial, as in (9b), indicating again that t^* is forward-shifted when a future-oriented complement is stative.

- (9) a. #If it's true now that Juliet is sick tomorrow ...
 b. If it's true tomorrow that Juliet is sick (then) ...

Bare eventives, on the other hand, fail the *it's true that* test altogether, as in (10a),

even though they are otherwise acceptable in antecedents, as in (10b):

- (10) a. #If it's true (now) that it rains tomorrow ...
b. If it rains tomorrow ...

There are morphologically bare eventives that nonetheless pass this test. These are futurates such as *Juliet dances tomorrow: It's true now that Juliet dances tomorrow* is perfectly acceptable. But as we will see below in section 1.2 below, these actually turn out to be derived statives, so are not a problem for the generalization that bare eventives fail the *it's true that* test.

So, taking into account the idea that the temporal perspective t^* can be forward-shifted, the *it's true that* test is more evidence that future-oriented statives are only future-oriented because t^* is itself shifted forward. Therefore, there are no statives that are future-oriented with respect to their temporal argument t^* , and temporal orientation varies with eventuality type, as in (1).

1.2 Adding modal flavor

To make the two-way correlation a three-way correlation, we now add modal flavor. As Copley points out, modal flavor also seems to vary with temporal orientation and eventuality type. For example, the future-oriented eventive in (11a) seems to be a prediction about something that will happen, regardless of whether the speaker will check to see if it is true or not. The present-oriented stative in (11b) seems to be about the speaker, or some idealized epistemic agent, checking slightly later to verify if it is true that Mary is cranky.

- (11) a. Mary will get cranky tomorrow.

- b. Mary will be cranky right now.

Thus, going by the contrast in (11), eventives (which are future-oriented) seem to have a metaphysical modal flavor which concerns events happening in time, while statives (which are present-oriented) seem to have an epistemic modal flavor concerning speaker commitments. Such judgments of modal flavor also hold in antecedents of indicative conditionals, as Copley reports, and as can be seen by comparing the antecedents in (4) with each other, for example.

It has, however, been argued that there are eventive complements in epistemic modal contexts as well as metaphysical modal contexts. Condoravdi (2002) claims that eventives describing “settled” events (Kaufmann, 2005; Kaufmann et al., 2006), i.e., futurates, can be used with epistemic modals, contrasting (12) (where *may* has a metaphysical reading) with (13) (where *may* has an epistemic reading).

- (12) a. It hasn’t been decided yet who he will meet with.
b. He may see the dean. He may see the provost.
- (13) a. It has been decided who he will meet with but I don’t know who it is.
b. He may see the dean. He may see the provost.

Copley (2008) counters that futurates like these, though they look like eventives, are actually derived statives. That is, there is an unpronounced stative-introducing layer insulating the lower event description from anything higher up.

Evidence that futurates are derived statives is detailed in Copley (2014). The state in question is the intention or plan that causes the described event to happen. First, the classic behavior of statives with the simple present and the progressive (Dowty, 1979) is replicated with futurates. In both cases, a state is presented as

somehow permanent with the simple present (the (a) cases) and temporary with the progressive (the (b) cases). In (14) the state is the state of Juliet living in Paris, while in (15) the state is the plan for John to see the dean.

- (14) a. Juliet lives in Paris.
b. Juliet is living in Paris.

- (15) a. John sees the dean tomorrow.
b. John is seeing the dean tomorrow.

Furthermore, as Copley (2008) notes, futurates in indicative conditionals behave like statives when it comes to temporal orientation. A non-futurate eventive in the antecedent requires the consequent event to be future-oriented with respect to the beginning of the antecedent event, as shown in (16a). Like the derived stative *it's raining* in (16b), the futurate reading of (16c) allows the call to occur in the near future, and crucially, before the dancing.

- (16) a. If it rains on Monday, I'll give Juliet a call #right now.
b. If it's raining, I'll give Juliet a call right now.
c. If Juliet dances on Monday, I'll give her a call right now.

So the futurates behaves like a present-oriented stative, not like a future-oriented eventive. Further supporting this idea that futurates are derived statives is the fact that in antecedents pass the *it's true that* test, as other statives do.

- (17) If it's true that Juliet dances on Monday, I'll give her a call right now.

In fact, futurates behave exactly like another kind of derived stative, namely gener-

ics/habituals. The generic/habitual reading of *Juliet dances* shows the permanent/temporary contrast in (18a)-(18b), just like (14) and (15); and in (18c), allows for an immediate consequent event, like (16c), and supports *it's true that*, like (17).

- (18) a. Juliet dances on Mondays.
b. Juliet is dancing these days.
c. If (it's true that) Juliet dances on Mondays, I'll give her a call right now.

Thus, contra Condoravdi (2002), we may conclude that there are no real epistemic future-oriented eventives; apparent cases are really epistemic present-oriented derived statives. Hence there is nothing standing in the way of a three-way correlation between eventuality type, temporal orientation, and modal flavor, as proposed in (2).

1.3 Why?

Having established that the table in (1) holds, the next question is why it holds. Recall that the PPE effect only addresses the unacceptability of present-oriented eventives, and treats all other eventuality type/temporal orientation combinations as acceptable. It is thus insufficient to explain the temporal facts we have just seen; in particular, an additional principle is needed to explain the fact that future-oriented statives are excluded. What could such a principle be? And what does any of this have to do with modal flavor?

A hint is given by the *it's true that* test in the antecedent of conditionals. We may reasonably expect that truth and falsity can hold only of propositions, not of other things. The contrast between (9a) and (18a) suggests that statives, which pass the *it's true that test*, are propositions, while bare eventives, which fail the *it's true that test*, are not propositions.

Another test that makes a similar distinction among antecedents seems to point in the same direction. Speaker-oriented adverbs such as *probably* and *allegedly* make a distinction in antecedents similar to the one that *it's true that* makes. Haegeman (2006) points out that speaker-oriented adverbs are impossible in an *if*-clause only when the *if*-clause is what she calls an event-related adverbial, as in (19a); they are possible when the *if* clause is a discourse-related adverbial, as in (19b).

- (19) a. If it #probably rains you may get wet.
 b. If you are probably going to move soon, there's no point in getting a broadband connection at home.

Bare eventive antecedents do not admit *probably*, while bare stative antecedents do, as shown in (20). Speaker-oriented adverbs do not however allow the future shifting in the antecedent that *it's true that* does; compare (20b) with (9). Antecedents with speaker-oriented adverbs are also strongly echoic (Mayol and Castroviejo, 2017); that is, someone in the discourse likely uttered “Juliet is probably (/evidently/possibly/allegedly) sick”.

- (20) a. #If it probably/evidently/possibly/allegedly rains tomorrow ...
 b. If Juliet is probably/evidently/possibly/allegedly sick (#tomorrow) ...

Haegeman (2003, 2006) argues that event-related adverbials are merged within the IP, while discourse-related adverbials are merged at the level of CP. So, speaker-oriented adverb distinguish antecedents according to eventuality type like *it's true that* does. Moreover, statives are associated with discourse phenomena such as speaker-oriented adverbs, echoicity, and adjunction at CP.

Discourse would seem to involve propositions. We might expect, for instance,

that only propositions can be asserted in a matrix clause. And indeed bare eventives are unassertable (*#It rains tomorrow*, again with the exception of futurates, to be addressed below). We can assume that assertion is the addition of a proposition to the some discourse-relevant set of propositions, let's say the speaker commitments, at t^* . A similar story can be told for epistemic modal contexts; see Papafragou (2006); von Stechow and Gillies (2010); Portner (2009) for discussion of this move. Thus it seems that English statives *are* propositions, and that is why they can be associated with epistemic modality, while English eventives *are not* propositions, and that is why they cannot be associated with epistemic modality.

The question then arises as to what bare eventives could be, if not propositions. It is likely the case that they are too small to be propositions. Work by, e.g., Chierchia (1985) and Ramchand and Svenonius (2014) suggests that a type difference is a reason why bare eventives would be too small to be a proposition; they would be event descriptions (predicates of events) rather than propositions (predicates of situations).³

This idea allows us to make sense of the three-way correlation. First, the temporal orientation facts: Statives are present-oriented with respect to their temporal perspective t^* because the temporal perspective represents the time at which the proposition is added to the speaker commitments. That is, part of what it means to be a temporal perspective is that it is the time at which propositions are added to speaker commitments. If there is additional temporal-aspectual material in the proposition, the eventuality time can be further shifted, but in the case of ordinary stative predicates, this is not the case, so they are present-oriented with respect to t^* . Eventives, on the other hand, are future-oriented with respect to their temporal perspective, which is the PPE effect, and it can be explained by whatever one thinks the PPE effect is due to.

For the modal flavor facts: assuming that bare eventives really are this small and that we are to take such syntactic claims and their type-theoretical consequences seriously in the semantics, that means that proposition-based modality is not available to us as a way of analyzing metaphysical modal flavor. Instead we need to find a way to analyze metaphysical modal flavor using event descriptions; this, I argue, will also give us a new perspective on the PPE effect. Additionally, there also arises from this line of thought a type-theoretic crisis for the denotation of conditionals, which will lead us to the conclusion that conditionals are causal. The next two sections consider these points in turn.

2 Metaphysical modality with event descriptions

How might one model metaphysical modality using event descriptions instead of propositions? Propositions are usually defined as sets of possible worlds, and possible worlds are the *sine qua non* of modality, so one might reasonably wonder whether it is even possible to do modality without propositions. However, there are existing proposals which suggest ways to derive both possible worlds and accessibility relations from events.

To derive possible worlds from events, a possible world should be treated as a course of events. Certain accounts of branching time (see, e.g., (Thomason, 1970; Krifka, 2014)) do this. Although they do not construct worlds literally in terms of Davidsonian event arguments, they do have discrete indices, a series of which forms a single world. Similarly, force-based approaches such as van Lambalgen and Hamm (2008); Fernando (2008); Copley and Harley (2015) create courses of events as causal chains. All of these approaches treat the pieces of worlds as ontologically prior to

worlds, unlike approaches which treat worlds as atomic and break the world into pieces via situations as partial worlds or a temporal dimension. While there is much more to be said about how to derive a world from atomic pieces, the existence of such proposals indicates at least that it can be done.

As for the accessibility relation: an accessibility relation relativized to an event argument, instead of to a world, has already been proposed by Hacquard (2006). Hacquard points out that the circumstances that are relevant to circumstantial readings of modals (what we call “metaphysical” readings here) are suspiciously similar to those that are important for the individuation of events, namely “the (physical) properties of the event’s participants, the location and the time of the event” (p. 146). Accordingly, she proposes that the accessibility relation for such readings returns the set of worlds that is “compatible with the circumstances” of the event argument.

This is good. But is there a way to go further, and understand an accessibility relation without resorting again to a set of worlds, which is after all a proposition? Remember, the smallness of bare eventives suggests that we are dealing with event descriptions rather than propositions. Of course it’s *possible* to do metaphysical modality with propositions, but the question is whether we can do it with event descriptions instead. So, how do we determine that a single course of events is an accessible one, without first determining the set of all the accessible courses of events?

In real life, when faced with the prospect of figuring out what will or might happen next, we do not have to first calculate all the possibilities. Instead, we use our knowledge of physics and rational behavior, resolving mutually opposed forces and intentions to imagine transforming the current state of affairs into the next one. This process uses the same information that is contained in a conversational background, but without going through a set of all the accessible worlds. The information is

instead applied directly to (what we believe to be) the current state of affairs.

The relationship between the traditional propositional approach and such an event-based approach would be similar to the relationship between Optimality Theory (Prince and Smolensky, 2008) and traditional phonological derivations. The propositional approach to modality and Optimality Theory both take all the possibilities and use constraints to winnow them down to the acceptable or accessible ones. An event description approach to metaphysical modality, like the traditional phonological derivation, would use rules to directly transform one element into another.⁴

In modality as in phonology, both technologies can in principle be made powerful enough to handle most if not all cases. Nonetheless, as ever, there can be hints that one approach or the other more cleanly carves the world at its joints in a particular case. Temporal orientation facts provide a hint that an event-based approach, if it can be fleshed out, is more appropriate than the propositional approach for metaphysical modality in English indicative conditionals.

It turns out that Copley's claim that eventives in these conditionals are future-oriented with respect to their temporal perspective is not quite right. When both antecedent and consequent are bare eventives, the consequent event is only required to not begin before the antecedent event begins, as in (21b). With a well-chosen example, it can begin at the same time, as in (21b).

- (21) a. #If it rains, Juliet gets sick previously.
b. If I push this cup it moves.

This non-past relationship of the consequent with respect to the antecedent is the same as the temporal relationship between cause and effect: the effect is non-past with respect to its cause. This is exactly the way in which (21b) is well-chosen, as

pushing causes the cup to move at the same time as the pushing, not after the pushing is completed. What matters is causal subsequence, not temporal subsequence.

On a theory in which conditionals quantify over atomic possible worlds, time must be added in; there is consequently no reason why one temporal relationship would be stipulated over another. The same is true for a material conditional theory. On an event-based theory, however, causation can be inherent to the theory if conditionals are held to be metaphysical and to express a causal relationship. Then the temporal relationship will come for free. This suggests that an event-based theory is the more plausible contender.

Causation in such a theory of metaphysical modality would reside in the accessibility relation, as in (22):

- (22) Causal accessibility: e_2 is causally accessible from e_1 iff e_2 is a possible causal outcome of e_1

The devil, of course, is in the details of how causal accessibility is defined. A possible causal outcome should be one that the speaker judges to be able to occur given their view of what is currently the case and what the laws of physics and rational behavior are. If the speaker concedes imperfect knowledge of any one of these, more than one causal outcome can be possible; in this way branching can be modeled.

On this account, incidentally, the PPE effect is split in two. There are actually two different reasons why an eventive could be future-oriented, one for the matrix and one for modal contexts. In the matrix, event descriptions are generally impossible as assertions because assertions must be propositional. Exceptions such as performatives and the narrative present, I assume, are not assertions; they directly describe the speech event or the privileged event with an event description. When there seems to

be a matrix assertion of a future-oriented bare eventive, it is actually a futurate, that is, it is really a derived stative. On the other hand, when a bare eventive is future-oriented or non-past-oriented in a conditional, it is because of a causal accessibility relation.⁵

This, then, is a sketch of metaphysical modality that uses causal chains of events rather than atomic possible worlds. There are two worries that arise at this point as to the viability of such a sketch. The first is the question of whether causation can be accounted for at all without using atomic possible worlds. Through Dowty (1979), formal semantics has inherited a version of David Lewis’s counterfactual theory of causation (Lewis, 1973), which is based upon atomic possible worlds. Lewis’s theory of causation is a “dependency” or “make-a-difference” theory, in which causation is ultimately explained by a dependency of the proposition that B occurs on the proposition that A occurs. So, Lewis relates the intuition that A causes B to the truth of the counterfactual “if A had not occurred, B would not have occurred.” A semantics of this counterfactual is then given in terms of atomic possible worlds.

However, causation can be accounted for without such dependencies (for example, Fair (1979); Wolff (2007); Mumford and Anjum (2011); see Copley and Wolff (2014) for an overview). These theories of causation relate the intuition that A causes B to a physical connection observable or adduced in the causing eventuality A. Such theories are termed “production”, “process”, or “mechanistic” theories. These theories account for intuitions of causation by describing the configurations of forces, influences, or transmissions of energy that obtain in the causing eventuality; there is no need to relate causal phenomena or causal intuitions to propositions, and thus no need to have atomic worlds. By understanding the particular influences at work, we can determine what will (or should, or could) happen next, again in an analogy to

traditional rule-based transformations.

So, not only can causation be constructed in terms of possibilities, as in dependency theories of causation, such as Lewis (1973), but possibilities can also be constructed in terms of causation, as in production theories of causation. There is no problem in principle going from causation to possibilities; it's just not the most familiar direction of explanation for most formal semanticists. So the first worry is nothing to worry about.

The second worry is that in the real world, causal chains are not as simple as a series of events that occur one after another like pearls on a string. Rather, there are numerous causing conditions that overlap in time and come together to cause what happens next. This point indicates that something larger than a Davidsonian event should be involved in these causal chains; perhaps situations. But the whole point of this discussion was to derive possible worlds from events, not from situations. I won't worry about this problem here except to say that it can probably be mitigated if (the correlates of) events and situations can be easily related to each other, as in Krifka (2014). If this can be done, then an event-based metaphysical modality, as suggested by Copley's type difference, is plausible.

3 A type-theoretic crisis for conditionals

Another consequence of Copley's type difference between statives and eventives is a type-theoretic crisis for the denotation of conditionals. The reason why is that prejacents can now be either predicates of events, type *vt*, or predicates of situations, type *st*. Notably, there exist "mixed" conditionals, i.e., those with an eventive antecedent and a stative consequent, or vice versa, as in (23).

- (23) a. If John gets sick, Mary will be sick.
b. If John is sick, Mary will get sick.

Incidentally, given the association of modal flavor with eventuality type, this means that antecedents can have a different modal flavor than their consequents. This directly contradicts the picture of conditionals from Stalnaker (1981) on which conditionals quantify over possible worlds, and the antecedent restricts the domain of quantification, with the result that there is room for only one modal flavor in a conditional.

But is it such a crazy idea that antecedents and consequents should have different modal flavors? Very often there is no grammatical evidence for modal flavor apart from linguists' judgments. However, as Copley notes, now we also have the *it's true that* test, which identifies propositions. If, as suggested, epistemic modality involves propositions, and metaphysical modality does not, then this test also is a test for epistemic modality in modal contexts. And this test, as in (24), shows that "mixed" conditionals are possible.

- (24) a. If (it's true that) it's raining, (#it is/will be true that) Juliet gets sick.
b. If (#it's true that) Juliet gets sick, (it is/will be true that) it's raining.

Thus it is perfectly possible for there to be two types in a conditional, with epistemic modality (the addition of a proposition to a set of commitments) in one conjunct and metaphysical modality (causal accessibility involving events) in the other. So we can now get to resolving this type-theoretic crisis.

3.1 Resolving the type-theoretic crisis

One way to resolve the crisis would be to give up a unitary denotation of conditionals, and propose that there are four different attested types for *if*: type $\langle vt, vt \rangle$, type $\langle st, st \rangle$, and the mixed types $\langle st, vt \rangle$ as in (24a) and $\langle vt, st \rangle$ as in (24b). This is unwieldy. A better solution is to preserve the unitary denotation for conditionals and propose a type-shifting operation for one of the different types.⁶ There are two possible ways to implement this solution:

- Option 1: Conditionals take predicates of situations. Eventives get type-shifted from predicates of events to predicates of situations.
- Option 2: Conditionals take predicates of events. Statives and temporal predicates get type-shifted from predicates of situations to predicates of events.

Let's consider option 1. What is needed is some way to relate a predicate of an event to a predicate of a situation. Remember, events can't *be* situations if the reason why bare eventives can't be asserted is that they are not propositions (predicates of situations). But option 1 runs up against the temporal facts, in particular the fact that eventives are future-oriented (or non-past-oriented). For why would eventives ever need to be forward-shifted from the temporal perspective t^* if they get type-shifted to propositions, given that propositions are present-oriented with respect to t^* (and assuming that the type-shifter is just a type-shifter)?

This leaves us with option 2, where conditionals take predicates of events, and propositions must get type-shifted from predicates of situations to predicates of events in order to shoehorn them into the conditional. We need a type-shift operator such as that in (25), where SC_C is the (perhaps idealized) speaker commitments in C , the context of utterance:⁷

(25) $\text{ADD}(e) = \lambda C \lambda p_{st} . e$ is an event of adding p to SC_C

Adding p to the speaker commitments is a kind of discourse operation, akin to an assertion or other speech act. While it has been argued (Hooper and Thompson, 1973) that speech acts generally cannot be embedded, here a predicate describing the event of adding p to the speaker commitments is meant to be embedded within a conditional. Is this move legitimate?

Krifka (2014) (among others) argues that it is. While speech acts cannot generally be embedded, in some environments, they can be—including in Austinian or “biscuit” conditionals, as in (26a). These Krifka analyzes as in (26b), differently to ordinary conditionals, which are given an unpronounced modal as in (26c).

- (26) a. If you’re thirsty (p), there’s beer in the fridge (q).
b. Supposing this index satisfies p , $\text{ASSERT}(\text{this index satisfies } q)$.
c. If the sun shines, $\text{MOD}(\text{it is warm})$

Relevantly for the present proposal, Krifka argues that the reason speech acts are usually not embeddable, but exceptionally are embeddable, is precisely because they are not propositions but something else entirely. As he points out, Szabolcsi (1982) makes the argument that speech acts change the speaker’s commitments. Krifka further elaborates this idea, treating speech acts as “illocutionary act potentials”. In this view, a speech act is something that changes the world, and which as it does so, “spawns” an event. Assertion, for instance, spawns a change of state event in which the speaker becomes liable for the truth of the asserted proposition.

This idea matches up quite well with the current proposal, on which ADD is a predicate of events. The main difference is that for Krifka the spawned event is not

actually reified in the type theory. In (26) it is, and crucially so, since the whole point is to type-shift propositions into event predicates. But this doesn't pose any particular problem for a Krifka-style theory of speech acts.

For example, this picture goes well with the observation that performative function is not compatible with aspect, if performatives are treated as event descriptions that directly describe the speech act. Aspect is indeed a sort of opposite of ADD; on many accounts (Klein, 1997; Kratzer, 1998, e.g.) aspect maps predicates of events to predicates of times or situations, so any aspectualized event description would be a proposition, and thus be unable to function as a performative.⁸

Option 2, then, seems to be a good way to integrate eventives and statives in the same conditional even though they have different types, allowing us to construct the desired unified causal denotation for conditionals.

3.2 A unified causal denotation for conditionals

To construct such a denotation, I take as a starting point a familiar propositional modality denotation for conditionals, abstracting away from ordering source. The denotation in (27) says that *if p, q* has the meaning that all worlds accessible from *w* in which *p* is true, are worlds in which *q* is true. The goal is to turn this into a denotation based on event descriptions rather than on propositions.

(27) conditionals, starting point: $\lambda w \lambda p \in D_{wt} \lambda q_{wt}$. for all *w'* accessible from *w* such that *p(w')*, *q(w')*

Our first move is to replace the propositions with event descriptions, and the accessibility relation with a causal accessibility relation like that in (22):

(28) conditionals, second try: $\lambda e \lambda p \in D_{vt} . \lambda q_{vt} .$ for all e' causally accessible from e such that $p(e')$, $q(e')$

There are several issues with (28) that require adjustment. First: How is the event argument e saturated? The speech event itself is certainly available to saturate it. But we wouldn't want to require that the event described by the antecedent be causally accessible from the speech event. To address this fact, we could add another term to the context, a privileged event e_C reflecting what is going on at the speech time that the speaker is focusing on, and consider causal accessibility from e_C .

Second, we don't want p and q to necessarily be predicated of the same event, as they are in (28). Since both eventive antecedents and eventive consequents are future-oriented (or in the case of the consequent, non-past-oriented) relative to their temporal perspective t^* , as shown in (3a) and (4a), the antecedent and consequent should be treated similarly in the denotation. This suggests that the consequent should have its own causal accessibility relation. Another reason for this move is that, as we have argued, antecedents and consequents can have independent modal flavors. Thus, they need independent accessibility relations.

Third, we do not want the consequent to say that *all* events that are causally accessible from a situation have a certain property; just that all courses of events include such an event.

Taking these considerations into account, we get something like (29):

(29) conditionals, final try: $\lambda p_{vt} \lambda q_{vt} .$ *all causally accessible courses of events from e_C that include an e' such that $p(e')$ are such that: all causally accessible courses of events from e' include an e'' such that $q(e'')$*

The upshot of option 2 is that all conditionals take event descriptions as arguments, and consequently have metaphysical modality, expressing a causal relationship between events. That is, conditionals are causal. Where they appear not to be, it is because one or more of the events is really a discourse event of adding a proposition to the speaker commitments.

There are two minor differences between this proposal and Krifka's account of Austinian conditionals. The first is that p moves forward in the causal chain, as well as q . Second, the ASSERT operator is replaced by ADD. ADD is (a) more general than an ASSERT operator, and (b) is always used when there is a stative; an eventive shifts forward (or in Krifka's terms, shifts to the next index) by itself.

3.3 Dealing with two apparent counterexamples

Let's see how the proposal in (29) plays out with two apparent counterexamples.

- (30) a. If you're thirsty, there's beer in the fridge.
b. If this creature has a heart, it has a liver.

The Austinian conditional in (30a) does not convey that the interlocutor's thirst causes there to be beer in the fridge. The classic conditional in (30b), with a stative antecedent and a stative consequent, does not convey that the creature's having a heart causes it to have a liver. Finally, the eventive predicates in (30c) seem not to describe two causally-related events but one single event, in two different ways.

The proposed account of (30a) is that both the antecedent and the consequent have an ADD operator. The causal relationship expressed by the conditional is between the two events of adding propositions to the speaker commitments: 'all currently causally

accessible courses of events that include an event e' of [adding *you're thirsty* to the speaker commitments], are such that all courses of events causally accessible from e' include an event of [adding *there's beer in the fridge* to the speaker commitments].⁷ If the antecedent were eventive, e.g. *If John shows up*, there would still be a causal relationship, in this case between John's showing up and the adding of the proposition *there's beer in the fridge*.

The sentence in (30b), *If this creature has a heart, it has a liver* is treated in the same way as (30a), with a causal relationship between two ADD events. In effect, the causation written into the conditional via the denotation of (29) emerges only as the causation of inference, which is appropriate. Inference here is a special instance of causation, residing in the informational domain rather than in the world itself. It can be, as Krifka suggests, essentially instantaneous, as it seems to be here. However, inference is not the only kind of informational causation, since the addition of a proposition can be caused in another way, as in (30a), where it is presumably the speaker's decision to utter the consequent proposition that causes it to be added to the speaker commitments.

4 Conclusion

Where we have arrived at is an account that generalizes Krifka's (2014) treatment of the consequents of Austinian conditionals to all statives in English indicative conditionals. A discourse operation ADD type-shifts propositions (which statives are) to an event description that describes the event of adding that proposition to the speaker's commitments. Eventives, on the other hand, are themselves event descriptions and are not shifted by such an operator. Krifka abstracts away from eventuality type in

his discussion. If we include it, we see that a unified causal theory of conditionals is within reach.

Notes

¹“Metaphysical” in the sense of having to do with how things happen in the world based on the world up to this point, in the sense of e.g. Condoravdi (2002) or a circumstantial modal base in Kratzer’s system; not in the sense of a totally realistic circumstantial modal base (Kratzer, 1981).

²An apparent counterexample to the PPE effect is the narrative present (*He shoots, he scores!*). In terms of the type-theoretic account to be proposed, this is plausibly a direct description of an ongoing event rather than an assertion about a situation.

³Temporal predicates in the sense of Condoravdi (2002), that is, anything with tense or aspect, also seem to be propositions:

- (i) a. If it’s true that Juliet left yesterday . . .
- b. If it’s true that Juliet has left . . .

This would make sense if the reason why bare eventives are not propositions is because they are too small; temporal predicates are certainly large enough to be propositions. And like statives, temporal predicates also are not future-oriented with respect to t^* even when they are apparently future-oriented; the future orientation comes from a shift of t^* itself, as diagnosed with the anchors (the acceptable habitual readings are irrelevant):

- (ii) a. At 4/When you see Juliet/If you see Juliet, she will have been sick.
- b. *At 4/When you see Juliet/If you see Juliet, she has been sick.
- c. *At 4/When you see Juliet/If you see Juliet, she is sick.

⁴Theories of force dynamics would be useful here in understanding events, in that they would be able to resolve the conflict between opposing forces to determine what will or might happen next. So, although Kratzer (2012) rightly points out that conflict resolution is at the heart of modality

and that proposition-based modality, like Optimality Theory, is a solution to conflict resolution, we still have a choice as to whether to model conflict resolution with propositions in that way. The other option is to calculate the force-dynamic outcome before we ever reach the linguistic level. At any rate, because Kratzer takes the propositions involved in modal bases and ordering sources to reside at the conceptual level, we agree that this conflict resolution takes place there. I just disagree that propositions are conceptual in nature. They seem to me to be linguistic objects.

⁵It's not clear why the "at the same time" option in (21b) is not available in antecedents or other modal contexts, when the causal chain is from an implicit event; the question is worth exploring.

⁶This heuristic is reminiscent of Lauer and Condoravdi (2012); Condoravdi and Lauer (2015), who succeed in maintaining a single denotation of conditionals in the face of a difference between propositions and actions. The direction indicated by the current inquiry, however, will point to the equivalent of actions (i.e., event descriptions) being the base case, rather than propositions.

⁷And in the end since we are not dealing with times but with events, what we have been calling the temporal perspective is the run time of the event in question.

⁸ADD could also easily be used for evidentials, in that an evidential manner ("visual", "indirect", e.g.) could be predicated of the adding event.

References

- Chierchia, G. (1985). Formal semantics and the grammar of predication. *Linguistic Inquiry* 16(3), 417–443.
- Condoravdi, C. (2002). Temporal interpretation of modals. In D. Beaver, S. Kaufmann, B. Clark, and L. Casillas (Eds.), *Stanford Papers on Semantics*. Palo Alto: CSLI Publications.
- Condoravdi, C. and S. Lauer (2015). Anankastic conditionals are just conditionals. *Semantics & Pragmatics*.

- Copley, B. (2008). Temporal orientation in conditionals. In J. Guéron and J. Lecarme (Eds.), *Time and Modality*, pp. 59–77. Springer.
- Copley, B. (2014). Causal chains for futurates. In P. de Brabanter, M. Kissine, and S. Sharifzadeh (Eds.), *Future Times, Future Tenses*, Oxford Studies of Time in Language and Thought, pp. 72–86. OUP.
- Copley, B. and H. Harley (2015). A force-theoretic framework for event structure. *Linguistics and Philosophy* 38, 103–158.
- Copley, B. and P. Wolff (2014). Theories of causation should inform linguistic theory and vice versa. In B. Copley and F. Martin (Eds.), *Causation in Grammatical Structures*, pp. 11–57. Oxford University Press.
- Dowty, D. (1979). *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Enç, M. (1996). Tense and modality. In S. Lappin (Ed.), *The Handbook of Contemporary Semantic Theory*, pp. 345–358. Oxford, England: Blackwell.
- Fair, D. (1979). Causation and the flow of energy. *Erkenntnis* 14(3), 219–250.
- Fernando, T. (2008). Branching from inertia worlds. *Journal of Semantics* 25(3), 321–344.
- von Fintel, K. and A. Gillies (2010). ‘must...stay...strong!’. *Natural Language Semantics* 18, 351–83.
- Hacquard, V. (2006). *Aspects of Modality*. Ph. D. thesis, MIT.
- Haegeman, L. (2003). Conditional clauses: External and internal syntax. *Mind & Language* 18(4), 317–339.

- Haegeman, L. (2006). Conditionals, factives and the left periphery. *Lingua* 116(10), 1651–1669.
- Hooper, J. B. and S. A. Thompson (1973). On the applicability of root transformations. *Linguistic inquiry* 4(4), 465–497.
- Kamp, H. and U. Reyle (1993). *From Discourse to Logic*. Dordrecht: Kluwer.
- Kaufmann, S. (2005). Conditional truth and future reference. *Journal of Semantics* 22, 231–280.
- Kaufmann, S., C. Condoravdi, and V. Harizanov (2006). Formal approaches to modality. *The expression of modality*, 71–106.
- Klein, W. (1997). *Time in Language*. New York: Routledge.
- Kratzer, A. (1981). The notional category of modality. In H.-J. Eikmeyer and H. Rieser (Eds.), *Words, Worlds, and Contexts*, pp. 38–74. Berlin: de Gruyter.
- Kratzer, A. (1998). Scope or pseudoscope? are there wide-scope indefinites? In S. Rothstein (Ed.), *Events and Grammar*, pp. 163–196. Kluwer.
- Kratzer, A. (2012). *Modals and conditionals: New and revised perspectives*, Volume 36. Oxford University Press.
- Krifka, M. (2014). Embedding illocutionary acts. In *Recursion: Complexity in cognition*, pp. 59–87. Springer.
- van Lambalgen, M. and F. Hamm (2008). *The proper treatment of events*, Volume 6. John Wiley & Sons.
- Lauer, S. and C. Condoravdi (2012). Anankastic conditionals are just conditionals. Talk given at Construction of Meaning Workshop.

- Lewis, D. (1973). Causation. *The journal of philosophy*, 556–567.
- Matthewson, L. (2012). On the (non)-future orientation of modals. In *Proceedings of Sinn und Bedeutung*, Volume 16, pp. 431–446.
- Mayol, L. and E. Castroviejo (2017). Premise conditionals are thematic hypothetical conditionals. Presentation at CSSP, Paris.
- Mumford, S. and R. L. Anjum (2011). *Getting causes from powers*. Oxford University Press.
- Papafragou, A. (2006). Epistemic modality and truth conditions. *Lingua* 116(10), 1688–1702.
- Parsons, T. (1990). *Events in the Semantics of English: A Study in Subatomic Semantics*. Cambridge, Mass.: MIT Press.
- Portner, P. (2009). *Modality*. Oxford Surveys in Semantics and Pragmatics. Oxford University Press.
- Prince, A. and P. Smolensky (2008). *Optimality Theory: Constraint interaction in generative grammar*. John Wiley & Sons.
- Ramchand, G. and P. Svenonius (2014). Deriving the functional hierarchy. *Language Sciences* 46, 152–174.
- Smith, C. (1991). *The parameter of aspect*. Dordrecht: Kluwer.
- Stalnaker, R. C. (1981). A theory of conditionals. In *Ifs*, pp. 41–55. Springer.
- Szabolcsi, A. (1982). Model theoretic semantics of performatives. In F. Kiefer (Ed.), *Hungarian linguistics*, Amsterdam, pp. 515–535. John Benjamins.

ASPECT, SCOPE, AND FUTURE CONDITIONALS*

Bridget Copley,
University of Southern California

copley@usc.edu

Abstract

This paper argues that though *will* and *be going to* both involve a future modal, their meanings differ aspectually. *Be going to* includes a progressive-like aspectual operator that takes scope over the future modal. *Will*, on the other hand, is ambiguous between a reading that is the future modal alone, and a reading that has a generic-like aspectual operator over the modal. The evidence for these logical forms consists primarily of modal effects caused by aspectual operation on the temporal argument of the future modal's accessibility relation. Similar evidence motivates a proposal that future modals in conditionals can have scope either over or under the antecedent of the conditional. These findings argue against analyses that treat futures as a kind of tense, and suggest possible directions for theories of aspect, modals, and conditionals.

1 Introduction

The goal of this paper is to provide a better understanding of futures in general, through comparison of *will* with another future, namely *be going to*. *Will* and *be going to*, I will argue, contain the same future modal, differing only in aspect. *Be going to* has a progressive-like operator located just under tense and over the future modal, while *will* initially at least seems to have no aspectual component. *Will*, however, is later argued to be ambiguous between an aspect-free reading and a reading with a generic-like aspectual operator. In all these cases, the aspect, or lack thereof, has detectable effects on the temporal argument of the future modal's accessibility relation.¹ However, since we know that higher *tense* has an effect on the temporal argument of accessibility relations, perhaps we should not be too surprised to see aspectual effects as well. A class of apparent counterexamples to the *be going to* proposal is shown to have a different scope for *be going to*, and a class of apparent counterexamples to the *will* proposal is accounted for via a reading of *will* with generic aspect. Subsequently the evidence for scope distinctions among *will* conditionals is examined. We are left with a fairly varied picture of future conditionals.

2 Aspect of *be going to*

In this section I offer a puzzle about offering, and solve the puzzle by proposing an aspectual difference between *be going to* and *will*. The puzzle is this: Why can *will* be used to make an offer, while *be going to* seemingly cannot be? The eventual solution is that *be going to* consists

*This research was supported in part by an NSF Graduate Research Fellowship and a Kosciuszko Foundation Tuition Scholarship. The author also wishes to thank Sabine Iatridou, Norvin Richards, Jennifer Cunningham, Kai von Fintel, Irene Heim, Elena Guerzoni, Noam Chomsky, and Joseph 'Jofish' Kaye.

¹The effect of higher aspect on modals has not been much remarked upon; in fact, the very existence of aspect in that position has not been much remarked upon (Cinque (2002), Tenny (2000))

of a progressive-like aspectual operator on top of a future modal, and that this combination conflicts with a pragmatic requirement on acts of offering.

As a first step in the argument that *will* and *be going to* differ aspectually, it is necessary to demonstrate that *will* and *be going to* do in fact differ in meaning. It is not immediately obvious that they do; in some contexts, as in (1), they seem almost interchangeable.

- (1) a. It will be sunny tomorrow
b. It's going to be sunny tomorrow.

Certain contexts, however, bring out clear assertability differences. Consider the sentence in (2a), seen outside Madera, California, on a billboard advertising a mechanic's shop. The sentence in (2b) was not on the billboard, and in fact could not felicitously have been used there.

- (2) a. We'll change your oil in Madera. √offer
b. We're going to change your oil in Madera. #offer

Thus here is a difference between *will* and *be going to*. Intuitively, (2a) is used to make an offer that you can take or leave. But the sentence in (2b), in the context given, is not an offer. Rather, it is somewhat bullying. The threatening nature of (2b) seems to stem from the intuition that there is no chance for you to have a say in the matter.

Suppose we consider in more depth what it is to make an offer. First, the contribution of the speaker. It seems clear that only someone who believes they can say whether an eventuality happens or not can felicitously make an offer for that eventuality to happen. I cannot felicitously offer for it to rain tomorrow, for instance, because I have no power over the weather, and I know it. So in order for an individual *s* ("speaker") to be able to make a valid offer to carry out a *q*-eventuality (an eventuality of which a predicate *q* holds), *s* must have power over whether a *q*-eventuality holds occurs. Let's call this ability (without going into a precise modal characterization of ability) *direction* (Copley 2002b).

- (3) An individual *s* *directs* *q* just in case *s* has the ability to determine whether *q* happens.

The one to whom the offer is made, whom I will refer to as *h* ("hearer"), also seems to have some control over whether the *q*-eventuality occurs. It should happen if *h* wants it to happen, and, equally importantly, it should not happen if *h* wants it not to happen. It would certainly be rude for someone to make an assertion that entails that in some cases where you do not want them to change your oil, they do it anyway. For an utterance to count as an act of offering, the speaker's carrying out of the offered eventuality has to be contingent on the interlocutor's preferences.

Let's treat a sentence of offering as a conditional with an elided antecedent *if you want q*, an overt consequent *will q*, and a presupposition that *d* has power over whether a *q*-eventuality occurs. The offerer *s*, in uttering that sentence in good faith, asserts the truth of that conditional. On a Lewis-Kratzer-style account of conditionals (Lewis (1986), Kratzer (1986)), *s* asserts that in all worlds where *h* wants *q*, a *q*-eventuality happens. And let us further agree that in making a valid offer, *s* is also committed to the truth of the proposition expressed by the conditional *If you don't want q, won't q* (where *don't want* = *want not*). This commitment reflects our intuition that the hearer's desires have an effect on whether a *q*-eventuality happens; it happens only if the hearer wants it to. Note that this commitment is not required by anything about the semantics of the conditional, but rather is just a pragmatic requirement on offers.

We also need a condition on offers. (I have ²²²abbreviated the intensional verbs *want* and *be-*

lieve; *w-t-believe*, for instance, is short for “believes in *w* at *t*,” with the usual possible world semantics.)

- (4) *Condition on offers*: A person *s* offers in *w* at *t* to bring about a *q*-eventuality for *h* only if *s* *w-t-believes* that: $\forall w'$ that agree with *w* up to *t*: $[\exists t'$ such that *s* directs *q* in *w'* at *t'*: $[h$ *w'-t'*-wants *q* $\Leftrightarrow \forall w''$ that agree with *w'* up to *t'*: $[\exists t'' > t'$: $[q(w'')(t'')]]]$]

Now let’s see how this characterization of offering intuitively conflicts with the semantics of *be going to*. According to our assumption, an offering utterance is interpreted with a certain kind of antecedent, whether or not it is pronounced. In that case, the billboard utterances actually have the meaning of the conditionals given in (5):

- (5) Revision of the billboard utterances
 a. (If you want us to change your oil in Madera,) we will change your oil in Madera.
 b. #(If you want us to change your oil in Madera,) we are going to change your oil in Madera.

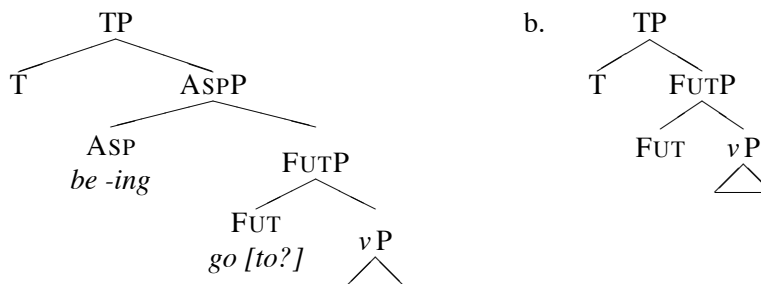
The problem with (5b) seems to be a conflict with part (b) of the offering condition in (4), instantiated in this case as follows:

- (6) If you don’t want us to change your oil in Madera, we won’t change your oil in Madera.

While (6) feels consistent with (5a), it feels inconsistent with (5b). This intuition is what is responsible for the feeling noted earlier: Felicitous offering requires the offerer to take the hearer’s desires into account, but using *be going to* feels like a decision has already been made, without prior consultation with the hearer.

The question we have arrived at is this: What is it about the meaning of *be going to* that causes (5b) to contradict (6)? The answer to this question, I propose, is that *be going to* consists of a progressive-like aspectual operator scoping over a future modal. The proposed structure is as in (7a) below. Tense is marked on the progressive auxiliary, yielding *was/were going to*.² Note that (7a) is minimally different from a proposal for the logical form of *will* and *would* (Abusch 1985), shown in (7b).

- (7) a. *Be going to* (Copley 2001, 2002a, b)



Two considerations motivate the proposed structure in (7a). The first is morphological. *Be -ing* often marks progressives; perhaps it does just that, or something quite like that, in *be going to*. English is notorious for reusing morphology, but the presence of *be -ing* should at least

²*To* is not separable from *going* (Copley 2001), giving the impression that *be going to* is something of an idiom. It is not unusual for constructions to lose transparency as they progress from main verb to tense/aspect marking (Dahl 1985).

prompt an investigation into the possibility of progressive semantics. And if we decide to take the morphology seriously, and if we believe in the Mirror Principle (Baker 1985), the future projection, presumably *go*, ought to be lower than the aspectual head, which is itself lower than the tense head.

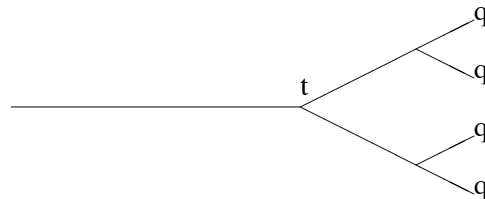
The second consideration is semantic in nature. The core meaning of progressives involves a kind of “ongoingness;” if John was singing, then at the time under discussion, the John-singing eventuality was already ongoing. Recall the intuition about why *be going to q* is not a felicitous offer: It’s already true that a *q*-eventuality will happen, so the hearer has no chance to say *yea* or *nay*. We may understand this fact as reflecting a kind of “ongoingness,” not of the eventuality itself, but of the *futurity* of the eventuality. If so, this intuition is another reason to give serious attention to the idea that there is something like a progressive scoping over the future element.

To evaluate the hypothesis, we need to flesh it out with specific future and progressive elements from among the existing literature: a version of Thomason’s (1970) future operator, and a very simple progressive operator first proposed by Bennett and Partee (1978). Thomason’s operator is defined as follows:

- (8) (Thomason 1970): For any time *t* and world *w*, $FUT(w)(t)(q)$
 $= 1$ if $\forall w'$ that agree with *w* up to *t*: $\exists t'$: $t < t'$ and $q(w')(t') = 1$;
 $= 0$ if $\forall w'$ that agree with *w* up to *t*: $\neg \exists t'$: $t < t'$ and $q(w')(t') = 1$;
 and is undefined otherwise.

The definition in (8) says that for any instant *t* and world *w*, $FUT(w)(t)(q)$ is defined just in case all the worlds share a truth value for *q* at the time in question. Then, if $FUT(w)(t)(q)$ is defined, it is true if on all worlds that agree with *w* up to *t*, there is some time *t'* that is later than *t*, at which *q* is true; and it is false if on all worlds that agree with *w* up to *t*, there is no time *t'* that is later than *t* at which *q* is true. The figure in (9) represents graphically a case in which $FUT(w)(t)(q)$ is true: The horizontal line in the diagram below represents the actual world, and the lines branching off represent the set of accessible worlds at time *t*.

- (9) A case in which $FUT(w)(t)(q)$ is true



The Bennett and Partee progressive operator, which I will call “P”, is a very simple one; it is true at a world and a time just in case its propositional argument is true at a superinterval of that time, in that world.³

- (10) $P(w)(t)(p) = 1$ iff $\exists t' \supset t$: $p(w)(t')$

Let us assume that present tense is null, and that *will* is just Thomason’s modal *FUT*, while

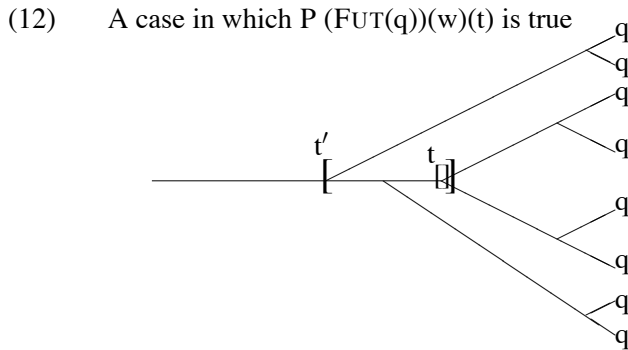
³This denotation of progressive aspect (Bennett and Partee 1978) runs afoul of the imperfective paradox, as noted by (Dowty 1979). Thus *P* cannot be the denotation of a “real” progressive. In Copley (2002b), I argue, following Dowty and practically everyone since (e.g., Landman (1992), Portner (1998), Cipria and Roberts (2000)) that “real” progressives have a modal component as well as this temporal component. I diverge from earlier accounts by pointing out a number of similarities between the modal component of “real” progressives and the future modal.

be going to has the proposed structure, with a Bennett and Partee progressive scoping over the Thomason modal, as expanded below.

- (11) $P(w)(t)(FUT(q)) = 1$ iff $\exists t' \supset t: [FUT(w)(t')(q) = 1]$
 $P(w)(t)(FUT(q)) = 1$ if $\exists t' \supset t: [\forall w'$ that agree with w up to t' : $[\exists t'': t' < t''$ and $q(w')(t'') = 1]]$

How can we characterize the set of worlds quantified over by this denotation of *be going to*? P , evaluated at t , w , and p , yields a truth value of 1 just in case p holds over a superinterval t' of t in w , where t is an internal interval of t' . *Be going to* represents a case where p is $FUT(q)(w)(t')$ (for some q).⁴

The worlds *be going to* quantifies over are not just the set of worlds $FUT(q)(w)(t)$ quantifies over, i.e., those that branch off during t , but a larger set of worlds: the worlds that branch off during some interval t' that surrounds t . We would represent the worlds *be going to* quantifies over as below in (12). If $[[be\ going\ to]](q)(w)(t)$ is true, that entails that all the worlds pictured branching off during some t' are q worlds, as shown in (12).



Be going to therefore quantifies over not only the worlds that FUT would quantify over given the same arguments, but also over additional worlds — those that branch off during t' but before the beginning of t — as long as t is not an initial interval of t' . While we could explicitly define the relation between t and t' to exclude such a possibility, there is no need to do so if we adopt a common⁵ assumption that the actual world only exists up to the time of utterance; equivalently, that future world-time pairs are not available except via modal means.

We are now in a position to return to the puzzle about offering, and explain why the speaker of ((13)a) (i.e., the billboard *be going to* utterance with the elided antecedent made explicit) cannot also consistently assert ((13)b), part of the offering condition.

- (13) a. #If you want us to change your oil in Madera, we’re going to change your oil in Madera.
 b. If you don’t want us to change your oil in Madera, we won’t change your oil in Madera.

Let p = the proposition expressed by *you want us to change your oil in Madera* (in the context in question); q = the proposition expressed by *we change your oil in Madera* (in the context in

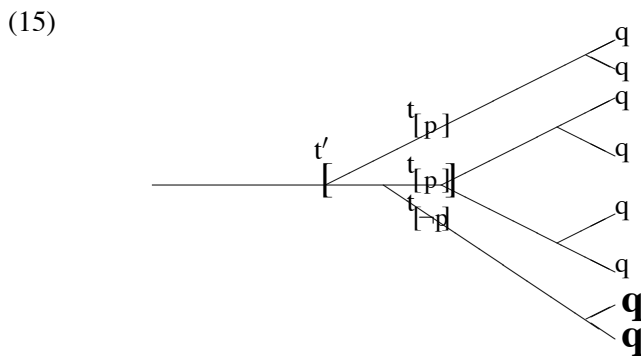
⁴Thomason’s original operator must be altered slightly so that it takes intervals rather than instants. The change is to substitute “agree with w up to the beginning of t ” for “agree with w up to t ” in the denotation of FUT . Intuitively, we can speak of branching worlds that branch off during an interval, rather than at an instant.

⁵See, among others, Prior (1967) and Abusch (1998) for independent justification of this assumption.

question); and t = a time at or after the reading of the billboard (i.e., the time when it matters whether the hearer wants q , and at which the offerer is prepared to bring about a q -eventuality). Then ((13)a) and ((13)b), the incompatible utterances from the puzzle, turn out as follows.

- (14) a. all worlds w such that $p(w)(t) = 1$ are worlds in which $P(w)(t)(FUT(q)) = 1$
 b. no worlds w such that $p(w)(t) = 1$ are worlds in which $FUT(w)(t)(q) = 1$

Now we will see how the current proposal derives the intuition that (14a) and (14b) are incompatible, solving the puzzle. Suppose now we consider one of the worlds in which p is true at t . We can imagine possible worlds in which p is not true at t (i.e., worlds in which $\text{not-}p$ is true at t , assuming contradictory negation for the sake of simplicity). These worlds would have to branch off from the p world before t . Of course, not all of the worlds that branch off before t are worlds that have $\text{not-}p$ true at t ; some of the worlds that branch off before t make p true at t . In general, for any interval t' which properly includes t , there will be some worlds that branch off from the actual world during t' such that $\text{not-}p$ is true at t (given, again, that t cannot be an initial interval of t'). Now, let us further suppose that (14a) is true. Therefore on any world that makes p true at t , there is an interval t' such that all the worlds that branch off during t' make q true at some later interval. This state of affairs is given below in (15).



But now notice that in a situation in which (14a) is true — that is, in which there is an interval t' including t such that all worlds branching off during t' have q true at some later time — there can still be $\text{not-}p$ worlds among these q worlds. Two such worlds in the diagram above are those with boldface, larger q . The existence of such worlds is inconsistent with the condition in (14b) that all $\text{not-}p$ worlds are worlds in which $\text{not-}q$ will happen (assuming that q and $\text{not-}q$ are inconsistent). That, then, is why the *be going to* sentence can't be used to make an offer. This incompatibility with a condition on offering explains the infelicity of *be going to* in this context, and is the correct characterization of the puzzle.

That this is the right approach to the puzzle becomes clear when we consider contexts in which $\text{not-}p$ worlds are assumed to be non-existent. In these contexts, *be going to* sentences don't sound so rude. Consider, for example, another possible billboard (you are already in Madera):

- (16) We're going to make you happy in Madera.

The sentence in (16) isn't exactly an offer, but neither is it entirely rude. The reason it is not so rude is that it is safe for the speaker to assume that there are no $\text{not-}p$ worlds; that is, conceivably, if you are already in Madera, there are no possible worlds in which you don't want to be happy in Madera. The utterance of (16) thus doesn't entail that any $\text{not-}p$ worlds are q worlds. Hence no conflict emerges.

The puzzle we began with, i.e., that *be going to* cannot be used to make an offer, provided empirical support to the proposal that this construction involves two ingredients: progressive-like aspect and a future modal. Indeed the semantic result of composing these two operators is apparently incompatible with what it means to make an offer.

Thus we have seen that an aspectual difference between *will* and *be going to* can account for modal differences between them. The modal semantics, we suppose, are indistinguishable, but because there is a temporal input to the accessibility relation, a difference in aspect means a difference in the set of worlds quantified over by the modal. In this case we saw that a progressive future conditional *If p, be going to q* will typically entail that some⁶ not-*p* worlds are *q* worlds, while a *will* conditional will not have such an entailment.

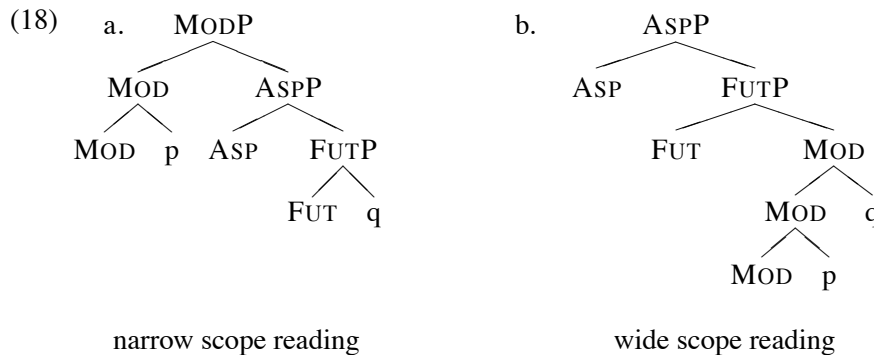
Let's call the entailment triggered by *be going to* the *anyway entailment*, since what is conveyed is that a *q*-eventuality will happen anyway whether a *p*-eventuality happens or not.

(17) *anyway entailment*: Some not-*p* worlds are *q* worlds

Conditionals that entail the anyway entailment I will term “anyway-entailing;” those that conflict with it I will call “anyway-conflicting”.⁷

3 Scope of *be going to*

In this section we will see that the aspectual component of *be going to* provides a way to detect scope differences among *be going to* conditionals. To do this, we first need to get a bit more precise about the logical form of the future modal. The presence of the aspectual element *P* makes it clear that *P*, and also *FUT*, must be part of the consequent of the conditional. For what drives the argument of the preceding section is the idea that all *p* worlds are “be going to *q*” worlds *at the time at which p is evaluated*. That is, the antecedent *p* and the constituent *be going to q* (= *ASP FUT q*) must get the same temporal argument. This is possible in a structure such as (18a), where *be going to q* is a constituent. This is not possible in a structure such as (18b) where *be going to q* is not a constituent, as *be going to* has scope over both *p* and *q*.⁸



⁶Actually, no other not-*p* worlds are accessible, so *all* not-*p* worlds under consideration are *q* worlds.

⁷Again, it will be important to remember that the semantics of conditionals, by assumption, has nothing to say about the not-*p* worlds; i.e., there is nothing inherently wrong with *be going to* in conditionals per se. Whether a conditional conflicts with the anyway entailment has rather to do with the pragmatics of the particular conditional.

⁸As we begin to construct trees for future conditionals, we have an immediate choice to make: Does the future modal take two (overt) propositional arguments, as is frequently proposed for modals, or does it take only one, as we have been assuming along with Thomason? We have no need for *FUT* to take two overt propositional arguments in this case; if it needed two arguments we would have to put a null argument in. As this is unwieldy, I will continue to assume that *FUT* has only one propositional argument²²⁷ seen by the syntax. Of course I do not mean to rule out contextually-supplied, syntactically invisible restrictions on *FUT*.

The informal meanings associated with the structures in (18) are given in (19); again, it is clear that the reading in which *be going to* has narrow scope is the one we want.

- (19) a. if p, q is going to happen narrow scope
 b. it's going to be like this: if p, q wide scope

To give a formal denotation for narrow scope *be going to* conditionals, let us assume a very bland modal semantics for the null modal:⁹

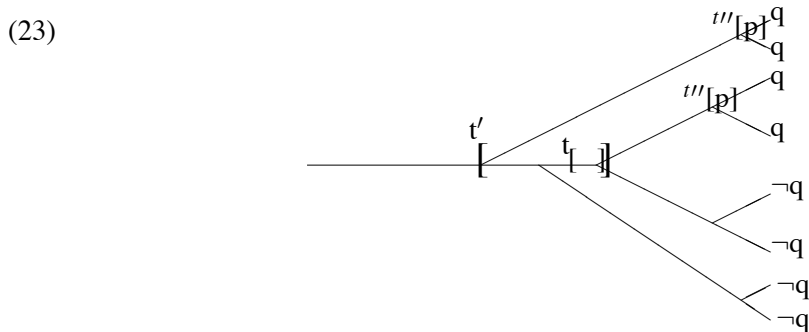
- (20) $\text{MOD}(w)(t)(p)(q) = 1$ iff $\forall w'$ such that w' is accessible from w, t and $p(w')(t)$:
 $[\exists t' \geq_q t: [q(w'')(t') = 1]]$

The denotation of a narrow *be going to* conditional is given in (21), and that of a wide scope *be going to* conditional in (22).

- (21) Narrow *be going to*: For any time t and world w ,
 $= \text{MOD}(w)(t)(p)(\text{P}(\text{FUT}(q)))$
 $= 1$ if $\forall w'$ s.t. w' is accessible from w, t and $p(w')(t)$:
 $[\exists t' \supset t: [\forall w''$ s.t. w'' is accessible from w', t' :
 $[\exists t'' > t': [q(w'')(t'') = 1]]]]]$

- (22) Wide *be going to*: For any time t and world w ,
 $= (\text{P}(w)(t)(\text{FUT}(\text{MOD}(p)(q))))$
 $= 1$ if $\forall w'$ is accessible from w, t : $[\exists t' \supset t$:
 $[\forall w''$ s.t. w'' is accessible from w', t' :
 $[\exists t'' > t'': [\forall w'''$ accessible from w', t''
 $\& p(w''')(t''): [\exists t''' \geq_q t'': q(w''')(t''') = 1]]]]]$

Narrow scope *bgt*, as we have seen, does trigger the anyway entailment: worlds that branch off during t' may or may not be p worlds, and must be q worlds. However, wide scope *bgt*, if it exists, would not trigger the anyway entailment, as it says nothing about not- p worlds. A branching diagram for a case where a wide scope *be going to if p, be going to q* is given below in (23).



But is the wide scope *be going to* conditional reading attested anywhere? It appears that it is. Under certain circumstances, it is in fact possible to use a *be going to* conditional to make an offer, as in (24).

⁹ \geq_q , briefly, would be a relation such that: if q is stative, $t' = t$; if q is not stative, $t' > t$. It is an old idea, in one version or another; c.f., e.g., Condoravdi (2002).

- (24) We're going to take good care of you before your defense.
 a. If you want a manicure, we're going to give you a manicure.
 b. If you want an oil change, we're going to give you an oil change.

These conditionals do present the manicure and the oil change as contingent on the hearer's desires. There still is something that does not depend on the hearer's desires; what is not negotiable in ((24)) is the idea that the speaker is going to take care of the hearer.

In addition to speaker intuitions that (24a,b) involve *be going to* scoping over the entire conditional, there is other evidence that (24a,b) are wide scope *be going to* conditionals. Since an offering reading is possible, it follows immediately that the anyway entailment is not triggered, just as we would predict for a wide scope reading. Furthermore, the offering reading disappears under *already*:

- (25) If you want a manicure, we're already going to give you a manicure. #offer

Supposing that *already* only takes a stative argument (Michaelis 1996), and further supposing that our simple progressive P counts as a stativizer, *already* forces P to be interpreted in situ, i.e., a narrow scope reading. Forcing the narrow scope reading causes the offering reading to disappear; therefore the offering reading must be associated with the wide scope reading.

4 Aspect of *will*

So far, I have argued that *will* and *be going to* differ in the presence or absence of an aspectual operator on the modal, and that *be going to* in conditionals exhibits two different scope-taking positions. The evidence for these claims rests on the idea that an aspectual operator, located higher than the future modal in *be going to*, triggers an entailment in a certain configuration.

Of course we do not want to stop here; ideally we would use the same means to determine whether *will*, like *be going to*, has two possible scope-taking positions in conditionals. We will begin such an investigation in section 5 below, but first it will be useful to re-examine the idea that *will* has no aspectual operator. Contrary to prediction, as we will see, some *will* conditionals are anyway-entailing. To explain these facts, I will posit a generic-like aspectual operator for these instances of *will*.

The anyway-entailing context that will prove surprising is furnished by relevance conditionals. Relevance conditionals are conditionals in which the antecedent seems to be a condition on the relevance to the hearer of the information in the consequent. Two examples of relevance conditionals are given in (26).

- (26) a. If you want to know, there's some beer in the fridge.
 b. If I may be frank, Frank is not looking good.

Unlike offering contexts, relevance contexts are anyway-entailing. We can see immediately that relevance conditionals are at least consistent with the anyway entailment; for example, the speaker of (26a) is not committed to (27a), nor is the speaker of (26b) committed to (27b).

- (27) a. If you don't want to know, there is no beer in the fridge.
 b. If I may not be frank, Frank is looking good.

Therefore, in the context in which a relevance conditional *If p, q* is truthfully uttered, not all not-p worlds are not-q worlds. That is, some not-p worlds are q worlds. So relevance conditionals

are anyway-entailing.

- (28) *Condition on relevance conditions.* If *p* is a relevance condition on *q*, some not-*p* worlds are *q* worlds.

We predict that *be going to* should be possible in the consequent of relevance conditionals, and *will* should be impossible. While it initially may seem that a *will* conditional *if p, will q* has nothing to say about the not-*p* worlds, this is not strictly true. Worlds that branch off before the present (or in the case of *be going to*, before the relevant superinterval of the present) are simply not accessible. So in a narrow scope *will* conditional, there will be no not-*p* worlds under consideration. We might, then, expect *will* conditionals to trigger a presupposition failure with respect to (28).¹⁰

The prediction seems at first to be borne out. While the conditional in (29a), using *will*, is not a good relevance conditional (but makes a fine offer), the conditional in (29b), using *be going to*, is a good relevance conditional (and as expected, is not a particularly good offer).

- (29) a. If you want to know, we'll go get some beer. #relevance, ✓offer
 b. If you want to know, we're going to go get some beer. ✓relevance, #offer

Interestingly, however, some *will* clauses *are* good in the consequent of relevance conditionals.

- (30) a. If you really want to know, John will win.
 b. If you really want to know, this comet will next be visible in 22 years.

What is responsible for these facts?

It does seem that there is something special about the felicitous anyway-entailing *will* conditionals in (30) that warrants addressing. In order for a *will* conditional to be anyway-entailing, the eventuality must be viewed by the speaker as a necessary outcome of forces that have already been set in motion and cannot be deflected. The same is true for *will* sentences that are *not* conditionals, as in (31).

- (31) a. Oh, she'll show up, all right.
 b. Don't worry, the Red Sox will win.
 c. It'll work. Trust me. I know about these things.

There seems to be some flavor of strong speaker certainty in these examples, though at this point it is hard to say what exactly. That is, we would not want to say that the corresponding *be going to* examples in (32) reflect some lesser level of certainty. In these examples, too, the speaker is absolutely sure.

- (32) a. Oh, she's going to show up, all right.
 b. Don't worry, the Red Sox are going to win.
 c. It's going to work. Trust me. I know about these things.

Yet, nonetheless, there is a clear intuition that *something* about the *will* sentences is stronger; somehow that they require more or better or more general evidence, or more strongly inevitable conclusions.

¹⁰For reasons of space I have had to abbreviate this point; what is important is the idea that, contrary to any homogeneous prediction, some *will* conditionals are anyway-entailing and some are anyway-conflicting.

I would like to propose the hypothesis that an aspectual difference between *will* and *be going to* is responsible for this intuition. Where *be going to* has an existential quantifier over times, the anyway-entailing version of *will* has universal quantification. In both cases the times thus picked out represent the times from which the worlds branch. If we suppose in this case that the branching is epistemic branching, then we can explain why the *will* sentences feel stronger. They require *q* to be true on epistemically accessible worlds branching off not merely from *some* time overlapping the present, but from *all* (realis) times that overlap the present.¹¹ This amounts to a requirement that the evidence for the statement be of relatively long standing.

Before addressing additional evidence for this idea, some formal details. We will proceed entirely in parallel to the *be going to* analysis, the only difference being the force of quantification. The proposed “dumb” aspectual component of anyway-entailing or G-*will* is given in (33), along with a timeline diagram illustrating the set of times that *p(w)* must hold of for *G(w)(t)(p)* to be true.¹²

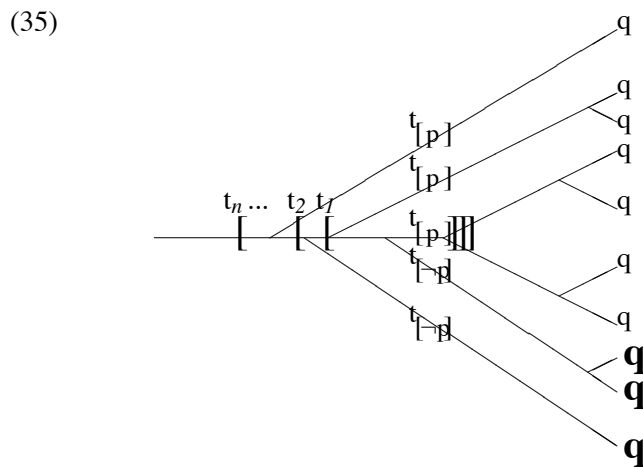
$$(33) \quad G(w)(t)(p) = 1 \text{ iff } \forall t' \supset t: p(w)(t')$$

Combining G with FUT, our future modal, yields the following denotation.

$$(34) \quad P(w)(t)(FUT(q)) = 1 \text{ iff } \forall t' \supset t: [FUT(w)(t')(q) = 1]$$

$$P(w)(t)(FUT(q)) = 1 \text{ if } \forall t' \supset t: [\forall w' \text{ that agree with } w \text{ up to } t': \\ [\exists t'': t' < t'' \text{ and } q(w')(t'') = 1]]$$

And (35) represents a state of affairs in which *G(w)(t)(FUT q)* is true.



As with *be going to* conditionals, we expect that all not-*p* worlds under consideration are *q* worlds (shown as worlds with boldface *q*), thus deriving the anyway entailment for narrow scope generic *will*. Why narrow scope? Again, the branching of the conditional modal MOD is not depicted. (35) represents a single *p*-world on which *G(FUT q)* is calculated at *t*.

This hypothesis seems to be supported by a conflict between the use of *will q*, and the speaker’s having just found out that *q*. This would be expected if the *will* used is G-*will*, where what G-*will* does is universal quantification over the contextually salient time, saying that FUT *q*

¹¹Naturally there will be contextual restriction on the universal quantification.

¹²As with the progressive-like operator P above, I use the single letter G in an attempt to evoke the traditional aspectual terminology for mnemonic purposes.

has been known all that time. The data is exemplified in (36). The use of *Look!* in in these examples forces a context in which the subsequent claim must follow from evidence that is new information. (36a) and (37a) show that *be going to* is fine in such a context; (36b) and (37b) demonstrate that *will* is not.

- (36) a. Look! It's going to rain!
 b. #Look! It'll rain!
- (37) a. Look! He's going to jump!
 b. #Look! He'll jump!

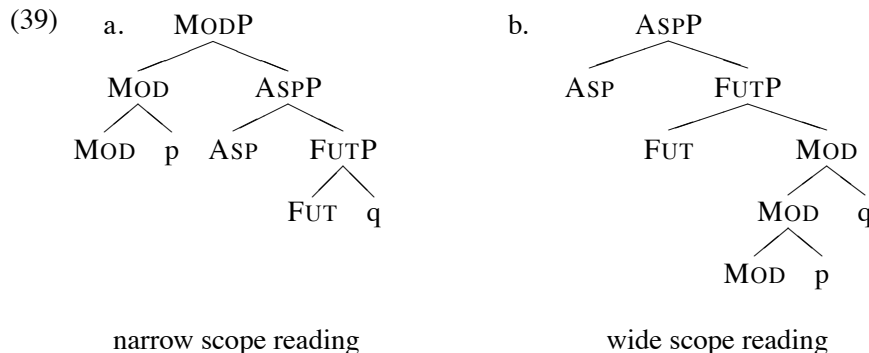
When the evidence is of long standing, *will* is fine.

- (38) a. Don't worry, it'll rain. It always does eventually.
 b. Oh, he'll jump. He's just that kind of person.

This is exactly what we would expect if the *will* in these examples is the G-future version of *will*. But to summarize where we are so far: We have seen that *will* does not behave in a homogeneous way with respect to the anyway entailment. This fact suggests two alternative theories. The first, which I will call the “aspectual theory”, is that *will* itself is aspectually ambiguous. One version, the G-future, triggers the anyway entailment by way of universal quantification over the temporal argument of the future modal's accessibility relation, and the other, an aspectless future (“A-future”), has no such aspectual element.¹³ Both of these contrast with the P-future *be going to*, which involves existential quantification over the temporal argument of the future modal's accessibility relation. The second alternative, which I will call the “structural theory”, is that there is only one aspectual value of *will*, namely the G-future reading. As with *be going to*, the narrow scope reading is anyway-conflicting, and the wide scope reading is anyway-entailing. We turn now to evaluate that alternative.

5 Scope of *will*

Recall that *be going to*, our P-future, has two different scope possibilities when in a conditional; it can occur either inside the consequent or scoping over the entire conditional.



¹³Would there be any aspect on “aspectless” *will*? Semantically there has to be at least a binding off of the temporal variable, which could be done by an unpronounced aspectual element:

(i) $\mathbf{A} = \lambda p \lambda w . \exists t: [p(w)(t)]$

Or it could be done by existential closure. Morphosyntactically, of course, there is no evidence for or against an aspectual head in either the A cases or the G cases.

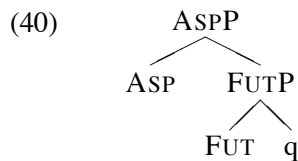
Likewise, we might expect *G-will* to have these scope possibilities, with *G* swapped in for *P* as the ASP head. Then the narrow scope reading would be anyway-entailing, and the wide scope reading would be anyway-conflicting, as in the *be going to* conditionals. There would be no need to posit two different aspectual values for *will*; *G-will* could do it all.

As initially satisfying as the structural account seems, there are a couple of reasons not to be satisfied with it. The first reason is that this theory has no principled way to explain the fact that wide scope *will* is much more natural as an offer than wide scope *be going to*. If we were to return to the aspectual theory, with an aspectually ambiguous *will*, we would at least be able to say that the aspectual futures *be going to* and *G-will* prefer to occur as narrow scope for some reason, and the aspectless future *A-will* prefers wide scope. There is still no principled reason, but at least the data are split into natural classes.

The second reason we should not be satisfied with the structural theory is that the wide scope *G*-future meaning simply does not seem to correspond to the meaning of *will* as it is used in offers. While the *G*-future semantics requires quantification over all the worlds that branch off within a contextually-specified interval, offering *will* seems intuitively to involve a “spur of the moment” decision. Indeed, *will* offers contrast with the wide scope *be going to* offers in that respect.

Thus it appears that the structural theory is not the one we want. We return to the aspectual theory, in which *will* is aspectually ambiguous, to see if that theory can be more satisfying. First we will develop a way to determine the scope of *A-will* in offers and *G-will* in inevitable *will* readings, based on whether the antecedent is obligatory or not.

The presence of *Mod* and its antecedent *p* is crucial to the wide scope readings. By compositionality, the only antecedentless structure possible should be (40):



Semantically this structure should always behave like a narrow scope reading rather than a wide scope reading in triggering the anyway entailment that all not-*p* worlds are *q* worlds, because for any *p*, whether or not *p*, *q*. Thus narrow scope readings should be able to occur either with or without an antecedent, while wide scope readings should only be possible with an antecedent. To detect an antecedent, we can rely on intuitions about whether the consequent is contingent on some other eventuality happening, or whether it will happen regardless. As per the discussion in section 1, it looks like offering *will* is wide scope, with the offer being contingent on the hearer’s desires. What we might call “inevitable *will*” must conversely be narrow scope, because the eventuality’s happening is not contingent on anything.

- (41) a. We’ll change your oil in Madera. offering *will*
 b. Don’t worry, it’ll rain. inevitable *will*

This is the same result the structural theory suggested. But in the structural theory, we expected wide scope to correlate with anyway-conflict, and narrow scope to correlate with anyway-entailment. In the aspectual theory, we do not expect such a correlation. That is, we expect to find a wide scope *G-will* conditional, and a narrow scope *A-will* conditional (or, failing that, a good reason why one or the other or both do not exist).

In fact there exists a good candidate for a wide scope *G-will* conditional. Consider the sentence in (42). It has two readings, paraphrased in (42a) and (42b). One is the familiar inevitable *will*;

the other is commonly called “dispositional *will*”. The readings also differ in truth value, as (42a) is false, while (42b) is true.

- (42) Dogs will eat doughnuts.
- a. That’s the way dogs are; there’s nothing you can do about it. inevitable *will*
 - b. If you give a dog a doughnut, it will eat it. dispositional *will*

The first reading is not contingent upon anything; the second is contingent on something. Thus the first reading (as before) should be narrow scope, and the second reading should be wide scope. The similarity between offering *will* and dispositional *will* conditionals is even more striking if we interpret (42b) as a kind of dispositional standing offer: Generally, if you want them to, dogs will happily oblige you and eat doughnuts.

The modal semantics also seems to be appropriate for G-*will*. (41b) says that generally, these days, any world where you give the dog a doughnut is one where it eats it. (42) That is, the quantification is over all normal worlds that branch off during a contextually specified interval that overlaps the present.

Therefore it appears that we have a good candidate for a wide scope G-*will* conditional, which supports the aspectual theory rather than the structural theory. We would also then wonder whether narrow scope readings of A-*will* conditionals exist. A reexamination of the data in (36)a and (37)b above suggests that they may not. For if they did exist, unlike G-*will* readings, we would not expect them to be ruled out in the relevant contexts. Hence we would not expect infelicity in these examples. Since there is infelicity, we conclude that only G-*will* is possible with narrow scope. If this is true, we should look for a principled reason why A-*will* is not possible in narrow scope conditionals.

6 Conclusions

I have presented evidence that futures such as *will* and *be going to* have aspectual components to their meaning. These aspectual components interact with future modality by modifying the temporal argument to the modal’s accessibility relation. This has the effect of altering the set of worlds over which the modal quantifies. These modal differences support a theory in which there are three different aspectual variations, and two different scope positions for futures in conditionals. The presence of aspect on modals therefore provides us with a new tool with which to investigate the logical form of conditionals.

One question deserving of further investigation is whether there are any correlations or dependencies between aspect or scope and the modal base for the future modal. For instance, we saw in section 4 above that the wide scope G-future apparently has an epistemic modal base. While this topic is omitted from this paper for reasons of space, it is omitted for reasons of space only; it would be instructive to see how the choice of aspect or scope constrains the choice of modal base for the future modal, and why.

Finally, it is worth pointing out that the explanations explored here absolutely require a modal analysis of *will* and *be going to*. Central to the explanation of the data is the idea that a higher aspect affects the temporal argument of the modal’s accessibility relation. If instead we were to begin from a tense analysis of these futures (see Hornstein (1990), Condoravdi (2001) for discussion of such an analysis in comparison with modal analyses), it is difficult to see how the facts presented here could be explained at all.

References

- Abusch, D.: 1985, *On Verbs and Time*, PhD thesis, University of Massachusetts.
- Abusch, D.: 1998, Generalizing tense semantics for future contexts, in S. Rothstein (ed.), *Events and grammar*, Vol. 70 of *SLAP*, Kluwer, Dordrecht.
- Baker, M.: 1985, The mirror principle and morphosyntactic explanation, *Linguistic Inquiry* **16**(3), 373–415.
- Bennett, M. and Partee, B.: 1978, *Toward the Logic of Tense and Aspect in English*, Indiana University Linguistics Club.
- Cinque, G. (ed.): 2002, *Functional Structure in DP and IP: The Cartography of Syntactic Structures*, Oxford University Press, Oxford.
- Cipria, A. and Roberts, C.: 2000, Spanish *imperfecto* and *pretérito*: Truth conditions and aktionsart effects in a Situation Semantics, *Natural Language Semantics* **8**(4).
- Condoravdi, C.: 2001, Will.
URL: citeseer.nj.nec.com/condoravdi01will.html
- Condoravdi, C.: 2002, Temporal interpretation of modals, in D. Beaver, S. Kaufmann, B. Clark and L. Casillas (eds), *Stanford Papers on Semantics*, CSLI Publications, Palo Alto.
- Copley, B.: 2001, *Be going to* as a case of high aspect, *Proceedings of SALT XI*, Cornell Linguistics Circle, Ithaca, NY.
- Copley, B.: 2002a, A linguistic argument for indeterministic futures, *Proceedings of NELS 32*.
- Copley, B.: 2002b, *The Semantics of the Future*, PhD thesis, MIT. In press in Garland's *Outstanding Dissertations in Linguistics* series.
- Dahl, Östen.: 1985, *Tense and Aspect Systems*, Blackwell, Oxford.
- Dowty, D.: 1979, *Word meaning and Montague Grammar*, Reidel, Dordrecht.
- Hornstein, N.: 1990, *As Time Goes By*, MIT Press.
- Kratzer, A.: 1986, Conditionals, *Papers from the Regional Meetings, Chicago Linguistic Society*, pp. 1–15.
- Landman, F.: 1992, The progressive, *Natural Language Semantics* **1**(1), 1–32.
- Lewis, D.: 1986, *On the Plurality of Worlds*, Blackwell, Oxford.
- Michaelis, L.: 1996, On the use and meaning of *already*, *Linguistics and Philosophy* **19**, 477–502.
- Portner, P.: 1998, The progressive in modal semantics, *Language* **74**(4), 760–87.
- Prior, A.: 1967, *Past, Present, and Future*, Oxford University Press, Oxford.
- Tenny, C.: 2000, Core events and adverbial modification, in S. Rothstein (ed.), *Events and grammar*, Kluwer, Dordrecht, pp. 333–348.
- Thomason, R.: 1970, Indeterminist time and truth-value gaps, *Theoria* **36**, 264–281.

Aspectualized Futures in Indonesian and English

Indonesian has three morphemes that are commonly used to express futurity:

- (1) Budi akan/mau/pasti makan ikan.
Budi AKAN/MAU/PASTI eat fish
'Budi (future) eat fish.'

In this paper, I will consider the grammaticality and felicity judgments of two Indonesian speakers from Jakarta,¹ for whom these future morphemes all have different meanings. That is, it seems that for these speakers, no two of these morphemes are merely stylistic or register variants of each other. I will argue that for these speakers, the meanings of these three morphemes all contain a future modal, and that two of the morphemes (*mau* and *pasti*) each additionally include as part of their meaning a different aspectual operator (progressive-like and generic-like respectively) affecting the temporal argument of the accessibility relation of the modal. These combinations of aspect and a future modal I will call "aspectualized futures." Throughout, I will compare the Indonesian future forms with those in English: *will* and *be going to*.

In the first section of the paper, I compare *akan* and *will* with *mau* and *be going to* with respect to contexts of offering. In the second section we will see an explanation of these facts that treats *mau* and *be going to* as aspectualized futures, with a progressive-like aspectual operator. The third section concerns a dialect in which the judgments are slightly different, and discusses how they might be accounted for. The fourth section proposes an aspectual operator for *pasti*, suggesting that *will* is ambiguous between an *akan* reading and a *pasti* reading.

¹I will refer to the language spoken by these speakers as "Indonesian" until section 1.3, when we will look at data from two other speakers.

1.1 *Akan* and *mau*

Suppose that the linguistics department is going to hold a colloquium, and that the students need to find someone to make the coffee for it. The colloquium organizer stands up at the student meeting and asks for a volunteer. Another student can felicitously offer to make the coffee by saying (2a), though not by saying (2b).

- (2) a. Saya akan membuat kopi.
 I AKAN make coffee
 ‘I (future) make coffee.’ √offer
- b. Saya mau membuat kopi.
 I MAU make coffee
 ‘I (future) make coffee.’ #offer

The sentence in (2b) is by no means ungrammatical. A student could use it to report that, contrary to the colloquium organizer’s beliefs, he was already planning to make the coffee. But it could not be used to make a spontaneous offer to make the coffee.

English has a similar phenomenon². Parallel to the contrast in (2a) and (2b), the sentence in (3a) can be used to make an offer, while the sentence in (3b) cannot be (Leech (1971), Brisard (2001)).

- (3) a. I’ll make coffee. √offer
 b. I’m going to make coffee. #offer

Indonesian and English thus have something in common: In the (b) cases but not the (a) cases, the speaker is reporting on an already-existing plan for the speaker to make coffee. Speakers of both languages have the intuition that in the (b) examples, the “being-going-to-ness” of the coffee-making is already underway: It has already been settled that coffee-making is going to happen. It is this intuition that seems incompatible with the offering context.

At this point we have a puzzle: Why are *mau* and *be going to* bad in offers, and why are *akan* and *will* good? Let’s call this puzzle “the offering puzzle.”³

An aside: We should be careful not to fall into the trap of equating *mau* with *be going to*, or for that matter *akan* with *will*. The next two examples demonstrate why. In Indonesian, it is *mau* that is used in dispositionals, while *akan* is impossible.

²For earlier discussions of this fact, see, for example, Nicolle (1997), Brisard (2001), Leech (1971). I have discussed it before in Copley (2001), Copley (2002a), Copley (2002b), and Copley (2007).

³I have discussed the offering puzzle elsewhere: Copley (2001, 2002a,b, 2007).

- (4) a. Budi mau makan ikan.
 Budi MAU eat fish
 ‘Budi is willing to eat fish.’
- b. Budi akan makan ikan.
 Budi AKAN eat fish
 #‘Budi is willing to eat fish.’

By contrast, in English *will* (which otherwise can behave like *akan*) is typically used for dispositionals, and *be going to* (which otherwise behaves like *mau*) is quite odd. The sentence in (5a) can be a perfectly good answer to the question “Does Budi eat fish?” but the sentence in (5b) is rather bad in that context.

- (5) a. Budi will eat fish.
 b. #Budi is going to eat fish.

I will not have anything further to say about dispositional readings here, but they demonstrate for us that whatever *mau* and *be going to* have in common, they do have differences; and whatever *akan* and *will* have in common, they have their differences as well.⁴

With that caveat in mind, let us consider how to solve the offering puzzle.

1.2 Solving the offering puzzle

Recall the puzzle: Why can *akan* and *will* be used to make an offer, while *mau* seemingly cannot be? I will propose that while *akan* is just a future modal, *mau* and *be going to* are aspectualized futures. Their meaning consists of a progressive-like aspectual operator on top of a future modal, and this combination conflicts with a pragmatic requirement on acts of offering.

Suppose we consider in more depth what it is to make an offer. There are a number of conditions on the felicity of offers.⁵ The first condition has to do with the contribution of the speaker. It seems reasonable that only someone who can decide whether an eventuality happens or not can felicitously make an offer for that eventuality to happen. I cannot felicitously offer for it to rain tomorrow, for instance, because I have no power over the weather. So in order for an individual *s* (“speaker”) to be able to make a valid offer to carry out a *q*-eventuality (an eventuality

⁴Moreover, we will be adding to the list of differences between *akan* and *will* in a later section, where *will* is argued to have another distinct reading corresponding to the third Indonesian future morpheme, *pasti*.

⁵The discussion here is tailored to the needs of the current project. See Searle (1975) for the classic treatment of conditions on offering.

of which a predicate q holds), s must have power over whether a q -eventuality occurs.⁶ Let's call this ability (without going into a precise modal characterization of ability) *direction*.

- (6) An individual s *directs* q just in case s has the ability to determine whether a q -eventuality happens.

The one to whom the offer is made, whom I will refer to as h ("hearer"), also seems to have some control over whether the q -eventuality occurs. It should happen if h wants it to happen, and, equally importantly, it should not happen if h wants it not to happen. It would certainly be rude for someone to make an assertion that entails that in some cases where you do not want them to make the coffee, they do it anyway. For an utterance to count as an act of offering, the speaker's carrying out of the offered eventuality has to be contingent on the interlocutor's preferences.

Let's suppose that when a speaker utters *will* q or *akan* q as an offer, they are actually committing themselves to the truth of a conditional *if you want* q , *will* q , and a presupposition that s has power over whether a q -eventuality occurs.⁷ On a Kratzer-style account of conditionals (Kratzer (1986), Kratzer (1981)), s asserts⁸ that in all worlds where h wants q , a q -eventuality happens. And let us further agree that in making a valid offer, s is also committed to the truth of the proposition expressed by the conditional *If you don't want* q , *won't* q (where *don't want* = *want not*). This commitment reflects our intuition that the hearer's desires have an effect on whether a q -eventuality happens; it happens only if the hearer wants it to. Note that this commitment is not required by anything about the semantics of the conditional, but rather is just a pragmatic requirement on offers.

This approach, while faithful to our intuitions about offers, makes the odd prediction (brought to my attention by an anonymous reviewer) that both (7a) and (7b) have the same felicity conditions.

- (7) a. We offer to play music during the party.
b. We offer not to play music during the party.

Actually, this prediction is correct. When $q =$ *we play music during*

⁶In fact, the requirement may be weaker. It may be merely that the speaker must believe she has power over whether a q -eventuality occurs. Here we will abstract away from this consideration.

⁷Presumably this is done by treating the utterance as the consequent of that conditional, with the antecedent elided.

⁸Later, we will make use of the idea that offers are performative, so perhaps assertion is not the right idea here. On the other hand, Searle takes the position that performative acts are also assertions, so perhaps there is no problem in using both.

the party, we predict in both cases that the speaker is committed to the same things: q if the hearer wants q , and not- q if the speaker wants not- q . This is as it should be. The problem is that something more needs to be said to distinguish (7a) and (7b), because clearly the content of the offer is not the same. One way of handling this would be to add a presupposition that the speaker expects the hearer will probably want q , while being aware of the possibility that they might not. We will set aside this presupposition for the purposes of the present argument.

Let us construct an informal condition on offers, meant to be a necessary and sufficient condition.⁹

(8) *Offering condition.*

s has felicitously offered to bring about a q -eventuality for h iff s has the power to determine whether q happens, and is committed to the truth of (a) and (b):

- a. If B wants q , will q .
- b. If B doesn't want q , will not- q .

This characterization of offering gives us a hint about the semantics of *mau* and *be going to*. Since *mau* and *be going to* are, in the cases we are interested in, incompatible with offering, their semantics should somehow conflict with the characterization of offering given in (8).

Let us see how this idea works. For the colloquium example, the student offering to make the coffee would thus have to be committed to (9a) and (9b).

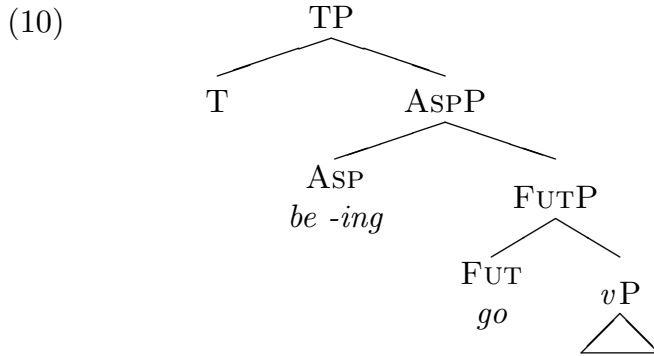
- (9) a. If you want me to make the coffee, I'll make the coffee.
- b. If you don't want me to make the coffee, I won't make the coffee.

The problem with using *mau* and *be going to* in offering contexts seems to be a conflict with the requirement in (9b). If you're going to make the coffee regardless of what anyone else says, then certainly (9b) isn't true. In fact, the problem is that *mau* and *be going to* apparently convey that it is *already* true that the speaker will make the coffee. This flavor of "ongoingness," an aspectual concept, suggests that there is aspect involved in the meaning of *mau* and *be going to*.

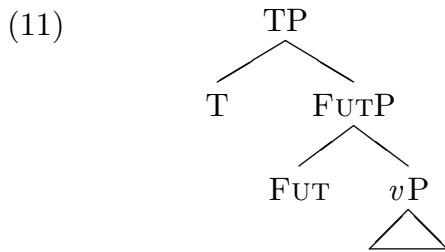
There are a couple of other reasons to think that the essential difference between *mau* and *be going to* on the one hand and *akan* and *will* on the other is one of aspect. One reason is evident in the morphology of English *be going to*, which suggests a progressive operator higher than the future modal, as in (10) below. This structure represents what I am

⁹For a more formal treatment of this condition, see Copley (2002b) and Copley (2007).

calling an aspectualized future.



(10) is to be contrasted with (11), which is the structure for a non-aspectualized (or bare) future modal.



English may not be alone in overtly marking a future form with aspectual morphology. Blackfoot has two future forms, *áak* and *áyaak*, where the second form is what would be expected from the composition of a durative marker *a-* and *(y)áak*. And indeed, in offering contexts *áak* behaves like *will* and *áyaak* behaves like *be going to*: (12a) is possible as an offer, but (12b) is not (Reis Silva, 2007).

- (12) a. Nisto nit**áak**ihkiita
 1sg 1sg-FUT-cook
 ‘I will cook.’
 b. Nisto nit**áyaak**ihkiita
 1sg 1sg-FUT-cook
 ‘I am going to cook.’

A third reason to ascribe the offering puzzle to an aspectual difference has to do with the fact that offers are performative speech acts. It is uncontroversial that performatives are incompatible with aspect: For example, the simple present is used for an act such as a christening, while the progressive is infelicitous:

- (13) a. I (hereby) christen this ship the Queen Mary.
 b. I am (#hereby) christening this ship the Queen Mary.

Therefore, we should not be surprised if aspectualized futures are like-

wise incapable of being used to express offers. This fact is thus another reason we might look to aspectual differences to explain the difference between forms that allow offers and those that do not.

Finally, there is a reason, aside from their lack of aspectual morphology, to think that *akan* and *will* lack aspectual meaning. Consider the sentences in (14) and (15), where the speaker is pointing at dark clouds that have formed on the horizon.

- (14) a. Aduh, mau hujan.
 Look, MAU rain
 ‘Look, it (future) rain.’
 b. #Aduh, akan hujan.
 Look, AKAN rain
 ‘Look, it (future) rain.’

The examples in (14) show a contrast between *mau* and *akan* in a context where the prediction is being made on the basis of evidence available just at the time of utterance (that is, not drawing on evidence from any earlier time, except for general knowledge about how rain clouds develop). That context is favored by the exclamation *aduh*.

The English futures provide a similar contrast, as shown below in (15).

- (15) a. Oh look, it’s going to rain.
 b. #Oh look, it’ll rain.

Like *mau*, *be going to* is possible in this situation, while like *akan*, *will* is not possible.¹⁰ Why are *mau* and *be going to* good here, but *akan* and *will* bad?

One possible hypothesis we might entertain is that *akan* and *will* both need to have a restriction, and since there is no restriction in (14b) and (15b), that is why *akan* and *will* are unacceptable. Now, this hypothesis requires some further elaboration. There is clearly no *overt* restriction required for *akan* and *will*, because it is possible to find *akan* and *will* sentences that have no overt restriction, for example (2a) and (3a). However, (2a) and (3a), I have argued, have a *covert* restriction: *if the hearer wants* q. So perhaps *akan* and *will* do have a requirement for a covert restriction. In the context in (14b) and (15b), there is no event upon which the rain event is presented as contingent, which is to say that there is no restriction. Thus on the hypothesis that *akan* and *will*

¹⁰The addition of *aduh* ‘look’ or *oh look* is crucial here, as it rules out other contexts. There are of course various other contexts in which *will* is fine; in particular, we might consider contexts where a “long experience” construal arises, as in *Don’t worry, it’ll rain*. This construal is discussed in greater detail below in section 1.4.

require a covert restriction, *akan* and *will* would correctly be predicted to be bad in (14b). However, this hypothesis fails when we consider promises.

Promises, like offers, are performative speech acts that commit the speaker to doing something. However, they are unlike offers in that they do not present the eventuality as being contingent on the hearer's desires. Instead they presuppose that the hearer desires the eventuality. *Akan*, like *will*, is just as felicitous with promises as it is with offers: Just as you can offer to make the coffee by saying *Saya akan membuat kopi* or *I will make the coffee*, you can promise to make the coffee by uttering these same sentences.

Therefore, it cannot be argued that the reason the sentences in (14b) and (15b) are bad because of a requirement that *akan* and *will* have a covert restriction.

A more plausible reason to rule out (14b) and 15b) is that it is a non-performative utterance predicated of the speech time, and that aspect is required in that case. The progressive sentence in (16a), for example, is fine, but the bare verb in (16b) yields infelicity.

- (16) a. Zoe is dancing.
 b. #Zoe dances.

The contrasts in (14) and (15) are best explained the same way as the contrast in (16), namely by way of an aspectual distinction.

I have argued for three reasons to think that *mau* and *be going to* are aspectualized—their flavor of “ongoingness”, the overt aspectual morphology of *be going to*, and their status as non-performative speech acts—and one reason to think that *akan* and *will* are non-aspectualized, namely their incompatibility with contexts relying on here-and-now evidence. I will thus suppose that *akan* and *will* have no aspect while *be going to* and *mau* are aspectualized futures, consisting of an aspectual operator scoping over a future modal, as in (10a). In order to evaluate this idea, it is necessary to decide upon meanings for both the aspectual operator and the future modal.

For the semantics of the future modal, we will use a denotation drawn from Thomason (1970), given below in (17), and paraphrased in (18).

(17) (Thomason, 1970)

For any instant t and world w , $FUT(w)(t)(q)$
 = 1 if $\forall w'$ that agree with w up to t :
 $\exists t': t < t'$ and $q(w')(t') = 1$;
 = 0 if $\forall w'$ that agree with w up to t :
 $\neg \exists t': t < t'$ and $q(w')(t') = 1$;
 and is undefined otherwise.

- (18) For any instant t and world w , $\text{FUT}(w)(t)(q)$ is defined iff all the worlds that branch off at t share a truth value for q . If $\text{FUT}(w)(t)(q)$ is defined, it is true iff on all those worlds there is some time t' later than t at which q is true; and it is false if on all those worlds there is no time t' later than t at which q is true.

A case in which $\text{FUT}(w)(t)(q)$ is true is represented in the branching time diagram in (19) below:



I will set aside the question of how to model precisely *which* worlds branch off; equivalently, if we are thinking of a Kratzer-style system (Kratzer (1991), e.g.), we will be ignoring what the modal base and ordering source would be. But let us suppose that these worlds are *inertia worlds* in the sense of Dowty (1979): worlds in which events develop normally.¹¹ The idea that the branching worlds are inertia worlds will be useful later, in section 1.4, but for now we will only be concerned with the temporal properties of the future modal.

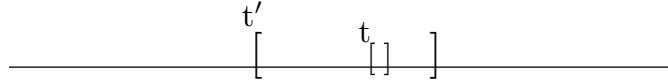
Since the denotation desired for *mau* and *be going to* is to be composed of a future modal and a progressive operator, it remains to choose a meaning for the progressive operator. We will adopt a very simple one, namely a version of the Bennett and Partee (1978) proposal for the meaning of the English progressive. This progressive operator takes a world, an interval, and a proposition, and returns truth if there is a superinterval of the original interval on which the proposition is true at that world.

¹¹This assumption may seem off-base, since it is perfectly possible to make a prediction and assert that the world will *not* develop normally. However, the speaker must at least assume that the world develops normally from the (possibly unusual) starting conditions that the speaker has in mind. For more discussion on this point, see Copley (2002b). See also Werner (2002), Condoravdi (2003) for more on the choice of worlds to be quantified over. Incidentally, setting aside the question of which worlds branch off was also what we did when we set aside the dispositional readings of *mau* and *will* in (4a) and (5a).

$$(20) \mathbf{P}(w)(t)(q) = 1 \text{ iff } \exists t' \supset t: q(w)(t')$$

As Dowty points out (Dowty, 1979), this denotation runs afoul of the imperfective paradox.¹² This is not a problem for the current project, since the goal is not to construct a meaning for the progressive.¹³

(21)



Let us assume that present tense is null, and that *akan* and *will* have the meaning of FUT. *Mau* and *be going to*, on the other hand, have the proposed structure, namely a Bennett and Partee progressive **P** scoping over FUT, as expanded below. Thomason’s original operator must be altered slightly so that it takes intervals rather than instants. The change is to substitute “agree with *w* up to the beginning of *t*” for “agree with *w* up to *t*” in the denotation of FUT. Intuitively, we can speak of branching worlds that branch off during an interval, rather than at an instant.¹⁴

$$(22) \begin{aligned} & \llbracket mau \rrbracket^g / \llbracket be\ going\ to \rrbracket^g = \mathbf{P}(w)(t)(\text{FUT}(q)) \\ & = 1 \text{ iff } \exists t' \supset t: [\text{FUT}(w)(t')(q) = 1] \\ & = 1 \text{ if } \exists t' \supset t: [\forall w' \text{ that agree with } w \text{ up to the beginning of } t': \\ & \quad [\exists t'': t' < t'' \text{ and } q(w')(t'') = 1]] \end{aligned}$$

How can we characterize the set of worlds quantified over by this denotation of *mau* (and equally, of course, *be going to*)? **P**, evaluated at *t*, *w*, and *p*, yields a truth value of 1 just in case *p* holds over a superinterval *t'* of *t* in *w*, where *t* is an internal interval of *t'*. *Mau* represents a case where *p* is FUT(*q*)(*w*)(*t'*) (for some *q*).

¹²The imperfective paradox is the fact that (i) is acceptable:

(i) John was drawing a circle, but then he got up to answer the phone and he never finished.

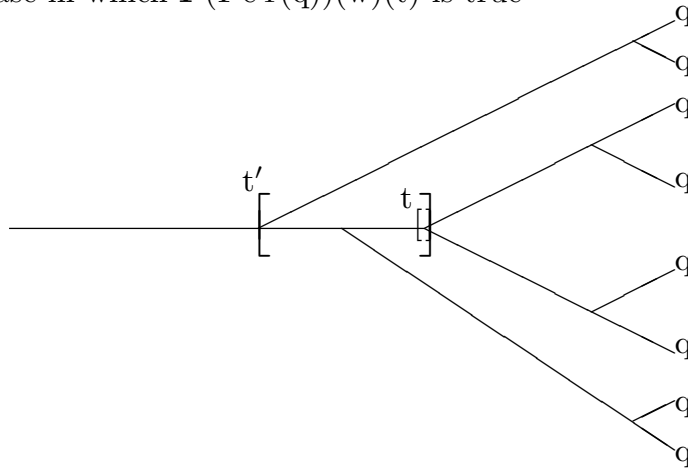
If the denotation of the progressive *be -ing* were really as in (20), then (i) would be predicted to be bad, since there is in this case no interval *t'* for which *John draw a circle* is true in the actual world.

¹³If anything, the present project is very much along the lines of Dowty’s analysis of the English progressive, since both his denotation for the progressive and mine for *be going to* place a modal under this strictly aspectual operator.

¹⁴The superscript *g* in the equation in (22) denotes a variable assignment along the lines given in, for example, Heim and Kratzer (1998). For reasons of clarity, the denotation in (22) does not include the cases where $\mathbf{P}(w)(t)(\text{FUT}(q)) = 0$ (those cases where on all the worlds that branch off from *t'* there is no interval on which *q* is true) and the cases where $\mathbf{P}(w)(t)(\text{FUT}(q))$ is undefined (those cases where some of the worlds branching off from *t'* have such an interval and some of the worlds do not); see for comparison the denotation of FUT in (17).

The worlds *mau* quantifies over are not just the set of worlds $\text{FUT}(q)(w)(t)$ quantifies over, i.e., those that branch off during t , but a larger set of worlds: the worlds that branch off during some interval t' that surrounds t . We would represent the worlds that *mau* quantifies over as below in (23). If $\llbracket \textit{mau} \rrbracket^g(q)(w)(t)$ is true, that entails that all the worlds pictured branching off during some t' are q worlds, as shown in (23).

(23) A case in which $\mathbf{P}(\text{FUT}(q))(w)(t)$ is true



Mau therefore quantifies over not only the worlds that *akan* would quantify over given the same arguments, but also over additional worlds—those that branch off during t' but before the beginning of t —but only as long as t is not an initial sub-interval of t' . Why must t not be an initial sub-interval of t' ? The reason is that there must be some part of t' before t begins, so that the world quantifier can quantify over those worlds that branch off before the beginning of t . If t and t' had the same initial point, there would be no worlds that branched off during t' but not during t . While we could explicitly stipulate the relation between t and t' to exclude such a possibility, there is no need to do so if we adopt a common¹⁵ assumption that the actual world only exists up to the time of utterance; equivalently, that future world-time pairs are not available except by modal means. In that case, the only way t can be a proper subinterval of t' is if t' begins before t begins, because they must both end at the time of utterance. Therefore there is no need for an additional stipulation that t not be an initial interval of t' .

Now to solve the offering puzzle. Let p be the proposition expressed by *you want me to make the coffee* (in the context in question); q be the proposition expressed by *I make the coffee* (in the context in question);

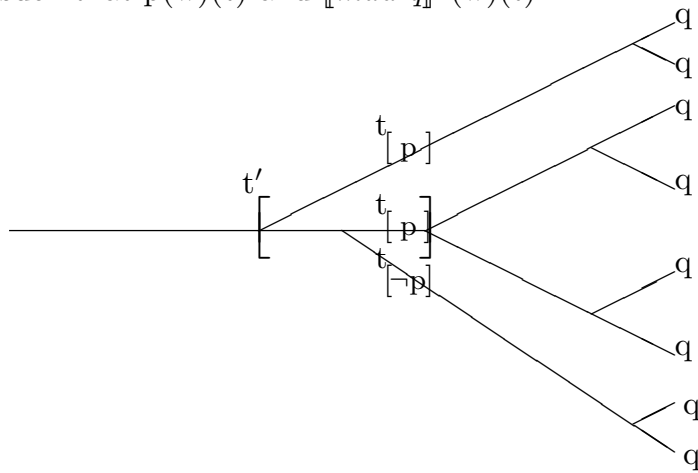
¹⁵See, among others, Prior (1967), Abusch (1998), and Werner (2002) for independent justification of this assumption.

and t be a time at or after the utterance time (i.e., the time when it matters whether the hearer wants q , and at which the offerer is prepared to bring about a q -eventuality). Then the incompatible propositions from the puzzle are rendered as follows.

- (24) a. *mau q/be going to q*: All worlds w such that $p(w)(t) = 1$ are worlds in which $\mathbf{P}(w)(t)(\text{FUT}(q)) = 1$
- b. Condition on offering (= (8b)): All worlds w such that $\neg p(w)(t) = 1$ are worlds in which $\text{FUT}(w)(t)(q) = 1$

Depicted below is a world in which p is true at time t , and in which *mau q* (or *be going to q*) is also true at t .

- (25) w, t such that $p(w)(t)$ and $\llbracket \textit{mau q} \rrbracket^g(w)(t)$



The first thing to note about (25) is that there are some not- p worlds among those that branch off during t' but before the beginning of t . This is accurate as long as p describes some sort of non-necessary occurrence. But in that case, there are not- p worlds that are q worlds (worlds in which they don't want you to make the coffee, but you do it anyway). This is the source of the conflict with the offering condition. *Mau* and *be going to* sentences have an entailment that q will happen anyway, whether or not p happens. Let's call this entailment the "anyway entailment."¹⁶

- (26) "Anyway entailment": Some not- p worlds are q worlds.

¹⁶Actually, a stronger version of the anyway entailment is true: All not- p worlds are q -worlds. This is argued for in Copley (2007). The argument is based on the idea that only worlds branching off during the topic time are under consideration, and all of those worlds that are not- p worlds are also q worlds.

That this is the right approach to the puzzle becomes clear when we consider contexts in which not-*p* worlds are assumed to be non-existent. In these contexts, *be going to* sentences do not sound rude. Consider, for example, another possible billboard that you might see in Madera:

(27) We're going to make you happy in Madera.

The sentence in (27) is not exactly an offer, but neither is it entirely rude. The reason it is not so rude is that it is safe for the speaker to assume that there are no not-*p* worlds. That is, conceivably, provided you are already in Madera, there are no possible worlds in which you don't want to be happy in Madera. The utterance of (27) thus does not entail that any not-*p* worlds are *q* worlds. Hence no conflict with the offering condition emerges.

The puzzle we began with, i.e., that *mau* and *be going to* cannot be used to make offers, provided empirical support to the proposal that this construction involves two ingredients: progressive-like aspect and a future modal. The modal semantics of *mau* and *be going to*, we suppose, is indistinguishable from that of *will* and *akan* (modulo any difference in modal base or ordering source), but because the set of branching futures is dependent upon time, a difference in aspect means a difference in the set of worlds quantified over by the modal. In this case we saw that a *be going to q* or *mau q* statement will typically entail that a *q*-eventuality will happen regardless of what else happens, while a *will q* or *akan q* statement will not have such an entailment.

1.3 Microvariation

My interviews with Indonesian speakers yielded a certain variation in judgments. This is not surprising, as “Bahasa Indonesian” is a nationally imposed lingua franca. Many speakers speak or spoke other languages or varieties at home, and are exposed to “official” Indonesian only upon starting their formal education. So we should not necessarily expect to find the same judgments among those who describe themselves as Indonesian speakers.

As I remarked above in the introduction to the paper, sections 1.2 and 1.3 were based on the judgments of two speakers who had the same judgments (DY and WH). I did consult with speakers whose judgments were quite different from these two speakers, on both grammatical and lexical items. More interesting for our present purposes, however, is a pair of speakers (YT and NP) whose grammar seems only minimally different from the first two speakers.

Let's call the original pair of speakers “group 1” and the second pair “group 2”. Unlike group 1 speakers, group 2 speakers reject the use

of (28a) as an offer. In addition, group 2 speakers accept (28b), which group 1 speakers reject entirely.

- (28) a. Saya akan membuat kopi.
 I AKAN make coffee
 ‘I (future) make coffee.’ 1: \checkmark offer 2: #offer
- b. Aduh, akan hujan.
 oh-look, AKAN rain
 ‘Oh look, it (future) rain.’ 1: # 2: \checkmark

I do not have an analysis of the Group 2 facts, but there is a little more to say about Group 2 offers.

Group 2 speakers can, of course, make offers, but they use the bare verb or *bisa* ‘can’ to make an offer, as in (29b) below. I did not ask group 1 speakers about the use of the bare verb to make an offer, as in (29a). They did not, however, volunteer it as a way of making an offer. They did accept sentences with *bisa* for offers.

- (29) a. Saya membuat kopi.
 I make coffee
 ‘I make coffee.’ 1: (not attested) 2: \checkmark offer
- b. Saya bisa membuat kopi.
 I can make coffee
 ‘I can make coffee.’ 1: \checkmark offer 2: \checkmark offer

All other group 2 judgments are the same as group 1 judgments.

How can the group 2 judgments be explained? One plausible hypothesis we must examine is the idea that *akan*, like *mau*, is also aspectualized for group 2 speakers. Of course, if this were the case we would not want there to be two lexical items with exactly the same meaning. Indonesian is rife with lexical items that vary only in register, i.e., their appropriateness in formal or informal situations. But the group 2 speakers rejected the idea that *akan* and *mau* belonged to different registers. On the other hand, *akan* and *mau* have another difference, namely, the possibility for dispositional readings, as shown in (4), repeated below as (30b).

- (30) a. Budi mau makan ikan.
 Budi MAU eat fish
 ‘Budi is willing to eat fish.’
- b. Budi akan makan ikan.
 Budi AKAN eat fish
 #‘Budi is willing to eat fish.’

The existence of this contrast shows that *akan* and *mau* are not entirely synonymous, making it possible that *akan*, like *mau*, could be aspectualized. But this hypothesis cannot be right. The judgment in (31) is

shared by group 1 and group 2 speakers alike, and is unexpected if *akan* has aspect.¹⁷

- (31) #*Kalau kamu mau tahu, Budi akan menang.*
 if you want know Budi AKAN win
 intended: ‘If you want to know, Budi will win.’

The reason is that, in the most plausible scenario, the speaker is not proposing that Budi’s winning is contingent on the hearer’s desire to know. Rather, the speaker is asserting that Budi will win regardless; the antecedent is something like a condition on relevance to the hearer.¹⁸ This context is thus an anyway-entailing context, and if *akan* were an aspectualized future for group 2 speakers, we would expect (31) to be acceptable for them. It is not, so we are forced to look elsewhere for an explanation of the group 2 judgments in (28).

It seems plausible at first blush that the availability of the simple present for offers, as in (29a), has something to do with the fact that (28a) is unacceptable as an offer for group 2 speakers. There are, however, languages in which both are available (with different meanings), such as French:

- (32) a. *Je fais le café.*
 I make DET coffee
 ‘I’ll make the coffee.’ √offer
- b. *Je ferai le café.*
 I make-FUT DET coffee
 ‘I’ll make the coffee.’ √offer

Since the French facts demonstrate that present-tense and future-tense offers can coexist in a language, the felicity of present-tense offers in Group 2 Indonesian is unlikely to be related to the infelicity of *akan* offers in Group 2 Indonesian. I will have to leave the question of the correct analysis of Group 2 Indonesian futures for later research.

1.4 *Pasti*

So far, I have given an account of *akan* and *mau* for certain speakers of Indonesian, and briefly discussed the problems that arise from a variant dialect. At this point, we turn to the third Indonesian future, *pasti*.

¹⁷The English version of (31) is discussed below in section 4. The scope-taking alternative discussed in that section for *pasti*, *will*, *be going to*, and *mau* is of no use here, because here is no configuration that will allow an aspectless future to generate the anyway entailment.

¹⁸See Austin (1961) for the classic discussion of this kind of conditional, and Siegel (2004) (and references therein) for more recent discussion.

I have analyzed both *akan* and *will* as aspectless Thomason-style future modals. Given this analysis, we would expect the *will* sentences in (33) to be unacceptable: They present the eventuality as non-contingent, hence the anyway entailment holds.

- (33) a. Don't worry, it'll rain.
 b. Trust me, it'll work.
 c. Oh, she'll be there.

The reason the examples in (33) are not contingent is because there is no restriction at all for *will*. The speaker of (33a), for instance, is not saying that it will rain if such-and-such a thing occurs, but rather that it will rain no matter what else happens.¹⁹ This is why the anyway entailment holds.

A similar problem arises with relevance conditionals, as in (34) (and similar to the Indonesian example in (31) above).

- (34) If you really want to know, Mary will win.

While there is indeed an *if* clause in (34), as we saw above, the truth of the consequent is not contingent on the truth of the antecedent. This can be seen from the fact that (on the most plausible reading) the speaker is asserting that Mary will win regardless of whether the hearer really wants to know that she will. The *if* clause is something like a condition on relevance.

In light of the analysis given above for *will* in offers, it is surprising that these *will* sentences apparently have the anyway entailment. If *will* is aspectless, as argued above, it should not trigger the anyway entailment. Interestingly, this problem does not arise for *akan*. To translate sentences such as those in (33) and (34), Indonesian speakers do not use *akan* but rather *pasti*.

- (35) a. Pasti hujan.
 PASTI rain
 'It'll rain.'
 b. #Akan hujan.
 AKAN rain
 'It'll rain.'
- (36) a. Kalau kamu mau tahu, Budi pasti menang.
 if you want know Budi PASTI win
 'If you want to know, Budi will win.'

¹⁹The examples in (33) have a characteristic intonation, supported in part by the extra elements *Don't worry*, *Trust me*, and *Oh*, without which they can sound very odd: *#It'll rain* by itself is extremely bizarre, for example.

- b. #Kalau kamu mau tahu, Budi akan menang.
 if you want know Budi AKAN win
 (= (31) above)

This third future morpheme can therefore occur in anyway-entailing contexts, just like *mau* does. But *pasti* behaves unlike *mau* in non-anyway-entailing contexts, where the consequent truly is contingent on the antecedent. In these contexts, *pasti* is acceptable, like *akan* and unlike *mau*. Despite the fact that *pasti* and *akan* receive similar judgments, however, the meanings of *akan* and *pasti* are apparently different, as is evident from one speaker's reports about his judgments in (37) and (38).

- (37) a. Kalau kamu menjatuhkan vas ini, vasnya akan pecah.
 if you drop vase this vase-det A-fut break
 'If you drop this vase, it will break.'
- b. Kalau kamu menjatuhkan vas ini, vasnya pasti pecah.
 if you drop vase this vase-det PASTI break
 'If you drop this vase, it will break.'
- "*Akan* works just fine but *pasti* sounds better." (YT)

In offering contexts, while *akan* is ordinarily used, *pasti* can be used, e.g., to report that one's son will help, conveying that the speaker is certain the son will offer.

- (38) a. Kalau kau mau, anak-ku akan membantu-mu.
 if you want child-my akan help-you
 'If you want, my child will help you.' (= (??) above)
- b. Kalau kau mau, anak-ku pasti membantu-mu.
 if you want child-my pasti help-you
 'If you want, my child will help you.'
- "*Pasti* will work but sounds stronger (how sure am I that my son will do it?)" (YT)

Let us consider the perceived difference in strength or certainty between *akan* and *pasti* in (38). How might we capture this difference? Presumably, *pasti* quantifies over more worlds than *akan* does. One way to achieve this result is to vary the strength of the quantification over the accessible worlds. The highest level of certainty corresponds to universal quantification, and increasingly lower levels of certainty correspond to increasingly lower levels of quantification. But even though (38a) corresponds to a lower level of certainty than does (38b), it is unthinkable that *akan* could involve less than universal quantification—it is nothing like a *might* or *may* modal.

Since weakening the quantificational force of *akan* is not an option, we must instead find another way to ensure that *pasti* quantifies over

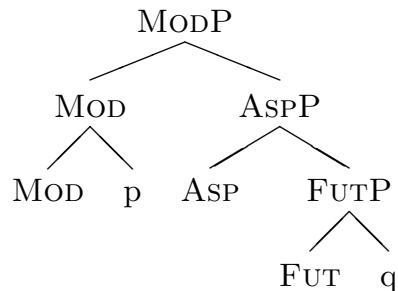
more worlds than *akan* does. I would like to propose that *pasti* is an aspectualized future. As I argued above, an aspectualized future modal quantifies over more worlds than does the bare future modal.²⁰ Partial confirmation for this idea is given by the fact that *pasti* can occur in anyway-entailing contexts; I argued above that only aspectualized futures are possible in those contexts. However, if *pasti* is aspectualized, it must be explained why *pasti* can also occur in non-anyway-entailing contexts as well.

To explain this, let us return to the account of the anyway entailment developed in the previous section. The account explained why conditionals like the one in (39) entailed that *q* will happen regardless of whether *p* happens.

(39) If *p*, be going to/mau *q*.

Crucial to this account was the idea that in a conditional where *mau q* is the consequent and *p* is the antecedent, *mau q* is evaluated at the same time as *p*. In that case, clearly *mau q* must be a constituent in the phrase structure for (39) (where *mau* is the spell out of the ASP and FUT heads). This means that the structure for (39) will be like that in (40). However, there is no reason that the structure in (40b) would not be possible.²¹ Both structures, for instance, are compatible with the independently developed account of conditional syntax given by Bhatt and Pancheva (2005).

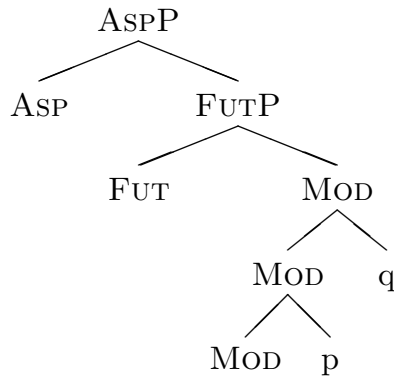
(40) a. narrow scope reading



²⁰It is not immediately clear that *be going to* is stronger than *will*, or that *mau* is stronger than *akan*, as this analysis might seem to predict. However, in the offering case, this is surely the case, since *will* and *akan* present the eventuality as contingent, and *be going to* and *mau* present it as non-contingent. In sentences where *will* seems stronger than *be going to*, *will* is anyway-entailing and therefore must have the *pasti* reading.

²¹In (40b) I have placed the conditional modal MOD under the future modal FUT to avoid the need for two denotations of FUT, where one denotation takes one propositional argument (needed anyway for (40a)) and one that takes two. If there were an independent reason to think that FUT has two such meanings, such an implementation would not materially affect the account developed here.

b. wide scope reading



If wide scope (i.e., over the entire conditional) is possible, then in those cases we would not expect to see the anyway entailment, because the aspectualized future is too high to trigger it. (Recall that the anyway entailment is triggered when the consequent of the conditional includes an aspectualized future.) The conditional part of (40b) says simply *if p, q*, so the anyway entailment is not triggered.²² I propose that this wide scope configuration in 40b is why *pasti* is possible in the non-anyway-entailing contexts in (37b) and (38b).²³

Further support for the scope-taking hypothesis comes from the group

²²This is an oversimplification. When *q* is stative, the anyway entailment is indeed triggered, as we can see from comparing the eventive predicate *go to my office* in (i) with the stative predicate *be in my room* in (ii), below. With the former, the consequent is contingent upon the antecedent, while with the latter, the consequent is not contingent upon the antecedent (that is, the speaker is going to be in her office regardless).

- i. If you need me, I'll go to my office.
- ii. If you need me, I'll be in my office.

This effect requires the future element to take wide scope, and is discussed at length in Chapter 4 of Copley (2002b). In any case, it is dependent upon the stativity of the complement of the future element, not on the aspectual element that scopes over the future element.

²³What about the other aspectualized futures, *mau* and *be going to*? They also can take wide scope. In (i), for example, what is already true, i.e., non-contingent, is that the speaker will do something to help the hearer relax. What that something is (i.e., making coffee for the hearer or giving the hearer a manicure) is contingent on the hearer's desires.

- i. I'm going to help you relax before your dissertation defense. If you want me to make you coffee, I'm going to make you coffee. If you want me to give you a manicure, I'm going to give you a manicure.

The meanings of the conditionals in (i) therefore correspond exactly to the wide scope meaning proposed in (40b), with *be going to* taking scope over the conditional. See Copley (2007) and Copley (2002b) for further justification of this claim.

2 data²⁴ in (41).

- (41) a. ?Kalau dia memukul dahinya, dia **akan** mengatakan sesuatu yang penting
 if s/he hit forehead-det s/he akan say something rel ir
 ‘If she hits her forehead, she will tell you something important.’
- b. #Kalau dia memukul dahinya, dia **pasti** mengatakan sesuatu yang penting kepadamu.
- c. Kalau dia memukul dahinya, dia **pasti akan** mengatakan sesuatu yang penting kepadamu.

Here, the consequent is contingent on the antecedent, so this is a non-anyway-entailing context. Neither *pasti* nor *akan* is entirely appropriate, but *pasti akan*, as in (41c), is perfect. *Akan pasti*, however, is not possible. One speaker (YT) remarked, “*Akan* alone will somewhat work . . . but *pasti akan* sounds better. To me, *pasti* alone in this case sounds awkward, because it makes the two events (hitting forehead and saying something important) sound like they are simultaneous. Something like ‘If he hits his forehead, he *pasti* feel pain.’” How to explain these intuitions?

Let’s leave aside (41a) for the moment. Note, however, that we have no way of knowing whether *akan* is taking wide scope or narrow scope in (41a), because *akan* is not an aspectualized future, and so could not generate the anyway entailment even if it was interpreted in the consequent, taking narrow scope.

By contrast, we can distinguish the scope-taking possibilities of *pasti*, assuming that *pasti* is an aspectualized future. The use of *pasti* in (41b) is infelicitous. Narrow scope *pasti* in (41b) is correctly ruled out, because a narrow scope aspectualized future would trigger the anyway entailment, which is not supported in this causal context. But why is wide scope *pasti* ruled out?

The answer is in the speaker’s comments: When confronted with (41b), he volunteered for the consequent an event that follows immediately from the event in the antecedent. The person’s hitting their forehead immediately causes the pain, similarly to dropping the vase causing it to break. The forehead-hitting does not *immediately* cause them to tell you something important, even if it does *ultimately* cause it.

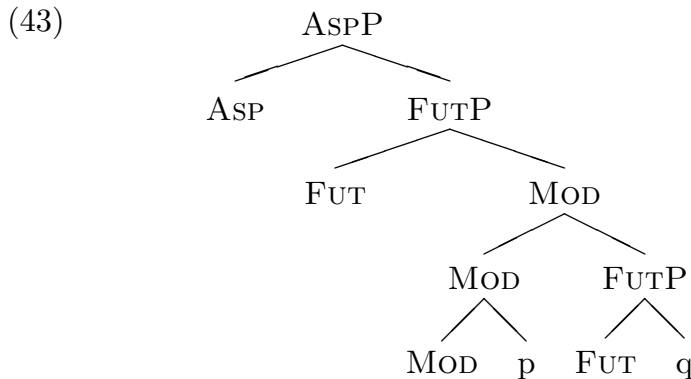
But this restriction to immediate cause is exactly what we would expect if there were no future interpreted inside the consequent. We can observe this situation in English conditionals that lack futures. While the conditionals in (42a) and (42b) lack a morphological analogue to

²⁴Examples with double futures were not attested with group 1 speakers.

pasti, the relation between cause and effect is similar, and (42b) tends to sound as though the events are simultaneous or nearly so.

- (42) a. If the vase falls, it breaks.
 b. If she hits her forehead with her hand, she tells you something important.

Thus, in the forehead-hitting case, a future is needed in the consequent. It cannot be *pasti*, because *pasti* is aspectualized and thus anyway-entailing. So *akan* must be used. The structure of (41c) would therefore be this:



The ASP head and the higher *Fut* head combine by head movement and are spelled out as *pasti*, while the lower FUT is *akan*. Because *akan q* is in the consequent of the conditional modal, the temporal-phenomenological distance between the *p*-eventuality and the *q*-eventuality will be closer than it would be in (41b), where *pasti* takes wide scope and there is no future interpreted in the consequent.

The opposite configuration, with *akan* scoping over *pasti*, would not be possible because of the inability of *pasti* to take narrow scope in this situation. This fact at least partly goes toward ruling out the infelicitous sentence in (44).

- (44) *Kalau dia memukul dahinya, dia **akan pasti** mengatakan sesuatu yang penting
 if s/he hit forehead-det s/he akan pasti say something rel important to-you.
 ‘If she hits her forehead, she will tell you something important.’

But as consultants rejected all instances of *akan pasti* out of hand, that may not be the only reason.²⁵

Let us recall where we are in the argument. We began by entertaining a hypothesis that *pasti*, like *mau*, is an aspectualized future. The

²⁵It is not the case that *akan* cannot take wide scope for group 2 speakers, because it is acceptable in the vase-breaking case in (37a), and by assumption could only do that if it has wide scope.

fact that *pasti* could occur in both anyway-entailing and non-anyway-entailing contexts seemed problematic. However, I argued that these two different possibilities stem from the ability to take either wide scope or narrow scope. Further corroboration for this account was provided by a case of double futures in group 2 Indonesian.

So we may conclude that *pasti* is an aspectualized future, like *mau*. But how is it different from *mau*? Speakers find it stronger than *mau*. I will assume that this fact indicates a different aspectual semantics (since it is unlikely to indicate a different force of quantification).

A relatively minimal adjustment to the aspect proposed for *mau* is appropriate. Suppose that where *mau*, like *be going to*, has an existential quantifier over times, *pasti* (and the anyway-entailing version of *will*) has universal quantification. The truth of *Pasti q* requires *q* to be true on all accessible worlds branching off not merely from *some* time overlapping the present, but from *all* (realis) times that overlap the present, within some contextually supplied domain interval *I*. This amounts to a requirement that the conditions that cause *q* be of relatively long standing.

This proposal makes sense of why (41a) is a little strange. Without the use of a wide scope *pasti* to indicate that the underlying causes of the conditional—the dispositions of the person under discussion—are longstanding, (41a) should convey that the underlying causes, i.e., the dispositions, are transient and hence irregular, in which case it is not clear why the speaker would try to assert a generalization at all.²⁶

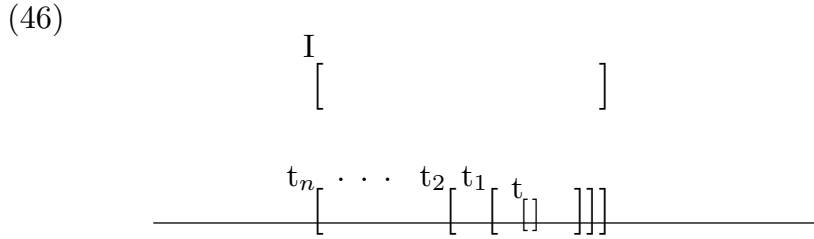
For the formal details, we will proceed entirely in parallel to the *be going to* analysis, the only difference being the force of quantification. The proposed aspectual component of the anyway-entailing reading of *will* is given in (45), along with a timeline diagram illustrating the set of times within a contextually-specified interval *I* that *p(w)* must hold of for $\mathbf{G}(w)(t)(p)$ to be true.²⁷

$$(45) \mathbf{G}(w)(t)(p) = 1 \text{ iff } \forall t' \in I \text{ such that } t' \supset t: p(w)(t')$$

The universal quantification may look strange in what is meant to be the denotation of a generic operator, but remember that we are quantifying over inertia worlds—those worlds in which circumstances unfold as they typically do. This restriction, plus universal quantification, gives rise to a generic-like meaning, because only the typical worlds are considered. The times over which t' varies are all the subsets of *I*:

²⁶This point, if clarified, might explain the fact that counterfactuals in Indonesian require *pasti*, not *akan*.

²⁷As with the progressive-like operator **P** above, I use the single letter **G** in an attempt to evoke the traditional terminology “generic,” for mnemonic purposes only.



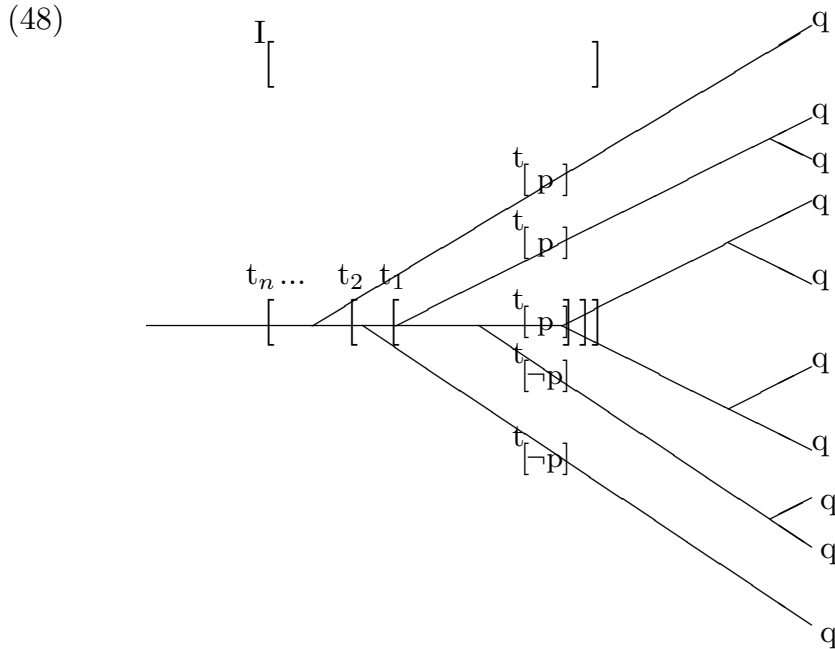
Combining \mathbf{G} with FUT , our future modal, yields the following denotation for *pasti*.²⁸

(47) $\mathbf{G}(w)(t)(\text{FUT}(q)) = 1$ iff $\forall t' \in I$ such that $t' \supset t$: $[\text{FUT}(w)(t')(q) = 1]$

$\mathbf{G}(w)(t)(\text{FUT}(q)) = 1$ if $\forall t' \in I$ such that $t' \supset t$: $[\forall w'$ agrees with w up to t' :

$[\exists t'': t' < t''$ and $q(w')(t'') = 1]]$

And (48) represents a state of affairs in which $\mathbf{G}(w)(t)(\text{FUT } q)$ is true.



Note that as desired, this denotation accounts for the anyway entailment seen in narrow scope *pasti* sentences. The argument is exactly parallel to the one for *mau/be going to* sentences: If this branching world is a p

²⁸Here as in (22) above, I omit the cases where $\mathbf{G}(w)(t)(\text{FUT}(q)) = 0$ or is undefined.

2.

Bridget Copley - University of Southern California ***So-called epistemic should***

copley@usc.edu

The so-called epistemic reading of *should* has traditionally (Horn, 1989) been treated as less-than-universal quantification over the speaker's epistemically accessible worlds. As shown in (1), it is weaker than epistemic *must*, which is taken to universally quantify over those worlds. While the continuation in (1a) is unacceptably redundant, the continuation in (1b) provides additional information. (Deontic readings of *should* are ignored throughout.)

- (1) a. #Xander must be there, in fact, he should be.
b. Xander should be there, in fact, he must be.

(1) is consistent with an analysis in which *must* and *should* both quantify over epistemically possible worlds, but *should* quantifies over fewer of them. However, the contrast in (2) seems to point away from an epistemic analysis of "epistemic" *should*. For if an utterance of *should* p really does assert p to be true on most of the speaker's epistemically accessible worlds, (2b) ought to be as contradictory as (2a). Yet it is not.

- (2) a. # Max must be there, but I have absolutely no idea whether he is.
b. Max should be there, but I have absolutely no idea whether he is.

(2b) seems instead to mean that if things proceed as they are supposed to, Max is there. So rather than quantifying over epistemic possible worlds, *should* apparently quantifies over inertially possible worlds (in the sense of Dowty, 1979). This idea might be modeled with an ordering source that picks out the best possible continuation worlds, i.e., those in which things proceed normally. The assertion is then that on those worlds, p.

On this story, an explanation for the contrast in (1) would depend on the set of inertia worlds being smaller than the set of epistemically accessible worlds. There is no reason for this to generally be so. However, another contrast, between *should* and *will*, suggests a different solution to the problem. *Will* also quantifies over inertial worlds; it also asserts that on all those worlds, p, but in addition presupposes that the actual future continuation is an inertial one (Copley, 2002) with respect to p. Note that *will* is also stronger than *should*:

- (3) a. # Zoe will win, in fact, she should win.
-

- b. Zoe should win, in fact, she will win.

Unlike *will*, *should* apparently does not commit the speaker to the belief that the actual future continuation will be an inertial one. Instead, the speaker merely has an expectation that the actual future will be an inertial one. There might be a presupposition to this effect, or alternatively, the expectation might stem from a restriction to inertially well-behaved continuations, without assuming that the actual future is well-behaved. Either way, the weakness of *should* is in a presupposition or restriction rather than in the assertion. But this introduces enough weakness into the meaning of *should* to explain the contrast in (3), and plausibly also the contrast in (1).

Reference

- Copley, Bridget (2002) *The Semantics of the Future*, Ph.D dissertation, MIT. (To be published by Routledge, Outstanding Dissertations in Linguistics series).
- Dowty, David (1979) *Word Meaning and Montague Grammar: The Semantics of Verbs and Times in Generative Semantics and in Montague's PTQ*, Reidel, Dordrecht.
- Horn, Laurence (1989) *A Natural History of Negation* (2nd edition), University of Chicago Press, Chicago.

What should *should* mean?*

Bridget Copley
CNRS/Université Paris 8

January 3, 2006

Abstract

One analysis of non-deontic *should* treats it as having less-than-universal quantification over the epistemically accessible worlds – the worlds that, for all the speaker knows, could be the actual world. This analysis is based on the intuition that *should* assertions are weaker than are assertions of epistemic *must* sentences. Problems with the traditional analysis, however, indicate that there must be a different reason why these *should* sentences express weaker propositions. This paper argues that non-deontic *should* can involve either epistemic or metaphysical modality; both are weaker than epistemic *must* because *should* does not trigger a presupposition that things work out normally, while *must* does. An initially problematic attempt to extend this analysis to deontic *should* prompts a revision to Kratzer’s theory of modals, in which the division of labor between the modal base and the ordering source is rethought.

1 The traditional view

English *should*, like many other modals, has more than one flavor of modal meaning, as demonstrated by the examples in (1). (1a) conveys the speaker’s assessment that the hearer would do well do go to school tomorrow. (1b) conveys the speaker’s assessment that it will likely rain tomorrow.

*I am indebted to Nathan Klinedinst for helping me to realize a number of consequences of my initial idea. Thanks as well to attendees of the *Language Under Uncertainty* workshop for much helpful discussion, and to everyone who (advertently or inadvertently) provided me with data. All errors and omissions are mine.

- (1) a. You should go to school tomorrow.
- b. It should rain tomorrow.

The same sentence can have both kinds of readings, as in (2), with two paraphrases given in (2a) and (2b):

- (2) Jenny should be there tomorrow.
- a. If she wants to get the job, she really needs to be there tomorrow.
- b. That's what I gather from what I know about her plans.

In each paraphrase, there are different kinds of facts that are presented as relevant. In (2a), as in (1a), the relevant information seems to be about ideals of some kind: either there is a rule saying what the ideals are, or there is in effect a rule about what one would ideally do if one had certain ideals. This kind of reading is often referred to as a “deontic” or “practical necessity” reading. We will leave this reading aside until the very end of the paper, and instead concentrate on the kind of reading exemplified in (1b) and (2b).

In these examples, the relevant information that the speaker takes into consideration seems to consist of facts about the world; the speaker's evidence or grounds for believing the proposition to be true. This kind of reading is commonly known as the “epistemic” or “logical necessity” reading of *should* sentences.

Behind the choice of the term “epistemic” is the suspicion that the kind of modality involved has to do with speaker knowledge. That is, it is the same kind of modality that is involved in epistemic readings of *must* sentences as in (3) (the parenthetical in (3) is intended to rule out the deontic reading of *must*, on which Xander is required to be there).

- (3) Xander must be there (his car is outside, his lights are on, etc.).

The starting idea is that the epistemic reading of a sentence *must p* says that all epistemically accessible worlds are *p* worlds (Kratzer, 1991). Let C be a context of utterance, an n -tuple including (at least) the speaker, the time of utterance, and the world of utterance.

- (4) $C := \langle x_C, t_C, w_C \rangle$

Let \mathcal{E}_C be the epistemically accessible set of worlds, the worlds that for all the speaker knows could be the actual world:

- (5) $\mathcal{E}_C :=$ the set of worlds compatible with what x_C knows at t_C in world w_C .

And let **All** be a function with the usual (Barwise and Cooper-inspired) semantics as follows:

- (6) $\mathbf{All} := \lambda p \lambda q . p \cap q = p$

We can assume then that the meaning of *must* is as given in (7); it says of a proposition that it is true in all the worlds that are epistemically accessible to the speaker at the world and time of speech.¹

- (7) $\llbracket \textit{must} \rrbracket(C)(p) := 1$ iff $\mathbf{All}(\mathcal{E}_C)(p)$

Actually, as Kratzer points out, this denotation is too strong; it predicts that the proposition expressed by *must p* entails the one expressed by *p*, since the actual world has to be among the set of epistemically accessible worlds. The solution (following Lewis (1968, 1975)) is to say that the set quantified over is not the set of epistemically accessible worlds, but a subset of those worlds; the set of best epistemically accessible worlds according to some plausibility metric (or “ordering source,” in Kratzer’s terminology). Let us suppose that we can construct a function, relativized to the context *C*, that takes a set of worlds as its argument and returns the subset that contains exactly the worlds in which the least out-of-the-ordinary things happen. We will be coy for the moment about precisely how to construct this function.² We change the denotation of *must* to reflect this new set:

- (8) $\llbracket \textit{must} \rrbracket(C)(p) := 1$ iff $\mathbf{All}(\mathbf{highest-plausibility}_C(\mathcal{E}_C))(p)$

Then, since it need not be true that the actual world is one of the most plausible epistemically accessible worlds, *must p* is weaker than *p*, as desired.

Can this epistemic analysis be extended to non-deontic *should*? If so, how? Horn (1989) proposes that *should* is to *must* as *most* is to *all*, based on the contrast shown in (9).

- (9) a. #Xander must be there, in fact, he should be.

¹For our purposes we are abstracting away from the temporal dimension; propositions are sets of worlds, and “*p* is true in *w*” is the same as “*w* is an element of *p*”.

²For instance, at this point our context will have to contain more than what we have put in it so far.

- b. Xander should be there, in fact, he must be.

Horn argues that the contrast in (9) shows that a *should* sentence expresses a weaker proposition than its *must* counterpart. The argument is based on a Gricean implicature: the proposition expressed by the second clause must not be entailed by that expressed by the first, or else the “Be informative” maxim would be violated. Horn argues that what goes wrong in (9a) is exactly that: The proposition expressed by *he should be* is entailed by the proposition expressed by *Xander must be there*.

This is exactly parallel to the behavior of *all* and *most*.

- (10) a. #I ate all of the raisins, in fact, I ate most of them.
- b. I ate most of the raisins, in fact, I ate all of them.

Horn argues that this weakness is due to a weaker quantifier in *should*. And it is parallel to *most*, not, for instance, *some*, assuming that something like *may* corresponds to *some*, as shown by (11) and (12).

- (11) a. #I ate most of the raisins, in fact, I ate some of them.
- b. I ate some of the raisins, in fact, I ate most of them.
- (12) a. #Xander should be there, in fact, he may be there.
- b. Xander may be there, in fact, he should be there.

To express the desired analysis of *should*, reflecting Horn’s idea in combination with our Kratzer-style modal semantics, we define a function **Most** with the usual semantics:

$$(13) \quad \mathbf{Most} := \lambda p \lambda q . | p \cap q | > | p - q |$$

And we give a denotation for *should* that is true if on most of the epistemically accessible worlds, p.

$$(14) \quad \llbracket \textit{should} \rrbracket (C)(p) := 1 \text{ iff } \mathbf{Most}(\text{(\textit{highest-plausibility}}_C(\mathcal{E}_C))(p))$$

This analysis of *should* I will call the “traditional view.”

2 Evaluating the traditional view

As it turns out, the traditional view does not adequately account for the meaning of *should*.

Unlike *must p* sentences, *should p* sentences are possible with a continuation expressing the speaker's absolute ignorance as to whether *p* is true or not. This contrast is shown in (15).

- (15) a. #The beer must be cold by now, but I have absolutely no idea whether it is.
b. The beer should be cold by now, but I have absolutely no idea whether it is.

The judgment for *must* in (15a) makes sense on the traditional view; if you use *must*, and thereby convey that on all of the most plausible epistemically possible worlds the beer is cold, it would be strange to then comment that you have no idea whether it is or not, giving rise to an instance of Moore's Paradox.³

The question is why the sentence in (15b) is not also an instance of Moore's Paradox. By the traditional view of *should*, the speaker is conveying that on most of the most plausible epistemically accessible worlds, the beer is cold. So if you utter (15b), there must be some reason why most of your most plausible epistemically accessible worlds are *p*-worlds. Perhaps you saw someone put the beer in the fridge. But the fact that there is some reason that the beer is cold on most of the worlds you are considering, is reason enough why you should not be able to assert that you have absolutely no idea if it is cold or not. You do have some idea.

The problem is even worse, however: it's not just that the speaker can continue that they have no idea whether *p*, but they can continue by asserting that not-*p* is true (thus entailing, for our purposes, that *p* is false).

- (16) a. #The beer must be cold by now, but it isn't.
b. The beer should be cold by now, but it isn't.

Again, *must* behaves as expected. If on all the most plausible worlds that for all the speaker knows, could be the actual world, the beer is cold, it is an instance of Moore's Paradox for the speaker to then assert that the beer is actually not cold. *Should*, however, again behaves unexpectedly. It would be strange for the speaker to assert that on most of the most plausible worlds that for all they know could be the actual world, the beer is cold, but that in the actual world it isn't. If the speaker knows that the beer isn't cold, there

³Moore's Paradox is, in its simplest form, the fact that the sentence *p but I don't believe that p* is contradictory.

is no way they can assert that on most of the worlds that for all they know could be the actual world, it is cold now.

A possible objection might be that really we should be using dynamic semantics; the context might be getting changed. After all, (17) (i.e., (16b) with the conjuncts switched), is decidedly odd, so dynamic semantics may well be relevant.

(17) #?The beer isn't cold, but it should be.

The hope is that perhaps dynamic semantics could save the traditional view from (16b). A dynamic semantics story for (17) would proceed roughly as follows. The meaning of *but* requires that we update a context first with the proposition that the beer is not cold, and then update that context with the proposition that it should be. However, if *should p* has the traditional meaning, that on most of the most plausible epistemically accessible worlds, *p*, then it is not informative to update with *should p*, so (17) sounds strange.⁴

Now for the contrast in (16). For the *must* sentence in (16a), the context is first updated with the proposition that on all of the most plausible epistemically accessible worlds, the beer is cold. Then it is not possible to update the context with the proposition that the beer is not cold. If, on the other hand, we are merely uttering the *should* sentence in (16b), there is no problem; first the context is updated with the proposition that on most of the most plausible epistemically accessible worlds, the beer is cold; and then the context is updated with the proposition that on the actual world the beer is not in fact cold.

Note that this explanation hinges on the idea that (16a) is bad exactly because *must* involves universal quantification. Less than universal quantification should pose no problem. However, consider (18).

(18) #?The beer may be cold, but it isn't.

The sentence in (18) ought to be felicitous, as the treatment of (18) ought to be similar to that of (16b). We ought to be able to update the context first with the proposition that on some of the most plausible epistemically accessible worlds, the beer is cold, and then with the proposition that the beer is not actually cold. But (18) is not felicitous. If we believe that *may* is

⁴There also seems to be a problem with a presupposition of *but* of contrast, but the same issue arises with *and*: *The beer should be cold, and it isn't* is much better than #?The beer isn't cold, but it should be.

epistemic, this is a problem for the traditional view of epistemic *should*, because the less-than-universal-quantification explanation for the acceptability of (16b) cannot be correct.⁵

It seems an inescapable conclusion that while both *must* and *may* preclude the speaker's having knowledge about whether *p* holds of the actual world, *should* does not. Why is this so? And what, if anything, does the answer to this question have to do with the reason why *should* is somehow less informative than *must*?

Let us retrace our steps. Recall the initial evidence in (9), repeated below as (19), that a *should* sentence is less informative than the corresponding *must* sentence.

- (19) a. The beer should be cold; in fact, it MUST be.
 b. #The beer must be cold; in fact, it SHOULD be.

The traditional view, we saw, attributes this property to *should* having a weaker force of quantification than *must*, though with both of them quantifying over (the most plausible) epistemically accessible worlds. However, this analysis was shown to wrongly predict that *should* triggers a version of Moore's paradox, which is not the case.

What could be done to make *should* weaker, aside from giving it a less than universal force of quantification? Let us return to the denotation we gave for *must* in (7) above, repeated below as (20).

$$(20) \quad \llbracket \textit{must} \rrbracket_C(p) = 1 \text{ iff } \mathbf{All}(\mathbf{highest-plausibility}_C(\mathcal{E}_C))(p)$$

The denotation of *must* suggests two ideas for how to proceed. The first idea is that perhaps *should* constrains the context less than *must* does, by presupposing less. In that case, a *must* sentence would be more informative than a *should* sentence because it would narrow down the context more. Another idea is that *should* does not quantify over the same set of worlds as *must* does; instead it quantifies over a differently-constructed set of worlds that happens to be smaller than **highest-plausibility**_C(\mathcal{E}_C). In that case, a *must* sentence would be more informative for reasons that would have to do with the relation between **highest-plausibility**_C(\mathcal{E}_C) and whatever this other set of worlds was.

⁵The story is the same for a story in which epistemic modality is defined in terms of the outcome of updating the context in various ways (as in Veltman (1996) and Beaver (2001)). The idea is that there is no problem updating the information state for (17).

Only one of these would have to be true to ensure that *must* sentences are more informative than *should* sentences. In what follows, I will argue that the first idea is correct: *must* sentences presuppose that the actual world will turn out to be among the highest-plausibility worlds, while *should* sentences only presuppose that it is possible for the actual world to turn out to be such a world. This difference, along an axis we shall call *efficacy*, is responsible for the fact that *should* sentences are less informative than *must* sentences.

But the second idea, that *should* quantifies over a different set of worlds than does *must*, also has a role to play. I will argue that some examples of what has been called “epistemic” *should* actually quantify over metaphysically accessible worlds. While a reading of *should* that quantifies over epistemically accessible worlds does exist, it appears to be marked typically by an different pattern of focus. Since it is not clear that the set of metaphysically accessible worlds has any relation to the set of epistemically accessible worlds, this idea does not do the job of making *should* weaker than *must*, but it is worth sorting out the facts.

As a postscript, of course *should* has also the deontic or practical necessity reading as well; extending the theory to account for this reading of *should* will motivate a change to Kratzer’s theory of modals.

First, however, let us take a closer look at the intuitions regarding “epistemic” *should*, to argue that the first idea is correct: *should* presupposes less than *must*. The conclusion we will come to is that these modals differ in the presupposition that they make about whether the expected course of events will actually come to pass. This axis we will call “efficacy”, since it reflects whether the things that are supposed to happen actually manage to happen.

3 Efficacy

So, what has been said about non-deontic readings of *should*? Leech (1971), for one, takes “logical necessity” *should* to indicate that “the speaker has doubts about the soundness of his/her conclusion.” To illustrate the difference between *should* and *must*, he provides the following contrasting glosses for the minimal pair of sentences in (21).

- (21) Leech p. 101
- a. Our guests must be home by now.
(‘I conclude that they are, in that they left half-an-hour ago,

- have a fast car, and live only a few miles away.’)
- b. Our guests should be home by now.
 (‘I conclude that they are, in that . . . , but whether my conclusion is right or not I don’t know – it’s possible they had a breakdown, for instance.’)

What is enlightening about this example is the particular flavor of doubt that surfaces in the gloss of (21b). It’s not that the speaker doubts their own inference from the facts to the conclusion, all else being equal; it’s that *they doubt that all else really will be equal*. The relevant intuition seems to be that *should* sentences say what ought to happen if things proceed normally, whatever “normally” means; this is our “highest plausibility” condition, and also Kratzer’s “ordering source”. So it seems that *must p* presupposes that the actual world is going to be one of the most plausible worlds, while *should p*, if it presupposes anything, presupposes merely that it is (still) possible that the actual world is (going to turn out to be) one of the favored worlds.

How can we model this intuition about the difference between *must* and *should*? What we’d like is for *must* to require that the actual world be in the set **highest-plausibility**_C(\mathcal{E}_C), while *should* requires only that the actual world could be in that set. While the requirement for *must* is sensical, the requirement for *should* is non-sensical, in the current framework. What does it mean for a world to not be in that set, but possibly be in it? Set membership is an in or out affair. What we are looking for seems to be not a relationship between a world and a set of worlds, but between two sets of worlds, which would provide the needed flexibility. That is, we are looking for a mystery set ϕ such that *must* requires it to be a subset of **highest-plausibility**_C(\mathcal{E}_C), while *should* requires only that ϕ and **highest-plausibility**_C(\mathcal{E}_C) have a non-empty intersection. This gets us closer, because it gives us a sense in which a world “could” be in **highest-plausibility**_C(\mathcal{E}). If ϕ is a subset of **highest-plausibility**_C(\mathcal{E}) any world in ϕ must be in **highest-plausibility**_C(\mathcal{E}). However, if ϕ is merely required to have a non-empty intersection with **highest-plausibility**_C(\mathcal{E}), then an arbitrary world in ϕ might be in **highest-plausibility**_C(\mathcal{E}), or it might not.

- (22) a. presupposition of *must*: **highest-plausibility**_C(\mathcal{E}_C) $\subseteq \phi$
 b. presupposition of *should*: **highest-plausibility**_C(\mathcal{E}_C) $\cap \phi \neq \emptyset$

What could play the role of the mystery set ϕ ? Remember the intuition: We want *must* and *should* to convey, via (22a) and (22b), whether the ac-

tual world turns out to be one of the most plausible epistemically accessible worlds. So perhaps an appropriate ϕ would be a set of worlds that are epistemically accessible in a later context: a set just like \mathcal{E}_C , but with a different (later) context. We can call these sets “epistemic states” for short.

In that case, the presupposition of *must* should say that a later epistemic state is a subset of the most plausible epistemically accessible worlds. That is not yet quite right; notice that the speaker of a *must p* sentence need not believe that they will get enough information to ever learn the truth, since (23) is non-contradictory.

- (23) The murderer must have thrown the murder weapon into the Seine, but we'll never find it.

So it seems we need to say something a bit weaker: that any more informative epistemic state (we assume that any later epistemic state is more informative) is a subset of the best (currently) epistemically accessible worlds. What it means for a later epistemic state to be more informative is that it rules out more possible worlds; it is necessarily a subset of the current epistemic state. However, in general, a later epistemic state need not be a subset of the set of most plausible worlds in the current epistemic state. The proposed presupposition for *must* adds exactly that requirement. Thus:

- (24) for all C, p:
- a. $\llbracket \text{must} \rrbracket (C)(p)$ asserts that **highest-plausibility** $_C(\mathcal{E}_C) \subseteq p$, and presupposes that $\forall \mathcal{E}$ more informative than \mathcal{E}_C :
 $\mathcal{E} \subseteq \mathbf{highest-plausibility}_C(\mathcal{E}_C)$
 - b. $\llbracket \text{should} \rrbracket (C)(p)$ asserts that **highest-plausibility** $_C(\mathcal{E}_C) \subseteq p$, and presupposes that $\forall \mathcal{E}$ more informative than \mathcal{E}_C :
 $\mathcal{E} \cap \mathbf{highest-plausibility}_C(\mathcal{E}_C) \neq \emptyset$

This difference⁶ ensures that Moore's Paradox does obtain for *must p*, but does not obtain for *should p*. If one asserts *must p*, one is committed to the idea that any more informative epistemic state is a subset of the set of most plausible worlds, as well as the proposition that the most plausible currently accessible worlds are a subset of the set p worlds. Therefore it is contradictory to continue by saying that you do not believe that a more

⁶See Copley (2002) for arguments that *will*, and future modals in general, have a similar presupposition. Werner (2005) also refers to it.

informative epistemic state will not be a subset of the set of p worlds. Since *should p* does not presuppose that any more informative state is a subset of the set of most plausible worlds, this contradiction does not arise for *should p* utterances.

Does this solve the problem of the weakness of *should*? It does, because *should*'s presupposition is weaker than *must*'s.

If this is all correct, we are done.

4 Metaphysical and epistemic modality

So, is it all correct? Seemingly. We have epistemic analyses of both *must* and *should*, explaining why *should p* is weaker than *must p*, also keeping *must p* weaker than p . But as it turns out, we have not yet accounted for the meaning of *should*, as we will see now.

Suppose you are indoors, and a friend who has been outside has just told you that, although it is not raining, the ground is wet outside. It would be entirely appropriate for you to utter the sentence in (25a) as a response. It would not, however, be appropriate to utter the sentence in (25b) (assuming that the only grounds for asserting it was what your friend had just told you).

- (25) a. It must have rained.
b. #It should have rained.

This difference between *must* and *should* cannot be explained by a difference in efficacy, i.e. whether or not the actual world turns out to be one of the best worlds. The reason is that the difference between (25a) and (25b) involves the time at which evidence can be admitted. While (25a) admits evidence of the results of the rain event, (25b) does not. The only way you can utter (25b) is if you have evidence about what the world was like *before* the (putative) rain event. If, for instance, you know that the clouds had been building up, and that a thunderstorm had been approaching, then you would be able to say (25b). But the knowledge (or belief) that the ground is now wet is not relevant.

Note as well that it is not a matter of past knowledge, either. You could felicitously say (25b) even if in the past, before the putative rain event, you didn't know that the thunderstorm was approaching. It seems that that there are two differences between the inference evoked by *must have* and the

inference invoked by *should have*. While *must have* reasons backwards from current evidence, or our knowledge about it, *should have* reasons forward from earlier events. And while *must have* reasons from what is known, *should have* reasons not from what was known in the past, but what was actually the case in the past.

So there are two differences: the direction of reasoning from the evidence, and the kind of evidence (what is known vs. what is actually the case).⁷ The latter difference indicates that we are dealing with two accessibility relations, not one. *Must* is indeed epistemic, since it takes into consideration what is known, and *should* in these examples is not epistemic, since it does not take into consideration what is known. We might call it instead a “metaphysical” modality:⁸ it takes all the facts that are actually the case at a particular time into consideration.

Assuming that we adopt this distinction, why then there is a difference in the direction of inference? Is there any reason why epistemic inferences proceed from present evidence to past or present events, while metaphysical inferences proceed from earlier facts to later facts?

Metaphysical causation, the garden-variety causation of one event causing another, requires that the causing event begin earlier than the caused event. So metaphysical inference is as follows: We infer, given the causing event, that the caused event happened.⁹ Epistemic inference seems at first to be just the opposite: surely there we reason from effect to cause (the wet ground to the raining) instead of the other way around. But in another sense, we are still inferring from cause to effect, using a different flavor of causation. Learning that the ground is wet causes us to conclude that it has rained, assuming that there is no other relevant information. This kind of causation we might term “epistemic causation:” information causes a certain change in a belief state, as long as no other information intervenes. This way of looking at epistemic inference makes it parallel to metaphysical inference, in which an event causes a certain change in the state of the universe, as

⁷A third difference is whether *have* scopes over or under the modal. This difference has been dealt with at length by, for instance, Condoravdi (2001), Stowell (2004), and Demirdache and Uribe-Etxebarria (2005). I will not address it here.

⁸Kratzer would derive such an accessibility relation from a “totally realistic” modal base; the idea is the same. I prefer the term “metaphysical” because of its use in the philosophical literature (see Thomason (1970), e.g.) to talk about the future, and because of the causal distinction discussed just below.

⁹Or, in the case of *should*, that it would have happened if nothing else intervened.

long as no other events intervene. The directionality of epistemic causation, from later events to earlier events, then would have to follow from what can be “information,” a topic I will not pursue here. In any case, modulo any type-shifting that a real definition of “information” might necessitate, we can maintain the same formal denotation for metaphysical *should* as we had for the epistemic denotation of *should*, changing only the ordering source and modal base. The ordering source changes from **highest-plausibility** (no other information intervenes, that is, all else is epistemically equal) to **highest-entropy** (no other events intervene, that is, all else is metaphysically equal). The modal base changes from “what is known” (yielding \mathcal{E}_C , the set of worlds epistemically accessible from C), to “what is/has been the case” (yielding \mathcal{M}_C , the set of worlds metaphysically accessible from C). Additionally, we use the relation “more restrictive than” rather than “more informative than.”

- (26) for all C, p:
 $\llbracket \text{should}_{meta} \rrbracket(C)(p)$ asserts that **highest-entropy** $_C(\mathcal{M}_C) \subseteq p$, and presupposes that $\forall \mathcal{M}$ more restrictive than \mathcal{M}_C :
 $\mathcal{M} \cap \text{highest-entropy}_C(\mathcal{M}_C) \neq \emptyset$

But since “more restrictive” means “later” for metaphysical states, we have a problem. If the non-deontic reading of (27) involves metaphysical *should*, it ought to mean that according to the current state of affairs, if nothing else happens, John is home *after* the moment of utterance. This is because any more restrictive metaphysical state must be a later one, because something has to have happened to make it a different metaphysical state. But (27) cannot have that meaning. Instead it conveys that the speaker thinks John is home now, not later than now.

- (27) John should be at home now.

We could circumvent this problem by replacing “more restrictive than” with “at least as restrictive as,” as in (28).

- (28) for all C, p:
 $\llbracket \text{should}_{meta} \rrbracket(C)(p)$ asserts that **highest-entropy** $_C(\mathcal{M}_C) \subseteq p$, and presupposes that $\forall \mathcal{M}$ **at least as restrictive as** \mathcal{M}_C :
 $\mathcal{M} \cap \text{highest-entropy}_C(\mathcal{M}_C) \neq \emptyset$

However, for the case where $\mathcal{M} = \mathcal{M}_C$, the presupposition would be trivially

true, which is not what we want.

So perhaps (27) is epistemic after all. Even with *should have*, which gave us the original metaphysical example, it is possible to get (28b) to be better in the context where the ground is wet, with a marked intonation:

- (29) I don't understand it. The ground is wet, even the leaves on the trees are wet, as far as the eye can see. It SHOULD have RAINED. But you're telling me it's just a very sophisticated sprinkler system.

I find the marked intonation to be obligatory here.

So epistemic readings of *should have* do exist, albeit with marked intonation. Present-oriented *should* seems to require an epistemic reading. And there is indirect evidence that epistemic readings exist for future-oriented *should*, with the same marked intonation as for *should have*. As Leech points out, *should* is a bit weird out of the blue if the eventuality is not one the speaker desires.

- (30) (adapted slightly from Leech 1971, p. 102)
- a. Our candidate should win the election.
 - b. Roses should grow pretty well in this soil.
 - c. ?*Our candidate should lose the election.
 - d. ?*Roses should grow pretty badly in this soil.

The weirdness of (30c) and (30d), whatever its cause, goes away when the marked intonation is used:

- (31)
- a. She raised less money than the other candidate, she had a lousy campaign manager, and what's more, she's actually a convicted felon. Our candidate SHOULD LOSE the election. Unless somehow all the other candidate's supporters stay home.
 - b. Roses SHOULD GROW pretty badly in this soil, but knowing how serious Jenny is about using the blue stuff, I bet her roses will do just fine.

Since the marked intonation correlates with the epistemic reading of *should have*, we may conclude here that it is the epistemic reading of *should* that escapes Leech's constraint.¹⁰

¹⁰Additional evidence for this claim comes from future-oriented epistemic *may*, which also needs the marked intonation:

So: while not every non-deontic use of *should* is epistemic, some of them are.¹¹ This denotation captures what we need for metaphysical *should*. Before going on to deontic or practical necessity *should*, we must confirm that metaphysical *should* is weaker than epistemic *must*, as desired.

To summarize the discussion so far: We have seen that the “traditional” analysis of non-deontic *should*, based on the idea that *should* has less-than-universal quantification than epistemic *must*, erroneously predicts that *should* should trigger Moore’s paradox. This led us to develop an alternative theory, in which *must*, but not *should*, requires that any later epistemic state turn out not to make p true. This distinction between *must* and *should* was called “efficacy,” since the issue is whether what is now most plausible actually

- | | | | |
|-----|----|-----------------|---|
| (i) | a. | John MAY LEAVE. | √epistemic (contrastive deontic also √) |
| | b. | John may LEAVE. | *epistemic, √deontic |

¹¹ *Should* behaves like *must* and *may* with respect to “epistemic containment” (von Fintel and Iatridou, 2003). On the epistemic reading of (i), von Fintel and Iatridou note, *his* cannot be a bound variable.

- (i) #Every student must be home if his light is on.
 a. epistemic reading: *
 b. deontic reading: fine

Epistemic *should* and *may*, as diagnosed by the marked intonation, also block the variable binding:

- (ii) #Every student MAY be HOME tomorrow if his light is on.
 (iii) #Every student SHOULD be HOME tomorrow if his light is on.

But even without the marked intonation, the bound variable reading is not possible, as shown by the unacceptability of (iv).

- (iv) #Every student should be home tomorrow if his light is on.

This means that our metaphysical *should* also exhibits epistemic containment. This fact is not necessarily a problem for the current analysis, however. Even epistemic conditionals without overt epistemic modals have the epistemic containment property:

- (v) #Every student is at home if his light is on.

Since the sentence in (v) has an epistemic flavor in some sense, but no explicit modal, we have to wonder how exactly the conditional semantics, as separate from the modal semantics, plays a role; it may play the same role in (iv). But we will have to leave this question here.

manages to be true.

This theory proved not to be adequate, as some instances of *should* seemed not to involve epistemic inference at all. In addition to epistemic modality, we introduced metaphysical modality to account for these cases. The table below sets out the analogous terms between epistemic and metaphysical modality.¹²

(32)		epistemic	metaphysical
	modal base	\mathcal{E} : set of worlds that agree with what is known	\mathcal{M} : set of worlds that agree with what is the case
	ordering source	highest-plausibility	highest-entropy

5 Deontic *should*

A similar issue of strength and weakness arises for deontic *should* and *must*:

- (33) a. #You must pay the rent, in fact you should.
 b. You should pay the rent, in fact, you must.

Does the analysis given above for epistemic and metaphysical *should* transfer to deontic *should*? Deontics are supposed to have a metaphysical modal base and an ordering source for the best worlds based on ideals. Suppose we entertain the denotations in (34) (just like the metaphysical denotations, but **highest-contentment** is a function that takes a set of worlds and returns the subset that best agrees with a salient set of ideals).

- (34) for all p, C:
- a. $\llbracket \text{must} \rrbracket(p)(C)$ asserts that **highest-contentment**(\mathcal{M}_C) \subseteq p, and presupposes that $\forall \mathcal{M}$ more restrictive than \mathcal{M}_C :
 $(\mathcal{M}) \subseteq \mathbf{highest-contentment}(\mathcal{M}_C)$
 - b. $\llbracket \text{should} \rrbracket(p)(C)$ asserts that **highest-contentment**(\mathcal{M}_C) \subseteq p, and presupposes that $\forall \mathcal{M}$ more restrictive than \mathcal{M}_C :
 $\mathcal{M} \cap \mathbf{highest-contentment}(\mathcal{M}_C) \neq \emptyset$

¹²It is worth asking whether the difference between *may* and *might* is that *may* has a positive efficacy presupposition, like *must*, and *might* has a zero efficacy presupposition, like *should*. My intuition is that *may* seems to express possibility given a certain state of affairs, while *might* seems to accept that outside events could intervene.

The presupposition of (34a) at first looks a bit odd, but it is exactly as Werner (2005) argues: “you do what you gotta do,” i.e., *must* implies *will*.¹³

The real problem is with the presupposition in (34b). It says that the set of metaphysically possible worlds at some later time has a non-empty intersection with the set of worlds that (as of this moment) would bring the highest-contentment. That is, it’s still possible that you’ll actually end up with a highest-contentment world. This is fine as far as it goes. Leech (1971) for instance says that:

[I]f someone says *You must buy some new shoes*, it is assumed that the purchase will be carried out; the tone of *must* tolerates little argument. But *You should buy some new shoes* is a different matter – the speaker here could well add in an undertone, ‘but I don’t know whether you will or not.’

It seems to me, however, that the presupposition in (34b) is more applicable to *be supposed to* than to *should*. Consider the minimal pair in (35):

- (35) a. You should buy some new shoes.
b. You’re supposed to buy some new shoes.

The *be supposed to* (“*bst*”) sentence in (35b) corresponds quite nicely to (34b). There is a set of ideals,¹⁴ which we use to construct a function **highest-contentment**. A *bst p* sentence says that all highest-contentment worlds are p worlds, and presupposes only that it’s possible for the actual world to turn into a p world, not that it will.

The *should* sentence, however, is a little different. Rather than presupposing that the salient set of ideals is a set that the interlocutor accepts, the speaker, if anything, is presupposing only that the interlocutor *might* accept this set of ideals.¹⁵ A paraphrase of a deontic *should p* sentence would thus be as in (36):

¹³Note that you don’t necessarily do what you should do; Werner specifically excludes *should* from his discussion.

¹⁴Of course *bst* requires that the ideals be provided by some authority. I’m betting that that lexical difference is irrelevant to the current discussion.

¹⁵Actually, not necessarily the interlocutor. Suppose you are talking to your friend about Tasha and you say (i).

- (i) Tasha should go to bed now.

- (36) Deontic *should p*: If you accept exactly these ideals, then, assuming certain laws of rational behavior, p

The rational behavior clause is needed because of course you could behave irrationally and not do what you want to do. But assuming that you are rational, you will do what you want to do.¹⁶

At first look, this paraphrase seems to ruin the parallelism between deontic *should* and the other *shoulds*. But note that we can restate the other *shoulds* in a similar way.

- (37) a. Metaphysical *should*: If exactly these facts are true, then, assuming certain laws of physics, p
b. Epistemic *should*: If exactly this information is known, then, assuming certain laws of probability, p

These paraphrases have three components:

- (38) a. The beginning ideals/facts/information
b. The ceteris paribus condition (exactly these, nothing else intervenes)
c. The laws of rational behavior/physics/plausibility

This is a slightly different picture from Kratzer's theory, which has two components:

- (39) a. Modal base: The beginning facts/information
b. Ordering source: ideals, ceteris paribus, possibly laws of physics, plausibility?

On Kratzer's theory, the role the ideals play is in the ordering source. That's what we were assuming when we created **highest-plausibility**, **highest-entropy**, and **highest-contentment**, functions that take a set of worlds handed them by the modal base and return the set of worlds that best agrees

Presumably you mean to say that whoever's in charge of Tasha's bedtime, if they accept the relevant ideals, will make her go to bed. Your interlocutor may or may not be in charge of Tasha, therefore it is not the interlocutor whose ideals matter, but whoever is in charge.

¹⁶One issue not resolved by this paraphrase is the fact that deontic *should p* sentences are strange if it is impossible for p to happen. So the laws of physics may need to be included here; it is not immediately clear to me how to include them.

with the ideals. So it should be analogous to the laws of physics or probability. Here, however, it seems as though the ideals are playing the same role the initial facts are, instead; for Kratzer, that would be the modal base. But on this theory, the analogies between the three kinds of *should* would be very surprising indeed; the ideals need to play the same role as the things that Kratzer put in the modal base.

One good reason to think that this is right is that ideals, like facts and unlike the laws of physics and probability, are particular to particular situations. What's constant are the laws of rational behavior. That, then, is the true analogue to the (naïve) laws of physics and the laws of probability. Note that all of these kinds of laws are deterministic, as long as we know what ideals, facts, or information we started with.

If ideals are in the same basket with things like facts and information, that basket must be able to have a set of propositions that yields no consistent set of worlds (this was the initial observation which led to the use of ideals in the ordering source in the first place). Can this be reconciled with epistemic and metaphysical cases? I think yes. There is no reason to believe that epistemic modals are not doxastic, with weighted beliefs, just as you might have differently-weighted ideals. As for the metaphysical cases, we can think of them as including differently-weighted physical forces.

If we accept this kind of story, we will have to jettison all the denotations we have given so far for modals, since they are predicated on the modal base/ordering source picture. More details need to be worked out, and there is no space to do it here, but here is a sketch of the formal elements of the meaning of *should* and *must*, to be treated as a starting point for future work.

Instead of a modal base, there is a situation argument, a set of propositions: everything that goes into a modal base, and ideals as well, all the things that are particular to the actual time and place. If f is a function that takes a situation and applies the relevant natural laws to it, the general assertion of all flavors of *must* and *should* is simply:

$$(40) \quad \lambda p \lambda s . p(f(s))$$

By choosing the situation argument appropriately, and choosing the natural laws appropriately, the different flavors are generated.¹⁷

¹⁷While it is not immediately clear how (40) might be extended to deal with *may* and *might*, since we are no longer quantifying over possible worlds, it could be done. One might take a subpart of the situation argument to be the argument for f , for example.

The presuppositions are harder to state, but an informal shot at them is given in (41):

- (41) a. presupposition of *must*: the salient situation s^* is exactly what matters (no other facts/ideals enter in)
b. presupposition of *should*: the salient situation s^* may or may not be exactly what matters (other facts/ideals may enter in)

With this admittedly unfinished suggestion we must stop and leave the details for future work.

6 What we should conclude

This discussion has generated three heuristics for further research on the semantics of modals.

Relative strength isn't always relative quantificational force; sometimes it's efficacy. Recall that the traditional theory of *should*, where it had a Most quantifier, was unsatisfying. I suspect that quantifiers like *most* play no role in modal semantics, and would hypothesize that relative weakness can always be explained by (a) the difference between existential and universal quantification, (b) whether the actual world is presupposed to be inertial or not (efficacy), and/or (c) how the quantificational set is selected. Thus, if a speaker of a language tells you that one modal sentence makes a “stronger” claim than another modal sentence, all you can conclude is that there is more work to be done.

Inference from evidence isn't always epistemic modality; sometimes it's metaphysical modality. While it seemed obvious that non-deontic uses of *should* were epistemic in nature, that turned out not always to be the case. There are two different ways of making an inference. Epistemic inference can go backwards in time; metaphysical inference does not. Therefore, if a speaker of a language tells you that a modal sentence involves some evidence for a claim, you still need to find out if it is epistemic or metaphysical inference (or conceivably something else).

We should reconsider “modal bases” and “ordering sources,” at least as they are currently understood. In trying to extend the analysis to deontic *should*, we saw that we needed to reconsider the role played by ideals, and thereby to reconsider the basic framework of modal semantics. Kratzer's theory of modality has brought us a very long way indeed, but it

would benefit from a re-division of labor along the lines sketched above.

References

- Barwise, J. and R. Cooper (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy* 4(2), 159–210.
- Beaver, D. (2001). *Presupposition and Assertion in Dynamic Semantics*. Oxford: CSLI and folli.
- Condoravdi, C. (2001). Temporal interpretation of modals. In D. Beaver, S. Kaufmann, B. Clark, and L. Casillas (Eds.), *Stanford Papers on Semantics*. Palo Alto: CSLI Publications.
- Copley, B. (2002). *The Semantics of the Future*. Ph. D. thesis, MIT. To appear, *Outstanding Dissertations in Linguistics*, Routledge.
- Demirdache, H. and M. Uribe-Etxebarria (2005). On the temporal syntax of non-root modals: Covaluation, binding, and scope reversal. Talk presented at the Paris Time and Modality International Roundtable.
- von Stechow, P. and S. Iatridou (2003). Epistemic containment. *Linguistic Inquiry* 34(2), 173–198.
- Horn, L. R. (1989). *A Natural History of Negation*. University of Chicago Press.
- Kratzer, A. (1991). Modality. In A. von Stechow and D. Wunderlich (Eds.), *Semantics: An International Handbook of Contemporary Research*. Berlin: de Gruyter.
- Leech, G. N. (1971). *Meaning and the English Verb*. Essex, U.K.: Longman Group Limited.
- Lewis, D. (1968). *On the Plurality of Worlds*. Oxford: Basil Blackwell.
- Lewis, D. (1975). *Counterfactuals*. Cambridge, Mass.: Harvard University Press.
- Stowell, T. (2004). Tense and modals. In J. Guéron and J. Lecarme (Eds.), *The Syntax of Time*, pp. 621–636. Cambridge, Mass.: MIT Press.
- Thomason, R. (1970). Indeterminist time and truth-value gaps. *Theoria* 36, 264–281.
- Veltman, F. (1996). Defaults in update semantics. *Journal of Philosophical Logic* 25(3), 221–261.
- Werner, T. (2005). You do what you gotta do, or why *must* implies *will*. In *Proceedings of SALT 15*.

When the actual world isn't inertial: Tohono O'odham *cem**

Bridget Copley

University of Southern California

The particle *cem*¹ in Tohono O'odham (an Uto-Aztecan language also known as "Papago") has two primary readings. The two readings, *unachieved-goal* and *non-continuation*, are both available for the Tohono O'odham sentence in (1).

- (1) Cem 'añ ñ-na:tokc.
cem 1sg 1sg-ready
- a. 'I was ready.'
(speaker: "I was ready, but you weren't there") unachieved-goal
- b. 'I was ready.'
(speaker: "I'm not ready anymore.") non-continuation

The unachieved-goal reading conveys that some goal that the subject had was not fulfilled, and the non-continuation reading conveys that some state held in the past but no longer holds. Both kinds of readings were noted first by Hale (1969).

Predicate nominal structures similarly can also have either reading, as in this example elicited by Marcus Smith (p.c.):

*Thanks to Tohono O'odham consultants Albert Alvarez and Ofelia Zepeda, without whose generosity, expertise, and forbearance this work could not have been attempted. Unless otherwise noted, the Tohono O'odham examples in this paper come from my elicitations and conversations with them, though of course any errors or omissions are my own. Thanks also to Marcus Smith, participants at the 2005 LSA Annual Meeting and SULA 3, and the late Ken Hale. This work was supported by an NSF Graduate Research Fellowship, a Ken Hale Fund Fieldwork Grant, and a Mellon Postdoctoral Fellowship.

¹The pronunciation of *cem* is something like IPA [tʃʌm], with a mid central vowel.

© 2005 by Bridget Copley

Michael Becker and Andrew McKenzie (eds.), SULA 3: 1–18

- (2) Heñ-veenag 'od: cem ge maakai.
 1s-sibling cop cem indef doctor
 a. 'My brother was a doctor (but now does his job badly).' unachieved-goal
 b. 'My brother was a doctor (but isn't anymore).' non-continuation

This ability to trigger either unachieved-goal or non-continuation readings is one of the properties of *cem* that we will be investigating in this paper.

The second target of our investigation is the behavior of *cem* in eventive sentences, marked with aspect. Eventive sentences such as the one in (3) get only the unachieved-goal reading; presumably they do not get the non-continuation reading because only states can continue in the appropriate sense.

- (3) Huan 'at o cem kukpi'o g pualt.
 Juan aux-pf fut cem open det door
 'Juan tried to open the door.' unachieved-goal

When *cem* appears with eventives, often the closest translation for *cem* in English is “tried to,” as above in (3). If we were to take this intuition at face value, we might propose a generalization that *cem p* sentences implicate that the event described by *p* did not happen. The sentence in (3) does seem to have such an implication. However, eventive *cem* sentences do not always have such implications. In *cem p* sentences marked with perfective aspect, the event actually happens.² This can be seen by the speaker's explication in (4a), and by the fact that (4b) feels contradictory with a continuation to the effect that the event was never given a chance to happen, as in (4c).

- (4) a. Howij 'at cem 'uama.
 banana aux-pf cem yellow
 speaker: “The banana tried to become yellow, but, say, the cow ate it. But it is yellow when the cow eats it.”
 b. Huan 'at cem ku:pio g pualt.
 Juan aux-pf cem open det door
 'Juan opened the door in vain.'
 c. #Huan 'at cem ku:pio g pualt, k'im hua 'i-gei.
 Juan aux-pf cem open det door but-forward there incept-fell
 #'Juan wanted to/tried to/was going to open the door, but he fell on his way there.'

These perfective cases are similar to the stative cases, since in both, while something goes wrong, it's not that the event (or state) itself doesn't happen. If *cem* makes reference to “something going wrong,” we need to make sure that it allows for the event to actually

²A stative predicate X marked with perfective aspect has the meaning “become X”. Note the speaker's attempt to capture the unachieved-goal reading with the English gloss *tried*; this shows that the unachieved-goal reading, or something like it, is possible even though bananas are inanimate. Devens (1972) also points out a number of *cem* sentences with inanimate subjects.

happen in perfective sentences, and the state to actually happen in stative sentences, and for something *else* to go wrong. And in general, we would like to understand interactions between *cem* and aspect in compositional terms.

The third phenomenon we will be investigating is the behavior of *cem* with negation. Hale (1969), in his detailed exposition of *cem*, reported “I do not understand the relationship of [*cem*] to the negative[.]”³ The sentence in (5) provides an excellent example of what is so maddening and tantalizing about the interaction between *cem* and negation.

- (5) Huan 'at cem pi cikp tako.
 Juan aux-pf cem neg work-pf yesterday
 a. speaker: “Juan did work, but he didn't want to.”
 b. speaker: “Juan worked, but he did it badly.”

The affirmative version of (5) would get an English translation ‘Juan tried to work, and in fact he did.’ The negative counterpart in (5) can get an English translation ‘Juan worked, but he didn't want to.’ Perhaps we have some intuitive notion that “trying” and “not wanting to” are somehow opposites, but to English speakers at least, it is not immediately clear how. Something interesting is going on in the interaction between the meaning of *cem* and the meaning of negation. So a theory of *cem* must account for these facts as well.

This paper has two major goals. The first is to propose a semantic contribution for *cem*, and thereby to explain the puzzling examples above.⁴ The second goal of this paper, to be addressed in a somewhat shorter section than the first, is to place *cem* in a cross-linguistic context. As exotic as it initially may look to English speakers, *cem* turns out to be only minimally different from other, more familiar modals.

There are a few issues to note briefly before we begin the discussion proper. First, although the related language Akimel O'odham (also known as “Pima”) also has a similar *cem* particle (Devens 1972), in this paper I will be discussing Tohono O'odham. Secondly, I will not have much to say about the syntax-semantics interface, since O'odham syntax is highly non-configurational (Smith 2004).

Another issue I would like to set aside for the moment is one more closely connected with the main topic at hand. *Cem* seems always to contribute pastness as part of its meaning; cf. Hale (1969) and Devens (1972). The question is whether this past specification can be entailed by the meaning of *cem*, or whether indeed *cem* includes a past tense sememe, in addition to a sememe corresponding to the rest of its meaning. Both Tohono O'odham and Akimel O'odham are so-called “tenseless” languages, but I am not sure that the non-existence of tense morphology in those languages provides any argument one way or the other. Hale and Devens both explicitly assume that there is something about ref-

³His comment continues with, “nor do I have data which would lead to an understanding of the use of [*cem*] with other than human subjects.” It should be mentioned that Hale wrote his paper based on data he had already elicited, without having had a chance to explicitly ask his consultant (Albert Alvarez) about *cem*.

⁴It is to be hoped that explicating these properties will shed some light on other, apparently related uses of *cem*, such as in desideratives and counterfactual conditionals (Hale 1969).

erence to the actual world that is limited to past times.⁵ But nothing in the current paper hinges on how this question is answered. I suspect that the answer will come, if it does come, from comparison with *cem*-like elements in typologically different languages, if any there be.

1 The proposal and its consequences

The proposal for the meaning of *cem p* sentences (where *p* stands for the linguistic form that denotes a proposition *p*), is given in (6). The concept of inertia worlds is discussed at length below, and is adapted from Dowty's (1977, 1979) proposal for the English progressive.

- (6) Meaning of *cem p* sentences:
Cem p sentences presuppose that all inertia worlds for *s* are worlds in which *p*(*s*), and assert that the actual world is not an inertia world for *s*.

It may not be immediately clear from this proposal how it accounts for any of the above data, but it is especially unclear, at first inspection, how it accounts for the two observed readings of *cem* sentences, non-continuation and unachieved-goal. The relevant idea is that inertia, the principle that “things proceed normally,” can make reference to either physical forces (in which case the non-continuation reading results) or intentions (in which case the unachieved-goal reading results). By reference to “things proceeding normally,” of course, we can make reference to things not proceeding normally, i.e., “something going wrong.”

In the first part of this section, we will construct the proposal, and in the second, see how it accounts for these two meanings in stative *cem* sentences, as in (1) and (2). The third part examines how this proposal fares when considering interactions between *cem* and aspect, as in (3) and (4), and the fourth part treats the interaction between *cem* and negation, as in (5).

1.1 Capturing inertia

Dowty (1977, 1979) introduced the notion of *inertia worlds* to account for certain properties of progressives in English. In physics, inertia is the principle that anything at rest or in motion will tend to stay at rest or in motion, unless outside forces intervene. This idea turns out to be quite useful for explaining why (7a) does not entail (7b).

- (7) a. John was drawing a circle.
 b. John drew a circle.

Dowty called the non-entailment of (7b) the “imperfective paradox.” It is a paradox, or at least surprising, under a certain kind of analysis of the progressive (Bennett and Partee 1978, Klein 1997): If the progressive conveys that the proposition *John draws a circle* holds

⁵For independent justification of the assumption with respect to past *and* present times, see Prior (1967), Abusch (1998), and Copley (2004a).

over an interval surrounding the topic time,⁶ we would expect (7a) to entail (7b). However, it does not; John could have been interrupted part of the way through the circle, and never finished it, and it could still have been true that he was drawing a circle, even though it was not true that he drew a circle. Dowty's solution was to propose that the proposition holds over an interval surrounding the topic time only on certain possible worlds, namely, those in which nothing interferes with the event. These worlds are the inertia worlds. The actual world, of course, need not be one of these inertia worlds. If John was interrupted in the actual world before he could finish the circle, clearly some other force intervened, so that actual world did not turn out to be an inertia world.

Whenever a set of possible worlds is deemed to be an ingredient of meaning, a large part of the work lies in determining precisely how that set of worlds should be characterized. A number of papers have addressed this question, among them Landman (1992), Portner (1998), and Higginbotham (2004), and attempted to deal with various difficulties in specifying the set of inertia worlds. The difficulties, as I see it, lie in three major categories.

The first difficulty is in deciding what constitutes an outside intervention; it seems that the difference between "outside" and "inside" is fairly flexible. The second difficulty is in deciding what constitutes an initial part of any event. For example, if John briefly touches his pen to the paper, how can we be sure whether that event is an initial part of a John-draw-circle event in the worlds where nothing else intervenes (supposing we have overcome the first difficulty and can define the "nothing else intervenes" part)? Finally, the third kind of difficulty is in dealing with cases where the run time of the event seems to be, problematically, *after* the topic time, as in progressive achievements (*Mary was arriving at the station*) and futurates (*The Red Sox were playing the Yankees tomorrow, but they changed their mind*).

Of these three kinds of difficulties, the last one may be specific to progressives; the first two, on the other hand, might be expected to arise wherever inertia worlds are invoked. Since we are invoking inertia worlds for the analysis of *cem p* sentences, we will have to deal with at least the first two kinds of difficulties.

I have no particularly new way to solve the first difficulty (defining the difference between "outside" and "inside" influences). It is generally solved by assuming that one can take different "perspectives" on the facts, including some facts and not others. In this vein, let's assume that there is a *local situation* that acts as the situational input to the logical form, and that what is in the local situation (individuals, event predications, etc.) is determined by pragmatics.

Elsewhere (Copley, to appear (a,b)) I have suggested that the way out of the second⁷ difficulty is to introduce another notion into the semantics, that of a *force*. A force can be thought of as an impetus towards an ideal set of situations; namely, the situations that would result if that force were left undisturbed. Many things are forces: physical forces, of course, as well as "intentional forces," i.e., obligations, plans, and schedules. (This

⁶Or equivalently for us, that there is an event of that description whose run time overlaps the topic time. Dowty was writing before the neo-Davidsonian revolution.

⁷And irrelevantly for us, the third.

is the part that captures the grammatical indifference to distinction between force of will and natural force, and which will get us the two meanings of *cem.*) The inertia worlds of a situation can be thought of as worlds in which the net force – the force obtained through the cognitive process of adding up all the forces active in the situation – does not get disturbed.

This move solves the second difficulty. We no longer are restricted to looking at what John actually does when he touches his pen to paper to draw an arc; we can look at what he intends to do, since his intention is a force. He could draw the same arc while intending to draw an oval, and we would not be able to say felicitously that he had been drawing a circle, unless there were other, stronger forces active in the local situation that outweighed his intention, to make a net force that “wanted” a circle.

The net force provides an ordering source (in the sense of Kratzer (1991)): It picks out the most ideal situations. Let’s model it with a function from situations to properties of situations. So a net force is “active” in a local situation s is a function f of type $\langle s, \langle s, t \rangle \rangle$ where s is in the domain of f . The image of f , namely $f(s)$, is the set of ideal-with-respect-to- f situations that result if the force is left undisturbed, i.e., no other forces external to the local situation are applied.

We can draw an analogy from forces to propositions. Both take a situational argument, by assumption; both have a relationship with situations. For propositions, the relation is *is true in*; for force, the relationship is *is active in*.

- (8) a. propositions: type $\langle s, t \rangle$, p is true in s iff $s \in \text{domain of } p$
 b. forces: type $\langle s, \langle s, t \rangle \rangle$, f is active in s iff $s \in \text{domain of } f$

There are certainly questions raised by the addition of forces, but for now, let’s use them to define inertia worlds, based on a notion of inertial continuations that does most of the work:

- (9) For any situation s , force f , and situation s' , where f is the net force active in s :
 s' is an *inertial continuation* for s iff $s' \in f(s)$.

We define inertial continuations as situations that are in the image of f , where f is the net force active in s . This notion is useful to define as a relation between situations because we have defined forces in that way as well; we need to be able to look at a local situation, not just the world it is in, and it makes sense to think of a set of situations, not a set of worlds, as being the image of f . Let’s assume that the image of f only contains situations whose run times are (just?) after the run time of s ; the cognitive-perceptual system is smart enough to not put any situations with earlier run times in $f(s)$.

An inertia world for a situation s is defined as a world that contains an inertial continuation for s :

- (10) For any situation s , and world w : w is an *inertia world* for s iff:
 $s \in w$ and $\exists s'$ that is an inertial continuation of s , such that $s' \subseteq w$.

I have not formalized the ontology of situation semantics and branching time which would be needed to give these definitions real meaning, though I have in mind something like a

marriage of Kratzer (1989), in which situations are parts of worlds, and Thomason (1970), in which worlds branch through time.⁸ If the reader can accept this admittedly imperfect state of affairs, we can see how it will provide the framework for an account of *cem*.

1.2 The two meanings

Keeping in mind that net forces can either be intentional or physical, let us now see how the proposal would account for the two meanings of *cem p* sentences. Recall the proposal, repeated below as (11):

- (11) Meaning of *cem p* sentences:
Cem p sentences presuppose that all inertia worlds for *s* are worlds in which *p(s)*, and assert that the actual world is not an inertia world for *s*.

The reader is asked to keep in mind that, while the proposal is not the simplest one that might account for these readings of statives, the complications will prove necessary shortly, when eventive predicates and negation are considered. But let us ascertain first how the statives fare under this proposal.

Consider first a non-continuation reading, as in (12):

- (12) 'O'ohona 'o cem suam.
 sign aux-impf cem yellow
 'The sign was yellow.'
 (speaker: "it's no longer yellow") non-continuation

We may assume that the local situation – that is, the past situation, at the topic time – includes just the sign, with a zero net force on it, since it is not changing color, or anything else, in that past situation. The predicted assertion and presupposition are also given:

- (13) Assertion: In all inertia worlds for *s*, the sign is yellow in *s*.
 Presupposition: The actual world is not an inertia world for *s*.

The proposed assertion is that in all inertia worlds for the local situation, the sign is yellow in the local situation. The proposed presupposition is that the actual world does not turn out to be an inertia world for the local situation. That is, there is no inertial continuation of *s* in the actual world;⁹ instead, a force intervenes to disturb the sign's color. This entails that the sign is no longer yellow at the speech time.

⁸In my head this system lacks the property of persistence, the property that every situation is part of at most one world. Kratzer has argued that persistence must be a property of any adequate situation semantics. My suspicion, however is that any branching version of situation semantics will have to be non-persistent, because that is exactly what is needed in order to model the branching of time. It remains to be seen whether the problems Kratzer raises with non-persistent systems will apply to situation semantics in a branching time model.

⁹By the definition of inertia world given above, this means that the sign stops being yellow exactly at the end of *s*. I do not think this is a problem; *s* could be arbitrarily long.

One crucial assumption that needs to be made to make this account work is that *s* is in fact a part of the actual world.¹⁰ For this, we simply need to assume that the situational input to the sentence is required to be actual. This would be a very reasonable assumption, given that default inputs, insofar as we can identify them, generally seem to reflect the here and now (the speech time, the speaker, etc.). If *s* is a part of the actual world, then it is clear that the actual world can't escape being a world in which the sign is yellow. But it escapes being an inertia world because the sign does not stay yellow; some force intervenes.

There is a possible conceptual problem with this story, that comes up if we switch to talking about bananas instead of signs:

- (14) Howij 'o cem suam.
 banana aux-impf cem yellow
 'The banana was yellow.'

This is the same sentence as (13), and has a very similar meaning, only that the sign has been replaced by a banana. As before, the local situation must include the banana, with no forces on it, so that the inertia worlds are ones in which the banana is still yellow. But conceptually, this is a problematic assumption; surely there is a force on the banana, namely its natural disposition to turn black eventually. Why wouldn't the inertia worlds be the ones in which it turns black? For the current proposal to be true, it must be that that force, no matter how internal it is, is nonetheless not in the local situation, though why they wouldn't be is puzzling. Unfortunately I will have to leave this issue here.

Recall where we are in the argument: We are trying to explain why the proposal in (11) accounts for both the non-continuation reading and the unachieved-goal reading of stative sentences. Consider now one of the unachieved-goal cases, as below in (15).

- (15) Cem 'añ ñ-na:tokc.
 cem 1sg 1sg-ready
 'I was ready.'
 speaker: "I was ready in vain, you weren't there" unachieved-goal

The local situation in this case presumably includes at least the speaker, and the plan for the interlocutor and the speaker to go out together. Remember that this plan counts as a force, from which inertial continuations are calculated (and from those, the inertia worlds are calculated). The inertia worlds are all those worlds in which the plan is realized, without any interference. The assertion and presupposition are predicted to be as in (16):

- (16) Assertion: In all inertia worlds for *s* (i.e., worlds in which the plan is realized), the speaker is ready at *s*.
 Presupposition: The actual world is not an inertia world for *s*.

¹⁰This point is where the question of whether *cem*'s past meaning is analytic comes up; recall that the origin of the past meaning is irrelevant to us at the moment.

According to this prediction, the assertion should be that in all inertia worlds for the local situation s (that is, those worlds consistent with the plan), the speaker is ready in s . The proposed presupposition is that the actual world did not turn out to be an inertia world for the local situation. That is, there was some development that made the actual world continue in a non-inertial way, so that the plan did not get realized as envisioned by the planners; in this context it is most likely that the interlocutor did not show up. This result is as desired.

We have seen that the proposed meaning for *cem p* sentences can account for both the non-continuation and the unachieved-goal readings of stative *cem p* sentences. Significantly, no component of the meaning of *cem p* sentences says that p does not hold of the actual world. We turn now to the interaction of *cem* with aspect, where this property will again be useful.

1.3 Behavior with aspect

As we shift our attention to eventive predicates, we will need to think Tohono O'odham aspect. There is no morphology for marking tense in Tohono O'odham; a sentence can typically have either past or present topic time, depending on context. Aspect is marked, and relates the situation in which the event takes place to the local situation.

- (17) a. Huan 'at o kukpio g pualt.
 Juan aux-pf fut open det door.
 'Juan will/would open the door.' future
- b. Huan 'o kukpi'ok g pualt.
 Juan aux-impf open-impf det door
 'Juan is/was opening the door.' imperfective
- c. Huan 'at ku:pio g pualt.
 aux-pf open det door
 'Juan opened the door.' perfective

The characterization we will assume here owes a debt to one proposed by Schachter and Otnes (1972) for Tagalog. The future¹¹ says that the event is not yet begun at the time of the local situation, the imperfective says that the event is ongoing at the time of the local situation, i.e., begun but not completed, and the perfective says that the event is already completed at the time of the local situation.

- (18) a. future: $\lambda w \lambda p \lambda s . \exists s' \text{ such that } s' \subseteq w \text{ and } s' > s: p(s')$
 b. imperfective: $\lambda w \lambda p \lambda s . \exists s' \text{ such that } s' \subseteq w \text{ and } s' \text{ overlaps } s: p(s')$
 c. perfective: $\lambda w \lambda p \lambda s . \exists s' \text{ such that } s' \subseteq w \text{ and } s' < s: p(s')$

As we have seen, *cem* can occur in sentences with aspect. Here it is in a minimal triple:

¹¹Here future counts as an "aspect;" see Copley (to appear, b) for why.

- (19) a. Huan 'at o cem kukpi'o g pualt.
 Juan aux-pf fut cem open det door
 'Juan tried to open the door.' future + *cem*
- b. Huan 'o cem kukpi'ok g pualt.
 Juan aux-impf cem open det door
 'Juan was trying to open the door.' imperfective + *cem*
- c. Huan 'at cem ku:pio g pualt.
 Juan aux-pf cem open det door
 'Juan opened the door in vain.'
 (entails: Juan opened the door) perfective + *cem*

According to the consultants, (19a) is felicitous when Juan trips before getting to the door at all, or when he tugs on the door but does not manage to open it; (19b) is felicitous when Juan tugs on the door but does not manage to open it, and (19c) is felicitous when he opens the door, but it doesn't stay open.

As mentioned above, the perfective example in (19c) is the most baffling at first, since it entails that Juan actually succeeded in opening the door. This means that 'Juan tried to open the door' is not an appropriate free translation for (19c), and more importantly, that *cem* does not trigger any entailment of the non-occurrence of the event. But we have already seen that the stative examples also require there not to be such an entailment, so we are on solid ground.

Let us see how the proposal fares with the examples in (19), assuming initially that the local situation contains at least Juan, the door, and Juan's intention to open the door. Note that the aspect seems to affect the event as usual, so it must take scope under *cem*. The proposed assertions in (21) take this fact into account.

- (20) a. Assertion of (19a), future:
 All inertia worlds w are such that $[\exists s' \text{ such that } s' \subseteq w \text{ and } s' > s: p(s')]$
- b. Assertion of (19b), imperfective:
 All inertia worlds w are such that $[\exists s' \text{ such that } s' \subseteq w \text{ and } s' \text{ overlaps } s: p(s')]$
- c. Assertion of (19c), perfective:
 All inertia worlds w are such that $[\exists s' \text{ such that } s' \subseteq w \text{ and } s' < s: p(s')]$
- (21) Presupposition (all): The actual world is not an inertia world.

For (19a), the future version, the predicted assertion is then that the inertial worlds the local situation s are such that Juan opens the door at a time later than the run time of s . The presupposition is that the actual world does not turn out to be an inertia world for s . This would entail, as desired, that Juan did not open the door at a time later than the run time of s . Since the Juan-open-door event takes place on the inertial continuations after s , it is not taking place during s , so the sentence is (as desired) appropriate in cases where the intervening forces intervene at a point when Juan has not yet begun to open the door. Why then is it also acceptable when he is tugging at the door but does not open? I would

suggest that it is acceptable because in one sense Juan hasn't opened the door yet, because the door isn't open; in another sense, he is in the midst of opening it because he has begun the action. This explanation would have to rest on a lexical ambiguity for the verb meaning 'open', but it would likely be a very general ambiguity.

For the imperfective case in (19b), the predicted assertion is the following: The inertia worlds of the local situation at *s* are such that there is a Juan-open-door event with a run time overlapping that of *s*. The predicted presupposition is that the actual world does not turn out to be an inertia world for the local situation *s*. As desired, this combination entails that Juan did not completely open the door, though he did partially open the door, since he was in the middle of doing so during the local situation.

Now let us consider the perfective in (19c). The predicted assertion is that the inertia worlds for the local situation *s* are such that Juan opened the door before *s* began. Since the inertia worlds all agree with the actual world up to at least the end of *s* (this is "historical determinism,") it is entailed that Juan opened the door before *s*. This does not conflict directly with the predicted presupposition, that the actual world (after *s*) was not an inertia world for *s*. That is, something else happened that made the actual world not an inertia world for the local situation. But if this is so, we have to reconsider what was in the local situation, and accommodate some other force in it. The reason is that the only force we put in it so far is Juan's intention to open the door. He did open the door, so his intention to open the door must not have been frustrated. Therefore, there must have been some other force in the local situation that was frustrated; perhaps it was an intention to keep the door open for some reason.

This option of accommodating an additional force in the local situation should also be available for unachieved-goal *cem p* sentences that are imperfective or future. I have no data bearing on whether this is true or not, but I predict that it should be true. The point about the perfective was that the first local situation we thought of was not a possible one, because the use of the perfective entails that the intention to do *p* cannot have been frustrated. As we have seen earlier, these other aspects permit this intention to be the only force, but it need not be.

1.4 Behavior with negation

So far we have accounted for the two readings of *cem* sentences, and the interaction of *cem* with aspect. We turn now to the interaction of *cem* with negation. The prediction with negation is (all else being equal) that the assertion in a negative sentence ought to be denied, but that the presupposition should be the same as with the affirmative sentence. Thus we predict that the assertion of a negative *cem p* sentence should be the following: On all inertia worlds for the local situation, not-*p*.¹² The predicted presupposition is the same; the actual world is not an inertia world.

Both the non-continuation and unachieved-goal readings for stative *cem p* sentences behave as predicted. Consider (22), for example:

¹²If you are wondering why not "On not all inertial continuations..., *p*", see section 2.3 below.

- (22) Pi 'o cem suam g howij.
 neg aux cem yellow det banana
 'The banana wasn't yellow.'
 speaker: "I walked by the banana tree yesterday, it wasn't yellow, but now it's
 yellow." non-continuation

We predict the following for (22):

- (23) Assertion: All inertia worlds for *s* are worlds in which *p*(*s*).
 Presupposition: The actual world is not an inertia world for *s*.

And indeed, (22) conveys that the banana is not yellow in the local situation. Tellingly, it also confirms that what we have written as a presupposition really should be a presupposition, since it survives negation.

The unachieved-goal case fares similarly:

- (24) Pi añ cem ñ-na:tokc.
 neg 1sg.aux.impf cem 1sg-ready.impf
 'I wasn't ready.'
 speaker: "Someone came by – I wasn't planning to go, so I wasn't ready."
 unachieved-goal

Here we assume that the local situation includes at least the speaker, and the speaker's plan to not go out. The predicted assertion is that on all inertia worlds for *s*, speaker wasn't ready in *s*. The predicted presupposition is that the actual world was not an inertia world for the local situation *s*. That is, the plan to not go out was frustrated by someone's coming by.

For eventive predicates, which are always unachieved-goal, let us reconsider our negative perfective example.

- (25) Huan 'at cem pi cikp tako.
 Juan aux-pf cem neg work-pf yesterday
 a. speaker: "Juan did work, but he didn't want to."
 b. speaker: "Juan worked, but he did it badly."

In this case the speaker has provided two different unachieved-goal readings,¹³ one in which Juan's desire is frustrated and one in which (let's say) the boss's desire for Juan is frustrated. We assume for the reading in (24a) that the local situation includes Juan's desire not to work; for the reading in (24b), it includes instead the boss's desire for Juan to work well. The predicted presupposition is that the actual world was not an inertia world for the local situation. For the reading in (24a), the reason is that Juan's intention for himself

¹³Technically, of course, these are not different readings on the current proposal, but the same reading in different contexts. The same could also be said of non-continuation "readings" of statives, as compared to unachieved-goal "readings;" the meaning is the same, but the contextual input, i.e., the local situation, is different.

(namely, the intention not to work) is not realized; for the reading in (24b), the reason is that the boss's intention for him to do good work is not realized.

In either reading the assertion and presupposition should be the same, as predicted:

- (26) Assertion:
 All inertia worlds w are such that $[\exists s' \text{ such that } s' \subseteq w \text{ and } s' < s: p(s')]$
 Presupposition: The actual world is not an inertia world for s .

For both readings, the predicted assertion is that on inertia worlds for the local situation s , Juan didn't work before s . But the actual world is not an inertia world for s . The most obvious way for the actual world to not be an inertia world for s is for Juan to have worked in the actual world before s . I predict that this should be an entailment if the local situation is either of the two possibilities we have given. However, I also predict that if another force is contextually salient, (25) should be able to convey that Juan didn't work, but that something else went wrong because he didn't work.

Marcus Smith (p.c.) has provided me with an example of a negative future sentence with *cem*:

- (27) Juan 'at cum pi o hii tako.
 Juan aux-pf *cem* neg fut go-pf yesterday
 'Juan didn't want to go yesterday (but he did).'

This example is very similar to the perfective one above. I leave it as an exercise for the reader to determine how the proposal accounts for this example.

To conclude this section: We have seen how the proposed meaning for *cem p* sentences accounts for the puzzles presented at the beginning of this paper. At this point, we will take a step back and consider how *cem* fits into a cross-linguistic picture of modality.

2 Placing *cem* in context

The preceding analysis raises a number of questions: Why is there a particle like *cem*? Where does it fall in a typology of modality? And is it particularly bizarre? In this section, I will argue that *cem*, despite initial appearances, is actually minimally different from other elements with modal semantics. (Such elements I will abbreviate as "modals," whether or not they are realized morphologically by modal auxiliaries.) It is certainly not the only modal to show an alternation between physical and intentional forces. Like other more familiar modals, it provides a presupposition specifying a relationship between the inertial continuations and the actual world (as I've argued, it happens to specify that the actual world is *not* an inertial continuation, but other relationships are possible). Finally, like other modals it exhibits what von Stechow (1997) calls Homogeneity: the exclusion of the middle under negation.

The examples of "more familiar modals" below are in English – historically the most familiar of languages to generative linguists – but many other languages could equally

have been used. The point is that *cem* is formally similar to many modals that are widespread in the languages of the world.

2.1 *The two meanings, revisited*

The idea that *cem*'s inertial ordering source uses either forces of will or physical forces does not single it out as unusual. A case for this kind of alternation can also be made for other, more familiar modals. For example, *will* can be used either to state an intention, or to make a prediction:

- (28) Will you marry me?
- a. Yes, I will. I (hereby) agree to marry you. (statement of intention)
 - b. Yes, I will. That's just the sort of thing I might do. (prediction)

The statement of intention reading in (28a), I have argued elsewhere (Copley 2002, to appear (b)), is a reflection of the use of intentions as an ordering source, while the prediction reading in (28b) uses natural forces to order the worlds. Of course it is odd pragmatically to have to make a prediction about one's own actions, so (28b) is somewhat strange. A more natural context for the prediction case is provided by (29), where the prediction reading is much more natural, as in (29b); one can also imagine a god of rain using an intentional ordering source, as in (29a).

- (29) Will it rain this summer?
- a. It will. (spoken by god of rain)
 - b. It will. (spoken by mere mortal with a knowledge of the patterns of nature)

Will is certainly not the only familiar modality to appeal both to intentions and to physical forces. Habituals as well can reflect either manmade laws or natural laws, as in (30a) and (30b) respectively.

- (30) John eats the rice.
- a. We need someone to eat it, and we've decided it's him. (statement of intention)
 - b. Whenever we get rice, John ends up eating it. (observation)

The manmade law reading in (30a) uses intentions to determine what the law-abiding worlds are like, while the natural law reading in (30b) uses physical and dispositional characteristics of John. But in either case, the same habitual form is used.

It seems fairly ordinary, then, for a morpheme to be indifferent to whether the net force (ordering source) is based on physical or intentional forces; *cem* is not unusual in this regard.

2.2 Efficacy

The second characteristic of *cem* that is not unusual is its specification of a relationship between the actual world and inertial continuations; in this it turns out to be minimally different from certain other familiar modals.

I have argued above that *cem* presupposes that actual world is not inertial. Elsewhere I have argued that other modals presuppose that the actual world *is* inertial. In Copley (2002), this is proposed for *will*, habituals, and other modals, in order to ensure that they actually make a claim about the actual world, instead of just making a claim about inertial continuations. That they do make a claim about the actual world is almost self-evident, but in any case, evidence is provided in (31).

- (31) a. #I'll marry you, but really I'm not actually going to.
 b. #Bears eat meat, but they are all strict vegetarians.

On the other hand, other modalities, such as “epistemic” *should* and the progressive, seem to presuppose nothing about whether actual world is inertial or not. I argue in Copley (2004b) that *should* says that all inertia worlds are p worlds, but that it makes no commitment to whether the actual world is one of those inertia worlds (as shown by the possibility of either continuation in (32a)). Likewise, the imperfective paradox shows us that the progressive also allows the actual world to be inertial or not, as shown in (32b).

- (32) a. John should be there, but he isn't/and in fact he is.
 b. John was drawing a circle, but he didn't finish/and in fact he finished.

If this line of thinking is correct, *cem* is one of a number of modals with a presupposition expressing a relationship between inertia worlds (those worlds in $f(s)$) and the actual world. If we call this dimension “efficacy,” we can then speak of three different kinds of efficacy: positive, negative, and zero.

- (33) Efficacy: a presupposition specifying the relationship between the inertia worlds and the actual world
 positive efficacy (actual world is an inertia world): *will*, habituals
 negative efficacy (actual world is not an inertia world): *cem*
 zero efficacy (no presupposition): *should*, progressive

Cem therefore differs from these other kinds of modality in the value of this dimension, but the dimension is relevant to all of these kinds of modality. Again, *cem* is no outlier.

2.3 Homogeneity

Earlier, in the discussion about the interaction between *cem* and negation, I sneaked in an assumption. Here I would like to show that that assumption is one relevant to many other modals. The assumption was that negation would have what amounted to low scope.

(34) Predicted assertion: On all inertial continuations of the local situation at *t*, not-*p*

Why wasn't this the predicted assertion? "On not all inertial continuations of the local situation at *t*, *p*"?

I have no answer to that question here (to do so might break my self-imposed restriction on not saying anything about the syntax-semantics interface), but I would like to note that the same question arises for other kinds of modality. von Stechow (1997) calls this property *Homogeneity*: the middle – the case where sometimes *p* and sometimes not-*p* – is excluded.

For example, the negation of (35a), given in (35b), only says of the situations in question that they are all not-*p* situations. It does not say that they are not all *p* situations.

- (35) a. Dogs eat meat.
 = In all normal/inertial situations with certain properties, dogs eat meat.
 b. Dogs don't eat meat.
 = In all normal/inertial situations with certain properties, dogs don't eat meat.
 ≠ In not all normal/inertial situations with certain properties do dogs eat meat.

Futures such as *will* have Homogeneity as well, as Aristotle first noticed. If you think a sea battle is possible but not necessary, you will not use the *won't p* sentence in (36b); that is reserved for cases when you think the sea battle is necessary.

- (36) a. There will be a sea battle tomorrow.
 = On all inertia worlds, there is a sea battle tomorrow.
 b. There won't be a sea battle tomorrow.
 = On all inertia worlds, there isn't a sea battle tomorrow.
 ≠ On not all inertia worlds is there a sea battle tomorrow.

So we should not be surprised that *cem* also exhibits Homogeneity.

3 Conclusions

This paper had two aims: to explicate the meaning of *cem p* sentences, and to put *cem* into cross-linguistic context.

The first aim was addressed by way of reference to inertia worlds: worlds in which the net force in the local situation are not disturbed. *Cem p* sentences, I proposed, assert that the inertia worlds for the local situation are worlds in which *p* holds (where *p* might be a non-atomic proposition, including aspect or negation); and they presuppose that the actual world is not an inertia world for *s*. The two main readings of *cem p* sentences, non-continuation and unachieved-goal, were argued to fall out naturally from the fact that forces can be either physical or intentional in nature.

The second aim was addressed by comparing *cem* to other kinds of modality on three different semantic properties. *Cem* was found to be like other, more familiar modals

in having the intentional/physical alternation, and in the property of Homogeneity (exclusion of the middle). It differs from other modals, but only minimally, along a dimension we called “efficacy”, a presupposed relationship between the actual world and the inertia worlds. The similarity between *cem* and other modals is an encouraging result for anyone interested in language universals, hinting as it does at a “toolkit” of sememes with which to understand modality in general.

References

- Abusch, Dorit. 1998. Generalizing tense semantics for future contexts. In *Events and grammar*, ed. Susan Rothstein, volume 70 of *SLAP*. Dordrecht: Kluwer.
- Bennett, M., and Barbara Partee. 1978. *Toward the logic of tense and aspect in English*. Indiana University Linguistics Club.
- Copley, Bridget. 2002. The semantics of the future. Doctoral Dissertation, MIT; In press, Routledge: *Outstanding Dissertations in Linguistics* series.
- Copley, Bridget. 2004a. Aspect and scope in future conditionals. URL www-ref.usc.edu/copley/, USC ms.
- Copley, Bridget. 2004b. So-called epistemic *should*. Snippets 9.
- Copley, Bridget. To appear a. A conceptual and a grammatical distinction for modals. In *Proceedings of NELS 35*.
- Copley, Bridget. To appear b. Ordering and reasoning. In *Modality*, ed. Jon Gajewski and Valentine Hacquard. MITWPL.
- Devens, Monica. 1972. Pima *cim*. *International Journal of American Linguistics* 45:349–61.
- Dowty, David. 1977. Towards a semantic analysis of verb aspect and the English ‘imperfective’ progressive. *Linguistics and Philosophy* 1:45–77.
- Dowty, David. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- von Stechow, Kai. 1997. Bare plurals, bare conditionals, and *only*. *Journal of Semantics* 14:1–56.
- Hale, Ken. 1969. Papago *cim*. *International Journal of American Linguistics* 35:203–212.
- Higginbotham, James. 2004. The English progressive. In *The syntax of time*, ed. Jacqueline Gueron and Jacqueline Lecarme, 329–358. Cambridge, Mass.: MIT Press.
- Klein, Wolfgang. 1997. *Time in language*. New York: Routledge.
- Kratzer, Angelika. 1989. An investigation of the lumps of thought. *Linguistics and Philosophy* 12:607–653.
- Kratzer, Angelika. 1991. Modality. In *Semantics: An international handbook of contemporary research*, ed. A von Stechow and D. Wunderlich. Berlin: de Gruyter.
- Landman, Fred. 1992. The progressive. *Natural Language Semantics* 1:1–32.
- Portner, Paul. 1998. The progressive in modal semantics. *Language* 74:760–87.
- Prior, Arthur. 1967. *Past, present, and future*. Oxford: Oxford University Press.
- Schachter, Paul, and Fe Otanes. 1972. *Tagalog reference grammar*. Berkeley, Calif.: University of California Press.

- Smith, Marcus. 2004. A Pre-group Grammar for a non-configurational language. URL <http://http://www.bol.ucla.edu/~smithma/papers.html>, UCLA ms., revised 3/12/2004.
- Thomason, Richmond. 1970. Indeterminist time and truth-value gaps. *Theoria* 36:264–281.

A force-theoretic model

Bridget Copley (SFL: CNRS/Paris 8) & Heidi Harley (University of Arizona)

This model relates conceptual forces and situations to formal (or “linguistic”) forces and situations. Conceptual forces and conceptual situations are related to each other via the conceptual function *NET* (section II). Linguistic forces and situations are related to each other in that the former are functions from linguistic situations to linguistic situations (section V, (d)). Conceptual situations reflect a part structure (Krifka, 1998). Linguistic situations, on the other hand, do not; they are organized instead in causal sequences, like pearls on a string. These two situational structures coincide only at s_0 , which is equal to the accepted conceptual situation σ^* (see section IV, (d) below).

I. Conventions

(a) Formal (linguistic) entities:

s	situations
f	forces
t	times

U_s is a non-empty set of *linguistic situations* (see V, (c) below; understood to map to *conceptual situations* via a variable assignment function).

U_f is a (possibly empty) set of functions from U_s to U_s , i.e. *linguistic forces* (understood to map to *conceptual forces* via a variable assignment function, see section V, (d) below). These functions are irreflexive.

$\forall s \in U_s, \forall f \in U_f, f(s) \neq s$ [irreflexivity]

U_t is a non-empty set of *times* (see section IX below).

Formal (linguistic) functions: *net*, *init*, *fn*, etc.; to be defined below (section V, (e)-(i))

(b) Conceptual entities:

σ	conceptual situations
φ	conceptual forces
κ	conceptual entities

These variables occur in definitions of formal (linguistic) functions, and in the contextual index of evaluation functions, but do not occur in logical forms. There are no conceptual times.

U_σ is a non-empty set of conceptual situations, and U_φ is a non-empty set of conceptual forces.

II. The conceptual function *NET*

The conceptual function *NET* is a partial function from conceptual situations to conceptual forces:

$NET(\sigma) = \varphi$ iff φ is the conceptual net force of σ .

Conceptual situations can be either dynamic or still-life (= non-dynamic). The latter do not have a conceptual net force, which is why *NET* is only a partial function.

III. Evaluation function

$\llbracket \cdot \rrbracket^{c,g}$ is an evaluation function iff:

g is a variable assignment function.

$c = \langle \varkappa, \sigma, \sigma^* \rangle$ is a contextual index. Such a 3-tuple is a conceptual index iff \varkappa refers to a sentient individual and σ, σ^* refer to conceptual situations. σ is understood as the conceptual situation \varkappa in which \varkappa accepts a conceptual situation σ^* .

IV. Conceptual situation structures

$\langle U_\sigma, \oplus_\sigma, \leq_\sigma, <_\sigma, \otimes_\sigma \rangle$ is a **conceptual situation structure** (a kind of part structure; Krifka, 1998) iff:

- (a) U is a non-empty set of conceptual situations.
- (b) \oplus_σ is a function from $U_\sigma \times U_\sigma$ to U_σ that is idempotent, commutative, and associative:

$$\begin{aligned} \forall \sigma \in U_\sigma : [\sigma \oplus_\sigma \sigma = \sigma] & \quad \text{[idempotence]} \\ \forall \sigma, \sigma' \in U_\sigma : [\sigma \oplus_\sigma \sigma' = \sigma' \oplus_\sigma \sigma] & \quad \text{[commutativity]} \\ \forall \sigma, \sigma', \sigma'' \in U_\sigma : [\sigma \oplus_\sigma (\sigma' \oplus_\sigma \sigma'')] = (\sigma \oplus_\sigma \sigma') \oplus_\sigma \sigma'' & \quad \text{[associativity]} \end{aligned}$$

- (c) The part relation \leq_σ , defined as: $\forall \sigma, \sigma' \in U_\sigma : [\sigma \leq_\sigma \sigma' \Leftrightarrow \sigma \oplus_\sigma \sigma' = \sigma' \ \& \ \sigma'$ is a conceptually possible situation according to \varkappa in σ]. σ' is a conceptually possible situation according to \varkappa in σ iff σ' obeys the laws of physics and the laws of rational behavior as understood by \varkappa in σ .
- (d) The proper part relation $<_\sigma$, defined as: $\forall \sigma, \sigma' \in U_\sigma : [\sigma <_\sigma \sigma' \Leftrightarrow \sigma \leq_\sigma \sigma' \ \& \ \sigma \neq \sigma']$

- (e) The overlap relation \otimes_σ , defined as: $\forall \sigma, \sigma' \in U_\sigma : [\sigma \otimes_\sigma \sigma' \Leftrightarrow \exists \sigma'' \in U_\sigma : [\sigma'' \leq_\sigma \sigma \ \& \ \sigma'' \leq_\sigma \sigma']]$
- (f) The remainder principle: $\forall \sigma, \sigma' \in U_\sigma : [\sigma <_\sigma \sigma' \Rightarrow \exists ! \sigma'' \in U_\sigma : [\sim[\sigma'' \otimes_\sigma \sigma] \ \& \ \sigma \oplus_\sigma \sigma'' = \sigma']]$

V. Causal structures

$\langle \llbracket \cdot \rrbracket^{c,g}, U_\sigma, \oplus_\sigma, \leq_\sigma, <_\sigma, \otimes_\sigma, U_s, U_f, net, init, fin, suc, pred \rangle$ is a **causal structure** iff:

- (a) $\llbracket \cdot \rrbracket^{c,g}$ is an evaluation function.
- (b) $\langle U_\sigma, \oplus_\sigma, \leq_\sigma, <_\sigma, \otimes_\sigma \rangle$ is a situation structure.
- (c) U_s is a non-empty set of *situations* such that $\forall s \in U_s, \exists \sigma \in U_\sigma : \llbracket s \rrbracket^{c,g} = \sigma$
- (d) U_f is a (possibly empty) set of irreflexive functions from U_s to U_s , i.e. *forces*.
- (e) *net* is a partial function from U_s to U_f such that $\forall s \in U_s, \forall f \in U_f : net(s) =: f$ iff $NET(\llbracket s \rrbracket^{c,g}) = \llbracket f \rrbracket^{c,g}$

Since *NET* is undefined for still-life conceptual situations, so is *net*; i.e., still-life situations have no net force.

- (f) *init* is a function from U_f to U_s such that: $\forall f \in U_f : [init(f) = net^{-1}(f)]$
- (g) *fin* is a partial function from U_f to U_f such that: $\forall f \in U_f : [fin(f) = f(net^{-1}(f))]$
- (h) *suc* is a partial function from U_s to U_s such that: $\forall s \in U_s : [suc(s) =: [net(s)](s)]$

Since *NET* is undefined for still-life conceptual situations, so is *suc*; i.e., still-life situations have no successor.

- (i) *pred* is a partial function from U_s to U_s such that: $\forall s \in U_s : [pred(s) =: suc^{-1}(s)]$

VI. Anchored causal structures

$\langle s_0, W(s_0), \llbracket \cdot \rrbracket^{c,g}, U_\sigma, \oplus_\sigma, \leq_\sigma, <_\sigma, \otimes_\sigma, U_s, U_f, net, init, fin, suc, pred \rangle$ is an **anchored causal structure** iff

- (a) $s_0 \in U_s$

(b) A causal sequence $W(s_0)$ is a sequence $s_n \dots s_{-1}, s_0, (s_1), \dots (s_m)$ such that:
 $\forall s \in W(s_0), \forall n \in \mathbb{Z}: [suc(s_n) = s_{n+1}]$

(c) The *anterior causal closure axiom* holds of $W(s_0)$:

$$\forall s \in W(s_0) : [\exists s' \in W(s_0) : [s' = s_{n-1}]]$$

This axiom holds even if nothing is known about s_{n-1} . Causal closure is only valid in one direction: every situation has a preceding situation in $W(s_0)$, but not every situation has a subsequent situation (i.e., states do not).

(c) The *conditional posterior causal closure axiom* holds of $W(s_0)$:

$$\forall s \in W(s_0) : [\exists s' \in U_s : [s' = s_{n-1}]] \Rightarrow s' \in W(s_0)$$

(d) $\llbracket \rrbracket^{c,g}$ is an evaluation function, such that $c = \langle \kappa, \sigma, \sigma^* \rangle$ and g maps s_0 to σ^* .

(e) $\langle \llbracket \rrbracket^{c,g}, U_\sigma, \oplus_\sigma, \leq_\sigma, <_\sigma, \otimes_\sigma, U_s, U_f, net, init, fin, suc, pred \rangle$ is a causal structure.

Note that because linguistic situations are not defined as a part structure, the following axiom holds:

(f) $\forall \sigma, \sigma' \in U_\sigma : [\sigma <_\sigma \sigma' \Rightarrow \text{at most one of } \sigma, \sigma' \text{ corresponds to a situation } s \text{ such that } s \in W(s_0)]$

That is, of any two conceptual situations in U_σ that stand in a part relation to each other, at most one of them corresponds to a linguistic situation that is in $W(s_0)$.

VII. Two ways to update the contextual index

An accepted σ^* can be either:

- (i) *revised*: updated to σ' where $\sigma^* <_s \sigma'$, or
- (ii) *succeeded*: updated to its own successor σ''

Recall that a superpart of a conceptual situation must still obey the laws of physics and of rational behavior (section IV, (c) above).

VIII. Efficacy and historical efficacy:

(a) Efficacy (presupposed in certain cases):

For all $s \in U_s$, s is efficacious iff:

$$(E) \quad \forall s' \in U_s: \llbracket s \rrbracket^{c.g} <_{\sigma} \llbracket s' \rrbracket^{c.g} \Rightarrow \llbracket suc(s) \rrbracket^{c.g} <_{\sigma} \llbracket suc(s') \rrbracket^{c.g}$$

(b) Historical efficacy:

For any anchored causal structure where χ accepts σ^* , then (noting that $\llbracket s_0 \rrbracket^{c.g} = \sigma^*$) it follows that:

$$(H) \quad \forall s \in U_s, n \in \mathbb{Z} \text{ such that } s = s_{n-1} \& s_{n-1} \in W(s_0) \& \chi \text{ accepts } \llbracket s_n \rrbracket^{c.g} : \\ \forall s' \in U_s: \llbracket s_{n-1} \rrbracket^{c.g} <_{\sigma} \llbracket s' \rrbracket^{c.g} \Rightarrow \llbracket suc(s_{n-1}) \rrbracket^{c.g} <_{\sigma} \llbracket suc(s') \rrbracket^{c.g}$$

(i.e., s_{n-1} is efficacious)

(H) is not quite how historical necessity has traditionally been formulated but it plays the same role. We suspect it can be proven from the characteristics of anchored causal structures.

IX. Anchored causal-temporal structures

$\langle s_0, W(s_0), \llbracket \rrbracket^{c.g}, U_{\sigma}, \oplus_{\sigma}, \leq_{\sigma}, <_{\sigma}, \otimes_{\sigma}, U_s, U_t, \text{net}, \text{init}, \text{fin}, \text{suc}, \text{pred}, U_t, \oplus_t, \leq_t, <_t, \otimes_t, \lll_t, \lll_t} \tau \rangle$ is an **anchored causal-temporal structure** iff:

(a) $\langle U_{\sigma}, \oplus_{\sigma}, \leq_{\sigma}, <_{\sigma}, \otimes_{\sigma}, U_t, \text{net}, \text{suc}, \text{pred} \rangle$ is a causal structure

(b) $\langle U_t, \oplus_t, \leq_t, <_t, \otimes_t \rangle$ is a part structure (Krifka, 1998)

(c) U_t is a non-empty set of *times*.

(d) \lll_t is a temporal precedence relation which is irreflexive, non-symmetric, and transitive:

$$\begin{array}{ll} \forall t \in U_t: \sim[t \lll_t t] & \text{[irreflexivity]} \\ \forall t, t' \in U_t: [t \lll_t t' \neq t' \lll_t t] & \text{[non-symmetricality]} \\ \forall t, t'', t''' \in U_t: [[t \lll_t t' \& t' \lll_t t''] \Rightarrow t \lll_t t'''] & \text{[transitivity]} \end{array}$$

(e) \lll_t is a relation read as “entirely precedes,” such that:

$$\forall t, t' \in U_t: [t \lll_t t' \Leftrightarrow [t \lll_t t' \& \sim[t \otimes_t t']]]$$

(f) The *causal-temporal bridge axiom* holds:

$$\forall s, s' \in U_s: [suc(s) = s'] \Rightarrow \sim[\tau(s') \lll_t \tau(s)]$$

In words, the (causal) successor of a situation s_1 does not entirely (temporally) precede s_1 , i.e., effects do not begin before the beginning of the situation whose net force

provokes them. However, a situation can be temporally simultaneous to the situation whose net force provokes it. So a situation can be causally subsequent without being temporally subsequent.

6

Eliminating causative entailments with the force-theoretic framework

The case of the Tohono O’odham frustrative cem

BRIDGET COPLEY AND HEIDI HARLEY

6.1 Introduction

In many cases in natural language, causation must be treated as “defeasible”—that is, one event is asserted or presupposed to normally cause a second event, but there is no entailment that the caused event actually occurs. To account for such cases, we propose that the arguments discovered by Davidson refer to forces instead of to events.*

While the notion of “force” is not commonly referred to in generative linguistic work, cognitive linguistics has long recognized that such a notion is relevant in linguistic semantics, starting from the commonsense insight that many lexical distinctions (*help*, *prevent*, etc.) are easily characterized in terms of force-dynamic interactions (Talmy 1976; 1981; 1985a; 1985b; 1988; 2000).¹ Working from a quite different theoretical perspective, computational linguists have modeled the development of events in time as “sequences of snapshots,” involving causal transitions between static representations of situations, as in motion pictures or comic books

* We gratefully acknowledge helpful comments and discussion from Berit Gehrke and two anonymous reviewers.

¹ Talmy, as well as Sweetser (1982; 1984), further proposed that the physical-force model maps straightforwardly to the psychological realm, since these same predicates are used to characterize psychosocial as well as physical causal relations. This proposal develops a central theme of cognitive linguistics according to which abstract conceptual content is derived from representations of physical reality (see e.g. Bloom et al. 1999 for an overview). Wolff (2007; Ch. 5, this volume) has demonstrated the psychological validity of Talmy’s proposals, showing experimentally that the magnitudes and interaction of physical forces in an animated environment can be very precisely predictive of speakers’ choice of lexical items for such predicates, and that these effects transfer unproblematically to psychosocial contexts.

6.2 Davidsonian events and causation 121

(Moens and Steedman 1988; Naumann 2001; Fernando 2004; ter Meulen 1990). Dahl (2007) also views events as transitions from one static situation to another.

We argue that these two approaches, taken together, can provide a simple answer to a central problem of standard event semantics: that of the defeasibility of causation. Intuitively, a force is an input of energy into a situation, causing a transition to another situation, as long as all else is equal—that is, as long as no stronger perturbing force intervenes to bring about a different result. Formally, we treat forces as functions from an initial situation to the situation that results *ceteris paribus* (all else being equal). This allows for the possibility that all else may not be equal, leading to the lack of a causative entailment. The key feature of the approach is that it allows a simple semantic characterization of a “normal” result that does not entail the existence of that result. In existing event-based treatments, in contrast, possible worlds (e.g. Dowty 1979; Tatevosov 2008) or unanalyzed partial events (in the sense of Parsons 1990) are used to defeat the equivalent entailment; the adoption of possible worlds overcomplicates the semantics, while the use of partial events glosses over the issue of how to link causes and results. This is not to say that events *must* be jettisoned to account for defeasible causation (see Copley and Wolff, Ch. 2, this volume). However, if a causal analysis is given of the data in question it must be explained how causation can be defeasible. Forces provide a natural way of achieving this goal.

To illustrate the application of the framework to natural language data, we sketch an analysis of non-culminating accomplishment predicates, and provide an in-depth analysis of “frustrative” morphology in Tohono O’odham, an Uto-Aztecan language spoken in southern Arizona and northern Mexico. The resulting analysis sheds light on the representation of statives, plans, and prospective, imperfective, and perfective aspect.

In section 6.2 we provide a quick review of the role of event arguments in semantic theory, sketching the development of the event-chaining view of event types involving transitions, and noting the difficulty with defeasible causation encountered in the general framework. Section 6.3 details the proposed force-theoretic framework, and in 6.4, we show how the framework allows a straightforward analysis of the Tohono O’odham frustrative morpheme *cem* (pronounced [tʃim]).

6.2 Davidsonian events and causation

The Davidsonian revolution in semantics reified the notion of “event.” In his discussion of sentences like that in (1), Davidson (1967) proposes that there is an argument that the predicates *with a knife*, *in the kitchen*, and *at midnight* are all predicates of.

- (1) Brutus killed Caesar with a knife in the kitchen at midnight.

122 6. *Eliminating causative entailments*

Not only do events have spatial and temporal location, as in (1), but they can also be observed, and referred to with pronouns: *Brutus killed Caesar and I saw it happen*.

Neo-Davidsonian analysts saw a way to extend Davidson’s proposal to characterize semantic subcomponents of predicates, such as theta-roles. They proposed to extract core arguments from the main predicate and introduce them via two-place predicates such as Agent (x, e) and Theme (y, e). The main predicate is thus reduced to a one-place predicate of events, on a par with the event-modifying adjuncts in Davidson’s schema (e.g. Castañeda 1967).

A separate line of analysis investigating the internal structure of events produced a consensus that certain events—Vendlerian Accomplishments, most saliently—are in fact composed of two sub-events, chained together in a causal relationship: *John opened the door*, for example, has a causing sub-event e_1 , and a result sub-event e_2 . Pustejovsky (1995) and Higginbotham (2000) proposed novel rules of composition to link events causally, allowing a straightforward expression of the insight that *John* is the Agent of only the first, causing, sub-event, e_1 ; this event then is “chained” with e_2 , of which the Theme is predicated. Kratzer (2005) and Ramchand (2008) moved the work of causally chaining e_1 and e_2 to the denotation of a functional head.

Cases of defeasible causation pose a challenge to the event-chaining account of complex events, however. The event-chaining hypothesis entails that e_2 is an inevitable consequence of e_1 . However, there are many cases in natural language where there is an Agent *doing* something (e_1) which would normally be the causing sub-event of a second *happening* sub-event, but the *happening* (e_2) is non-existent, or the wrong kind of happening. In effect, these are cases where Brutus does something with the intention of killing Caesar, but Caesar does not end up dead. The best-studied such effect is the imperfective paradox (e.g. Dowty 1979; Parsons 1989; 1990; Landman 1992; Portner 1998),² but there are others, two of which we will illustrate here.

In many languages, unmarked telic predicates often fail to have a causative entailment; these constructions are called in the literature “non-culminating accomplishments.”³ For example, Malagasy has an agentive infix, *-an-*, which indicates the presence of an initiating event and an active Agent, but the *-an-* infixed form does not entail successful completion of the caused event—it is implied, but defeasible, as described by Travis (2000), and illustrated in in (2).⁴

- (2) Namory ny ankizy ny mpampianatra
 past.Agent.meet the children the teachers

² We address the English progressive and the imperfective paradox at length in Copley and Harley (to appear).

³ We use the term “accomplishment” following common usage, although this category includes some achievement predicates as well.

⁴ Note that although the underlying form of the infix is listed as *-an-*, it is subject to morphophonological changes that can affect its surface realization.

6.2 Davidsonian events and causation 123

... nefa tsy nanana fotoana izy.
 ... but NEG PAST.have time they

'The teachers gathered the children but they didn't have time.' (Travis 2000: 172)

This phenomenon is not a parameter at the level of the language, but occurs in various forms cross-linguistically. For example, the neutral form of the verb in Tagalog does not entail completion (Schachter and Otnes 1972; Dell 1987); the completion can be explicitly contradicted.⁵

(3) Inalis ko ang mantas,
 N-PERF-remove GEN-I NOM stain,
 pero naubusan ako kaagad ng sabon, kaya hindi ko.
 but run-out-of NOM-I rapidly GEN soap hence not GEN-I
 naalis
 A-PERF-remove

'I tried to remove (lit. 'I removed') the stain, but I ran out of soap, and couldn't.'
 (Dell 1987: 186)

Similar examples are found in a number of languages, for example in the Salish languages St'át'imcets and Skwxwú7mesh of the Pacific Northwest (Bar-el et al. 2005), in Karachay-Balkar, a Turkic language spoken in Russia (Tatevosov 2008), in Hindi (Singh 1998), and in Mandarin (Koenig and Chief 2008). In all these cases, the agent *does* something but is unsuccessful in getting the intended result to *happen*.⁶ As Dell puts it, "the lexical meaning of the [verb] root ... involves two distinct ideas. One has to do with the agent's engaging in a certain action or 'Maneuver' ... and the other has to do with a certain "Result" that may (but need not) be brought about by that Maneuver" (1987: 181).

Another especially striking example in which the intention and the result of the action diverge is in the case of so-called "frustratives." Descriptively speaking, sentences with frustratives can express the fact that the subject intended to do something that is not realized; that the subject does something in vain; that a situation is unsatisfactory or does not develop as expected, or that a state does not continue. For example, the frustrative marker *-pana-* in Amahuaca, a Panoan language spoken in parts of Peru, can be used to express that the subject was going to do something but was foiled, as in (4).⁷

⁵ In Dell (1987), "N" stands for the "neutral" form of the verb, "A" for the "abilitative" form of the verb.

⁶ It is worth emphasizing that these neutral sentences, while not entailing completion, are not imperfectives or progressives; they do not e.g. behave in discourse as though they were derived statives, and cannot be an answer to the question "What is/was happening?" (Matthewson 2004). In fact, Bar-El et al. (2005) assert that the neutral form is perfective, lacking an overt marking for imperfectivity. We follow these authors in considering it to be inappropriate to treat such sentences as containing e.g. a null imperfective operator.

⁷ Abbreviations: ACT = actuality aspect, COMPL = completed, DS = different subject, NONSQ = non-sequence, SQ = sequence, TH = theme, TR = transitive, DECL = declarative.

124 6. *Eliminating causative entailments*

- (4) Xau vuchi-pana-x-mun hun hovi hi-cain
 turtle look.for-FRUS-NOM-TH me rain do-NONSQ(DS)
 ca-yama-vahii-ha-hqui-nu.
 go-NEG-all.day-COMPL.PAST-ACT-DECL
 ‘I was going to look for a turtle, but it rained and I did not go all day.’
 (Sparing-Chávez 2003: 5)

To our knowledge, frustratives remain relatively underexplored. The particular frustrative we will discuss in detail is the morpheme *cem* (Hale 1969; Devens 1972; Copley 2005a) in Tohono O’odham, a Uto-Aztecan language spoken in southern Arizona and northern Mexico:

- (5) Huan ‘o cem kukpi’ok g puat.
 Juan aux-IMPF FRUS open DET door
 ‘Juan pulled on the door but failed to open it.’

The *cem* sentence in (5) expresses the notion that the forces that Juan has brought to bear on the situation are inadequate to produce the intended effect of opening the door. We will see that *cem* also interacts with aspectual meanings (perfective, imperfective, and prospective) to express the particular nature of the inadequacy of Juan’s effort.

These data highlight the difficulty that event chaining has with events that fail to culminate as expected. What is the status of the event (e_1) of which Juan is an agent? Whatever it is, it is not necessarily an event that causes e_2 to occur. The event-chaining framework as it stands merely stipulates that there is a causal relationship between e_1 and e_2 . As things stand, we don’t have any understanding of how e_1 might cause e_2 , or how e_2 might possibly fail to occur even in the presence of an apparently appropriate e_1 . Indeed, the usual unselective existential binding of open event variables within a verb phrase in event-chaining formulae *entails* the existence of the result event e_2 .

This problem has been addressed in two ways by existing accounts of defeasibility. The first is through the use of possible worlds: e_2 does occur, but only in certain possible worlds, the “inertia worlds” where things proceed normally and nothing else intervenes. This approach was first proposed in Dowty’s (1979) treatment of the English progressive, with many others refining the account (e.g. Landman 1992; Portner 1998). Non-culminating accomplishments have been accounted for in this way by Matthewson (2004) and Tatevosov (2008), while *cem* itself has been given a possible worlds treatment in Copley (2005a).

Another way of addressing the problem of defeasibility has been to give up on causation altogether, and adduce a subpart relation between partial and culminated events. Parsons’ (1990) treatment of the English progressive is one such theory; see also Singh (1998) for a partial theta role approach to non-culminating accomplishments that is linked to Krifka’s (1989; 1992) use of partial and complete events.

As discussed in Copley and Wolff (Ch. 2, this volume), there are likely to be other ways to alter event theory to account for defeasible causation. However, there is a reason to think that events are not quite the right intuitive notion. In cases of defeasible causation, something intervenes to interrupt the normal course of events. But events are typically understood as changes (Cleland 1991). If this is so, it is plausible to think that changes, strictly speaking, cannot interact, intervene, or be defeasible. Forces, on the other hand, can do all of the above.

Our goal here is to use the notion of *force* to address the issues for Davidsonian event semantics described above. Forces in physical systems interact with each other in predictable and well-understood ways, such that a given force may produce varied, or even null, results, depending on what other forces are active in the situation. We claim that implementing an abstract version of this notion in a semantic system allows us to understand grammatical expressions of defeasible causation. The problem of the missing causative entailment is solved by not generating these entailments in the first place.

6.3 Forces

We have seen two kinds of data—non-culminating accomplishments and frustratives—whose key similarity lies in the fact that there is an e_1 and an e_2 , where e_1 is expected or supposed to cause e_2 , but e_2 does not occur. We turn now to the task of defining a force-based model that builds this into the representations.

The only formalist approach to systematically employ the concept of “force” as such that we are aware of is extensive work by van Lambalgen and Hamm (2003; 2005). These authors share several convictions with the present approach, including the idea that the concept of *inertia*—implemented here with our *ceteris paribus* condition—is central to the treatment of events and should be treated directly in the model, instead of with the additional machinery of possible worlds. However, van Lambalgen and Hamm introduce forces as a supplement to the familiar machinery of events, processes, and results. In our framework, forces are irreducibly central to the cognitive and grammatical representation of verbal predicates.⁸

This task begins with deciding what forces are, and how to model them. We then present the framework of causal chains of situations that emerges from this picture, and consider what this account means for branching time. In addition, we discuss how something like gravity might be represented and what such a representation has to do with non-spatiotemporal forces. Finally, we give a brief account of how psychological forces such as intentions are to be understood.

⁸ See also Vecchiato (2003; 2004) for a use of “force” that is very much in the spirit of the proposal here, but without a specific formal implementation.

126 6. *Eliminating causative entailments*6.3.1 *Initial and final situations*

We take a situation to be a kind of annotated snapshot of a collection of individuals and their (relevant) properties. A force is a particular input of energy into some initial situation. This energy is either generated by an animate entity, or comes from the motion or other properties of an individual in the initial situation.⁹ The application of this energy can change the initial situation into a different situation.

A force results in a changed situation as long as no stronger force keeps it from doing so. So, for example, if you push on a cup hard enough to overcome the friction between the cup and the table it is sitting on, the cup is set in motion. The initial situation is the one where the cup is at rest and the final situation is one where the cup has velocity. The input of energy causes the change from the initial to the final situation. We take events (as opposed to states) to always involve such an input of energy.

Now suppose that you push on a stationary cup, but that you do not push hard enough to overcome the force of friction on the cup. Nevertheless you are still applying a force by pressing against the cup. This force has essentially no effect because an opposing force, namely, the frictional force of the cup on the table, is stronger.

In the case where the force is strong enough to make the cup move, we observed an initial situation (cup at rest) and a different final situation (cup in motion). On the other hand, in the case where the force is not strong enough to make the cup move, the observed initial situation (cup at rest) has the same properties as the observed final situation (cup still at rest). If we were to grease the bottom of the cup, and thereby reduce the magnitude of the force of friction acting on the cup, we could reduce it sufficiently such that a pushing force with the same magnitude as the previous force would now allow the cup to move, so again the initial situation would be different from the final situation.

A force's observed final situation is thus contingent on the existence and strength of other forces opposing it. Since this is the case, it is not going to be useful for us to define any given force based on its *observed* final situation; i.e. we don't want to say that intuitively "the same force" would be defined differently depending on whether the bottom of the cup is greased or not. In fact, much of the work we will want forces to do to account for defeasible causation has to do with counterfactual final situations—those that would ordinarily have been expected to happen if some other force hadn't intervened. So we will base the definition of any particular force on the "*ceteris paribus* ('all else being equal') final situation"—the situation that would obtain in the case that is just like the actual case but in which there is no stronger external opposing force.

⁹ For a more detailed discussion of how the terms *force* and *situation* are to be understood in the force-theoretic framework, see Copley and Harley (to appear).

6.3.2 Representing forces

In physics, forces are represented as vectors. Vectors are determined by three parameters: an origin, a direction, and a magnitude. We might understand the origin to be the initial situation in which the force is applied. The direction is, in an abstract sense, towards the force’s *ceteris paribus* final situation. Magnitude is only important in relative terms, to characterize the interaction of opposing forces. We will exploit intuitions deriving from such representations in illustrating causal chains of forces below.

We propose to represent forces in a Montagovian semantics as functions¹⁰ from situations to situations, type $\langle s,s \rangle$, which we will abbreviate for convenience’s sake as type f .

(6) *Type of situations:* s

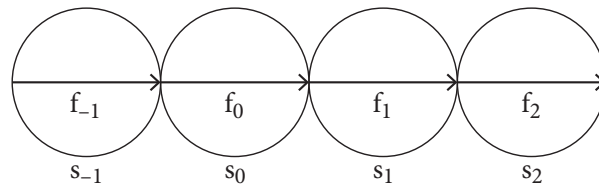
(7) *Definition of force:*

A force f is a function from an initial situation to the *ceteris paribus* final situation, i.e. it is of type $\langle s,s \rangle$.

The idea behind the $\langle s,s \rangle$ type, as before, is that if you have an initial situation in which a force is applied, and no stronger force intervenes (i.e. *ceteris paribus*) the final situation results—not a different *set* of situations; but a single situation, according to the laws of naive physics, which are, we will assume, deterministic.

While it is true that many different forces can combine to result in another force, the idea here is that the causing situation will include all of the individuals and properties that give rise to the *net force* that results in the final situation. (What makes a force “net” is that it arises from the totality of the individuals and properties in the situation, rather than a subset of them.) Supposing as we do that the laws of naive physics are deterministic, we may speak of causal chains of situations or forces, with the net force of one situation, when applied to that situation, resulting in a unique successor situation. The bubble diagram in (8) depicts such a causal chain.

(8) Causal chain of situations with net forces



¹⁰ Davidson (1966) expresses skepticism that events can be represented by transitions from one state to another, remarking that there are any number of ways to go from San Francisco to Pittsburgh (by foot, by air, by mule, ...) and all these are different kinds of event although the initial and final state are the same. This objection does not, however, pertain to the idea of events as functions from one state (situation) to another. There are any number of ways to get from the integer 2 to the integer 4 ($x+2$, $x*2$, x^2 , ...) by way of distinct functions; likewise, there are in general different ways to get from one situation to another by way of distinct functions.

128 6. *Eliminating causative entailments*

Successive situations will be numbered in series, as shown in (8). We will assume that for any given situation s_n , we can always recover its net force f_n (which in some cases may be zero by virtue of our knowledge of the individuals and properties in s_n).

(9) $\text{net}(s) =:$ the net force of s

The net force itself is calculated in the cognitive system. This calculation is easiest to understand for cases of forces whose effects are strictly spatiotemporal; it is possible to sum the physical forces that act on a single object to compute the net force acting on that object. However, the notion of force that we are constructing here acts on situations rather than objects. Energy inputs into a situation will not all necessarily be acting on the same object in the situation; indeed, the effects may not be purely spatiotemporal. Nonetheless, we assume that this more abstract kind of summation is unproblematic, as humans (and other animals) are very good at looking at a situation and perceiving causality (White 2010; Hubbard 2012) as well as deciding what will happen next if nothing intervenes (Zacks et al. 2011).¹¹

Using the function *net* we can define two other functions that will be useful. Given a net force f , the initial situation of f is simply the situation s of which f is a net force. The final situation is the situation that results when f takes s as its argument. (The superscript-1 on a function f denotes the inverse of f , namely the function g such that for all x in the domain of f , $g(f(x)) = x$.)

(10) a. $\text{init}(f) = \text{net}^{-1}(f)$
b. $\text{fin}(f) = f(\text{net}^{-1}(f))$

We also define a situation's successor and predecessor situation:

(11) a. $\text{suc}(s) = \text{fin}(\text{net}(s))$
b. $\text{pred}(s) = \text{suc}^{-1}(s)$

6.3.3 *Causal chains of situations*

This point of view raises a question: if the laws of naive physics are deterministic, and causal chains are as we have depicted them, how can there be branching futures? This question is not only of concern to philosophy; it is of concern to semantics as well, since the latter is also concerned with representing what might happen or (if things had turned out a little differently) what might have happened.

In the framework we are proposing, outcomes of fully understood situations are indeed deterministic. However, real-world states of affairs may be incompletely represented, resulting in several different possible net forces, and therefore in several different potential outcome situations, i.e. in branching futures. There are (at least)

¹¹ In a sense, we are proposing that the cognitive system treats the initial situation as the "object" on which all forces act; a force on a cup in fact is a force that applies to the situation to result in another situation where the cup is located somewhere else. If this perspective is correct, it may provide some insight into the way our cognitive system represents such apparent "forces on objects"; no object can be represented in isolation; it always forms part of a situation, even if that situation is quite minimal. A force diagram containing just an object, with no external spatiotemporal frame of reference, makes no intuitive sense.

three distinct ways that things may turn out differently due to incomplete situations in the mental model, even given the deterministic nature we are assuming for naive physics. The mental representation of the real-world state of affairs might suffer from any of the following: underspecification of the magnitudes of relevant forces, incomplete knowledge of the identity of the relevant forces, and/or incomplete knowledge of the individuals and/or properties from which forces arise. Any discrepancy in the determination of which forces are included in the calculation of the net force will result in a different net force obtaining in the real world.

First, we may not know the magnitude of the forces that are acting. For example, in the cup-pushing scenario, we may not know that the tabletop has a rubberized surface, resulting in a greater frictional force than expected, counteracting the pushing force acting to move the cup. More generally, Barbey and Wolff (2007) and Wolff (Ch. 5, this volume) have argued that a causal chain of forces can result in several different outcomes according to the magnitudes of the forces involved. Moreover, they argue, people are bad at assessing anything but the relative magnitudes of two forces, so this indeterminacy arises quite generally and increases with the length of the causal chain, despite the deterministic nature of causation in their model.¹²

The second way that branching can occur is if we do not know which forces are acting. For example, in a coin toss, we don't know exactly what forces are acting on the coin. If we did, we would be able to say confidently whether it would come up heads or tails. One major source of unknown and unknowable forces is the volition of animate entities. We assume that naive psychology includes a form of free will; animate entities can choose to act on the world in one way or another, according to their preferences. Based on what an animate entity decides to do, there can be different outcomes of what is apparently the same state of affairs. In any situation with an animate entity in it, then, there is the potential for unknown forces to appear, producing variable outcomes.

The third way that branching can occur is if the speaker is mistaken about the entities and properties in the initial situation. For example, suppose a car is traveling smoothly along the highway, but runs over a tack, puncturing a tire and resulting in an accident. If you did not initially perceive the tack, the initial situation in your mental representation is not the one that led to the real-world outcome. Alternatively,

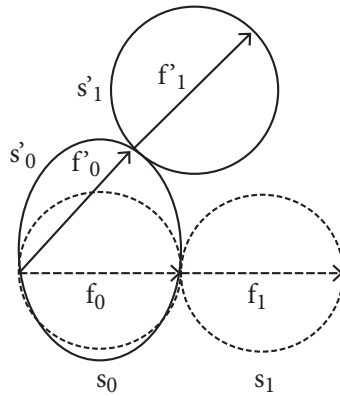
¹² This implies that the nature of the indeterminacy of the future may be epistemic, i.e. that there is a fact of the matter but we just don't know what it is (cf. McTaggart's 1908 B-theory of time). We do believe that there is a metaphysical difference between the past and the future in that the future hasn't happened yet (making us A-theorists, in McTaggart's terms), in part because of overwhelming grammatical evidence that there are temporal differences between metaphysical and epistemic modality (e.g. Condoravdi 2001; Werner 2006). It is true that the nature of the indeterminacy is in general epistemic in the model, with the (important) exceptions of animate entities' whimsical choices and, presumably, quantum events. However, it is significant that in our model, what is not known is not the future, but the present; this principle is also endorsed by Kissine (2008) with respect to *will*.

130 6. Eliminating causative entailments

consider a case in which you look at a vase tipping over and you judge that it is about to fall to the ground and break. But then someone standing next to the vase suddenly catches it. The situation of the person catching the vase is not the successor of the situation that includes only the falling vase; instead, it is the successor of the larger situation which includes both the falling vase and the person making the decision to catch it. (This kind of scenario will become important in our discussion of frustratives below.)

The choice of the initial situation s_0 does considerable work in this framework. When a speaker makes a claim about what forces are in play, they have a specific s_0 in mind and they assume that no forces arising externally to that situation will intervene to prevent the successor of s_0 from happening.¹³ In all the cases discussed below, the unexpected outcome is the result of the speaker’s incorrect choice of s_0 . The situation that actually determines what comes next is a different (in this case, larger) situation than s_0 , call it s'_0 . So the successor of s_0 (call it s_1) does not actually occur; what occurs instead is the successor of s'_0 (call it s'_1). This state of affairs is illustrated in (12) (the incorrect choice of s_0 , its force f_0 , and its non-realized successor s_1 are illustrated with dotted lines to indicate that they were not realized; the realized situations and forces s'_0 , f'_0 , etc., are illustrated with solid lines):

(12)



We will call situations whose successors do occur *efficacious*.

(13) Definition of efficacy (Copley and Harley, to appear)

A situation s_n is *efficacious* just in case its normal *ceteris paribus* successor s_{n+1} actually obtains. That is:

for any s_n with a net force f_n , then s_n is efficacious iff $\text{fin}(f_n)$ (i.e., s_{n+1} , the successor of s_n) actually obtains.

¹³ This is the “closed-world” assumption; see Weld (1994) and van Lambalgen and Hamm (2005).

This definition will undergo a slight revision in section 6.4.2.1, as we discuss staves in the context of Tohono O’odham frustratives. For now, we note simply that the effect of branching comes about when the initial situation is not efficacious; the result expected from the net force of s_0 does not occur, while the result expected from the net force of an alternative initial situation does occur.

6.3.4 Gravity, tendencies, and fields

In the spatiotemporal cases such as pushing on the cup, it is evident that there is an application of energy. But in what sense is there an application of energy in the case of the frictional force, which results from the effect of gravity on the cup? For that matter, if you hold the cup in the air and then let go of it, and it falls due to the force of gravity, where is the application of energy? There are two answers to this question: the ancient physics answer (represented here by Aristotle) and the modern physics answer.

The Aristotelian explanation (*Physics*, VIII:4) is that heavy things (earth etc.) have a tendency to descend, while light things (smoke, fire) have a tendency to ascend. “[H]ow can we account for the motion of light things and heavy things to their proper situations? The reason for it is that they have a natural tendency respectively towards a certain position: and this constitutes the essence of lightness and heaviness, the former being determined by an upward, the latter by a downward, tendency.”

In Talmy’s work (e.g. 1988; 2000) on the linguistic reflexes of cognitive representations, he echoes this Aristotelian notion: “in terms of the cognitive structure of language, an object in a given situation is conceptualized as having an intrinsic force tendency, either toward action or toward rest. This concept appears to correlate with historically earlier scientific theories involving an object’s impetus in motion or a tendency to come to rest” (Talmy 2000: 1.456).

Newtonian physics has done away with this tendency but has its own tendency, namely *inertia*. Beginning with Newton, rest is understood as zero velocity, and objects tend to move at their current velocity unless acted upon by an outside force (Newton’s First Law of Motion).

A more modern understanding of gravity—setting aside general relativity and particle physics—is that of a vector field that interacts with objects in it. Any object in a gravitational field has a gravitational force on it that is calculated by using the value of the vector field at the location where the object is, and the mass of the object. The “application of energy” comes from the *potential energy* stored up by the energy it took to put the object at that location in the field. It takes energy to raise the cup to the table, against the force of gravity. This energy is converted to acceleration if the cup should fall.

These two perspectives both express the idea that where there is gravity and an object with mass, a force arises; this force results in an event if nothing stronger

132 6. *Eliminating causative entailments*

intervenes. In both perspectives there is an expression of the general (the tendency itself, or the ability of the field to exert a force on any object put into it) and the particular (the specific force that arises from the tendency in any particular situation, or the specific force that arises from the field acting on the particular object). A tendency or field, whatever its provenance, is therefore treated in any particular scenario as producing a specific force whenever an appropriate individual is present.

Many linguistic explanations of meanings make reference to tendencies, natural laws, and so on; we propose to treat these as abstract analogues of the case of gravity. We turn to these next.

6.3.5 *Beyond spatiotemporal effects*

We are used to thinking of physical forces as contact forces that result in a change in the spatiotemporal properties of an object: where it is, whether it is moving or at rest, etc. In such cases, *init*(f) and *fin*(f) are situations that differ only in these respects. But actually, *any* physical change could be represented as a function from one situation to another.¹⁴ Consider a fruit ripening: *init*(f) includes the unripe fruit and *fin*(f) includes the ripe fruit. Insofar as ripening happens to all fruit unless it is chilled, eaten while it is still green, etc., this case is less like pushing a cup and more like gravity: fruit has a tendency to ripen.

We will collect tendencies such as that of unsupported objects to fall and that of fruit to ripen into something we will call the “normal field.” Of course, the normal field does not produce a force unless there is an object of the appropriate kind in the field. So the normal field can include the tendency of fruit to ripen, for instance, but unless there is a fruit in the initial situation, such a ripening force is not realized.¹⁵ The forces provided by the normal field should be assumed to combine with other forces in the initial situation to produce the net force that yields the final situation.

We mention the normal field here simply to signal that we are aware of the many forces that arise from dispositions, laws, and the like.¹⁶ For the data we are

¹⁴ This abstraction is already present in Aristotle’s *Physics*, though he does not extend this analysis to verbs of creation and destruction (V:1); we assume that it applies to all predicates.

¹⁵ Our normal field bears some similarity to Mackie’s (1974) background or causal field.

¹⁶ Many of the intervening situations in a causal chain involve forces which are crucial to the outcome, but not usually licit as causer subjects in sentences about that causal chain, as illustrated by the example in (i):

(i) Booth/The gunshot/The bullet/#Gravity/#Friction/#The density of his clothes and flesh killed Lincoln. Languages may vary in which causers in the causal chain can be subjects (see e.g. Folli 2001 on Italian vs. English), but one feature of the illegitimate subjects in (i) above is that the entities which they name are associated with forces in the normal field. We do not propose to try to provide an account of which causes in the chain are licensed as appropriate subjects in a given language or in general, that being properly within the purview of psychologists or philosophers studying causation (see e.g. Thomason, Ch. 3, this volume). We note, however, that one relevant factor may be whether the speaker mentally represents a given force as derived from the normal field.

considering here, the normal field does not have a counterpart in the semantics. Instead, the forces generated by the normal field are considered together with any other forces present in the situation, and the cognitive system is assumed to calculate the net force of the situation—the one that will lead to the *ceteris paribus* successor situation, if nothing external intervenes.¹⁷

6.3.6 Physical and psychological forces

Just as we can speak of pushing or putting pressure on an object, we can also speak of pushing or putting pressure on someone, in a psychological sense, to accept an idea or to perform an action. The idea that the conception of the physical world is co-opted for use in the psychological or psychosocial domain is present in Jackendoff (e.g. 1987) and Lakoff and Johnson (1999), among many others (see e.g. Bloom et al. 1999 for a representative sample). Talmy (e.g. 1988; 2000) has extensively championed the view that force dynamics is the way to understand this link between the physical and the psychological. For example, while the sentence in (14a) is “force-dynamically neutral,” the sentence in (14b) conveys that some other force, whether physical or psychosocial, prevents the subject from leaving the house if he wants to.

- (14) a. John doesn’t go out of the house.
 b. John can’t go out of the house. (Talmy 2000: 1.412)

Wolff (2007) has tested this idea experimentally, showing subjects a scene in which a pedestrian wants to go in a certain direction and a policeman directs her to go in a certain (possibly different) direction, and asking his subjects if the policeman *caused* her to reach, *enabled* her to reach, or *prevented* her from reaching her destination. The results exactly parallel the results he obtains in scenarios where inanimate objects are exerting forces on each other.

Copley (2010) proposes an analysis of desires that treats them analogously to our formal treatment of forces, but assigns them a higher type, to account for the intensional nature of intentions (e.g. Heim 1992; Portner 1997). Rather than being functions from situations to situations, desires are functions from situations to properties of situations, or, in some cases (we suspect), to properties of forces: intention to act is a kind of net desire.¹⁸

The interaction of intentions with a particular tendency in the normal field will provide our treatment of agency. In brief, we propose that volitional individuals are subject to a normal field tendency which we will call the Law of Rational Action. The Law of Rational Action governs any individual who is subject to a particular psychological force—an individual with an intention or desire. If such an individual

¹⁷ In generic sentences, however, we suspect that the normal field may make an appearance in the semantics; the idea would be that generics assert that a particular force is in the normal field of the topic situation.

¹⁸ See Condoravdi and Lauer (2009), as well as the notion of “commitment” in Copley (2009).

134 6. *Eliminating causative entailments*

is in a situation which does not satisfy the desired property, then that individual is the source of forces which (*ceteris paribus*) will result in a later situation that does satisfy the desired property (or which contains a force which satisfies the desired property).

(15) *Law of Rational Action* (see also Copley and Harley, to appear):

If an individual *x* has a net desire for *p* in a situation *s*, *x* is the source of a force which has a later situation with property *p*, as long as nothing prevents *x* from being the source of such a force.

A full implementation of intentionality and agency will take us too far afield here; however, we leave a full discussion of psychological forces and agency for future work.

6.4 Forces in action: non-culminating accomplishments and Tohono O’odham frustratives

In section 6.2, we introduced two cases of defeasible causation. Non-culminating accomplishments do not require any special construction or morphology to indicate the failure of a normal or expected event to occur—that is, the normal consequence is not entailed by the assertion of a causal event. In other languages, a separate construction is dedicated to such failures: the frustrative. We suggested that to do justice to these data, the causal relationship should be codified quite centrally in the semantics, via the notion of force and we explained how we intended to represent forces in language. In the remainder of this chapter we show how this proposal allows us to treat cases of defeasible causation straightforwardly, instead of first generating and subsequently undoing a causative entailment. The non-culminating accomplishments are derived quite immediately. We then present an analysis of the Tohono O’odham frustrative and its interactions with aspect.

To briefly introduce our formal apparatus: We propose that eventive vPs¹⁹ are predicates of forces, type $\langle f,t \rangle$; they will be represented by the lowercase Greek letter π . Propositions, as well as statives (including small clauses), are predicates of situations, type $\langle s,t \rangle$, and are represented by lowercase Roman letters *p*, *q*, etc.²⁰

- (16) a. $\llbracket [_{VP} \text{Juan open the door}] \rrbracket = \lambda f . \text{source}(\text{Juan}, f) \text{ and } \llbracket [_{SC} \text{open the door}] \rrbracket (\text{fin}(f))$
 b. $\llbracket [_{SC} \text{open the door}] \rrbracket = \lambda s . \text{the door is open in } s$

Situations will be referred to by the variables *s*, *s'*, and so forth. Recalling the definitions given in (9)–(11), the net force of a situation, *s*, is *net(s)*, and a situation

¹⁹ The vP corresponds to the constituent which in Government-Binding theory and other syntactic theories is typically labeled VP, “verb phrase”; it is the highest projection within the verb phrase and responsible for introducing the Agent argument. See Harley (2010) for a fuller exposition.

²⁰ The force-theoretic framework thus provides a type distinction between eventive and stative predicates; some consequences of this distinction are noted in Copley and Harley (to appear).

can also be referred to as *init*(f) or *fin*(f), as well as *pred*(s) and *suc*(s). In bubble diagrams, we will continue to refer to situations with respect to other numbered situations in the causal chain; i.e. if s_0 is a situation (typically the topic situation), s_1 is its (*ceteris paribus*) successor, and s_{-1} is its predecessor.

6.4.1 Non-culminating accomplishments

In culminating and non-culminating accomplishments alike, the net force of the topic situation s_0 is described by the vP. In languages or forms where accomplishments culminate, we propose that there is a presupposition that s_0 is *efficacious* (see (13)). That is, it is presupposed to proceed successfully, via the action of its net force, to its successor, without interference from forces generated from outside of s_0 . When s_0 is presupposed efficacious, it is entailed that the final situation of the net force of s_0 actually occurs.

Where accomplishments are non-culminating, on the other hand, as in (2) and (3), we propose that there is *no* presupposition that s_0 is efficacious. Thus the result situation *fin*(f_0) of the net force of s_0 is not entailed to occur. On the other hand, there is still an implicature that the result situation *fin*(f_0) holds. The reason is ultimately one of Gricean Quantity: *fin*(f_0) is by definition the *ceteris paribus* successor of s_0 , the situation that occurs if all else is equal. But if all else is not equal, i.e. if the circumstances are somehow unusual, the speaker would be expected to have said so. So unless something specific is said to indicate that the result situation of the net force of s_0 does not hold, it is implicated to hold. Significantly, there is no need for a modal operator quantifying over possible worlds to account for the non-culmination cases (cf. Matthewson 2004; Copley 2005a; Tatevosov 2008), as the absence of culmination follows from the absence of a presupposition of efficacy, rather than from any additional operator that removes the culmination entailment from the sentence.²¹ Thus, the culmination entailment is simply dispensed with—never generated at all—rather than defeated, in our analysis of these forms. It is an *additional* component in languages (like English) that have it, introduced via the extra presupposition of efficacy. In short, the absence of a culmination entailment is the basic case, because by their very nature forces can always be interrupted or overcome, and entailed culmination is the marked case.

The difference between languages with and without culminating accomplishments, then, is a difference in the presuppositions attached to the vP. Such a purely semantic parameter would be unusual in the modern Minimalist generative framework, which generally treats parameters as associated with the properties of particular functional categories in different languages. It is possible that this presupposition is attached to a particular morpholexical item in the relevant languages, rather like the presence vs.

²¹ We note also that partial event accounts such as that of Singh (1998) have the same problem as pointed out in Portner's (1998) critique of Landman (1992) and Parsons (1990): namely, that the question of how a partial event is related to a completed event is left unaddressed.

136 6. *Eliminating causative entailments*

absence of definite determiners cross-linguistically.²² For the moment, we leave the presuppositional treatment as a proposal, noting however that *non*-efficacy shows up as a presupposition in the Tohono O’odham frustrative (see (19) and (20)). For a further indication of the line of argumentation that motivates our view, see e.g. Copley’s (2008; 2009) treatment of the presupposition of ability in futurates and futures. We also believe that there is a strong parallel between this presupposition and that of maximality in definites; see e.g. Filip (2008) on maximality applied to event semantics in the analysis of telic predicates. We leave the investigation of the existence and nature of this parameter for future research.

6.4.2 *The Tohono O’odham frustrative*

We now turn to the particular empirical analysis that is our central concern here, exploiting the framework developed above. Tohono O’odham, a Uto-Aztecan language spoken in southern Arizona, has a frustrative particle *cem* (Hale 1969; Devens 1972; Copley 2005a). This particle is associated with two²³ meanings: “non-continuation” and “unachieved-goal,” as shown in (17), applied to the stative predication ‘I (was) ready’:²⁴

- (17) Cem ‘añ ñ-na:tokc.
 FRUS 1SG 1SG-ready
non-continuation: ‘I was ready but now I’m no longer ready.’
unachieved-goal: ‘I was ready but you weren’t there.’

(Copley 2005a: 1)

²² It is striking to note that in languages with non-culminating accomplishments, there are frequently overt morphosyntactic indicators of completion; see also Copley and Wolff, Ch. 5, this volume. This may support the notion that the efficacy presupposition is attached to a particular lexical item.

²³ There are also other readings of *cem*; it occurs in counterfactuals (Hale 1969) and also with a “bad example” reading, as shown in (i) from Devens (1972: 351, in the very closely related language Akimel O’odham, orthography updated) and (ii) from Copley (2005a: 3); for the latter, reading (ii.a) is the unachieved-goal reading, while reading (ii.b) is the bad example reading.

- (i) M-a-n-t cem hikc heg heñ mo’o c ‘abs heg heñ novi ‘ep hikc.
 INTR-AUX-1SG-PERF FRUS cut.PERF ART my hair and but ART my finger also cut.PERF
 ‘I cut my hair but I cut my finger at the same time.’
- (ii) Huan ‘at cem pi cikp tako.
 Juan aux-PERF FRUS NEG work-PERF yesterday
 a. speaker: ‘Juan did work, but he didn’t want to.’
 b. speaker: ‘Juan worked, but he did it badly.’

We do not follow Copley’s (2005a) assumption that bad example cases like (ii.b) are straightforward instances of the unachieved-goal reading. We suggest that the bad example reading might be an epistemic variant of the unachieved-goal reading: instead of *p* being a plan that fails to be realized, *p* is an expectation that fails to materialize. This story is in line with the idea that metaphysical/circumstantial modality progresses into the future but epistemic modality doesn’t (e.g. Werner 2003).

²⁴ Note that past tense is not overtly marked in Tohono O’odham.

Next, we first explicate the treatment of statives and efficacy in the force-theoretic model, and then show how the two readings are derived when *cem* is combined with stative predicates.

6.4.2.1 *Statives in the force-theoretic framework* We treat statives, first of all, as properties of situations. The interpretation of the main predicate in (17), then, is given in (18), which is true if $\llbracket I \text{ ready} \rrbracket$ holds of a situation s :

(18) stative : $\lambda s . \llbracket I \text{ ready} \rrbracket(s)$

In sentences with *cem*, we propose that a presupposition of non-efficacy is introduced. In (17), for instance, it adds the presupposition that the situation s of which $\llbracket I \text{ ready} \rrbracket$ is predicated is not efficacious. The behavior of negated *cem* sentences (Copley 2005a: 12) motivates the treatment of non-efficacy as a presupposition, since for them too, s is not efficacious. In (19), for example, the (negative) state fails to continue, and in (20) a goal is unsatisfied—in this case, the goal of the speaker not to go.

(19) Pi 'o cem suam g howij.
NEG AUX FRUS yellow DET banana

'The banana wasn't yellow.'

speaker: 'I walked by the banana tree yesterday, it wasn't yellow, but now it's yellow.'

[non-continuation]

(20) Pi añ cem ñ-na:tokc.
NEG 1SG.aux.IMPF FRUS 1sg-ready.IMPF

'I wasn't ready.'

speaker: 'Someone came by—I wasn't planning to go, so I wasn't ready.'

[unachieved-goal]

(Copley 2005a: 12)

Recall our definition of efficacy from (13):

(13) *Definition of efficacy*

A situation s_n is *efficacious* just in case its normal *ceteris paribus* successor s_{n+1} actually obtains. That is: for any s_n with a net force f_n , then s_n is efficacious iff $\text{fin}(f_n)$ (i.e., s_{n+1} , the successor of s_n) actually obtains.

A presupposition of non-efficacy, then, as things currently stand, says that the successor situation s_{n+1} does not occur. However, it is not clear that this will suffice to capture the readings associated with *cem* when applied to a stative predicate. The reason is that this definition of efficacy does not address the status of the successor to a situation described by a stative predicate. The question is whether the model must represent such situations as having no net force at all; if such situations are to be

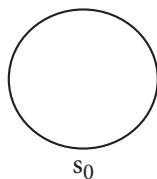
138 6. *Eliminating causative entailments*

represented, the further question that arises is how to define the notion of efficacy in such cases.

We take it to be reasonable to represent such situations. A speaker can easily have in mind a “still-life” snapshot—a situation where no energy is being added, and hence no net force exists (making *net* and *suc* partial functions). It is crucial to distinguish still-life situations from situations in which energy is being input but counteracted, which have a zero-magnitude net force because the forces involved in the calculation of the net force are exactly balanced. The latter kind of situation can be described by a verb of maintaining, such as *keep* or *stay* (see Copley and Harley, to appear). In such cases, there is a successor situation, and it is identical to the first situation: a zero-magnitude net force creates a successor situation to *s* just as any other net force does. In the case of the still-life situations, however, we claim that no successor situation is defined; in order for a situation to have a successor, force (i.e. energy) must exist in the situation.²⁵

A still-life situation, having no causal relation to a subsequent situation, is depicted in the bubble diagram notation as shown in (21).

(21)



Such a situation is a good candidate for the situation argument of stative predicates. The failure of stative assertions to advance the temporal anchor of the narrative in discourse suggests that asserted statives indeed do describe such a situation: a stative assertion has a “scene-setting” effect, adding information about the situation under discussion, but not providing any information about what happens next. In other words, stative assertions do not entail (or even imply) the existence of a successor situation. We conclude that statives can only be asserted of still-life situations.

(22) *Assertability of statives*

A stative predicate of *p* is asserted to hold of a situation *s* only if there are no forces represented in *s*.

²⁵ It is, incidentally, perfectly possible to conceive of a still-life situation *s* without entailing the end of the universe: since the transition to a successor situation is causally, not temporally, defined, time may go on during *s* although nothing happens. That scenario at first blush sounds like a recipe for “heat death”—the point at which the universe reaches a state of highest entropy and nothing else can happen—but recall that *s* is not the entire universe, but only a representation of a small bit of it. Forces generated externally to *s* can, as usual, intervene to change the individuals and properties in *s*.

6.4 Forces in action 139

We can now ask what it would mean for a still-life situation to be efficacious. A speaker with a still-life situation in mind does not expect anything to happen; if no energy is input into the situation, it will not lead to a successor situation. For such a situation to be efficacious, then, nothing should happen.

A situation therefore can be efficacious regardless of whether it has a net force. If an efficacious situation has a net force, the result of that force applied to the situation actually happens. If an efficacious situation does not have a net force (because no energy is being applied to the situation), then it is efficacious to the extent that, or just as long as, that situation persists. When something else happens, as it inevitably will, necessarily the energy that causes that something else will come from outside of the situation. The intuition is that without an input of energy, nothing happens.

Let us then add a clause to our definition of efficacy to capture this intuition:

(23) *Definition of efficacy* (extended to include statives)

A situation s_n is *efficacious* just in case its normal *ceteris paribus* result actually obtains. That is:

for any s_n with a net force f_n , then s_n is efficacious iff $fin(f_n)$ (i.e., s_{n+1} , the successor of s_n) actually obtains.

for any s_n that has no net force, no successor is defined, and so s_n is efficacious iff it has no successor.

6.4.2.2 *Stative cem sentences* Now we are ready to consider what happens when a speaker uses *cem* with a stative predicate as in (15). We have said, following Copley (2005a), that *cem* contributes a presupposition of non-efficacy.

(24) $\llbracket cem \rrbracket \lambda s \lambda p . p(s)$

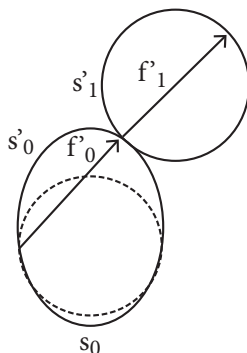
presupposed: s is not efficacious

This denotation is appropriate because when *cem* is added, in both the non-continuation reading and the unachieved-goal reading alike, the property actually does hold at the past topic situation; the speaker was ready, but the state didn't continue or some goal was not achieved.

Now, we elucidate how the combination of *cem* with a stative predicate derives the two readings. First, the non-continuation reading: the *cem* presupposition is that s_0 is not efficacious. Since s_0 is described by a stative predicate, s_0 is a still-life situation—it has no net force. That means that nothing happens next; s_0 has no successor s_1 . However, if s_0 is non-efficacious, as presupposed by the use of *cem*, we know that something happens next instead of nothing happening next. In fact, there is an efficacious situation s_0' that includes s_0 , and what happens next is exactly the successor of s_0' . This state of affairs is illustrated in (25).

140 6. Eliminating causative entailments

(25)



That means that s_0 was not a good representation of the relevant state of affairs in the actual world: something external to s_0 , but in s'_0 , produced a force f'_0 that intervened to produce s'_1 .

Because s_0 is a still-life situation, it does not have any forces represented in it. Let us assume for now as well that s_0 is minimal; we will look at the non-minimal case shortly. If situations are annotated snapshots, then a minimal s_0 in this case is one that contains only the speaker with the annotation that corresponds to readiness (and no other individuals, nor any other annotations representing properties of the speaker).

For the non-continuation reading, what we want to derive is that the speaker is not ready in s'_1 . *Cem* tells us that there was a perturbing force, i.e. energy was put in that produces s'_1 . Given that s_0 was minimal, the force that was put in must have produced an alteration in the characteristics included in s_0 ; for if nothing had happened to these characteristics as a result of the input of energy, nothing would have resulted, contra the presupposition contributed by *cem*.²⁶ So, as desired, the only possible net force in s'_0 results in a successor s'_1 in which the speaker is not ready.

Now let us suppose instead that s_0 was *not* minimal. What else could be represented in s_0 while still respecting the assertability condition on statives? The assertability condition tells us there can't be any energy in s_0 , so if s_0 is not minimal, the only other annotations it contains must also be stative in character. Aside from p , $\llbracket I \text{ ready} \rrbracket$, suppose some other arbitrary stative proposition q also holds of s_0 . In this case, given what we have said up to this point, the addition of *cem* would not be

²⁶ Recall that we have differentiated here between a still life (with no net force) and a keeping/staying situation, with a zero net force. The difference is that there is a non-zero input of energy in the latter situation, counterbalanced by a force in an opposite direction. That is, in the keeping/staying situation, there is a subsituation with a net force that would take you to a different situation that the keeping energy input counteracts. Here, on the other hand, there is no subsituation with a force. Still-life situations have no force (and indeed probably no subsituations, as they are minimal). Consequently, if energy is put into a minimal situation, a zero net force could not arise from that input of energy. So things have to change: the speaker has to become unready.

6.4 Forces in action 141

expected to guarantee the non-continuation of p , because q could also be affected by the (unexpected) net force of s'_0 , so we would predict a “non-continuation of arbitrary q ” reading. That is, there could be an s'_0 such that its net force results in s'_1 where p holds of s'_1 but q does not—i.e. it could be that the net force of s'_0 makes it be that not q . Then we would expect to be able to get a reading in which p holds in both s_0 and s'_1 , that would be neither the non-continuation (of p) reading, nor the unachieved-goal reading (on which see below). However, no such “non-continuation of arbitrary q ” reading is available. We assume that such a scenario is out for reasons of relevance: if q is what changes, the speaker would be expected to say so. So there is no such reading because the speaker is talking about p , not about another arbitrary stative property q ; p must be what fails to continue to the successor situation s'_1 .

Now we move to the unachieved-goal reading. In this reading, p does hold in the successor situation s'_1 , in which what goes wrong is not the continuation of p but rather a goal or plan that depends on p holding for its realization.²⁷ To make sense of the unachieved-goal reading, we must therefore first consider how to characterize the relevant notion of a plan within the force-theoretic framework.

We hypothesize that the notion of plan evoked in the unachieved-goal reading is the same as that in futurate sentences, in which only plannable events are allowed (as in (26a); (26b) is possible if it can be felicitously planned that the Red Sox defeat the Yankees tomorrow).

- (26) a. The Red Sox play the Yankees tomorrow.
 b. #The Red Sox defeat the Yankees tomorrow.

Futurates occur in many but not all languages; Tohono O’odham, for instance, lacks them. A plan in futurates is held by an entity (the “director”) who has a desire for p and the ability to control whether an instantiation of p happens (Copley 2008; 2009a).²⁸ We distinguish between the existence of the plan (or goal) itself, the content of the plan, and the realization of (the content of) the plan. For example, in (26a), there exists a present plan for the Red Sox to play the Yankees tomorrow; the content of the plan is the proposition that the Red Sox play the Yankees tomorrow, and the plan is realized just in case the Red Sox actually do end up playing the Yankees tomorrow as a causal consequence of the director’s desire and ability.

A more explicit characterization of plans and planning will take us too far afield. In the context of the force-theoretic model, we will note merely that the existence of the plan behaves like a present stative predication, as might be expected for an

²⁷ Note that the plan is not analogous to q in the “non-continuation of arbitrary q ” reading, as we will see shortly; the existence of a plan in s_0 entails that there is a successor s_1 of s_0 , which is not the case with the stative predicate q . Furthermore, the plan is not arbitrary.

²⁸ The director can be but need not be the subject. For example, in (26a), it can be someone else, not the Red Sox themselves, who holds a plan for them to play the Yankees tomorrow and has the ability to ensure that that plan is realized.

142 6. *Eliminating causative entailments*

existence predicate. For instance, similar to the stative in (26a), the futurate in (27b) is compatible with *It's true that* in the antecedent of a conditional (cf. Copley 2009b); we know it's a futurate in (27b) rather than any other kind of future reference because the unplannable eventuality in (27c) is unacceptable.

- (27) a. If it's true that Mary is here ...
 b. If it's true now that Mary leaves tomorrow ...
 c. If (#it's true that) Mary gets sick tomorrow ...

In the force-theoretic framework, this means that plans can be treated essentially as states, albeit rather special states; they are states that somehow entail a successor. Copley (2014) argues that when a futurate is asserted of s_0 , the speaker presupposes (due to a presupposition of the ability of the director) that the plan is realized in the successor of s_0 . This successor, s_1 , is the causally immediate successor of s_0 but is not necessarily the temporally immediate successor of s_0 ; it can happen after a temporal gap. This ability to provoke causally immediate but temporally distant effects is a hallmark of volitionality. For most physical forces, on the other hand, the causally immediate result is necessarily temporally immediate; the causal successor of s_0 is either coterminous to s_0 or is immediately temporally subsequent to s_0 . It is in part because of this difference between plans and physical forces that the planning contrast in futurates arises, as it is only plannable eventualities that can leap into a distant future time with one causal step via a plan.²⁹

A plan is evoked in unachieved-goal readings of *cem* sentences such that p is apparently related to the successful carrying out of the plan. We have just suggested that the existence of a plan, asserted in futurates, is presupposed in unachieved-goal readings of *cem* sentences. A question thus arises: why the existence of a plan is necessarily presupposed in the reading where p continues (recall from the discussion above of the non-continuation reading that an arbitrary stative predicate q is not possible).

To address the first question, recall that we argued for a constraint we called the “assertability of statives,” which requires there to be no energy input into the situation of which a stative is asserted. So, as we argued, no force, and thus no eventive predicate, can figure presuppositionally in the calculation of the failed result entailed by *cem*. The only thing that can be presupposed to hold of s_0 is another stative predicate. As we have argued, the existence of a plan is a stative predicate holding of a situation, so it is a possible candidate presupposition.

However, we also argued, appealing to relevance, that *arbitrary* stative q can *not* be presupposed of s if p holds of s'_1 . Does this erroneously rule out the case when q is the existence of a plan? We suggest that it does not, because p can be relevant to the

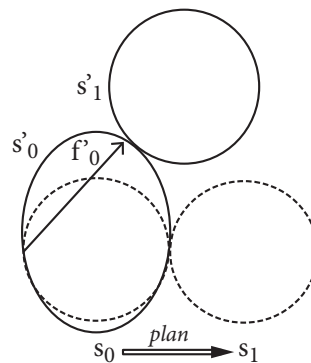
²⁹ Plans thus require us to talk about the length of causal chains, which is possible in the current framework but has not been addressed in possible-worlds approaches.

plan in a certain way, so the argument about arbitrary q does not apply to plans. The state p is relevant to the plan in the sense that it contributes to the ability of the director to bring about the realization of the plan. That is, if the speaker thinks that p is causally necessary to their ability to be the source of forces to realize their plan (i.e. to make the successor come about), then relevance is satisfied.³⁰

Thus, since plans are statives that nonetheless entail the existence of a successor situation, and since a stative p can be relevant to a plan, the accommodation of a plan licenses stative *cem* sentences in which p is true of s_0 and s'_1 , guaranteeing that such sentences have an unachieved-goal reading. What is unachieved is the realization of the plan.

We are at a disadvantage when it comes to representing such a state of affairs in bubble diagrams, as we have not given a full analysis of what it is to be a plan (cf. Copley 2008; 2014 for earlier efforts). In the absence of such an analysis, we will indicate that a plan in s_0 yields a successor s_1 with a double arrow, as illustrated in (28).

(28)



Having addressed the interaction of *cem* with lexical statives, we next consider the derivation of the readings that occur when *cem* is added to sentences containing eventive predicates—predicates denoting properties of forces.

6.4.2.3 Tohono O’odham aspect in the force-theoretic framework In combination with an eventive predicate, the meaning contributed by *cem* depends on the viewpoint aspect (Smith 1991) of the sentence, as shown in (29ac) (Copley 2005a: 9).³¹ The unachieved-goal meaning is always possible. However, only the perfective can license the non-continuation meaning.

³⁰ This point might be due to a more general requirement that when p is asserted with the purpose of conveying something about q , p needs to be causally relevant to q .

³¹ The future is always expressed by means of the perfective auxiliary plus a future marker. Tohono O’odham has no overt past tense marking, so that non-future-marked sentences are interpreted as either past or present tense. *Cem* sentences, however, are always interpreted as past tense; whether this fact follows from something in the meaning of *cem* or whether it is a pragmatic effect is not known.

144 6. *Eliminating causative entailments*

- (29) a. Huan 'at o cem kukpi'ok g pualt.
 Juan aux.PF FUT FRUS open DET door
unachieved-goal: 'Juan tried to/was going to open the door.'
 (He tripped before he got there)
- b. Huan 'o cem kukpi'ok g pualt.
 Juan aux.IMPF FRUS open DET door
unachieved-goal: 'Juan tried to open the door.'
 (He pulled but couldn't get it open)
- c. Huan 'at cem ku:pi'o g pualt.
 Juan aux.PF FRUS open DET door
 'Juan opened the door in vain.'
non-continuation: Juan got the door open but it didn't stay open
unachieved-goal: The door's being open didn't have the desired effect

Thus only the perfective *cem* sentence, i.e. (29c), has both the non-continuation reading (where it is the result state that fails to continue) and the unachieved-goal reading. In addition, the unachieved-goal reading, common to all three of (29a–c), is realized differently in each. Note that (29c) is different from (29a) and (29b) in that in (29c), the force applied to open the door is actually successful; instead it is the staying open, or being open for some reason, that fails.³² We will argue below that these differences between aspects follow straightforwardly from the composition of aspect and *cem*.

It is clear that in order to fully understand the patterns illustrated above, we must understand how O'odham aspect interacts with the denotation of the vP in the force-theoretic framework. We therefore will take a brief detour to accomplish this.

Aspect, we assume, maps from predicates of forces to predicates of situations, so it is type $\langle\langle f,t \rangle, \langle s,t \rangle\rangle$ (this assumption is analogous to the common idea that aspect maps from event predicates to temporal predicates; e.g. Klein 1994; Kratzer 1998).

The prospective aspect³³ is shown in (30).

³² The frustrative morpheme *cem* is in a different place in the word order in (17) and (29), which raises the question of whether *cem* has the same scope when it occurs with statives as it does when it occurs in eventives. Since Tohono O'odham has quite (albeit not entirely) free word order (see Smith 2004 and references therein for discussion of syntax in the closely related language Akimel O'odham (Pima)), there is a limit to the syntactic information that can be drawn from the word-order facts, but it seems to occur just before (above) the state in the unmarked examples. The semantics reflects this as well: the existence of two similar readings for each of (17) and (29c) seems to indicate that *cem* bears the same relationship to the result state in (29c) as it does to the state in (17). We can also see that *cem* scopes over aspect, because aspect seems to apply directly to the verb phrase; the failure happens at a different point in the action in (29a–c) depending on the aspect.

³³ This periphrastic form is normally called a future (e.g. by Zepeda 1983); we call it an "aspect" here to emphasize the similarity in meaning to the imperfective and perfective. We call it "prospective" because it seems appropriate, not because it means *about to*. We suspect that *about to* may make a claim about s_1 : $\llbracket \text{about to} \rrbracket = \lambda \pi \lambda s. \pi(\text{net}(\text{suc}(s)))$.

- (30) Huan 'at o kukpi'ok g pualt.
 Juan aux.PF FUT open DET door
 'Juan will open the door.'

In the force-theoretic framework, we propose that the prospective takes a predicate of forces π , the denotation of the vP , and a situation s_0 , the topic situation provided by tense, and says that π holds of the net force of some situation in the causal chain proceeding from s_0 , that is, in one of s_0 's successor situations.³⁴ We inductively define a successor function 'sucⁿ' below:

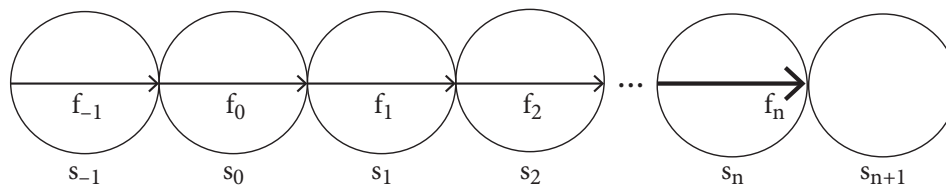
- (31) a. $\text{suc}^1(s) =: \text{fin}(\text{net}(s))$
 b. $\text{suc}^{n+1}(s) =: \text{fin}(\text{net}(\text{suc}^n(s)))$

The denotation of the prospective is given in (16):

- (32) $\llbracket \text{prospective} \rrbracket = \lambda \pi \lambda s . \exists n: \pi(\text{net}(\text{suc}^n(s)))$

The diagram in (33) below shows that some future net force is referred to in the denotation of the prospective; (32) is true in s_0 because there is a later situation s_n in the *ceteris paribus* chain of situations proceeding from s_0 such that $\llbracket \text{Juan open the door} \rrbracket$ holds of the net force of s_n . The thickened arrow represents the net force of which the vP is predicated.

- (33)



The imperfective is realized as an auxiliary in Tohono O'odham, as shown in (34).

- (34) Huan 'o kukpi'ok g pualt.
 Juan aux.IMPF open DET door
 'Juan is opening the door.'

For the progressive reading of the Tohono O'odham imperfective³⁵ we propose, following our discussion of the English progressive in Copley and Harley (to appear), a denotation that takes a predicate of forces (π , the denotation of the vP),

³⁴ The idea that futures should refer to longer causal chains than imperfectives is first raised in Copley (2004; 2005b).

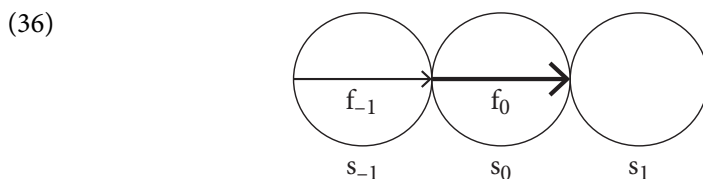
³⁵ The O'odham imperfective does not occur with statives (Zepeda 1983) and also has a generic reading, which we will ignore for the purposes of this chapter.

146 6. *Eliminating causative entailments*

and a situation s (which will be identified with s_0 , the topic situation provided by tense), and says that the property π holds of the net force of s .

$$(35) \quad \llbracket \text{imperfective} \rrbracket = \lambda \pi \lambda s . \pi(\text{net}(s))$$

So, for example, if Juan is baking a cake, the net force of the current situation is one which leads to a situation in which a cake³⁶ has been baked by Juan (i.e. the normal result obtains), if all else is equal.



That is, a force with the property π is the net force in the topic situation, and if all else is equal and nothing external interferes, s_1 results. For example, $\llbracket \text{imperfective} \rrbracket (\llbracket \text{Juan open the door} \rrbracket)(s_0)$ will say that the net force of s_0 is the force of Juan opening the door; if nothing intervenes, the door will subsequently be open in the situation immediately following the topic situation.

Finally, we will treat perfective aspect as a kind of resultative, signaling that the result of some force holds of the topic situation; this entails that π holds of the net force of the situation in the causal chain immediately preceding s_0 . We define a function ‘pred’ that picks out the³⁷ immediate predecessor of a situation.

$$(37) \quad \text{pred}(s) =: \text{the } s' \text{ such that } \text{fin}(\text{net}(s')) = s$$

Like imperfective aspect, perfective aspect in Tohono O’odham is also realized by means of an auxiliary:

$$(38) \quad \text{Huan } x'at \quad cem \quad ku:pi'o \quad g \quad pualt.$$

Juan aux.PF FRUS open DET door

‘Juan opened the door.’

The proposed denotation for perfective aspect takes a predicate of forces (π , the denotation of the νP), and a situation s (to be identified with s_0 , the topic situation)

³⁶ As Landman (1992) notes, the progressive creates an intensional context: if Mary is baking a cake, the cake does not (yet) exist and may never exist. The status of such “temporally opaque objects” (von Stechow 2000) in the present framework is that they are objects referred to in the ceteris paribus result situation of the Mary-bake-a-cake force—a situation that may never come to pass. This status is similar to that of objects that exist only in inertia worlds. The status of the force itself is a different question, but it too has an existence; the Mary-bake-a-cake force exists, as it is the net force of a current situation. Thus we avoid positing partial events such as those proposed by Parsons (1989; 1990), and one key empirical benefit of inertia worlds is retained.

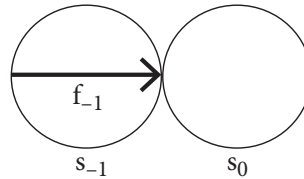
³⁷ We know that there is a unique such situation because of historical necessity; cf. Thomason (1970; Ch. 3, this volume).

and says that the predicate of forces π is the net force of the predecessor of s —that is to say, π is true of the net force of s_{-1} , the situation preceding the topic situation.

$$(39) \quad \llbracket \text{perfective} \rrbracket = \lambda \pi \lambda s . \pi(\text{net}(\text{pred}(s)))$$

In (40), the net force that has the property π is again in bold:

(40)



That is, a force with the property π is the net force in the causal predecessor to the topic situation, and s_0 results. (Because of historical necessity, we already know that s_{-1} is efficacious and results in s_0 ; or rather, the speaker knows how to choose s_{-1} so that it is efficacious.) The denotation $\llbracket \text{perfective} \rrbracket(\llbracket \text{Juan open the door} \rrbracket)(s_0)$ says that the net force of s_{-1} is a Juan-opening-the-door force; in the topic situation s_0 , the door is open.

6.4.2.4 Eventive *cem* sentences Now we will show how the interaction of *cem* with aspect results in the correct denotations for the eventive *cem* data. We will take each aspect in turn, first repeating the denotation of the sentence without *cem* and then showing how the correct denotation arises from the addition of the presupposition supplied by *cem* (namely that s_0 , the topic situation, is not efficacious).

The prospective aspect *cem* sentence, as in (29a), conveys that Juan tripped on his way to open the door (for instance) and so never began the event of opening the door. We analyze (29a) as follows. The assertion is the same as if *cem* were not there: there is a situation s_n in which the net force is described by the νP where s_n is in the causal chain proceeding from the topic situation s_0 .

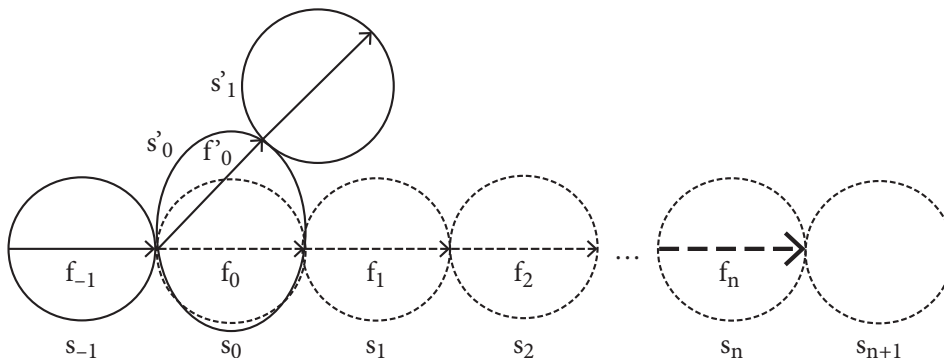
$$(41) \quad \llbracket (29a) \rrbracket = \exists n: \llbracket \text{Juan open the door} \rrbracket(\text{net}(\text{suc}^n(s_0)))$$

We propose that *cem* adds the presupposition that s_0 is not efficacious; that is, that s_0 did not proceed without interference. Thus the immediate successor of s_0 (namely, s_1) does not happen.³⁸ Therefore s_n doesn't happen either—no Juan-open-the-door net force ever occurs, so Juan doesn't even start opening the door. This is indeed the correct meaning for (29a). The addition of forces external to s_0 originating in s'_0 is illustrated in (42).

³⁸ Recall that the topic situation s_0 has a net force which, *ceteris paribus*, will result in s_1 . But when s_0 is not efficacious, *ceteris* are not *paribus*.

148 6. Eliminating causative entailments

(42)

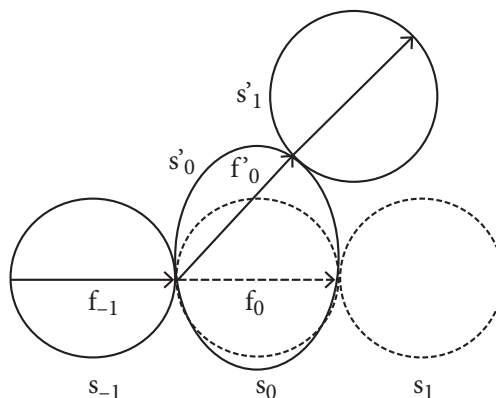


In the case of the imperfective, a sentence with *cem* as in (29b) conveys that Juan does something to open the door, but the door does not open. As before, the assertion is the same as without *cem*. In this case that means that the net force in s_0 , the topic situation, is described by the *vP*. In (29b), for instance, the net force in s_0 is a Juan-open-the-door force, which results, *ceteris paribus*, in a situation where the door is open.

(43) $\llbracket (29b) \rrbracket = \llbracket \text{Juan open the door} \rrbracket(\text{net}(s_0))$

With *cem* we add the presupposition that s_0 is not efficacious, therefore s_1 did not happen, because something from outside s_0 (but, we assume, inside s'_0) originates a force that intervenes. Instead, s'_1 , the successor of s'_0 , happens. This correctly entails that the force was applied in s_0 without successfully causing s_1 , as illustrated in (44).

(44)



Unlike the prospective and imperfective *cem* sentences, perfective *cem* sentences have both of the meanings attested for statives: non-continuation as well as unachieved-goal. Again, the assertion of the perfective *cem* sentence is the same as that of

6.5 Conclusions and consequences 149

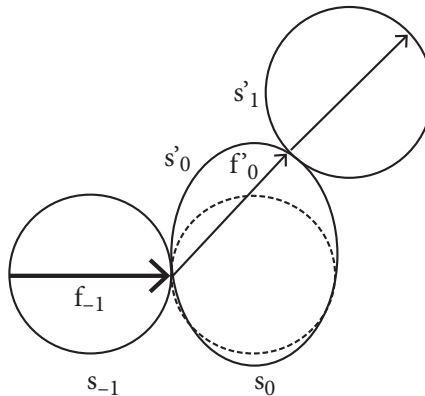
a perfective sentence that lacks *cem*. That is, the *cem* sentence in (29c) asserts that the vP characterizes the net force of s_{-1} , the immediate predecessor situation of s_0 . The final or resulting situation of the net force of s_{-1} thus holds in s_0 , the topic situation.

(45) $\llbracket (29c) \rrbracket = \llbracket \text{Juan open the door} \rrbracket (\text{net}(\text{pred}(s_0)))$

So in the perfective case, the result state holds of the topic situation s_0 . But then, as in the stative case, a stative predicate holds of s_0 , so by exactly the same arguments as for the stative case, the unachieved-goal and non-continuation readings arise.

The perfective *cem* sentence is thus true at s_0 in a state of affairs such as (46).

(46)



Given that these two readings occur with both perfective and stative *cem* sentences, the question arises as to whether the theory correctly predicts that imperfective and prospective *cem* sentences do not get their own analogues of the non-continuation reading. It turns out that the theory does correctly make this prediction. The non-continuation reading is derived when compliance with the non-efficacy presupposition means interrupting a state—that is, something happening instead of nothing. In the prospective and imperfective cases, there is no state to interrupt.³⁹

6.5 Conclusions and consequences

We have proposed to reify *forces* in the semantic ontology, as functions from situations to situations. We argue that this provides a natural approach to phenomena

³⁹ Another question that arises is whether the single reading available to prospective and imperfective *cem* sentences, which we have labeled “unachieved-goal” following Hale (1969) and Copley (2005a), is indeed the same reading as the “unachieved-goal” reading for stative and prospective *cem* sentences. On our analysis, they are not exactly the same, because no accommodation of a plan is required in prospective and imperfective sentences with *cem* (though they are intuitively quite similar). Thus, if nothing more is said, we expect that a speaker should be able to say *Maria cem [prospective] get sick* (meaning something like “Maria was going to get sick (but she didn’t)”) and *Maria cem [imperfective] get sick* (with a meaning like “Maria was getting sick (but she didn’t)”), with an unplannable event that is not relevant to anybody’s plan; i.e. Maria’s getting sick does not make any relevant director able to carry out their plans. We hope to verify or falsify this prediction in future work.

150 6. *Eliminating causative entailments*

in which one event would normally be expected to cause another in a causal chain, but exceptionally the second event fails to occur. We have suggested that this defeasibility of causation should be modeled by understanding Davidsonian arguments as forces rather than events, where the first argument is the force and the second argument is the situation that results from the force only if nothing external to the initial situation intervenes to perturb that force. We have illustrated the application of these ideas in the analysis of the O’odham frustrative particle *cem*.

In so doing, we have come to various conclusions about the behaviors of different types of predicates in the framework. In particular, the discussion leads to a concrete proposal about how stative predicates function. Statives are asserted only of “still-life” situations—those with no net force. Without a net force, no successor situation is defined. The interaction of the absence of forces with the notion of “efficacy” imposes restrictions on the interpretation of stative sentences modified by *cem*. In analyzing how these restrictions play out, we have been motivated to incorporate the notion of “plan” into the linguistic semantics as a natural component of the treatment of unachieved-goal readings of stative and perfective sentences. We note that the alternative, in a standard Kratzerian model, would be to posit an unpronounced plan modal (cf. Copley 2008; 2009) that quantifies over possible worlds, just for the unachieved-goal readings but not for the non-continuation readings. We consider such an alternative to be a non-starter for these data. Even if the plan is accommodated in such a model rather than represented directly in the semantics, it would not be clear why. In our force-theoretic framework, we have proposed that the reason why is that it is the only way to satisfy two constraints imposed by the model on the representation: namely, that only statives are predicated of the still-life situation s_0 , and that s_0 nonetheless has a successor.

The viewpoint aspect denotations represent a departure from many analyses of aspectual operators in that there is no explicit reference at all to temporal relationships between times, situations, or events. Rather, the way that we put the “view” in “viewpoint aspect” is by appealing to discrete situations, net forces, and the causal relationships between them in a deterministic causal chain. Causally precedent and subsequent situations and forces can be referred to, using the functions *pred* and *suc*, which are themselves derived in large part from the definition of net force. In our framework, for instance, the denotation of the (resultative) perfective is nearly immediate; the other aspects are also simplified greatly by the notion of net force. We expect that a force-theoretic approach to aspect will prove similarly fruitful in treating aspectual distinctions in other languages; we plan to revisit this topic in future work.

The overall result of the force-theoretic framework is a simpler semantics, compared to the possible-world approach, which must rely on additional semantic machinery to account for non-occurring results, to defeat the causative entailment. The denotations that result are markedly simpler than in the possible world

6.5 *Conclusions and consequences* 151

approaches. We do not deny that *some* notion of inertia is necessary for many different types of meaning; in our model, however, this complexity is managed in the cognitive system that calculates net forces, rather than in the semantics.

Our feeling is that the force-situation framework could clarify the interface with the cognitive system, since its ontology—situations as spatiotemporal arrangements of individuals with the forces on them—may be preferable to that of the event-based framework with its concatenated events that somehow cause one another.⁴⁰ It may also be preferable to treatments of situations as partial worlds within the framework of situation semantics (Barwise and Perry 1981; Kratzer 1989; 1990–2009; Portner 1997), since it is not at all clear how to make cognitively plausible sense out of possible worlds thus constructed.⁴¹ On the other hand, we see no reason why many of the advantages of situation semantics (e.g. the use of situations as arguments of quantification in modals, Kratzer 2009) could not be retained with our situations.

⁴⁰ The force-theoretic framework should have ramifications for the interaction of lexical syntax with the semantics as well, as it represents a significant departure from now-standard accounts according to which each subevent in a causal chain is described by a separate predicate in its own phrasal projection within the lexical syntax (cf. e.g. Folli, Ch. 13, this volume; Ramchand, Ch. 10, this volume; and Tatevosov and Lyutikova, Ch. 11, this volume, for analyses within this general tradition). See Copley and Harley (to appear) for extensive discussion.

⁴¹ The difference between constructing possible worlds in a Lewis–Kratzer-style model and constructing them as we have suggested boils down to difference between the dependency and production views of causation; see the contributions of Copley and Wolff, Kistler, and Wolff in this volume.

DERIVING THE READINGS OF FRENCH *ÊTRE EN TRAIN DE*

BRIDGET COPLEY and ISABELLE ROY
CNRS – Université Paris 8
UMR 7023 Structures Formelles du Langage

French *être en train de* (*êtd*, lit. ‘be.INF in the midst of’), generally considered to be the French progressive, has a reading in which the speaker expresses a negative attitude toward the described event. However, not all readings have this expressive meaning. Curiously, the “neutral” reading is not always felicitous. We consider and reject possible analyses in which the expressive meaning arises due to Gricean inference or due to there being two lexical entries for *êtd*. We propose that, like ordinary progressives (Portner, 1998), *êtd* has a modal at-issue meaning with a circumstantial modal base and a stereotypical ordering source. In addition, we argue, it has a modal conventional implicature with either a stereotypical or a bouletic ordering source. In this way we account for the behavior of *êtd*, and raise certain questions as to how conventional implicatures might be related to grammaticalization of aspect.

1. Introduction

The French simple present has both a generic/habitual reading and an ongoing reading. Hence, a sentence like (1) is ambiguous between a reading where that person normally or habitually eats bread and a reading where he is eating bread at present.

- (1) Il mange du pain.
he eats of.the bread
a. ‘He eats bread.’ [generic/habitual]
b. ‘He is eating bread.’ [ongoing]

French also has another construction that expresses ongoing meaning, namely *être en train de* (henceforth, *êtd*), lit. ‘be in the midst of’. This construction is traditionally referred to as the French progressive.

- (2) Il est en train de manger du pain.
he is in midst of eat.INF of.the bread

· We thank the organizers and audience of Going Romance 2013 (Amsterdam) and TbilLLC 2013 (Tenth International Tbilisi Symposium on Language, Logic and Computation). We also thank Fabienne Martin and Chris Piñon for comments on a previous draft.

‘He is eating bread.’

So, like many languages, French has two ways to express ongoing meaning, via the simple present and the progressive form. However, as has been noted (Franckel 1989, Lachaux 2005, Martin, 2006, Do-Hurinville 2007, Patard & De Wit, 2011), French *êtd* differs from “ordinary” progressives (for instance, English *be -ing* or Spanish *estar -ndo*) in two notable ways. First of all, French *êtd* cannot express ongoing meaning in certain contexts where “ordinary” progressives are fine: compare (3)-(4), in English and Spanish respectively, with (5). The normal way to express the ongoing falling of rain is the simple present in French as in (5b). The *êtd* sentence in (5a) is judged awkward or inappropriate by native speakers in a neutral, out-of-the-blue context (but we will see below that (5a) is sometimes possible in other contexts).

- (3) It’s raining.
- (4) Está lloviendo.
 estar.PRES.3S raining
 ‘It’s raining.’
- (5) a. # Il est en train de pleuvoir.
 it is in midst of rain.INF
 ‘It’s raining.’
 b. Il pleut.
 it rains

Second, some instances of *êtd* seem to be associated with an additional expressive meaning, compared to the simple present: *êtd* sentences very often seem to convey information about the speaker’s attitude toward the ongoing event. For instance, the question in (6b) is associated with an expressive meaning (glossed as ‘the hell’), and seems to imply that the person is doing something that (s)he shouldn’t be doing. A similar meaning of disapproval is found in examples (7b) and (8b).

- (6) a. Qu’est-ce que tu fais?
 what.is-it that you do
 ‘What are you doing?’ / ‘What do you do?’
 b. Qu’est-ce que tu es en train de faire?
 what.is-it that you are in midst of do.INF
 ‘What (the hell) are you doing?’
- (7) a. Nous savons tous ce qui se passe en Crimée.
 we know all that which REFL goes.on in Crimea

- ‘We all know what’s going on in Crimea.’ / ‘We all know what goes on in Crimea.’
- b. Nous savons tous ce qui est en train de se
we know all that which is in midst of REFL
passer en Crimée.
go.on.INF in Crimea
‘We all know what’s going on in Crimea (and I disapprove).’
- (8) a. Il prend un bonbon.
he takes a candy
‘He is taking a piece of candy.’ / ‘He takes a piece of candy.’
- b. Il est en train de prendre un bonbon.
he is in midst of take.INF a candy
‘He is taking a piece of candy (and he shouldn’t be).’

And, in fact, while we said that the *êtd* construction is not possible in a normal, neutral context with the verb *pleuvoir* 'rain' as in (5a), it becomes possible with an expressive meaning conveying, e.g. in (9) that we don't want rain on our picnic:

- (9) Il est en train de pleuvoir sur notre pique-nique.
it is in midst of rain.INF on our picnic
‘It is raining on our picnic (and the picnic is ruined).’

Yet the expressive meaning does not always arise with *êtd* sentences. There are felicitous cases of *êtd* that do not seem to convey expressive meaning. For instance, *êtd* is commonly used to disambiguate between an ongoing and a habitual reading (10-11):

- (10) Quand je rêve de moi, je cours. Je veux dire, je suis en
when I dream of me, I run I want say.INF I am in
train de courir.
midst of run.INF
‘When I dream of myself, I {run/am running}. I mean, I am running.’
- (11) Chaque enfant est en train de décorer son sapin de
each child is in midst of decorate.INF his tree of
Noël.
Christmas
‘Each child is decorating their own Christmas tree.’ (and they are not done yet)

This article addresses the various readings associated with French *être en train de*. The issues to be explained are: (i) the content of the additional expressive meaning, (ii) the reason why the expressive meaning seems to not always arise, and (iii) the reason why the “neutral,” non-expressive reading—i.e, the reading without the expressive meaning—is sometimes felicitous, as shown in (10) and (11), but is not always felicitous, as shown in (5a).

We consider and reject two analyses: one in which the additional meaning is derived via Gricean implicature, and another in which *êtd* is ambiguous between one lexical entry that has a conventional implicature to convey the expressive meaning, and another lexical entry that lacks it. We propose instead that *êtd* always has a conventional implicature. Following Portner’s (1998) analysis of the English progressive, we treat the at-issue (ongoing) meaning of *êtd* as involving a modal with a stereotypical ordering source. We also treat the conventional implicature as involving a modal, but unlike the modal in the at-issue meaning, the modal in the conventional implicature can have a bouletic as well as a stereotypical ordering source. We derive the taxonomy of readings of *êtd* according to the ordering source of the conventional implicature and the interaction of the conventional implicature with the at-issue meaning.

2. A conventional rather than a conversational implicature

One possible analysis of the contrast between *êtd* and the simple present is that of a Gricean implicature from the fact that the speaker chose the progressive over the simple present, to the conclusion that the speaker must be insisting on the ongoingness for some reason, namely that they disapprove. We see two issues with such an analysis.

First of all, a conversational implicature is cancellable. However, the expressive meaning associated with *êtd*, when it is present, is not cancellable. Any lexical material that indicates that the speaker has a positive attitude toward the proposition effectively contradicts the expressive meaning. If the expressive meaning is cancellable, adding such lexical material should be possible. However, we see in (12) and (13) that with material signaling a positive attitude toward the proposition, the only reading available is a negative one (ironic or suspicious); the speaker does not really have a positive attitude (contrary to (13a)).

- (12) Qu’est-ce que tu es en train de nous faire pour le
 what.is-it that you are in midst of us do.INF for the
 dîner? - On va se régaler!
 dinner we go REFL enjoy
 ‘What are you cooking for dinner? - We are going to love
 it!’ only negative/ironic

- (13) a. Qu'est-ce que tu fais de beau ?
 what-is-it that you do of nice
 'What are you doing that's nice?'
 b. Qu'est-ce que t'es en train de faire de beau ?
 what-is-it that you-are in midst of do.INF of nice
 'What are you doing that's nice?'
 Franckel (1989); only negative/ironic

This fact indicates that the expressive meaning is not cancellable, therefore it is not contributed by a conversational implicature.

Secondly, if the expressive meaning of *êtd* really were contributed by a Gricean conversational implicature, we would expect such an implicature to arise quite generally in languages that have both a simple present and a progressive. But when we compare French and, e.g., Italian, it appears that for at least some speakers of Italian, the ongoing reading of (14a) and the only reading of (14b) are very similar if not identical in meaning:

- (14) a. Cosa fai?
 what do.2S
 'What are you doing?' / 'What do you do?'
 b. Cosa stai facendo?
 what stand.2S doing
 'What are you doing?'

And, moreover, in contrast to French, the use of (15b) does not require the speaker to have a negative stance toward what the interlocutor is doing; (15a) and (15b) are equivalent:

- (15) a. Cosa fai di bello ?
 what do of nice
 'What are you doing that's nice?'
 b. Cosa stai facendo di bello ?
 what stand doing of nice
 'What are you doing that's nice?'

The *stare -ndo* construction in Italian thus does not contribute a negative expressive meaning. Such an expressive meaning seems, therefore, to be particular to the French *êtd* construction rather than a general Gricean conversational implicature provoked by the hearer's knowledge that the speaker could have chosen the simple present but didn't.

Rather than a conversational implicature, it seems we are dealing with a conventional implicature. We take our sense of what a conventional implicature is from Potts (2005), who builds on Grice (1975). Conventional

implicatures (henceforth “CIs”) are part of the conventional meanings of words, they are independent of the at-issue meaning, and they are non-cancellable speaker commitments. The expressive meaning associated with *êetd* fulfills all these conditions: it is associated with a particular phrase (namely, *êetd*), it is independent of the at-issue meaning (e.g., the expressive meaning is not what’s being questioned in (5b)); and as we have just shown, it is not cancellable.

3. A first conventional implicature proposal for *êetd*

Taking on board the idea that a CI is the source of the expressive meaning associated with *êetd*, a first proposal might be that *êetd* is simply ambiguous between the expressive and “neutral” readings: one reading has the CI and one reading lacks it. The content of the expressive meaning on this account would be that the propositional complement of *êetd* is bad according to the speaker.

- (16) a. *êetd*_{neutral} at-issue meaning: p is ongoing
 b. *êetd*_{expressive} at-issue meaning: p is ongoing;
 CI: p is bad

This hypothesis treats the at-issue meaning of expressive *êetd* the same as the ongoing reading of the simple present, and correctly so; to see why, consider the question (17) and the responses in (18). A question with *êetd* can be felicitously answered using the simple present, as shown in (18a). In fact, as demonstrated in (18b), it *must* be answered using the simple present.

- (17) Qu’est-ce que tu es en train de faire ?
 what.is-it that you are in midst of do.INF
 ‘What (the hell) are you doing?’
- (18) a. Bah, je joue.
 uh I play
 ‘Uh, I’m playing.’
 b. #Bah, je suis en train de jouer.
 uh I am in midst of play.INF
 ‘Uh, I’m playing.’

The fact that using *êetd* is odd in response to an *êetd* question also provides further support for our claim that there is a CI involved with *êetd*, in that it is odd for the speaker of (18b) to add their own CI in answer to the question.

The hypothesis in (16) is thus *prima facie* plausible. However, it faces several problems related to ambiguity and the content of the CI. The first two problems concern the idea that *êetd* is lexically ambiguous. First, the reason for the proposed ambiguity is left unexplained. The assumption

that there are two lexical entries (whether accidentally homophonous or diachronically related) does not shed any particular light on why *êetd* should be ambiguous in this way. The second problem with the lexical ambiguity view is that the neutral reading of *êetd* is predicted to always be possible. The infelicity of, e.g., (5a) is completely unexpected if *êetd*_{neutral} is available, since there is no particular reason to assume that *êetd*_{neutral} should have a restricted distribution. So, the hypothesis in (16) presents two lexical items but does not explain their distribution.

The third issue regarding the hypothesis in (16) involves the content of the proposed CI of *êetd*_{expressive}. It is not always the case that the expressive meaning conveys that the speaker considers p to be bad. Cases such as (19) and (20) below illustrate this point.

- (19) Le général était en train de s’habiller.
 the general was in midst of REFL-dress.INF
 ‘The general was getting dressed.’
 ⇒ the general wasn’t “visible”
- (20) Je suis en train de me brosser les dents.
 I am in midst of REFL brush.INF the teeth
 ‘I am brushing my teeth.’ (context: the phone rings)
 ⇒ I cannot pick up the phone

These cases make it clear that the speaker need not disapprove of p: (19) and (20) can be felicitously uttered even if, according to the speaker, it’s not bad that the general is getting dressed, or that the speaker is brushing their teeth. These are, in fact, quite normal things to do. Rather, the intuition in these cases seems to be that some other proposition q is desired (the speaker seeing the general, the speaker picking up the phone), but it so happens that q is incompatible with p. Such a characterization would also account for the cases where p seems to be $\sim q$, as in examples (6) - (9). This intuition will give us one of the tools we will need to understand the apparent variation in the contribution of the CI.

4. Proposal

With these cases in mind, we propose to understand the CI of *êetd* as making reference to an additional proposition q. We will use modal semantics, and the relationship between p (the propositional argument of the at-issue meaning, thus explicitly described by the lexical material in the sentence) and q (the propositional argument of the CI, not referred to by the lexical material in the sentence) to account for the various readings of *êetd*, including the neutral reading.

We argued above on the basis of the question-answer pair in (17) and (18a) that the at-issue meaning of *êtd* is the same as the ongoing reading of the simple present. We base our analysis of the at-issue meaning on Portner's (1998) modal proposal for the English progressive. We first assume an index *c* that collects contextual variables as in (21), including variables representing the speaker's conversational backgrounds in s_c , the situation of utterance.

- (21) $c = \{x_c, s_c, f_c, g_c, b_c\}$
 x_c : speaker
 s_c : situation of utterance
 f_c : speaker's circumstantial conversational background in s_c
 g_c : speaker's stereotypical conversational background in s_c
 b_c : speaker's bouletic conversational background in s_c

The at-issue denotation of *êtd* is as in (22). The idea is that all the stereotypically-best circumstantially accessible worlds—those worlds accessible, given the circumstances, from the actual world, that most agree with stereotypical or lawlike behavior—are such that they contain a situation s' , where s' is a supersituation of the topic situation s , such that p is true of s' .

- (22) at-issue meaning of $\llbracket \hat{e}td \rrbracket^c$ (stereotypical ordering source)
 $= \lambda p \lambda s . \forall w \in \text{Best}(f_c, g_c) : \exists s' \text{ is part of } w \text{ and } s \text{ is a non-}$
 $\text{final part of } s' : [p(s')]$

As for the CI, we know that the expressive meaning has something to do with the desire of the speaker. Adapting Heim's (1992) analysis of *want*, we treat the speaker's desire-worlds as being those which are, according to the speaker, accessible from the circumstances of the speech situation and most preferable. Thus, we use the speaker's circumstantial conversational background to form a modal base consisting of the accessible worlds, and we use the speaker's desires to form a "bouletic" (desire) ordering source, which picks out the accessible worlds that best satisfy the speaker's preferences. Using the same aspectual semantics as in (22), we get (23) as the bouletic CI:

- (23) CI of $\llbracket \hat{e}td \rrbracket^c$ (bouletic ordering source) =
 $\lambda q \lambda s . \forall w \in \text{Best}(f_c, b_c) : \exists s' \text{ is part of } w \text{ and } s \text{ is a non-}$
 $\text{final part of } s' : [q(s')]$

We retain the aspectual semantics of the at-issue meaning because in the CI the desired event would be begun or in progress at the speech situation and, if telic, would reach its conclusion after the speech situation. Note that the

CI in (23) has its own proposition q , with no particular relation to p , and that the value of q may be different from the value of p .

So we have the at-issue modal, in (22), with a circumstantial modal base and a stereotypical ordering source, and the modal CI, in (23), with a circumstantial modal base and a bouletic ordering source. Now, we know that if a modal has a circumstantial modal base, one and the same modal can often have *either* a bouletic or a stereotypical ordering source.

- (24) I think that I will go to Harvard Square tomorrow...
- a. ...I've been meaning to get some shopping done.
[bouletic]
 - b. . .that's just the kind of thing I might do.
[stereotypical]
- Copley, 2002

We're not suggesting that the at-issue meaning of *êtd* given in (22) has another construal with a bouletic ordering source. However, we would like to suggest that the modal CI in (23) has both possibilities for its ordering source. So, in addition to (23) being a possible CI for *êtd*, we claim that the denotation in (25) is also available as a CI for *êtd*:

- (25) CI of $[[\hat{e}td]]^c$ (stereotypical ordering source) =
 $\lambda q \lambda s . \forall w \in \text{Best}(f_c, g_c) : \exists s' \text{ is part of } w \text{ and } s \text{ is a non-final part of } s' : [q(s')]$

Using these CIs, we now explain how they account for the various readings of *êtd*. We propose that *êtd* ALWAYS has a CI, including in the neutral case. In expressive readings, the CI has a bouletic ordering source as in (23); this is clear enough from the cases in (6) - (9) and (19) and (20). Neutral cases should obviously not have a bouletic ordering source in the CI; we will argue that they have the CI with the stereotypical ordering source, as in (25).

The choice of ordering source, however, is not the only difference between the expressive reading we have seen so far and the neutral reading we have seen so far: while the former requires that p be incompatible with q , the latter has no such requirement. Compare, for instance, (6)-(9) and (10)-(11). This difference raises the possibility of a taxonomy of readings based on two factors: the choice of ordering source in the CI, and the relationship between p (the proposition expressed by the complement of *êtd* and involved in the at-issue meaning) and q (the proposition introduced by the CI). *Êtd* does not impose any particular relationship between p and q , which means that the logical possibilities in such a taxonomy are as follows:

- (26) a. bouletic ordering source in the CI (expressive reading)
- (i) $p \neq q$
 - (ii) $p = q$

- b. stereotypical ordering source in the CI (neutral reading)
- (i) $p = q$
 - (ii) $p \neq q$

Note that only the choice of ordering source, strictly speaking, involves different *readings* per se; the relation between p and q is not represented in the semantics, so is strictly a matter of vagueness. We will call the four different logical possibilities “cases” for ease of discussion. Let us consider the four cases in turn.

5. A taxonomy of *êetd*

5.1 Expressive cases: bouletic ordering source

5.1.1 Discordant case: bouletic ordering source, $p \neq q$

The expressive readings we have seen so far, in (6)-(9), (19), and (20), fall into this case. Consider for instance (8b), repeated here as (27):

- (27) Il est en train de prendre un bonbon. = (8b)
 he is in midst of take.INF a candy.
 ‘He is taking a piece of candy (and he shouldn’t be).’
 ($q = \neg p$)

The at-issue meaning, according to (22), is that the current situation s is such that there is a supersituation s' of s , s a non-final part of s' , such that on all circumstantially accessible worlds most compatible with the speaker’s stereotypical knowledge, *he take a candy* is true of s' . The CI has a bouletic ordering source as in (23): the current situation s is such that there is a supersituation s' of s , s a non-final part of s' , such that on all circumstantially accessible worlds most compatible with the speaker’s desires, a proposition q is true of s' . What the speaker judges is that p is in the midst of happening, but the speaker would prefer that q be in the midst of happening.

For example (27), q could be $\neg p$. However, as we have seen above for (19) and (20), q doesn’t have to be $\neg p$. It could simply be incompatible with p , as in (20), repeated here as (28):

- (28) Je suis en train de me brosser les dents. = (20)
 I am in midst of REFL brush.INF the.PL teeth
 ‘I’m brushing my teeth (so I can’t answer the phone).’
 ($p \cap q = 0$)

And in fact, the requirement can be weakened further still: p need not even be incompatible with q . This can be seen from the fact that in (29), q is something like “the children are safe”. In a subset of q worlds p holds, because some of the worlds in which the children are safe are worlds in which the children cross the street (safely).

- (29) Attention! Les enfants sont en train de traverser la rue.
 Watch.out the.PL children are in midst of cross.INF the street
 ‘Watch out! The children are crossing the street (there is
 imminent danger).’ (p \subset q)

The choice of q is predicted to be highly sensitive to context, and indeed the speaker might intend a value for q that is different from what the hearer presumes. Nonetheless, these examples show that the logical possibility where p is not the same as q and the ordering source of the CI is bouletic is in fact attested, since it is not possible to paraphrase these examples using any other of the logical possibilities listed in (26).

5.1.2 Accordant case: bouletic ordering source, $p = q$

Another logical possibility is that there is a bouletic ordering source and $p = q$; we will call this the accordant case. The question is whether the accordant case is attested. We can certainly come up with examples where a q equal to p can be chosen. For example, we could understand the bouletic CI in (30) to convey that the speaker wants to be speaking.

- (30) a. Je parle.
 I talk
 ‘I’m talking.’
 b. Je suis en train de parler.
 I am in midst of talk.INF
 ‘I’m talking (and I want to be talking).’ (p = q)

Likewise, in (31), the bouletic CI could be that the speaker wants the interlocutor’s sister to be sleeping.

- (31) a. Ta soeur dort.
 your sister sleeps
 ‘Your sister is sleeping’.
 b. Ta soeur est en train de dormir.
 your sister is in midst of sleep.INF
 ‘Your sister is sleeping (and I want her to be
 sleeping).’ (p = q)

However, in these examples it is possible to choose q differently and achieve more or less the same effect.¹ That is, in these examples, q could instead be some proposition that is conducive to p . So for instance, for (30) q could be the proposition that someone else is not speaking; for (31), q could be the proposition that the interlocutor does not disturb their sister or alternatively, simply that the interlocutor keeps quiet. Since this is the case, we cannot conclude that there is positive evidence for the accordant case; on the other hand, we see no evidence against it either.

5.2 Neutral cases: stereotypical ordering source

As we have said above, we propose that *êtd* always has a CI; in that sense, every instance of *êtd* is “expressive”. However, the neutral examples don’t have an expressive flavor because the meaning of the CI is not bouletic. We consider now the logical possibilities that have a stereotypical ordering source: first the case where $p = q$, and subsequently, the case where $p \neq q$.

5.2.1 Disambiguating case: stereotypical ordering source, $p = q$

If the CI’s ordering source is stereotypical and $p = q$, that means that the CI has exactly the same denotation as the at-issue meaning. This will allow us to make sense of the fact that it is odd to say (5a) out of the blue (repeated here as (32a); recall that it is also possible to say *il est en train de pleuvoir* in the discordant case, section 5.1.1), but that *êtd pleuvoir* is possible in other apparently non-expressive contexts, such as (32b). The question is how (32b) can be possible given that (32a) is impossible under a “neutral” interpretation.

- (32) a. #Il est en train de pleuvoir.
it is in midst of rain.INF
'It's raining.'
- b. Il doit être en train de pleuvoir.
it must be.INF in midst of rain.INF
'It must be raining.'
(ongoing-epistemic / *future-deontic)
- c. Il doit pleuvoir.
it must rain.INF
'It must be raining / rain.'
(ongoing-epistemic / future-deontic)

The example in (32b) is possible, we claim, exactly because the simple present version in (32c) is ambiguous. The reason for the ambiguity in this particular example is the modal *devoir*. Both an ongoing reading and a

¹ We thank an anonymous reviewer for bringing this point to our attention.

future-oriented reading are possible with the French simple present under modals. The ongoing reading is only compatible with an epistemic reading of *devoir* ('it must be true that...'), and the future-oriented reading is only compatible with a deontic reading ('someone requires that...'; Condoravdi, 2002, among many others). Thus, the simple present as in (32c) is ambiguous between an ongoing, epistemic reading: 'It must be true that it is raining' and a future-oriented, deontic reading: 'Someone requires that it rain.'

We propose that when the simple present cannot be disambiguated and the speaker wishes to express an ongoing reading, they can use *êtd*, using a stereotypical ordering source for its CI (which, recall, is the same as its at-issue meaning), to disambiguate. This possibility is not available for (32a), as in (32a), there is no need to disambiguate. Therefore the simple present, which lacks the CI but has the same at-issue meaning, is preferred on grounds of economy to *êtd*.

This disambiguation strategy is not limited to the complement of models, but is general to whenever the speaker needs to disambiguate an ongoing reading from another reading, as in (10) and (11), repeated below as (33) and (34):

- (33) Quand je rêve de moi, je cours. Je veux dire, je suis en
when I dream of me, I run I want say.INF I am in
train de courir. (=10)
midst of run.INF
'When I dream of myself, I {run/am running}. I mean, I am
running.' (p = q)
- (34) Chaque enfant est en train de décorer son sapin. (=11)
each child is in midst of decorate.INF his tree
'Each child is decorating their own Christmas tree.' (p = q)

5.2.2 Interpretive case: stereotypical ordering source, $p \neq q$

We also predict that another neutral case exists, namely one in which there is a stereotypical ordering source for the CI but p and q are not equal. This agrees very well with a reading that has been noted in previous literature on *êtd* as well as other progressives (though in the latter we would not expect q to be "hard-coded" into the semantics as we propose for *êtd*), namely the "interpretive" reading. The "interpretive" reading (Buysens 1968, König 1980, Kearns 2003, Martin 2006, e.g.), as in (35), has been noted as presenting an alternative way of (re)describing a particular eventuality. As shown in (36), when an overt description of the event (*Mary left*, e.g.) is given first, it has a different relationship to the following progressive sentence when the progressive sentence is understood as interpretive (36c), compared to when it is not (36d).

- (35) You are making a mistake.
= ‘In doing what you are currently doing, you are making a mistake.’
- (36) a. Mary left, making a mistake.
b. Mary left, smoking a cigarette.
c. By leaving, Mary is making a mistake.
d. #By leaving, Mary is smoking a cigarette.

Consider the sentences in (37). In our proposal, the propositional argument p of the at-issue meaning of the second sentence, is the alternative description of the event described by the first sentence. We propose that q , the propositional argument of the CI contributed by *êtd*, is *Pierre leave the meeting*. The CI of the second sentence thus echoes the description of the event given in the first sentence. The *êtd* sentence then conveys that something is going on—namely, that Pierre is making a mistake—while effectively presupposing that something else is going on—namely, that Pierre is leaving. Note that the simple present, though grammatical, does not get an interpretive reading, as shown in (37b); it can only have an ongoing reading if it does not have an interpretive reading, as shown in (37c).

- (37) a. Pierre quitte la réunion. Il est en train de faire
Pierre leaves the meeting he is in midst of make.INF
une erreur.
a mistake
‘Pierre is leaving the meeting. He is making a
mistake.’ (p ≠ q)
- b. #Pierre quitte la réunion. Il fait une erreur.
Pierre leaves the meeting he makes a mistake
‘Pierre is leaving the meeting. He is making a
mistake.’
- c. Pierre quitte la réunion. Il fume une cigarette.
Pierre leaves the meeting he smokes a cigarette
‘Pierre is leaving the meeting. He is smoking a
cigarette.’

The interpretive reading in (37) could be explained by using the bouletic ordering source option for the CI of *êtd*, since the speaker presumably has a negative attitude toward Pierre’s mistake (=she wants Pierre to be doing something else). However, it is possible to use positive-attitude lexical material, as we did above in example (13), to test whether the negative attitude is part of the meaning of the interpretive reading. If we do this, we

see that it is possible to have an interpretive reading with a non-ironic meaning, as in (38).

- (38) En faisant cette tournée, je suis en train de me rendre
 in doing this tour I am in midst of REFL render
 service moi-même.
 favor myself
 ‘In doing this tour, I am doing myself a favor.’

This indicates that it is possible for CI not to have a bouletic ordering source, but rather a stereotypical ordering source, in a case where *p* is not the same as *q*.

The speaker’s stereotypical ordering source gives a sense of how the speaker thinks the course of events will proceed from the current situation. Since a single person in a single situation can’t believe simultaneously that incompatible courses of events will happen, *p* and *q* are not allowed to be incompatible. (Note that this means that the possible relation between *p* and *q* is more restricted than with a bouletic ordering source.) However, *p* and *q* can still be non-identical.

6. Conclusion

In conclusion: we have proposed that there is only one *êtd*. The at-issue meaning of *êtd*, we have argued, is just an ongoing meaning, the same as the ongoing reading of the simple present. It has a modal conventional implicature with either a bouletic or a stereotypical ordering source. The following taxonomy of readings of *êtd* results:

- (39) Taxonomy of readings of *êtd*:
- a. bouletic ordering source in the CI
 - (i) $p \neq q$: ‘discordant’
 - (ii) $p = q$: ‘accordant’
 - b. stereotypical ordering source in the CI
 - (i) $p = q$: ‘disambiguating’
 - (ii) $p \neq q$: ‘interpretive’

We presented evidence for all of these logically possible cases. Three of the four cases were attested; the existence of accordant case examples is difficult to prove, but we found no evidence to the contrary. This account entails that the CI is always there, but that when it has a stereotypical ordering source, it is not “expressive” in Potts’ (2005) sense (good/bad). This makes it look as though the CI disappears. However, we know it is still there because *êtd* is not always felicitous in describing ongoing situations in out-of-the-blue contexts (e.g., example (5a), *#Il est en train de pleuvoir*,

‘it is raining’). We proposed that this is because *êetd* has the exact same at-issue meaning as the ongoing reading of the simple present. The simple present should be preferred unless the CI is needed to disambiguate (stereotypical ordering source, $p = q$) or to convey that there is another description of an already-described event (stereotypical ordering source, $p \neq q$).

This proposal raises a couple of intriguing questions as to the nature of CIs and of grammaticalization. If, as we have argued, *êetd* has a CI, it is an odd one according to Potts’ (2005) theory, because (i) CI meaning is supposed to take at-issue meaning as an argument, and our CI does not, and (ii) any word is supposed to express either at-issue or CI meaning but not both; our *êetd* does both. The issue in (i) could be resolved by positing a two-dimensional Predicate Modification (see also Morzycki 2009). However, (ii) can’t be resolved unless there are two heads involved in *êetd*. But since *êetd* isn’t grammaticalized as a progressive, it may well be that it is comprised of two meaningful heads; likely *être* ‘be.INF’ would carry the at-issue aspectual meaning, as French verbs generally do, while (*en*) *train* (*de*) would carry the CI. Given this idea, we wonder whether there might not be a correlation, among aspectual morphology, between lack of grammaticalization and the presence of a CI. That is, we wonder whether there are other non-grammaticalized aspects that carry both at-issue meaning and CIs, and conversely, whether there are any grammaticalized aspects that do the same.

References

- Buysens, Eric, 1968, *Les deux aspectifs de la conjugaison anglaise au XX siècle*, Bruxelles: Presses universitaires de Bruxelles.
- Condoravdi, C. 2002. Temporal interpretation of modals: Modals for the present and for the past. In Beaver, D., L. Casillas Martínez, B. Clark, S. Kaufmann (eds.), *The construction of meaning*, 59-88. CSLI: Stanford.
- Do-Hurinville, Danh Thanh. 2007. “Etude Sémantique et Syntaxique de *Être en Train de*”. *L’Information Grammaticale* 113: 32-39.
- Heim, Irene. 1992. Presupposition Projection and the Semantics of Attitude Verbs. *Journal of Semantics* 9, 183-221.
- Franckel, Jean-Jacques. 1989. *Etude de Quelques Marqueurs Aspectuels du Français*. Genève: Droz.
- Kearns, Kate. 1991. The semantics of the English progressive. MIT Ph.D. thesis.
- König, Ekkehard. 1980. On the context-dependence of the Progressive in English.” In Christian Rohrer (ed.), *Time, Tense, and Quantifiers. Proceedings of the Stuttgart Conference on the Logic of Tense and Quantification*. 269-292. Tübingen: Niemeyer.

- Lachaux, F. 2005. La périphrase *être en train de*, perspective interlinguale (Anglais-Français): une modalisation de l'aspect. *Les périphrases verbales*. Bat-Zeev Shyldrot & Le Querler (eds). *Linguisticae Investigationes* 25. John Benjamins.
- Martin, Fabienne. 2006. Progressive stative sentences in French. Talk presented at the Deuxième Atelier Franco-Allemand de Linguistique de l'École Doctorale Internationale Stuttgart/Paris 8.
- Morzycki, Marcin. 2009. "Degree modification of gradable nouns: Size adjectives and adnominal degree morphemes." *Natural Language Semantics* 17(2): 175-203.
- Patard, Adeline. and Astrid De Wit. 2011. "The Present Progressive in French in Comparison with English". In the Proceedings of CHRONOS 10 – 10th International Conference on Tense, Aspect, Modality and Evidentiality.
- Portner, Paul. 1998. The progressive in modal semantics. *Language* 74: 760-787.
- Potts, Chris. 2005. *The Logic of Conventional Implicatures*. OUP.
- Traugott, Elizabeth Closs, and Ekkehard König. 1991. "The semantics-pragmatics of grammaticalization revisited." *Approaches to grammaticalization* 1. 189-218.

2

Theories of causation should inform linguistic theory and vice versa

BRIDGET COPLEY AND PHILLIP WOLFF

2.1 Introduction

Linguistics has long recognized that causation plays an important role in meaning. Over the last few decades of the generative linguistic project, it has become clear that much of phrase structure is arranged around causal relationships between events (or event-like entities such as situations). Reference to causation in this tradition has most often taken the form of a relation CAUSE, with little further elucidation, in effect treating CAUSE as a primitive. This treatment of causation as a primitive relation has proved adequate to the task of developing grammatical structures that make reference to causation. But arguably, this hands-off approach to the meaning of causation has obscured potentially relevant details, impeding linguists' ability to consider hypotheses that might yield a more comprehensive analysis of the roles played by concepts of causation in language. Unpacking the notion of causation should, on this view, afford a deeper understanding of a range of linguistic phenomena, as well as their underpinnings in conceptual structure.*

In this chapter, we show how attention to the variety of existing theories of causation could advance the understanding of certain linguistic phenomena. In the first section, we review the two major categories of theories of causation, including some of the principal challenges that have been raised for and against each category. We identify in the second section a range of linguistic phenomena that we feel would benefit from a deeper investigation into causation—defeasibility, agentivity and related concepts, and causal chains—and also speculate on how theories of causation might inform our understanding of these phenomena. Since the linguistic theories make testable claims about cognition, they give rise to potential connections between syntactic structure and cognition. In the concluding section, we express our hope that further investigations along these lines

* Thanks to Kevin Kretsch and Jason Shepard for helpful discussion.

12 2. *Theories of causation*

may pave the way for a theory of meaning grounded in both syntactic and cognitive realities, in a way that has not previously been possible.

2.2 Theories of causation

Given the importance of causation in linguistic theory, the question naturally arises as to whether some of the varied insights about causation from philosophy and cognitive psychology might have consequences for our understanding of linguistic theory. Up until now, they have not. The single theory of causation most often referred to in linguistic articles—by an extremely large margin—is Lewis’s (1973) counterfactual theory of causation, which is discussed and adapted in Dowty’s influential (1979) book. But even when Lewis or Dowty are cited, the causal relation is usually¹ treated by linguists essentially as a primitive. As a consequence, even Lewis’s theory has not had a particularly meaningful impact on our understanding of the role of causal concepts in forming causal meanings.² Certainly, when causation has been treated as a causal primitive, it has just been a placeholder, a way of not having to deal with what causation is. Historically, this move was defensible since it was not clear that linguistic phenomena really depended on how causation was defined, or whether the grammar had access to anything more fine-grained than a primitive relation CAUSE. Arguably, it was even provisionally necessary to treat causation as an unanalyzed primitive at the outset of the development of the syntax–semantics interface, to avoid unnecessary complication.

As the generative enterprise has progressed, however, the need to address the lacunae still present in linguistic phenomena related to causation has become more and more pressing, both in familiar and in novel data. A number of linguistic phenomena, some of which we will present in this chapter, are not well addressed by appeal to a primitive CAUSE. It has therefore become increasingly apparent that

¹ Notable exceptions—i.e. authors who further investigate the Lewis–Dowty approach—include: Bittner (1998) (type lifting for cases where causal meaning is morphologically unmarked); Eckardt (2000) (focus sensitivity of the verb *cause*); Kratzer (2005) (a causal head in resultatives); Neeleman and van de Koot (2012) (questioning whether there is a causal event associated with causative predicates; see also Van de Velde 2001 for a similar point); Truswell (2011) (constraints that causal structure puts on extraction). A related theory, that of causal modeling (see section 2.2.1.4) is starting to be of interest to people working on modals and counterfactuals; e.g. Dehghani et al. (2012). Production theories of causation that rely on forces, or transmission of energy are very similar to a parallel development in cognitive linguistics that had its start with Talmy (1985a; 1985b; 1988). A few lines of inquiry in formal linguistics have explicit, or implicit links to production theories, most notably those of van Lambalgen and Hamm (e.g. 2003; 2005) and Zwarts (e.g. 2010).

² Lewis’s theory has had an enormously meaningful and fruitful impact on semantics in the realm of conditionals (counterfactual and otherwise) and modals, stemming from initial work by Stalnaker (1968 and much later work), and Kratzer (1977; 1979 and much later work), as well as Dowty’s work on the progressive (1977; 1979). The clear predictions and expressive power of the possible worlds approach have deservedly made it a jewel in the crown of modern semantic theory. However, this body of research has not generally been explicitly linked to the issue of causation. As we will discuss in section 2.2.2, causation and at least one kind of modal notion (that of volitionality) are related to each other, whether or not one agrees with Lewis on the best way to represent them; see also Ilić, Ch. 7, this volume, for discussion of linguistic data bearing on the relationship between causality and modality.

2.2 Theories of causation 13

the story one tells about causal meanings will have to depend on one's theory of causal concepts. If, for instance, we were to take the details of Lewis' counterfactual theory of causation into account, it could have some interesting consequences.

Lewis's theory, though, is not the only theory in town. Other modern theorists have suggested that causal relations might be based on statistical dependencies (Suppes 1970; Eells 1991; Cheng and Novick 1991), manipulation (Pearl 2000; Woodward 2003), necessity and sufficiency (Mill 1973; Mackie 1974; Taylor 1966), transfer of conserved quantities (Dowe 2000), force relations (Fales 1990; White 2006), energy flow (Fair 1979), causal powers (Mumford and Anjum 2011a), and property transference (Kistler 2006a). While this list accurately reflects the considerable variation among philosophers as to the nature of causation, discussions of causation often categorize theories of causation according to several dimensions, such as whether the relata are single or generic, individual or population level; whether the causal relation is physical or mental; whether the causal relation is objective or subjective; or whether it is actual or potential (see Williamson 2009, e.g.). Many of these distinctions are not particularly relevant to current linguistic understanding of the causal relation as an element that occurs in a wide range of different environments. For example, linguistic consensus treats genericity as a separate operator from the causal relation CAUSE, so any viable proposal for the latter must be consistent with both generic and individual causation. In the following categorization of causation we emphasize two broad categories: *dependency* theories, in which A causes B if and only if B depends on A in some sense, and *production* theories (also commonly referred to as *process* theories), in which A causes B if and only if a certain physical transmission or configuration of influences holds among the participants in A and B.

2.2.1 Dependency theories

One major category of theories holds that causation is understood as a *dependency*. There are three main classes of dependency theory.

2.2.1.1 Logical dependency There is intuitive appeal in defining causation in terms of necessary and/or sufficient conditions. However, an analysis of such accounts raises a range of problems that are generally considered insurmountable (see Scriven 1971; also Hulswit 2002; Sosa and Tooley 1993). Consider, for example, a definition that identifies the concept of causation as a condition that, in the circumstances, is necessary. With such a definition, we might agree with Hume's comment that one event causes another "where, if the first object had not been, the second never had existed" (Hume 2007[1748])—i.e. a cause is a factor without which the effect would not have occurred.³ The simplest version of such an account is contradicted by cases of late

³ "Necessary" here is not necessarily to be thought of in the later modal logic sense of quantification over possible worlds; see e.g. Hume's "necessary connection" between cause and effect wherein "the determination of the mind, to pass from the idea of an object to that of its usual attendant" (Kistler 2006a).

14 2. *Theories of causation*

pre-emption, i.e. cases where a potential alternative cause is interrupted by the occurrence of the effect.⁴ For an example of late pre-emption, consider a scenario developed by Hall (2004).

There is a bottle on the wall. Billy and Suzy are standing close by with stones and each one throws a stone at the bottle. Their throws are perfectly on target. Suzy happens to throw first and hers reaches the bottle before Billy's. The bottle breaks. In this scenario, the effect of a particular candidate cause, Billy's throw, is "pre-empted" by another cause, Suzy's throw. As empirically verified by Walsh and Sloman (2005), Suzy's throw is understood to be the cause of the bottle's breaking, but Suzy's throw was not a *necessary* condition for the effect: if Suzy had missed, the bottle still would have broken because of Billy's throw.

An alternative account of causation in terms of logical dependency would be the proposal that causation is a sufficient condition for an effect. Under this view, a factor is the cause of an effect if the presence of that factor guarantees the occurrence of an effect. Of course, one problem with this view is that it is rare to find a case where single condition is sufficient in and of itself. An event is rarely, if ever brought about by a single factor; as Mill (1973[1872]) notes, every causal situation involves a set of conditions, which are sufficient for an effect when combined. Another problem for a sufficiency view is the case of late pre-emption described above. As noted, we would not say that Billy caused the breaking of the bottle. This is surprising from a sufficiency view, since Billy's throw is a sufficient condition for the breaking of the bottle.

Yet another possibility would be to define a cause as a necessary *and* sufficient condition (Taylor 1966). Such a definition fails because it entails that the cause would be a necessary condition and, as already discussed, there can be causes that are not necessary. A related view of causation is Mackie's (1965) INUS condition, that says a cause is an *insufficient* but *necessary* part of a condition which is itself *unnecessary* but *sufficient* for the result. The INUS condition, ultimately, defines causation in terms of sufficiency, but as discussed above, a factor (or set of factors) can be sufficient and yet not be a cause. A modern instantiation of an account of causation based on logical necessity and sufficiency can be found in Goldvarg and Johnson-Laird's (2001) model theory.

2.2.1.2 Counterfactual dependency Another type of dependency theory is based on the idea of counterfactual dependency: the counterfactual proposition that E would not have occurred without C. As we have seen, counterfactual dependency can be thought of as a paraphrase of the proposition that C is necessary for E. The modus operandi behind counterfactual theories of causation is thus to link two groups of

⁴ Late pre-emption occurs when there are two potential causes but the occurrence of the effect prevents one of the causes from causing the effect. Early pre-emption (to be discussed in section 2.2.1.2) occurs when the initiation of one cause prevents the other potential cause from happening at all. See Menzies (2008) and Paul (2009) for more details.

2.2 Theories of causation 15

intuitions: intuitions about whether certain counterfactual propositions are true and intuitions about whether certain events cause other events.

The simplest way to link these intuitions would be to identify causation with counterfactual dependency: i.e. to say that C is a cause of E if and only if E would not have occurred if C had not occurred. This looks as though we are equating causation with logical necessity, because it asserts that C must be present in order for E to occur. As we have seen, a definition of causation in terms of logical necessity erroneously predicts that C is not a cause of E if E could have been caused by something other than C. David Lewis, in the original version of his influential counterfactual theory of causation (1973 et seq.), proposed to avoid this problem by weakening the biconditional (“if and only if”) to a mere conditional: counterfactual dependency entails causation, but causation does not entail counterfactual dependency. According to Lewis (1973), the reason that causation does not entail counterfactual dependency is because causal relations can sometimes emerge from transitive reasoning, but counterfactual relations, arguably, are not transitive (see Stalnaker 1968), and so causal relations may sometimes exist in the absence of a counterfactual dependency.

An example of such a scenario occurs in cases of so-called *early* pre-emption. Imagine, for example, a slightly different version of the Billy and Suzy scenario that was discussed above (which demonstrated *late* pre-emption). In this new scenario, Suzy throws a rock at a bottle (breaking it) and Billy acts as a backup thrower just in case Suzy fails to throw her rock. Here Suzy is the cause of the bottle’s breaking, but just as in the case of late pre-emption there does not exist a counterfactual dependency between Suzy and the bottle’s breaking; if Suzy had not thrown, the bottle would have still been broken because Billy would have thrown his rock.

To insulate his theory against such scenarios, Lewis (1973) proposes that C causes E if and only if *stepwise* counterfactual dependency holds between C and E, i.e. only if there are counterfactual dependencies holding between adjacent events in the chain, but not necessarily non-adjacent events in the chain. In the early pre-emption scenario, Lewis (1973) would argue that while the rock’s breaking does not depend counterfactually on Suzy, there is a counterfactual dependency between Suzy and the intermediate event of the rock flying through the air, and a counterfactual dependency between the rock flying through the air and the bottle’s breaking, and this chain of counterfactual dependencies licenses a judgment that Suzy’s throw caused the bottle to break.⁵ Lewis’ approach to the problem raised by early pre-emption ultimately led to a definition of causation in terms of causal chains: specifically, C is a cause of E if and only if there exists a causal chain leading from C to E. Importantly, however, the links in the causal chain are defined in terms of counterfactual dependencies.

⁵ Contra Lewis (1973), it is not entirely clear that there exists a counterfactual dependency between Suzy’s throw and a rock flying through the air. Had Suzy not thrown her rock, there still would have been a rock flying through the air due to Billy.

16 2. *Theories of causation*

There are a number of problems with Lewis's initial proposal, some of which continue to complicate counterfactual theories today. One kind of problem occurs in the case of *late* pre-emption. In both early and late pre-emption, a counterfactual dependency fails to hold between C and E, suggesting that counterfactual dependency is not *necessary* for causation. Lewis (1973) was able to address the lack-of-necessity problem in cases of early pre-emption by defining causation in terms of *stepwise* counterfactual dependency; but this fix only works for early pre-emption, not for late pre-emption, so the lack-of-necessity problem remains in the case of late pre-emption. Two other problems can be illustrated with a single type of scenario (see Hall 2000). Consider a case where an assassin places a bomb under your desk, causing you to find it, which causes you to remove it, which causes your continued survival. Without the assassin putting the bomb under your desk, you would not have removed it and thereby ensured your survival. Cases such as this demonstrate that counterfactual dependencies are not *sufficient* for causation. In this example, there exists a counterfactual dependency between the assassin and survival, but we would not want to say that the assassin caused your continued survival. Such cases also raise a problem for Lewis' (1973) definition of causation in terms of causal chains. As already noted, this definition was motivated by the assumption that causation is transitive; but, as shown in this example, there may be cases where transitivity in causation fails (see also McDermott 1995; Ehring 1987).

Lewis's 2000 theory attempts to address several of the problems facing his 1973 theory. In Lewis's new theory, counterfactual dependency exists when alterations in the cause lead to alterations in the effect. So, for example, if Suzy's throw is slightly altered—she throws the rock a bit faster, or sooner, or uses a lighter rock—the resulting breaking of the bottle will also be slightly altered. Lewis's new theory is able to explain why Suzy's throw, and not Billy's throw, is considered to be the cause: alterations to Suzy's throw result in changes in the effect, while alterations to Bill's throw do not. However, there is reason to believe that Lewis's new theory still does not escape the challenge raised by late pre-emption. As noted by Menzies (2008), in the case of Billy and Suzy, there is a degree to which alterations in Billy's throw could result in alterations of the final effect—if, for example, Billy had thrown his rock earlier than Suzy's. In order for Lewis's theory to work, only certain kinds of alteration may be considered. To foreshadow a point we will later make in the discussion of production theories (section 2.2.2), it may be that Lewis's theory can be made viable if the alterations are confined to those that are relevant to the creation of forces.

2.2.1.3 Probabilistic dependency According to Hume (2007[1748]), if it is true that an event C causes an event E, it is true that events similar to C are invariably followed by events similar to E. This view is referred to as the “regularity theory” of causation. A well-known difficulty with the regularity theory is the simple observation that causes are *not* invariably followed by their effects. The observation has motivated

2.2 Theories of causation 17

accounts of causation that ground the notion of causation in terms of probabilistic dependency.⁶

The simplest type of probabilistic dependency is one that relates causation to probability raising (Reichenbach 1956; Suppes 1970; Eells 1991). A variable C raises the probability of a variable E if the probability of E given C is greater than the probability of E in the absence of C (formally, $P(E|C) > P(E|\neg C)$). Thus on this theory, if smoking causes cancer, the probability of cancer given smoking is greater than the probability of getting cancer in the absence of smoking. An alternative way of describing the relationship between the conditional probabilities $P(E|C)$ and $P(E|\neg C)$ is to say that C is a cause of E when C makes a difference in the probability of E . Indeed, whenever $P(E|C) > P(E|\neg C)$ holds, E and C will be positively correlated and whenever E and C are positively correlated, $P(E|C) > P(E|\neg C)$. A relatively recent instantiation of probability raising is instantiated in Cheng and Novick's (1992) probabilistic contrast model.

While probabilistic approaches to causation address important limitations not addressed by other dependency accounts, they do not escape some other problems. Probability raising on its own seems to be not *sufficient* for causation: that is, C might raise the probability of E without C 's being a cause of E . The reason it is not sufficient is because the presence of one event might (appear to) make a difference in the probability of another, but that appearance might in fact be due to a shared common cause, rather than from one causing the other (Hitchcock 2010). So, for instance, seeing a spoon raises the probability of seeing a fork; not because spoons cause forks, but rather because there is some overlap between the causes of seeing a spoon and the causes of seeing a fork. Reichenbach suggested that such cases could be flagged in the following manner: if two variables are probabilistically dependent and if one does not cause the other, they have a common cause that, if taken into account, renders the two variables probabilistically independent. Williamson (2009), however, points out that Reichenbach's characterization excludes cases of probabilistic dependency where C and E are related logically, mathematically, through semantic entailment, or accidentally.

Even with Reichenbach's common-cause cases excluded, however, sufficiency is still a problem. Returning to Suzy and Billy's case of late pre-emption, we can also see that probabilistic dependency is not sufficient for causation (C raises the possibility of E but C is not a cause for E). We can imagine that Billy's throw hits the bottle with a certain probability while Suzy's throw hits it with a certain, possibly different, probability. They both throw, and Suzy's stone hits the bottle, and breaks it. In that case we would say

⁶ Unlike in other dependency theories discussed above, in probabilistic dependency theories there can be a causal relation (between kinds) even when the effect does not occur (at the individual level), since all that is needed to calculate a causal relation is the probability of the effect's occurring under certain conditions. As we will see in section 2.3.1, this property could be useful in understanding cases of defeasible causation in language, such as non-culmination of accomplishments.

18 2. *Theories of causation*

Suzy's throw was the cause of the bottle breaking—and indeed her throw raised the probability of the bottle's breaking. However, Billy's throw also raised the probability of the bottle's breaking, although his throw was not the cause (Hitchcock 2010).

Additionally, probability raising is apparently not *necessary* for a factor to be considered a cause; cases exist where C is a cause of E but C does not raise the probability of E. Imagine that Suzy throws her rock with a 25% chance of shattering of the bottle. If Suzy had not thrown the rock, Billy would have done so, with a 70% chance of shattering. In this example, Suzy's throw would be the cause of the shattering, even though it lowered the chance of that effect (from 70% to 25%) (Hitchcock 2010).⁷

As usual, problems such as these are probably not insurmountable, but any viable solution would be expected to bring complications to the theory. Probabilistic dependency theorists have addressed such problems by getting more specific about the background contexts on which probabilities are calculated (Cartwright 1979; Skyrms 1980), as well as by recognizing differences between singular and general (kind) causation (Eells 1991; Hitchcock 2004), since probabilities can arguably only be calculated for kinds of events, not for individual events.

2.2.1.4 Causal modeling approaches to causation One particular formal implementation of the dependency view of causation has had a wide-ranging influence on a number of fields. As Williamson (2009) points out, the formalism of Bayesian networks developed in the 1980s (Pearl 1988; Neapolitan 1990) provided an efficient way to think about causal connections at a time when causal explanations were out of fashion in scientific fields, in part due to Russell's (1913) attack on the notion of causation as being unnecessary for scientific explanation.

A causal Bayesian network represents the causal structure of a domain and its underlying probability distribution. The causal structure of the domain is represented by a directed acyclic graph of nodes and arrows, whereas the probability distribution consists of the conditional and unconditional probabilities associated with each node. The alignment of these two kinds of information allows us to make predictions about causal relationships using probability theory. A simple causal Bayesian network is shown in Fig. 2.1. Each node in the network is associated with an unconditional, prior probability. For example, in the the network shown in

⁷ Another example of how probability raising is not necessary for causation is seen in cases where the influence of one cause is overwhelmed by the influence of another (Cartwright 1979; Hitchcock 2010). For example, under the right circumstances, the probability of cancer might be less in the presence of smoking than the probability of cancer in the absence of smoking, that is $P(\text{cancer} | \text{smoking}) < P(\text{cancer} | \text{not smoking})$. Clearly, smoking causes cancer, but a positive correlation between cancer and smoking might be masked, or even reversed in the presence of another cause. Imagine a situation in which not smoking is correlated with living in a city, breathing highly carcinogenic air. In such a situation, not smoking could be more strongly associated with cancer than smoking, but the causal relationship between smoking and cancer could remain. Such reversals are widely known as examples of Simpson's paradox; see Kistler (Ch. 4, this volume) for additional discussion.

2.2 Theories of causation 19

Fig. 2.1, exercise is associated with a 0.5 probability of being true and a 0.5 probability of being false, while debt is associated with a 0.2 probability of being true and a 0.8 probability of being false. The arrows in this graph represent causal relations (in the broad sense). In Fig. 2.1, the arrows from exercise and debt to happiness convey that these two variables affect happiness. The exact way in which they do so is described in the probability table associated with happiness, which specifies several conditional probabilities: for example, the probability of happiness being present when one exercises but also has debt, i.e. $P(\text{Happiness} \mid \text{Exercise and Debt})$, is 0.6, and the probability of not being happy when one exercises and has debt, i.e. $P(\sim\text{Happiness} \mid \text{Exercise and Debt})$, is 0.4. The conditional probabilities specified in the probability table specify that exercise raises the probability of happiness, whereas debt lowers the probability of happiness. It is in this manner that a causal Bayesian network can represent both facilitative and inhibitory causal relations, and it is for this reason that the arrows are causal in a broader sense than is encoded in the meaning of the verb *cause*. Roughly, the arrows mean something like *influence* or *affect*.

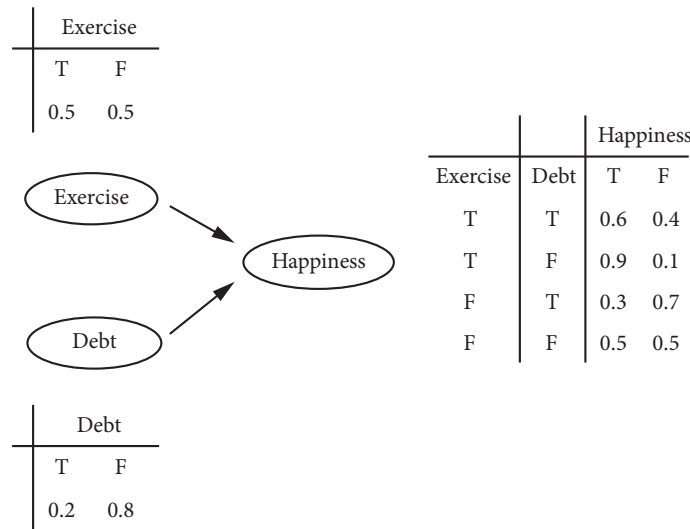


FIG. 2.1 Causal Bayesian network with associated probability tables

Causal Bayesian networks allow us to reason about causation in more than one dimension, i.e. in networks rather than mere chains. For example, they allow us to predict—using Bayes’ rule—the probability of certain variables being true when other variables are either true or false, both in the direction of causation and diagnostically, i.e. working from effects to causes. However, in order to understand where the causal arrows themselves come from—i.e. when we are justified in asserting a causal relation between two variables—more must be said.

20 2. *Theories of causation*

In order for a Bayesian network to qualify as a causal Bayesian network, it has been argued (Hausman and Woodward 1999) that its probabilistic dependencies and arrows must honor the *Causal Markov Condition*.⁸ The Causal Markov Condition holds that a variable C will be independent of every variable in a network except its effects (i.e. descendants) (e.g. E), conditional on its parents. Hausman and Woodward (1999) use the Causal Markov Condition as part of a sufficiency condition on causation: if C and E are probabilistically dependent, conditional upon the set of all the direct parents of C in the given Causal Markov Condition-satisfying model, then C causes E . However, late pre-emption provides a counterexample to this sufficiency condition (i.e. a case where the condition holds but the intuition is that C does not cause E).

Another way to characterize causation in a causal Bayesian network is in terms of the notion of *intervention* (Pearl 2000; Woodward 2009). An intervention is a process by which a variable in a network is set to a particular value. The notion of intervention is closely related to our sense of causation. In effect, interventions allow us to conduct counterfactual reasoning. If C causes E , then intervening on, or “wiggling” the value of C should result in corresponding changes in the value of E . If we can intervene to counterfactually change the value of C to any possible value, and can still predict the probability of the value of E being true, we can be confident that C causes E . For example, suppose that you want to find out if a switch being in an up position causes a light to be on. The natural thing to do is to try the switch and see if the light is on when the switch is up and off when the switch is down. If the status of the light depends on the switch position in all positions (i.e. on and off), we feel justified in concluding that setting the switch to the up position causes the light to turn on. Note that wiggling the value of E should have no effect on the value of C . Thus, interventions allow us to determine the direction of the causal arrow. Interventions thus provide us with an alternative sufficient condition on causation: if interventions on C are associated with changes in E , C causes E (Hausman and Woodward 1999).⁹

⁸ Strictly speaking, dependence means $P(E|C) \leftrightarrow P(E)$, so an arrow will be justified only if this is true. For example, if $P(E|C) = .5$ but $P(E) = .5$, there will be no arrow between C and E in a model that satisfies the Causal Markov Condition.

⁹ The notion of intervention may seem to approach the notion of agency, and indeed an alternative approach to causation has pursued this idea. Woodward (2009) separates ‘manipulation-based’ accounts into interventionist theories such as we have described, which refer merely to intervention by whatever external cause, and agency theories (e.g. Menzies and Price 1993), which define causation in terms of explicitly animate or human agency. Menzies and Price propose that rooting the theory in our personal experience of agency keeps the theory from being circular, which is a desirable outcome (and foreshadows the production class of theories, section 2.1.2). On the other hand, there are counterexamples to their claim that agency is a sufficient condition for causation, including cases where there is no possibility for an agentic manipulation (Hausman and Woodward 1999); at any rate, an animate intervener is not necessary in order to define an intervention, just as inanimate entities can be causers (see section 2.2.2).

2.2 Theories of causation 21

The light-switch example suggests an additional way to use causal models: it is possible to model deterministic causal structures as well as probabilistic causal structures. The special case where the values of each variable are limited to 1 and 0 (true and false, on and off) yields tables reminiscent of familiar Boolean truth tables and is therefore possibly of more interest to linguists (though of less interest to probability theorists; Bayes's rule is no longer relevant). One example of such an approach is Hitchcock (2010), which shows how a deterministic model accounts for the problem of late pre-emption that so bedeviled previous dependency theories of causation.

In addition to the node-and-arrow notation, Hitchcock presents his causal networks in terms of *structural equations* (see also Sloman et al. 2009).¹⁰ Consider the causal network in Fig. 2.2.

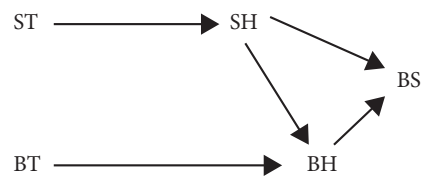


FIG. 2.2 An example of late pre-emption in terms of a direct graph (Hitchcock 2010)

The causal graph shown in Fig. 2.2 specifies the late pre-emption scenario discussed earlier, in which ST corresponds to Suzy's throw, SH to Suzy's ball hitting the bottle, BS to the ball's shattering, BT to Billy's throw, and BH to Billy's ball hits the bottle. The causal network shown in Figure 2.2 can be re-expressed in terms of structural equations as follows. The “:=” relation is an asymmetrical relation, read as “gets”, in the opposite direction of the arrows.¹¹

- (1) SH := ST
 BH := BT
 BS := SH \vee BH
 BH := BT and \sim SH

¹⁰ These are equally available for the probabilistic case; here we examine the special case where values are either 1 or 0. One advantage to this notation over the node-and-arrow plus table notation is that it allows us to see at a glance whether a value of a parent variable has a positive or negative effect on the probability of a certain value of the child variable (since, as we have noted, both positive and negative effects are represented with the same kind of arrow).

¹¹ Note that there is an arrow from BT to BH and from BH to BS, even though we do not want to say that BT (or BH) causes BS. These arrows and the associated truth value distributions satisfy the Causal Markov Condition (see section 2.2.1.4), however. This failure in the face of late pre-emption shows that the Causal Markov Condition alone is not the correct sufficiency condition for causation.

22 2. *Theories of causation*

As Hitchcock notes, an interventionist approach can offer a solution to the problem of late pre-emption. Given the equations in (1), we can simulate different scenarios by setting the variables to different values. For example, we could simulate the late pre-emption scenario by setting Suzy's hitting the bottle, SH, and Bill's hitting the bottle, BH, to "1". When this is done, the value of BS would be 1 as well; the bottle would shatter.

As we have said, a variable C is taken to cause E in a certain scenario if the values of E co-vary when C is wiggled and all external variables are held constant *at their actual values*¹² in that scenario. In the Suzy and Billy late pre-emption case, the actual values of Suzy's and Billy's throw, ST and BT, would be 1, the actual value of Suzy's hit, SH, would be 1, while the actual value of Billy's hit, BH, would be 0. It is interesting to see how such a graph is able to account for the intuition that, when both Suzy and Billy throw their rocks, with Suzy throwing first, we would describe Suzy and not Billy as the cause. To test whether Suzy is the cause, we need to hold BH fixed. In the actual scenario, BH is 0. Under these conditions, the value of BS would covary with the value of ST, implying that Suzy's throw is a cause of the shattering. To test whether Billy's throw is a cause, we need to hold SH to the value it has in the actual scenario, i.e., 1. With SH set to 1, the bottle would shatter regardless of the value of BT and the counterfactual test for BT would often be incorrect, offering evidence against BT being the cause of the shattering.

It is worth emphasizing the reason why the structural equation approach to encoding counterfactuals is able to account for late pre-emption. The reason why it succeeds is due to the asymmetry in the values of SH and BH. These two variables take on different values because of the requirement to freeze values at only their actual values; SH can be set to 1 while BH is set to 0, while the converse is not possible.

Causal Bayesian networks and structural equation modeling have several attractive properties: not only do they allow us to go beyond simple causal chains to specify causal networks in which some nodes have more than one parent (especially useful for counterfactuals; e.g. Dehghani et al. 2012), but they can be used to model both probabilistic and deterministic causation. Furthermore, they suggest straightforward accounts for late pre-emption. However, some concerns linger.

There are cases in which both of the sufficiency conditions mentioned hold between C and E, but C does not cause E: suppose that a villain gives the king poison (C), which causes the king's adviser to give the king an antidote, which on its own would kill the king but which neutralizes the poison harmlessly so the king survives (E) (Hitchcock 2007). In that case, it turns out that the intervention condition predicts C to be a cause of E, but we do not have the intuition that

¹² This requirement is an analogue to Lewis's similarity metric over possible worlds, relating them to the actual world: in both cases, certain other potentially interfering variables must be held constant at their actual value in order to determine if C causes E.

2.2 Theories of causation 23

C causes E. Of course, one might propose a different sufficiency condition, and/or additional constraints on the model to explain these facts.

A more serious issue is the question of what these models are for. As Hausman and Woodward (1999) point out, it is curious to characterize causation in terms of intervention, which is itself arguably a causal notion. Such a characterization of causation is uninformative at best and circular at worst. This is not a problem if the models are used to analyze structures in which the direct causal relations are already known, and the question at hand is to find out how certain direct causal relations combine to yield causal relations in a complex structure. However, if these models are meant to be a theory of causation, and intervention is disqualified for circularity, it is only the Causal Markov Condition and other such conditions on the models that bear on the question of what causation actually is (and as demonstrated in the case of late pre-emption, the Causal Markov Condition is not enough to guarantee causation, though other conditions on the model can and have been added; see e.g. Woodward 2009). This is fine, but the complexity of the Causal Markov Condition and whichever additional conditions would be added to it raises the question of whether these are merely tests for whether certain structures can arise from causation, rather than accounts of our intuitive notion of causation itself (Mackie 1974).

2.2.2 Production theories

In the previous section, we touched on the major kinds of dependency theory of causation: logical dependency, counterfactual dependency, probabilistic accounts, and Bayesian and causal modeling accounts. What they have in common is the idea that causation can be explained by means of a dependency between the cause and the effect. The hope that motivates dependency theorists is that causation can be reduced to correlation or regularity if the conditions are pruned and the potentially confounding variables are fixed correctly. As we have seen, this hope is in large part justified by the success that such theories have had in providing appropriate sufficiency conditions for causal intuitions.

On the other hand, we seem also to have an intuition that something more than correlation or regularity is involved in causation (Pinker 2008; Saxe and Carey 2006). Hume recognized as much. He acknowledged that we often associate causation with a sense of force and energy. But for Hume, these were mental experiences that accompanied causation. He maintained that these notions could not be the basis for our understanding of causation, on the assumption that they could not be objectively observed. For Hume, these notions were imposed on experience by the mind, rather than experience imposing these notions on the mind. Ideas of force or energy are epiphenomena of our personal, subjective interactions with causation (Fales 1990; White 1999; 2006; 2009; Wolff and Shepard 2013).

It may be, however, that ideas of force and energy are more central to the notion of causation than was recognized by Hume, or for that matter by dependency

24 2. *Theories of causation*

theories, which are largely descendants of the Humean perspective. One argument for why force and energy may be central to the notion of causation emerges when we consider the range of properties commonly associated with causal relationships.

One such property is temporal order: if C causes E, C must precede, or at least be simultaneous with E (Lagnado et al. 2007). This temporal relation between cause and effect is thus a necessary condition for causation. Like correlation, this relation is clearly not a sufficient condition for causation. Nonetheless, temporal precedence has been shown to be a stronger indication that C causes E than even correlation between C and E (Lagnado and Sloman 2006). The relationship between causation and temporality has been discussed by some linguistic researchers as well (e.g. Shibatani 1973a; Talmy 1976), though it has been ignored in much of the literature on the syntax–semantics interface.¹³

A second property is having a physical link between cause and effect (Salmon 1984; Walsh and Sloman 2011). This property requires some qualification. By physical link, we do not necessarily mean a direct physical contact; rather, that the cause and effect are linked in some way either directly or indirectly, through a chain of physical connections. This property appears not to be a necessary condition of causation, because of a large class of exceptions to this property that rely on “spooky action at a distance” (Einstein’s famous description of quantum entanglement). This class includes not only gravity, electromagnetism, and quantum entanglement, but also magic and divine intervention.¹⁴ Exactly when there is no plausible physical link, spooky influences such as these are called upon to justify impressions of causation.

These properties are problematic for dependency theories because these theories do not provide motivation for why these properties are relevant to causation. Temporal precedence or simultaneity, for example, is handled by stipulation, i.e. it needs to be explicitly stated in all these theories that the cause precedes the effect or occurs at the same times as the effect (Wolff, Ch. 5, this volume). The physical-link property is rarely if ever mentioned by dependency theorists. Why are these properties associated with causation? And is an answer to this question crucial to our notion of causation?

Our personal view is that the answer to that question is important, and since dependency approaches to causation give us no understanding of why these properties are relevant to causation, we must look elsewhere for an answer. In theories of causation based on concepts of force or energy, these properties of causation fall out naturally. A force is exerted or energy is transmitted, before or simultaneously with the effect that is provoked. Most forces also require a physical link, except, notably, for the class of spooky influences. These facts suggest that concepts such as

¹³ See Copley and Harley (to appear) for a recent linguistic discussion of the difference between launching causation, in which the cause precedes the effect, and entrainment, where the cause and effect happen at roughly the same time (Michotte 1946/1963).

¹⁴ Chains involving “social forces” might be thought to be part of this class, but as long as there is transmission of information from one person to another, there is still a physical link.

2.2 Theories of causation 25

force and energy provide a necessary part of our notion of causation, and that Hume had it exactly backwards: that force and energy are in fact the basis of our notion of causation, while correlation and regularity are the epiphenomena.

Theories that characterize causation in terms of concepts such as force and energy view causation as a *production* or process. The production may involve a transmission of conserved quantities such as energy (Dowe 2000; Kistler 2006a; Ch. 4, this volume). It may also be viewed in terms of causal powers, namely the ability of entities to transmit or receive a conserved quantity (Mumford and Anjum 2011a). Yet another approach would be in terms of forces being imparted, for instance, by an agent to a patient (as in the parallel cognitive linguistic tradition, e.g. Talmy 1988; 2000; Gärdenfors 2000; Warglien et al. 2012; Croft 1991; 2012; Ilić, Ch. 7, this volume; also Wolff 2007; Ch. 5, this volume). See also Copley and Harley (Ch. 6, this volume) for a more abstract view of forces.

Theories of causation that characterize causation in terms of transmission include Salmon's (1984; 1998) mark transmission theory. In this theory, causation is understood primarily as a process rather than as a relation between events. A causal process is understood as a transmission of a causal mark, i.e. a propagation of a local modification in structure. A causal process would be instantiated if, for example, one put a red piece of glass in front of a light. In such a case, the red glass would impart a mark on a process that would transmit the mark to a different location, such as a wall.

Salmon's theory's greatest strength may be in its ability to distinguish, in certain circumstances, causation from pseudo-causation. However, because the theory emphasizes processes over events, it does not provide a direct definition of what counts as causation. It is not hard to imagine how Salmon's theory might be extended to provide such a definition. To say that A causes B might be to say, in effect, that a mark is propagated from A to B. In some cases, a procedure can be specified for determining whether a mark has been propagated. In the case of the light filter, one can check to see what happens when the filter is removed. However, in many other cases, procedures for determining whether a mark has been propagated are less clear. For example, in the ordinary billiard-ball scenario, what is the mark and how do we know it has been propagated? If the procedures cannot be specified, then the legitimacy of the causal relation should be ambiguous; but in the case of billiard-ball scenarios, at least, the legitimacy of the causal relation is not in doubt. It might be possible, through further elaboration of the theory, to address this challenge. In particular, in order to make the criteria for causation easier to assess it would help to have a clearer idea of the notion of a mark.

A potential solution to this problem is offered by Kistler (2006a), who proposes a transmission theory of causation that brings back the idea of causation being a relation between a cause and an effect. According to this theory, "Two events *c* and *e* are related as cause and effect if and only if there is at least one conserved quantity *P*, subject to a conservation law and exemplified in *c* and *e*, a determinate amount of

26 2. *Theories of causation*

which is transferred between *c* and *e*.” Kistler (2006a) goes on to define “transference” as present if and only if an amount *A* is present in both events. In order for this to occur, events *c* and *e* must be located in space and time in such a manner that allows for the transference. In particular, the transference process requires spatial and temporal contiguity and implies that causation must take place over time (but does not, according to Kistler (2006a), necessarily imply that the cause precedes the effect).

Kistler’s (2006a) proposal that causation involves a transference of a conserved quantity builds on a highly influential theory by Dowe (2000). According to Dowe’s Conserved Quantity Theory, there are two main types of causation: persistence (e.g., inertia causing a spacecraft to move through space) and interactions (e.g., the collision of billiard balls causing each ball to change direction). Causal interactions are said to occur when the trajectories of two objects intersect and there is an exchange of conserved quantities (e.g. an exchange of momentum when two billiard balls collide). Unlike earlier theories, exchanges are not limited to a single direction (i.e., from cause to effect). One problem that has been raised for Dowe’s theory—and that also applies to transference theories—is that such a theory is unable to explain the acceptability of a number of causal claims in which there is no physical connection between the cause and the effect. In particular, such a theory seems unable to handle claims about causing preventions or causation by omission (Schaffer 2000; 2004). Consider, for example, the preventative causal claim, “Bill prevented the car from hitting Rosy”, assuming a situation in which Bill pulls Rosy out of the way of a speeding car. Such a causal claim is acceptable, even though there was no physical interaction between Bill and the car. Perhaps even more problematic are causal relations resulting from omissions, as when we say: “Lack of water caused the plant to die.” The acceptability of such a statement cannot be explained by transmission or interaction theories since, plainly, there can be no transmission of conserved quantities from an absence.

Another type of production theory holds that causation is specified in terms of forces (Copley and Harley, Ch. 6, this volume; Talmy 1988; 2000; Gärdenfors 2000; Croft 1991; 2012; Ilić, Ch. 7, this volume; Warglien et al. 2012; Wolff 2007; Ch. 5, this volume). One such theory is Wolff and colleagues’ force dynamic model (Wolff 2007; Wolff et al. 2010). According to this model, causation is specified in terms of configurations of forces that are evaluated with respect to an endstate vector. Different configurations of forces are defined with respect to the patient’s tendency towards the end-state, the concordance of agent’s and patient’s vectors, and the resultant force acting on the patient. These different configurations of forces allow for different categories of causal relations, including the categories of cause-and-prevent relations. In a preventative relationship, there is a force acting on the patient that pushes it towards an end-state, but the patient is then pushed away from the end-state by the force exerted on it by the agent. Philosophers and cognitive scientists have

2.2 Theories of causation 27

argued that transmission theories are unable to explain preventative relationships, as well as the notion of causation by omission. In order to capture these phenomena, it has been argued that theories of causation must go beyond a production view of causation to include, perhaps, counterfactual criteria for causation (e.g. Schaffer 2000; Dowe 2001; Woodward 2007; see also Walsh and Sloman 2011). Interestingly, Talmy's theory of force dynamics and, relatedly, Wolff's dynamics model are able to explain how the notion of prevention can be specified within a production view perspective without having to incorporate distinctions from dependency theories, such as counterfactual criteria. Wolff et al. (2010; see also Wolff, Ch. 5, this volume) also show how a production view of causation is able to handle the phenomenon of causation by omission—a type of causation which, according to several philosophers, is beyond the explanatory scope of production theories (Schaffer 2000; Woodward 2007).

Production theories have several attractive qualities. As already noted, they motivate why the concept of causation is associated with temporal and spatial properties. They also provide relatively simple accounts of people's intuitions about scenarios that are problematic for dependency theories, such as late pre-emption. In the case of late pre-emption, there are two possible causers and one effect. For example, in the Suzy and Billy scenario, Suzy and Billy both throw rocks at a bottle and the bottle breaks, but Suzy's rock hits the bottle first. Intuition says that Suzy's throw caused the bottle to break. This intuition falls out naturally from production theories: in transmission theories, in particular, Suzy is the cause of the breaking because it was from Suzy's rock that conserved quantities were transmitted to the bottle, while in force and power theories, Suzy's throw is the cause because it was from Suzy's rock, not Billy's, that force was imparted upon the bottle.¹⁵

Though production theories have several strengths, they also face several significant challenges. Without further qualification, production theories require that knowing that two objects are causally related entails being able to track the transmission of conserved quantities linking two objects. Such a requirement often does not hold for a wide range of causal relations. For example, common sense tells us that there is a causal relationship between the light switch and the lights in a room, but most of us could not say exactly how conserved quantities are transmitted through this system. As argued by Keil and his colleagues (Rozenblit and Keil 2002; Mills and Keil 2004), people often feel as if they understand how everyday objects operate, but when they are asked to specify these operations, it becomes clear that they have little knowledge of the underlying mechanisms. Keil and his colleagues refer to this phenomenon as the "illusion of explanatory depth". The

¹⁵ As we have seen, Lewis in his later work (e.g. 2000) responds to criticism of his counterfactual approach by proposing that causation must be evaluated not just on whether C and E are true, but on finer properties of the events referred to by C and E. Late pre-emption is accounted for by noting that counterfactually changing the properties of Sally's throw changes the properties of the bottle's breaking, while changing the properties of Billy's throw does not. This interest in finer properties of events, rather than just truth values, is perhaps the closest approach of a dependency theory to the spirit of production theories, though it should be noted that Lewis's 2000 theory still relies on the notion of change rather than the notion of energy.

28 2. *Theories of causation*

illusion of explanatory depth presents production theories with a challenge: how can causal relations be asserted of situations in which the underlying mechanism is not known? Production theory advocates might appeal to people's general knowledge of how things are likely physically connected, but such a move introduces uncertainty into their knowledge of causal relations, and if there is uncertainty, why not simply represent the causal relations in terms of probabilities and relationships between probabilities? Currently, there are no simple answers to such a challenge (but see Wolff and Shepard 2013).

A second major challenge for production theories concerns the problem of how such an approach might be extended to represent abstract causal relations. Production theories are clearly well suited for causal relations in which the quantities being transmitted are grounded in the physical world. For example, production theories seem especially well suited for explaining the acceptability of statements such as *Flood waters caused the levees to break*, or *The sun caused the ice to melt*. Much less clear is how a production theory might represent statements such as *Tax cuts cause economic growth*, or *Emotional insecurity causes inattention*. Obviously, such abstract instances of causation cannot be specified in terms of physical quantities, so how might they be represented? According to some theorists, abstract causation might be represented in a fundamentally different manner than concrete causation. Such a view has been dubbed *causal pluralism* (Psillos 2008; see Kistler, Ch. 4, Wolff, Ch. 5, this volume). Another possibility is that abstract causation might be represented in a manner analogous to physical causation (Lakoff and Johnson 1999; Wolff 2007). While explaining abstract causation in terms of metaphor might be an easy move to make, questions soon arise about such an explanation's testability. As with the problem created by the illusion of explanatory depth, there is currently no simple answer to the challenge raised by abstract causation for production theories (but see Wolff, Ch. 5, this volume, for an attempt).

2.3 Linguistic phenomena to which causation is relevant

Recall that our main purpose in this chapter was to demonstrate that theories of causation are relevant to linguistic theory and vice versa. Having presented the state of research on causation as we see it, we now turn to examine three linguistic domains to which causation is relevant. We will argue that a more sophisticated understanding of different theories of causation has real potential to advance our knowledge of these phenomena, and conversely, that these linguistic analyses, especially those concerning data from less familiar languages, should be taken seriously by philosophers and cognitive scientists working on causation.

The phenomena we will examine are:

Defeasibility: A causal relation has been proposed between a cause and effect in the two sub-events of accomplishments, but in certain environments, such as progressives, non-culminating accomplishments, and frustratives, the effect does not occur.

2.3 Relevance to linguistic phenomena 29

Volition, intention, and agency: Numerous linguistic phenomena seem to distinguish animate agents from inanimate causers. Language thus appears to be sensitive to whether the causing entity is volitional (or intentional) or not, though volitionality seems to not always be quite the right notion; rather, a broader causal notion that subsumes but is not limited to volitionality is called for. We argue that disposition fits the bill.

Representations of causal chains: How conceptual representations of events and participants in causal chains are mapped onto language, both to syntactic event chains and within certain lexical items.

Apart from being of interest in themselves, discussion of these phenomena will allow us to demonstrate several ways in which the choice of causal theory can bear on linguistic theory. For example, one instance of defeasible causation—non-culminating accomplishments—illustrates the heuristic that complex semantics should be adduced only when there is visible morphology in some language. Since different theories of causation predict different parts of causal semantics to be complex, choosing a causal theory whose distribution of complexity matches what is seen in the morphosyntax has the opportunity to greatly simplify the (morpho)syntax–semantics interface. Another example of how causal theory can be of use to linguists is when grammatical evidence suggests that certain concepts are linked, for example volitionality and the ability of inanimate objects to be the external arguments of activities (Folli and Harley 2008). In such cases, using a causal theory that explains the link between these concepts is preferable to one that does not, since it has a better chance of informing the semantic theory. Finally, it is fairly easy to see how causal theory can bear on the question of how conceptual causal chains correspond to the causal chains that are represented in language. In the mapping from conceptual causal structure to semantics, certain phenomena corresponding to components of causal theories are observed at the syntax–semantics interface, and/or the lexicon, while others are not. Ideally, for whichever causal theory is chosen, the components that are observed linguistically should be those that are important to the theory; conversely, nothing important to the causal theory should be completely invisible to language.

Two caveats must be mentioned. First, we are prepared for the possibility that different causal theories may be useful for different linguistic phenomena. This possibility is related to the notion of causal pluralism discussed earlier. However (and this is the second caveat), it should be clear that the study of language's relation to a mental representation of causation by definition has only to do with how causation is represented in the mind, not with the actual nature or metaphysics of causation. To the extent that certain philosophers are concerned with the metaphysics of causation rather than the mental representation of causation, a causal pluralism in language would not bear directly on their findings, although the use

30 2. Theories of causation

of linguistic data by even metaphysically-oriented philosophers suggests that they might do well to pay attention to what linguists find.

2.3.1 *Defeasibility*

The first phenomenon we will examine is that of defeasibility, especially in the case of accomplishment predicates. These have been argued to involve a causal relationship between two eventualities (Pustejovsky 1991; 1995; Giorgi and Pianesi 2001; Kratzer 2005; Ramchand 2008; Higginbotham 2009; see also Thomason, Ch. 3, Ramchand, Ch. 10, and Lyutikova and Tatevosov, Ch. 11, this volume). So, for instance, *Mary build a house* is true, roughly speaking, if Mary is the agent of an event that causes the state of a house existing.

Not everyone treats accomplishments as involving a causal relation. Parsons (1990), building on Bach (1986), uses a part–whole relation between a non-culminated event (e.g. an event of Mary’s building, up to but not including the part where there is a completed house) and a culminated event (an event that includes e.g. the part where there is a completed house). While a *Mary build a house* event holds if the event in question is at least a partial event of Mary’s building a house, it culminates just in case it is a complete event of Mary’s building a house. As Portner (1998) has noted, Parsons has no particular definition of the relation between events of a certain sort that hold and events of the same sort that culminate. That said, recent non-causal treatments of accomplishments (Piñon 2009, e.g.) characterizes such a relation in terms of gradability,¹⁶ relying on the assumption that we intuitively have a sense of the degree to which an event is complete.

Despite the existence of this alternative perspective, however, the idea that accomplishment predicates involve a causal relation has widespread support. This idea is generally represented by causal relation that relates two existentially bound events.

(2) $\exists e_1 \exists e_2 : e_1 \text{ CAUSE } e_2$

However, accomplishments can occur in environments in which the caused event does not occur; these are the cases of “defeasible” causation. The particular theory of causation one chooses will have consequences for one’s linguistic theory of these phenomena. The reason why is because some theories of causation are “result-entailing”—i.e. they assume that the caused event occurs—whereas other, “non-result-entailing” theories lack this assumption. As we will see, defeasible environments suggest that it might be best that one’s theory of causation be non-result-entailing.

Cross-linguistically, there are a number of expressions which include accomplishment predicates but which do not entail the final result.¹⁷ If there is indeed a causal

¹⁶ Koenig and Chief (2008) also use gradability to account for non-culminating accomplishments. However, they retain the notion of causation.

¹⁷ Sometimes the “accomplishments” are predicates that are normally considered achievements; we follow existing practice in calling all cases “non-culminating accomplishments”.

2.3 Relevance to linguistic phenomena 31

relation in accomplishments, this may be surprising, since there is a causal connection and yet the final caused event is not actualized. The simplest case of these is non-culminating accomplishments, as in the examples below.¹⁸ The assertion in such expressions is that something has been done that would normally be expected to cause the effect. Thus culmination is implicated but not entailed. Most typical are cases where the non-culminating case is expressed with an ordinary verb form, where the culminating case expressed by a morpheme meaning something like ‘finish’, with or without the (non-culminating) verb, as is shown in (3) and (4):

- (3) a. *Watashi-wa keeki-o tabeta dakedo keeki-wa mada nokotteiru.*
 I-TOP cake-ACC ate-PERF but cake-TOP still remains
 ‘I ate the cake but some of it still remains.’
- b. **Watashi-wa keeki-o tabeteshimatta dakedo keeki-wa mada nokotteiru.*
 I-TOP cake-ACC eat-finish-PERF but cake-TOP still remains
 ‘I ate the cake but some of it still remains.’
- (Japanese; Singh 1998: 173–4)

- (4) *Wo gai le xin fangzi, fangzi hai mei gai-wan.*
 I build PERF new house house still not build-finish
 ‘I built a new house, but it is still not finished.’
- (Mandarin; Koenig and Chief 2008: 242)

The ‘finish’ verb can often be used as a main verb to express culmination:¹⁹

- (5) a. *K’ul’-ún’-lhkan ti ts’lá7-a,*
 make-DIR-1SG.SU DET basket-DET
t’u7 aoy t’u7 kw tsukw-s.
 but NEG just DET finish-3POSS
 ‘I made the basket, but it didn’t get finished.’ (St’át’imcets)
- b. *Kw John na kw’el-nt-as ta skawts*
 DET John RL COOK-DIR-3ERG DET potato
welh haw k-as 7i huy-nexw-as.
 CONJ NEG IRR-3CONJ PART finish-LC-3ERG
 ‘John cooked a potato but never finished.’ (Skwxwú7mesh)
- (Bar-el et al. 2005: 90)

¹⁸ Note that the non-culminating accomplishments are not progressives, or imperfectives; see Bar-el et al. (2005).

¹⁹ See also Zucchi et al. (2010) for an account of FATTO/FINISH in *Lingua dei Segni Italiana* and American Sign Language as completion markers.

32 2. Theories of causation

- (6) Kerim ešik-ni ac-xan-di, alaj boša-ma-~~van~~-di.
 Kerim door-ACC open-PERF-3SG but finish-NEG-PERF-3SG
 (Context: The lock is broken and Kerim tries to open the door.)
 Lit. ‘Kerim opened the door, but he did not succeed.’
 (Karachay–Balkar; Tatevosov 2008: 396)

Verbs other than ‘finish’ are sometimes also used to signal culmination, such as a verb meaning “take” in Hindi:

- (7) a. Māē ne aaj apnaa kek khaayaa aur baakii kal khaaūūgaa.
 I ERG today mine cake eat-PERF and remaining tomorrow eat-FUT
 ‘I ate my cake today and I will eat the remaining part tomorrow.’
 b. *Māē ne kek khaa liyaa, jo bacaa hae wo raam khaayegaa.
 I ERG cake eat take-PERF what remain is that RAM eat-FUT
 ‘I ate the cake and Ram will eat the rest.’
 (Hindi; Singh 1998: 173–4)

In all these examples, the non-culminating form may not be as morphologically marked as the culminating form (as in (3) and (7)). Something is added to the non-culminating form to get the culminating form. Mandarin (as in (4)), and certain Austronesian cases (Tagalog and Malagasy) discussed by Dell (1987) and Travis (2000), seem to be a counterexample to this generalization. Tagalog, for instance, distinguishes between a neutral (N) form, which does not entail culmination, and an abilitative (A) form, which does:

- (8) Inalis ko ang mantas, pero naubusan
 N-PERF-remove GEN-I NOM stain, but run-out-of
 ako kaagad ng sabon, kaya hindi ko naalis.
 NOM-I rapidly GEN soap hence NEG GEN-I A-PERF-remove
 ‘I tried to remove (lit. ‘I removed’) the stain, but I ran out of soap, and couldn’t.’
 (Tagalog; Dell 1987: 186)

In these Austronesian cases, the culminating and non-culminating forms are both (differently) morphologically marked. The appropriate generalization thus seems to be that the culminating cases are at least as morphologically complex as the non-culminating cases, and very often more so.

A non-morphologically-marked alternation between culminating and non-culminating readings of accomplishments can also show up with certain lexical items which can have either culminated readings (as for *warn* in (9a), where an unsuccessful warning is described via the addition of *try*) or non-culminated readings (as for *warn* in (9b), where *try* is not used to describe an unsuccessful warning):

- (9) a. I tried to warn him, but he didn’t listen.
 b. I warned him, but he didn’t listen.

2.3 Relevance to linguistic phenomena 33

Defeasibility also arises for accomplishments in combination with certain morphemes that seem to carry additional meaning, notably frustrative morphemes, as in (10) and progressives (as has long been noted; see e.g. Dowty 1979).

- (10) Huan 'o cem kukpi'ok g pualt.
 Juan aux-IMPF FRUS open DET door
 'Juan *cem* opened the door.'
 = 'Juan pulled on the door but failed to open it.'
 (Tohono O'odham; Copley 2005a; Copley and Harley, Ch. 6, this volume)
- (11) Mary was building a house, but then she had to leave the country, so the house was never finished.

If we still want to maintain that cross-linguistically there is a causal relation in accomplishments and a causal relation requires the caused event to occur (i.e. the caused event argument is existentially bound), such cases of defeasibility are problematic, because in these cases a causal relation is supposed to hold, despite the non-occurrence of the final event.

Dowty's (1979) solution to this problem with respect to the progressive was to say that in these cases, the caused event occurs only on certain possible "inertia" worlds—the worlds where events proceed normally or stereotypically. This kind of approach has also been adopted for non-culminating accomplishments by Matthewson (2004), Tatevosov (2008), and Martin and Schäfer (2012). Using this solution, both the causation relation in accomplishments and the insistence that the caused event occurs (the existential quantification on the caused event) can be maintained. This solution comes at the cost, however, of additional semantic machinery for which there is cross-linguistically little or no morphological support; as we have seen, languages with both culminating and non-culminating forms of predicates do not mark the culminating forms with more morphology than the non-culminating forms, so it is odd that the non-culminating forms would involve so much extra meaning. Furthermore, as Martin and Schäfer (2012) point out for their data, there is no evidence that such modals take scope over other modals, which would also tend to indicate that they are not visible to the logical form *per se*.²⁰

Dowty (1979) uses a result-entailing theory, a version of Lewis's (1973) counterfactual theory of causation. Though we are used to expressing Lewis's counterfactual condition as a mere conditional—if C had not occurred, E would not have occurred—in fact the converse is also asserted: if C had occurred, E would have occurred. Causal dependency of E on C thus requires that E occur, since there is no way to simultaneously have E not occur on the actual world, and at the same time for the causal dependency biconditional to be true, i.e. for some C-world where E occurs to

²⁰ Note however that if the inertia world possibilities were not represented in the semantics, but somewhere else, e.g. in a conceptual model inaccessible to (morpho)syntax, neither of these problems would arise.

34 2. *Theories of causation*

be closer to the actual world than any C-world where E does not occur (“Our actual world should be closest to actuality, resembling itself more than any other world resembles it”: Lewis 1973: 560). Stepwise dependency does not improve matters. So Dowty was right to see that Lewis’s theory did not sit easily with defeasibility.

Other result-entailing theories are equally problematic. For instance, logical dependency theories that define causation in terms of necessity and sufficiency (e.g. Sosa and Tooley 1993) also require the caused event to occur. Under the view that a cause is a sufficient condition for an effect, the occurrence of the effect is guaranteed in the presence of a cause. However, if actuality is dropped, assessing sufficiency becomes difficult. For example, if a cause occurs and the effect does not, this presumably should count as evidence against the sufficiency of the cause, and hence as evidence against there being a causal relation, assuming causation is based on sufficiency. Structural equation theories can be instantiated with probabilities, in which case (as we will see just below) they inherit the benefits of probability relationships, and do not entail actuality of the caused event. However, if the values are limited to truth values, as in the model we discussed earlier, then the dependencies used to check for the causal relation are logical necessity and sufficiency. But it is difficult to model defeasible causation in terms of logical necessity and sufficiency, as we have seen. Certain production theories, such as Kistler’s (2006a) transference theory, are also result-entailing. In this theory, causation is defined as a transference of a conserved quality from the cause to the effect. If the effect does not occur, there can be no transference on conserved quantities.²¹

We may provisionally conclude that, if the idea that there is a causal relation in accomplishments is to be maintained, while still being faithful to the morphosyntactic facts, it is better to choose a theory of causation in which the effect is not required to be actual, i.e. a non-result-entailing theory. Two kinds of causal theory fit the bill: probability theories and certain production theories. To use either one of these in a semantic theory of non-culminating accomplishments, a technical innovation (different in either case) is required to ensure that the effect does not occur.

One approach to specifying defeasible causation would be in terms of probability raising, which allows for exceptions to sufficiency and necessity. As we have seen, probability-raising theories would say that C (the occurrence of e_1) causes E (the occurrence of e_2) iff $P(E | C) > P(E | \sim C)$: the probability of E occurring is greater if C occurs than if C doesn’t occur. In such probability statements there is no existence or occurrence asserted of the caused event E, but just the assertion that the frequency of a certain kind of event is higher in the presence of another kind of event. This seems to indicate that a probability-based theory should make use of event kind arguments (Gehrke 2012), as individual events do not have frequencies; only kinds of events do. The use of event kind arguments is equally helpful with the technical issue

²¹ However, as we will see next, Kistler’s theory may offer a solution to this problem.

2.3 Relevance to linguistic phenomena 35

of ensuring that e_2 does not necessarily occur, as an event kind argument does not refer to an actually occurring event, even when it is existentially bound.²²

We might then say that if the probability statement, using event kinds, is true, one can assert the non-culminating predicate with an individual event argument as the causing event and an event kind argument as the caused event. Using ‘O’ in the spirit of Lewis’s “occur” typeshifting predicate to turn events into propositions, so that we can use negation, we might write the following. On the left-hand side, c is an individual event, because neither culminating nor non-culminating accomplishments predicate something of kinds. The caused event is either an event kind, as in (12a), reflecting a non-culminating causal relation or an individual event as in (12b), reflecting a culminating causal relation. The definition given on the right-hand side is the same in either case.

- (12) $O(e_k) = 1$ iff there is an eventuality e such that e realizes e_k
- a. for any eventuality c and eventuality kinds c_k and e_k where c realizes c_k :
 $c \text{ cause}_{\text{non-culminating}} e_k$ iff $P(O(e_k) \mid O(c_k)) > P(O(e_k) \mid \sim O(c_k))$
 - b. for any eventualities c, e , and eventuality kinds c_k and e_k where c realizes c_k and e realizes e_k :
 $c \text{ cause}_{\text{culminating}} e$ iff $P(O(e_k) \mid O(c_k)) > P(O(e_k) \mid \sim O(c_k))$

This solution does not seem to predict, as we might wish, that the culminating case is cross-linguistically the more morphologically marked case, but in any case it is not incompatible with the morphological facts.

Probability theories of causation are useful here because they are non-result-entailing. Another way out of the actuality requirement on the caused event is to adopt a production theory of causation that is non-result-entailing.²³ If we define causation in terms of forces, such an account offers us a possible explanation for what accomplishment predicates might denote, whether they culminate or not. That is, they might refer to force interactions. Forces can be imparted with the occurrence of an effect, such as when a person kicks a tire or slaps a table; or when another stronger force opposes it, as when you hold an object, opposing a gravitational force. Whether there is a result or not is an entirely different matter. The non-culminating

²² The idea of treating defeasible causation in terms of event kinds is due to Berit Gehrke (p.c.); the particular implementation in terms of probability raising is ours.

²³ Yet another way out of the actuality requirement on the result event is to change the relation—a tactic we have already used in our appeal to event kind arguments. Instead of using events, or event kinds, one could also take accomplishments to involve inferential relations between propositions, as Asher (1992) and Glasbey (1996) have proposed for the progressive. The inferential relation is in effect a defeasible causal relation between propositions rather than events. The inferred proposition, i.e. the proposition that the result event occurs, which is caused to be defeasibly inferred when the speaker learns that the proposition that the causing event occurs, does not require existential binding, as it is a proposition and not an event. Such a solution is also offered by Thomason in the last part of Ch. 3, this volume. But note the similarity to production theories, with information playing the role of force; both are naturally understood as having effects that are defeasible in the presence of perturbing influences (i.e. information to the contrary).

36 2. *Theories of causation*

cases are thus seen as semantically more basic than the culminating cases, which is also morphologically desirable, as we have seen.

Another advantage to production theories is that they make more sense of accomplishment predicates in which the causal relation is less plausible. It is arguably odd to say that *Mary walked to the store* is analyzed as one in which Mary's walking event *causes* a state of her being at the store. However, it is unobjectionable to say that the force, or effort, expended by Mary in walking *resulted in* her being at the store. This is possible with production theories because they are not only theories of intuitions about the word *cause*, but about our intuitions about forces (or energy, etc.) and their results. Note that this point represents a retreat from the idea that accomplishments involve a causal relation in the narrow sense. This retreat provides no aid to result-entailing theories, however. The reason is because in these theories, causation is defined in terms of the occurrence and non-occurrence of the result. If you peel away the occurrence of the outcome, very little or nothing is left in the case of result-entailing dependency theories such as Lewis (1973). In contrast, in the case of production theories, if the outcome does not occur, there can still be a very specific kind of relationship referred to by the accomplishment predicate. According to force theories, that relationship would be a specific pattern of forces or force interaction. In terms of transmission theories, if the outcome is removed, there can still be the occurrence of a transmission because there can be the transmission of a conserved quantity (e.g. momentum, energy) without the occurrence of a (noticeable) result. According to Kistler, causation entails the occurrence of a result. Kistler would therefore not view non-culminating accomplishments as instances of causation; however, his account would be able to represent non-culminating accomplishments using some other kind of transmission relation besides causation.

As far as semantic theory is concerned, the use of forces or energy transmission is *prima facie* problematic if Davidson's (1967) event arguments are to be maintained. However, Copley and Harley (to appear; Ch. 6, this volume) have integrated force-dynamic theory into the syntax-semantic interface by treating the Davidsonian argument as a force, where such arguments formally have the meaning of functions from situations to situations. This move also provides a solution to the technical problem of the non-actuality of the caused eventuality, as the output of a function does not need to be existentially bound.²⁴

We have seen that if we want to maintain a causal relation as a component of accomplishments, we must ask whether and how our conception of causation accounts for cases of defeasibility. Although many theories of causation have no

²⁴ And thus its referent need not (be asserted to) occur. On the other hand, why some cases are culminating and others are non-culminating must still be accounted for. A situation kind argument could be employed, or the assumption that the situation is all the speaker need consider (equivalent to the assumption that the modal base is totally realistic, the "closed world" assumption, or Copley and Harley's (to appear; Ch. 6) efficacy presupposition; such assumptions would correspond to the "finish" morphology).

2.3 Relevance to linguistic phenomena 37

easy way to address this question, the use of one of the theories that does—probabilities with event kinds or force dynamic theories—should be of use to linguists studying this phenomenon. Likewise, philosophers would be well advised to pay attention to the existence of non-culminating accomplishments and their treatment in linguistic theories.

2.3.2 Understanding agency through dispositions

We have addressed how theories of causation may apply to apparent cases of defeasibility. Researchers should also consider how different theories of causation might apply to agency and related notions. Languages are sensitive to a collection of concepts related to agency that seem particular to—or at least prototypical of—humans, including animacy or sentience (Dowty 1991; Ritter and Rosen 2010), and volitionality, which for our purposes we will consider equivalent to intentionality, though that may not be precisely the case.

The notion of volitionality has played a significant role in linguists' understanding of the syntax–semantics interface, especially through the related notion of agency (see, e.g. Duffield, Ch. 12, this volume). Intention is another similar concept. The precise way in which grammar interacts with these concepts is, however, still the subject of very active discussion. Recent theories have proposed that, although there are numerous cases where volitionality seems to be a distinguishing factor, volitionality is not the concept that the grammar is sensitive to in these cases; rather, it is sensitive to properties of the causal structure being referred to. This idea suggests that the notion of disposition—a notion that has links to causation—is relevant. Our point here is that a wider appreciation of existing theories of causation could be very helpful to understanding these issues.

2.3.2.1 Volitionality is not always the right notion While certain kinds of linguistic data are sensitive to whether the subject is volitional (or intentional, but we will largely not distinguish these notions in this chapter), it is not always clear whether this sensitivity reflects a real grammatical distinction or an epiphenomenon. Some of the clearer cases are those in which there is a strict selection of either animate, volitional agents (as in lexical cases such as *murder*) or (possibly) inanimate, non-volitional causers, as in *from* phrases. The latter seem to denote the cause of an event, as in (13). Only non-volitional entities are acceptable as complements of *from*; volitionally acting entities, as in (14), are unacceptable (see Piñon 2001a; 2001b; Kallulli 2006; Alexiadou et al. 2006; Copley and Harley, to appear):

- (13) a. The window broke from the pressure/the rock.
 b. The door opened from the wind.
 c. The floor collapsed from the elephant's weight.
 d. He got sick from pneumonia.
 e. The sidewalk is warm from the sun.

38 2. Theories of causation

- (14) a. *The window broke from Mary.
 b. *The door opened from the man.
 c. *The floor collapsed from the elephant.

However, it is not always clear whether grammars always “see” volitionality per se or whether something that looks like a volitionality requirement is actually a case where language refers to a certain kind of causal structure, of which volitionality is just one example (albeit the most prototypical one). This seems to be the case in many phenomena which appear at first to distinguish animate, volitional agents from possibly inanimate, non-volitional causers, but which upon closer inspection do not make such a clear distinction.

Thomason (Ch. 3, this volume) reaches such a conclusion on the basis of considerations of how conceptual causal structures map to our intuitions about subjects. Likewise, a similar consensus has been reached in the literature on argument structure. For instance, Folli and Harley (2008) argue that while agents are prototypically animate and volitional, in certain cases inanimate entities behave like agents as well. The subjects of unergatives such as verbs of sound emission like *whistle* are without question agents rather than themes, as shown, for example, by the fact that they pass the *V x-self Adj* test (Chierchia 1989; 2004; Levin and Rappaport Hovav 1995), as in (15). The agent of *whistle* can be an inanimate, non-volitional entity, as in (16a). Notably, however, certain inanimate entities require an extra phrase such as *into the room* in order to serve as the agent for a verb like *whistle*, as demonstrated in (16b) (Levin and Rappaport Hovav 1995).

- (15) a. John whistled himself silly.
 b. *John fell himself silly.
- (16) a. The teakettle whistled.
 b. The bullet whistled *(into the room).

Folli and Harley attribute the contrast in (16) to the difference between the teakettle’s causal properties and the bullet’s causal properties. “Agents, then, are entities which can produce particular events by themselves: they are sufficient on their own to initiate and carry out the entire event denoted by the predicate” (Folli and Harley 2008: 192). The teakettle can initiate and carry out the whistling event on its own, while the bullet can only do so if it is in motion (hence the need for a path-denoting prepositional phrase). They conclude that agency is sensitive not to animacy or volitionality, but to a more fundamental property termed by Higginbotham (1997) *teleological capability*: “the inherent qualities and abilities of the entity to participate in the eventuality denoted by the predicate”.

Latrouite (Ch. 14, this volume) proposes a similar but more permissive causal condition for voice selection in Tagalog. Subjects in Tagalog, as in other Austronesian languages, are not prototypically agents; the question of which argument is realized as the subject is a complex one and as yet no consensus exists. Latrouite argues that subjects in Tagalog are *event-structurally prominent*: that is, a subject

2.3 Relevance to linguistic phenomena 39

must be an argument that is crucial for the event because it delimits the run time, either because it is an agent and can volitionally decide the course of the event up to the endpoint, or because it is not an agent, but otherwise causally determines the endpoint of the event.

In a similar vein, Sichel (2010) observes that certain English nominalizations of non-alternating lexical causatives, unlike their corresponding verbal forms, apparently require *direct participation* of their subject in the event. This is demonstrated by the fact that although the verbal form in (17a) is felicitous with *the results* as the subject, the nominalized version in (17b) is not. *The expert* is felicitous, as in (17c), but this is apparently not because of its animacy or volitionality, because *the sun* can appear as the subject of the nominalization *illumination*. Sichel argues that the difference between (17b) and (17d) is that the results do not directly by themselves verify the diagnosis (though an expert does) while the sun does directly illuminate the room.

- (17) a. The results/the expert verified the initial diagnosis.
 b. #The results' verification of the initial diagnosis.
 c. The expert's verification of the initial diagnosis.
 d. The sun's illumination of the room.

Alexiadou et al. (2013) who investigate this phenomenon in English, German, Greek, Romanian, Spanish, French, Hebrew, and Jacaltec, provide further support for the idea that volitionality is not responsible for the effect, even though there is a great deal of variation among constructions and across languages.

Another causal property that is more general than volition is the ability to have *direct causation of a temporally distant effect*. Copley (2014) argues that (18a), which lacks future marking, is acceptable in English ultimately because a volition today for the Red Sox to play the Yankees is asserted to directly cause them to do so tomorrow, and volitions can directly cause temporally distant effects. No volition is plausible that would make (18b) similarly felicitous. Copley argues that cases such as (18c) and (18d) also involve current properties of the subject that have temporally distant direct effects, though no volition is involved.

- (18) a. The Red Sox play the Yankees tomorrow.
 b. #Mary gets sick tomorrow.
 c. The sun rises at 5 tomorrow.
 d. The hurricane arrives tomorrow.

Like the ability to be the agent of an activity, then, event-structural prominence, direct participation, and direct causation of a temporally distant effect are conditions that make no reference to animacy or volition, but rather to causal properties of the entity.

Many of the above examples make reference to lexical causatives; analytical causative facts also suggest that volitionality is often not quite the right notion. For example, Ramchand (Ch. 10, this volume) relates an apparent volitionality requirement in certain Hindi analytic causatives to the lexicalization of both the

40 2. Theories of causation

“initiation” and “process” subevents—again, a causal notion rather than volitional-ity. We can also add English *have* causatives as in (19) (Dowty 1979; Ritter and Rosen 1993; Copley and Harley 2009; 2010). *Have* causatives have been claimed to permit only subjects with volitional control (Ritter and Rosen 1993), but inanimate causers are possible too, as in (19b)—as long as the caused eventuality is a stage-level stative, e.g. *laughing* instead of *laugh*, in this case.²⁵

- (19) a. Mary had Sue laugh/laughing.
b. The book had Sue *laugh/laughing.

Again, such examples suggest that the grammar cares about a causal property which can be exemplified by volition, but is not limited to it.

2.3.2.2 *Implications for the kind of volitionality involved in agency* The above discussion suggests that linguists would benefit from making use of theories of causation in which these notions such as teleological capability and direct causation or participation can be easily explained. In other words, what is needed is a theory of causation that ensures that volitional causing entities and certain non-volitional causing entities are treated similarly. In part this will require us to rethink what volition is in the context of agency. For instance, Folli and Harley propose that the requirement for agents is not volition, but is rather teleological capability, the “inherent qualities” that are among the causing conditions causing an entity to participate in an event. Volition might be thought of as one of these qualities, and its analysis should therefore be similar to the analysis of other such qualities in relevant ways.

Volition has been studied in the context of the main verb *want*, which probably does not have the same meaning as volition in the context of agency—indeed, unlike agency, (standard) English *want* really does require animacy—but which is a good place to start. Heim’s influential 1992 account presents a denotation which is squarely in the counterfactual tradition of Lewis (1973), via Stalnaker’s (1968) extension of Lewis’s theory to non-counterfactual conditionals:

- (20) ‘ α wants φ ’ is true in w iff: for every $w' \in \text{Dox}_\alpha(w)$:
Every φ -world maximally similar to w' is more desirable to α in w than any non- φ - world maximally similar to w' .

²⁵ Another reason why *have* causatives make us think that a better notion of causation would be useful is the fact, originally pointed out by Ritter and Rosen (1993) that a sentence such as *Mary had Sue laughing* has a special “director’s” reading. The sense in which Mary is a “director” is in that Mary must have near-omnipotent power over Sue: she is either the director of a play that Sue is in, or an author writing about Sue and choosing what she will do in a scene, etc. The particular oddness of the director’s reading ought equally to stem from some peculiarity of the causal relationship between the subject and the caused eventuality; Copley and Harley (2009; 2010) suggest that the director’s reading occurs when the director’s volition directly causes the eventuality.

2.3 Relevance to linguistic phenomena 41

The idea is that a wantor considers only the worlds they believe to be possible; “ α wants φ ” holds if and only if, among the worlds that are maximally similar to the belief worlds, the φ -worlds are all preferable to the non- φ -worlds. Wanting is thus explained in terms of belief and desirability, i.e. preference (see also Egré, Ch. 8, this volume).

Such a denotation cannot obviously be extended to describe teleological capability. The teakettle does not whistle due to any beliefs or preferences. Now, it is not likely that we will be able to entirely elide the reference to the animate agent’s beliefs, as the ability to hold beliefs is a significant difference between animate and inanimate entities.²⁶ But regardless, there are apparently also similarities between animate and (certain) inanimate entities in terms of their causal abilities. It would therefore be desirable to replace preference with a property that is more conducive to understanding how the grammar can sometimes see physical causing properties in the same way it sees volition.

An alternative way of defining *want* has been explored not only by Lewis (1986b) but also by Stalnaker (1978), Portner (1997), and Condoravdi and Lauer (2009). This alternative way of defining *want* treats desire as a disposition instead of a preference: i.e. roughly, as a state of readiness, or tendency to act in a specific way. The general idea is that wanting p is a property (a state, since dispositions are states) that holds if, should the circumstances be right, the entity would act to bring p about. Consider one dispositional definition of volition in (21), taken from Portner’s (1997) discussion of exactly this issue; note that belief is still a part of this definition, through the wantor α ’s doxastic worlds $\text{Dox}_\alpha(b)$.

(21) Portner (1997)

- For any wanting situation s of α and belief state b of α , $\text{want}_{\alpha, b}(s) =$
the set of plans which would satisfy α ’s desire in s , relative to his or her
beliefs in $b = \{s'$:
- a. for some $w \in \text{Dox}_\alpha(b)$, $s' \leq w$, and
 - b. s' begins with a dispositional counterpart s'' of s ,
 - c. α acts in s' in ways which tend, given $\text{Dox}_\alpha(b)$, to bring it about that s''
develops into s' , and
 - d. α is disposed in s to act in those ways}

Both (20) and (21) are, as far as we know, perfectly reasonable characterizations of volition. The fundamental difference between them is that the preference denotation in (20) explains wanting in terms of preference, whereas the dispositional denotation in (21) explains wanting in terms of disposition to act. Inanimate entities, as well as animate ones, have dispositions. We would not generally call their dispositions “dispositions to

²⁶ Although the beliefs might be understood as another causal property.

42 2. *Theories of causation*

act”, but it is not a stretch to call them “dispositions to cause”, and this perspective could equally apply to the animate entities. Thus, unlike the preference definition, the dispositional denotation immediately suggests a commonality between a volitional entity and a non-volitional but teleologically capable entity.²⁷

We can say, then, that there are two kinds of disposition: psychological (of which we are concerned with one, namely volition) and physical (non-volitional teleological capabilities). Apparent volitionality requirements in language often are dispositionality requirements instead. But here a problem seems to arise regarding intensionality.²⁸

A widely-accepted thesis attributed to Franz Brentano (1874) holds that intensionality distinguishes psychological from physical phenomena: only psychological phenomena are intensional. Volition, for instance, is clearly intensional, according to several non-controversial criteria for intensionality (Place, 1996; Molnar 2003), including: (i) directedness towards something, e.g. the directedness of a desire toward the propositional content of the desire; (ii) the fact that an intensional object may be either existent or nonexistent, e.g. John may want a unicorn although no unicorns exist; and (iii) referential opacity, the fact that co-referring expressions are not substitutable, e.g. just because Mary wants to see the morning star does not mean she wants to see the evening star. If physical dispositions are analogous to volitions, they should be intensional too, contra Brentano’s thesis. And in fact this is what Place argues, that “inten[s]ionality is the mark, not of the mental, but of the dispositional” (Place 1996: 91). Namely, (i) dispositions are directed toward their proper manifestation; (ii) dispositions exist whether or not their manifestations exist; and (iii) they provoke referential opacity, as shown by the fact that *Acid has the power to turn this piece of litmus paper red* does not entail that *Acid has the power to turn this piece of litmus paper the colour of Post Office pillar boxes* (Molnar 2003: 64).

The idea of physical intensionality is controversial, and previous arguments for it have been challenged on various grounds, the strongest perhaps being that the criteria for them such as (iii) are themselves linguistic, i.e. in the mind (Crane 1999). In Mumford’s introduction to Molnar (2003), he points out that criteria (i) and (ii) are not in the mind, though from a linguistic perspective it would not matter if they were; if dispositions are in the mind we do not care, as long as they are intensional. This point suggests that we are on firm ground: the intensionality of volition is no barrier to understanding non-volitional teleological capabilities as (intensional) dispositions. A dispositional definition of volition can and (given the

²⁷ It is intriguing to speculate about whether psychological research methods might bear on the question, by distinguishing preference vs. disposition to act a certain way.

²⁸ *Intensionality*, often (though not always) spelled with an “s”, refers to a kind of meaning that e.g. distinguishes *the morning star* from *the evening star* even though both expressions refer to the same object. Intentions (with a “t”) and beliefs are examples of intensions. Some characterizing properties of intentions are given just below in the text.

2.3 Relevance to linguistic phenomena 43

linguistic data) should be used to characterize the volition that is relevant to agency, and apparent volitional requirements can and should be analyzed in terms of dispositionality.

2.3.2.3 Intentions, like volitions, can be seen in two ways Shortly we will ask how the theories of causation can be used to address dispositions, so that we can determine how they account for volitionality. First, however, we will make a small digression. We said at the beginning of this section that we were going to treat volitions and intentions as essentially the same. And in fact, experimental evidence relating to intentions mirrors the two forms of volition that have been proposed. Recent experimental work has demonstrated an intriguing connection between an action's intentionality and the goodness or badness of an outcome brought about by that action. The connection between intentionality and good and badness can be illustrated by scenarios in which an actor moves forward with a plan that brings about either a bad or good side-effect. A scenario in which the side-effect is bad is shown below (see Knobe 2003b):

- (22) The vice-president of a company went to the chairman of the board and said, "We are thinking of starting a new program. It will help us increase profits, but it will also harm the environment."

The chairman of the board answered, "I don't care at all about harming the environment. I just want to make as much profit as I can. Let's start the new program." They started the new program. Sure enough, the environment was harmed.

After reading the above scenario, Knobe (2003b) asked participants: "Did the chairman intentionally harm the environment?" Knobe (2003a) found that 82% of the participants respond that the chairman intentionally harmed the environment. A very different result was found when the side-effect was described as good. When the scenario was changed so that the business plan not only made a profit but also helped the environment, only 23% of the participants felt that the chairman intentionally helped the environment (Knobe 2003a). The basic finding has been replicated by a number of researchers across a wide range of scenarios (Shepard and Wolff 2013; Sloman et al. 2012; Knobe 2010). The only outward difference between the bad and good side-effect scenarios was the badness of the side-effect. According to Knobe (2003b; 2006; 2010), difference in intentionality are driven by differences in badness, but a number of other explanations have been offered. One general class of alternative explanation holds that the asymmetry observed in Knobe (2003b) is due to differences in causal structure (Shepard and Wolff 2013; Sloman et al. 2012; Nanay 2010).

Shepard and Wolff (2013) have found that when Knobe's scenarios are changed to include unjust laws in which there is greater pressure (a production theory notion)

44 2. *Theories of causation*

against doing a good than bad thing, the alignment between badness and intentionality flips: participants are more willing to say that doing a good thing is more intentional than doing a bad thing, but the relationship between intentionality and causal structure remains the same (Shepard and Wolff 2013). Relatedly, Nanay (2010) notes that the good and bad scenarios used in Knobe's research are associated with a difference in counterfactual dependency: if the chairman had not ignored the environmental ramifications of harming the environment, he might not have made the same decision, whereas if the chairman had not ignored the environmental ramifications of helping the environment, his decisions would probably have been the same.

Note how these three explanations mirror what we have already seen for volitionality in section 2.3.2.2. Volitionality can be thought of in terms of preference (i.e. goodness/badness), like Knobe's theory; cf. Heim's (1992) denotation for *want*. Alternatively, volitionality can be thought of in terms of dispositionality to act, as per Portner (1998). Note too that with a dispositional view, as with volitions, intentions can either be seen in terms of counterfactuals like Nanay's account, or in terms of tendencies, like Shepard and Wolff's account.²⁹

To summarize: we have seen evidence so far that both volitionality and intentionality can be viewed either in terms of preferences or dispositions. If they are viewed in terms of dispositions, this makes it easier to understand why neither volitionality nor intentionality is exactly the right notion for the data discussed in section 2.3.2.1. These data presented a number of cases where an entity is very nearly, but not quite, required to be volitional; a constrained set of non-volitional entities is possible. Since non-volitional entities can have dispositions but not preferences, it makes sense to think of these data as requiring a certain kind of disposition, of which volition is but one example. The last goal of this section is therefore to address how different causal theories treat dispositions.

2.3.2.4 *How different causal theories fare on dispositional explanations for volition*

This section is interested in how causal theories can help us to understand volition in language, especially in the case of agency. We have argued that, at least in the case of agency, a dispositional view of volition is more successful than a preference view of

²⁹ Just as Knobe's work is useful for linguists, linguistic theory about intentionality can be useful to philosophers asking Knobe-type questions. Egré (Ch. 8), for instance, takes up a linguistic property (gradability) and applies it to the notion of intention. He argues that Knobe contrasts can be explained by the proposal that agents have degrees of intentionality, where intentionality is further broken down into properties of foreknowledge and desire (cf. again Heim's 1992 denotation of *want*). This is partly based on Tannenbaum et al.'s (2007) finding that the fact that an action was done *intentionally* does not necessarily entail that the agent *had an intention* for the outcome.

2.3 Relevance to linguistic phenomena 45

volition. We now therefore consider how causal theories bear on the representation of dispositions.³⁰

As we have seen, dispositions are states, but—as is evident for the state of wanting—they are states for which certain future possibilities are somehow relevant. The idea is to provide an essentially causal analysis of the relationship between the disposition state and the occurrence that is sometimes—but not always—caused by the disposition.³¹

Note that this means that dispositions are cases of defeasible causation. Since we are analyzing volition in terms of dispositions, this would suggest that all volitional cases should be defeasible.³² On the other hand, since not all dispositions are volitions, we would expect to see cases of defeasible causation occurring with certain non-volitional cases involving physical dispositions. This is exactly what we see. The presence of a volitional agent seems, on the one hand, to sometimes be linked to the defeasibility of the occurrence of the caused event (Demirdache and Martin 2013). For instance, non-culminating accomplishment readings, for instance, seem at first glance to occur only with animate agents, in the French examples below (Martin and Schäfer 2012; 2013):

- (23) a. Pierre l'a provoquée, mais elle n'a même pas réalisé.
 Pierre her-has provoked, but she NEG-has even not realized
 'Pierre provoked her, but she didn't even realize.'
- b. La remarque l'a provoquée, #mais elle n'a même pas réalisé.
 The remark her-has provoked, but she NEG-has even not realized
 'The remark provoked her, but she didn't even realize.'

Similar generalizations have been noticed for Tagalog (Dell 1987) and Skwxwú7-mesh (Jacobs 2011). However, Martin and Schäfer point out that certain cases do allow inanimate (i.e. necessarily non-volitional) causers to have defeasibility:

- (24) a. Cette situation leur a montré le problème, #mais ils ne l'ont pas vu.
 This situation them has showed the problem but they NEG it-have not seen
 'This situation showed them the problem, but they didn't see it.'

³⁰ We are not going to do justice to the large literature on disposition in philosophy, although, like causation, this is a topic where linguists and philosophers could learn from each other.

³¹ There is not even consensus on whether causation is relevant to dispositions (Choi and Fara 2012). For our linguistic purposes we assume that they are, based on two premises: the fact, discussed above, that linguistic data requires volition in agents to have a similar account as causal properties of certain inanimate causers; and the plausibility of a dispositional analysis of volition in this context.

³² We should qualify this statement: actually (departing from our assumption that intention and volition are the same), there is a linguistic approach whereby we might view intentions as "total", or "net" volitions, i.e. taking all volitions and all circumstances into account, which means that intentions *do* entail the effect. See Condoravdi and Lauer (2009), Lauer and Condoravdi (2011), Copley (2012). Though, even with intention, some cases are defeasible (Martin and Schäfer 2012). If one *intentionally* performs an action, that action must occur, while if one *intends* to perform the action, that action does not have to occur. See also the previous footnote.

46 2. Theories of causation

- b. Clairement, cette situation leur a bel et bien montré le problème! C'est fou qu'ils ne l'aient pas vu!
 clearly this situation them has well and truly shown the problem! It's crazy that-they NEG it-have not seen
 'Clearly, this situation well and truly showed them the problem! It is crazy that they didn't see it!'

Similarly, non-volitional subjects are consistent with a defeasible result in Finnish morphological causatives (Ilić, Ch. 7, this volume).

- (25) Vitsi naura-tt-i minu-a (mutta en nauranut).
 joke.NOM laugh-CAUS-PAST I-PART but not.1SG laugh.SG.PAST
 'The joke made me feel like laughing (but I did not laugh).'

While all of these facts must be examined in closer detail, they are squarely in keeping with the limited non-volitional exceptions we saw in section 2.3.2.1, supporting the idea that the grammar, in these cases of defeasible causation, cares about dispositions rather than volitions. We may indeed provisionally suppose that defeasible causation might in some or all cases be identified with disposition.

The question now is how causal theories help us understand dispositions, so that we can ultimately understand the reasons for the distributions of agents and causers. Since we are understanding dispositions to be cases of defeasible causation, we might expect the same answer as in section 2.3.1 on defeasible causation: namely, that result-entailing theories of causation (counterfactual, transmission) fare poorly, while non-result-entailing theories (probability, force) fare well.

In fact, however, a popular starting point for philosophers concerned with dispositions is a counterfactual theory (Choi and Fara 2012). A basic counterfactual analysis of dispositions is given in (26a). We can see how dispositions on this analysis might relate to causation by means of Lewis's 1973 counterfactual theory of causation, which gives us the proposition in (26b). Together (26a) and (26b) allow us to conclude (26c).

- (26) a. [O is disposed to M when S] iff [if it were that S, then O would M]
 b. if [if it were that S, then O would M] then [S causes O to M]
 c. [if O is disposed to M when S], then [S causes O to M]

So, for example, supposing a glass is disposed to break when struck, we may conclude that if it were struck, the glass would break, and indeed that striking causes the glass to break.³³ This seems largely correct. Note the similarity between this approach and inertia world solutions to non-culminating accomplishments (section 2.3.1), as well as Martin and Schäfer's stereotypical modal base they use to account

³³ For some reason, *allow* sounds better than *cause* with a volitional subject: if Mary is disposed to eat doughnuts in the presence of doughnuts, then the presence of doughnuts seems to *allow* her to eat doughnuts, rather than to *cause* her to eat doughnuts. This relates to a familiar issue about whether a contributing factor is "the" cause; see Dowty's (1979) revision of Lewis's (1973) theory.

2.3 Relevance to linguistic phenomena 47

for the facts in (23) and (24). In all these cases, defeasibility is attained by restricting the worlds in which the causal relation holds to a certain subset of possible worlds—the normal, stereotypical, or optimal³⁴ worlds. These are all thus essentially the same solution to the problem of trying to use a result-entailing theory of causation to account for defeasible causation.³⁵

Despite the popularity of this solution among philosophers for dispositions, recall that there were linguistic reasons for dispreferring this kind of semantic solution for non-culminating accomplishments: the lack of scope-taking (Martin and Schäfer 2012) and the cross-linguistic lack of morphology. Now that we are understanding defeasible causation in terms of disposition (both volitional and non-volitional), these reasons should be re-examined.

There are cases of morphology that are likely to denote dispositions: derivational morphology such as *-able* in English, for instance, and even possibly generic/habitual markers (as in Hindi). Thus there may not be such a strong case to make from morphosyntax that a simpler semantics is to be preferred.

On the other hand, in the agent/causer cases we have been discussing, volitional and other dispositional meanings indeed do not seem to take scope over other modals (Martin and Schäfer 2012). We think the lack of scope-taking in agency/causerhood indicates that we should still (just) disfavor complex semantic solutions. If this complexity were taken out of the logical form and put elsewhere, for example in the cognitive system (which would interface with the semantics via axioms of the model), the scope problem would not arise, as desired.

The problems of scope-taking and semantic complexity did not arise for defeasible causation with non-result-entailing theories of causation such as probability and force-based theories. Further consideration of dispositions, however, shows that if these theories are used, they run up against a couple of different problems that would need to be resolved.

We saw that a probability theory of causation, augmented with a distinction between events and event kinds, can account for defeasible causation. However, as far as dispositions are concerned, it may be objected that a disposition should be more than something that raises the probability of the kind of event occurring. One difficult point for dependency theories is that the notion of a disposition typically is thought of as a property of an entity. Dependency approaches such as counterfactual or probability theories, however, do not easily specify whether the likelihood of an outcome is due to internal or external factors, so they are not well suited for

³⁴ There is a question that arises here (as in discussions of inertia worlds) about how one decides what the normal, stereotypical, or optimal worlds are. It is not trivial.

³⁵ The remaining result-entailing theories of causation (logical, transmission, some causal models) run into the same issue as the counterfactual theories.

48 2. *Theories of causation*

capturing the idea that the disposition is due to properties that hold of an entity. And in fact, a prominent line of criticism of basic counterfactual treatments of dispositions raises exactly this point (see e.g. Martin 1994).

We might expect production theories to fare better in constructing a notion of an internally-generated tendency (or force or energy) because, as we have seen, spatial information is relevant to production theories of causation, while it is irrelevant to dependency theories of causation. Indeed, one of the strengths of transmission theories of causation is that they can specify both the origin and destination of the quantity that is transmitted. As a consequence, such theories can specify whether a conserved quantity emerged from forces internal (e.g. a car's engine) or external (e.g. a leaf falling and being blown about by the wind) to an entity. However, while transmission theories are certainly able to distinguish internal from external influences, they do not provide a motivation for why making such a distinction might be of value. Such motivation is provided in force theories of causation, which, according to White (1999; 2006; 2009) and Wolff and Shepard (2013), are based on our personal experiences of acting on objects and having objects act on our bodies.

But how important is the intrinsic/extrinsic distinction to language? In terms of objective reality, being non-committal about whether the tendency is due to internal or external factors might be a positive feature. Consider, for example, a tendency of physical objects to fall. Objectively, this tendency emerges in part from factors that are external to the object—specifically, the force field created by the earth. Psychologically, however, people typically will attribute this tendency to factors that are internal to the object, a point captured in Aristotle's theory of impetus (Aristotle 1999). To the extent that we want our theories to accurately capture people's representations of entities and their properties, we should prefer theories of causation that allow the internal/external distinction to be made. There is already an argument, for instance, that the internal/external distinction is relevant to the event and argument structure of verbs (Levin and Rappaport Hovav 1995), and it is evident at least that a volitional disposition is conceived of as being proper to the entity whose volition it is. On the other hand, certain dispositions are seemingly not entirely intrinsic: the disposition of a key to open a particular lock, visibility, etc. However, whatever extrinsic relations are involved in such dispositions, they are still based on intrinsic properties (e.g. the shape of the key, the material of which the visible object is constructed).³⁶

This makes it seem as though force theories are the winners of this particular round. Yet at first glance it is hard to see how a theory of force dynamics can provide a basis for the intensional nature of dispositions. Talmy (2000), for instance, treats

³⁶ Molnar (2003) argues that there is no way to remove the requirement for intrinsicity from all dispositional properties.

2.3 Relevance to linguistic phenomena 49

desires and physical forces as the same.³⁷ However, desires and physical dispositions are intensional while physical forces are not (cf. e.g. substitutability of co-referring phrases: *This acid changed the color of the litmus paper to red* = *This acid changed the color of the litmus paper to the color of Post Office boxes*). This is a devastating problem for a Talmy-like system, and it arises because while propositions are crucial for dealing with intensionality, propositions are not particularly well dealt with in systems that address physical forces.³⁸

On the other hand, it is possible to borrow the notion of proposition from dependency theories into the spatio-temporal anchoring of force theory. For example, physical forces can be understood as abstract functions from situations to situations (Copley and Harley, to appear),³⁹ while dispositions can be understood as “second-order forces”, i.e. functions from situations to propositions (sets of situations; Copley 2010). The result of a “second-order” force is thus a proposition or set of states of affairs rather than a single state of affairs.⁴⁰ In such a way it is possible to integrate forces into a system that does justice to propositions, and hence to the intensionality of dispositions. Likewise, a primitive “dispositional modality” could be understood to be at work (Mumford and Anjum 2011); if modality is taken to involve propositions, this is a very similar solution to the problem.

To summarize: the fact that some inanimate causers can appear in contexts that by and large seem to have only volitional agents indicates that what the grammar cares about in these cases is not volitionality but a causal structure of which volitionality is just one example. That being the case, in studying agents and causers, it behooves us to adopt a theory of causation that can make reference to a notion of volition that has similarities with non-volitional causation. The dispositional approach to volition (e.g. Portner 1997) does better than the preference approach to volition (Heim 1992) on these terms, which (after a detour through research on intention) led us to question which theories of causation can deal with dispositions. Several theories can represent dispositions, but if dispositions are to be understood

³⁷ On the other hand, philosophical production theories of causation often have a different focus when discussing psychological states in the context of causation: the questions of whether intentions have effects (i.e. whether there is ‘mental causation’) and whether intentions have causes (i.e. whether there is free will).

³⁸ See Kistler, Ch. 4, this volume, for related discussion of this point.

³⁹ As we have seen, this functional treatment of forces also allows a result situation to be the output of the force function; it is thus not existentially bound, and therefore its referent is not asserted to occur. This also yields intensionality, in that various properties can be attributed to that situation without asserting that the situation occurs. However, this move is not really available for *want*, as *want* has a propositional complement. This point underlines the idea that there are currently several different technologies available that can account for defeasibility: not just first- and second-order force functions, but also event kinds, the lack of an efficacy presupposition, scales and less than totally realistic modal bases. All of them apparently model intensionality appropriately. It remains to be seen how many ways to achieve defeasibility and/or intensionality are suggested by the cross-linguistic data.

⁴⁰ See also Kamp (1999–2007) for related discussion on this very Davidsonian question of how to link intentions with mental representations of the physical world.

50 2. *Theories of causation*

as *intrinsic* tendencies, force-based theories have the upper hand. The intensional nature of dispositions still poses a major problem for force-based theories. It can be overcome, however, by appealing to the idea that a proposition can formally be the result of a more abstract kind of “force”.

2.3.3 *Representations of causal chains*

So far we have investigated how different causal theories account for two related linguistic issues: defeasibility, and the role of volitionality in agency. Our third linguistic issue is the question of how conceptual representations of participants and events in causal chains are mapped onto linguistic representations of these chains. This issue arises both in syntax and in the lexicon, as well as in determinations of the boundary between the syntax and the lexicon (e.g. Folli, Ch. 13, this volume). Since several of the chapters in this volume deal with this issue in detail (Thomason, Wolff, Ilić, Martin and Schäfer, Ramchand, Lyutikova and Tatevosov), we will not do so here. We still want to ask, however, whether the linguistic facts related to the representation of causal chains favor the choice of one causal theory over another, either for use of the theory as a tool in further linguistic analysis or to provide evidence of the theory’s cognitive reality.

2.3.3.1 *Causal chains in grammatical structures* There are several linguistic phenomena that suggest that causal chains—i.e. sequences where more than one causal relation is linked together—are visible to grammar. In other words, more than just the beginning cause and the ending effect of the causal chain are represented in the grammar; intermediate steps are also represented. One case would be the distinction between lexical (e.g. (27a)) and periphrastic (e.g. (27b)) causatives, which have been claimed to differ in terms of whether the causation is “direct” or “indirect” (Fodor 1970; Cruse 1972; Shibatani 1976; Smith 1970).

- (27) a. John turned the baby.
b. John made the baby turn.

So, for example, for (27a) to be true, John must physically turn the baby himself (direct causation), whereas for (27b) to most felicitously be true, John does something that causes the baby to turn herself (indirect causation). If the baby turns herself, (27a) cannot be truthfully asserted. The question that this contrast raises is how to best represent the difference between direct and indirect causation, noting that “direct” and “indirect” are intuitive judgments which must be treated as non-linguistic intuitions about the world. One general approach is to define direct causation in terms of how causal chains in the world are conceptualized, and to put a restriction on lexical causatives such that they can only be used to describe causal relations that lack intermediaries. Causal relations in which the cause and effect are mediated through some intermediate causal agent would thus need to be described using periphrastic causatives.

2.3 Relevance to linguistic phenomena 51

Futurates provide a similar example of indirect causation (Copley 2014). On this view, a futurate sentence such as *Mary is building a house next year* makes reference not only to the subeventuality of which Mary is the agent and the result eventuality of the existence of the house, but also to a subeventuality corresponding to the volition of the entity causing Mary to build the house (the “director”; possibly but not necessarily Mary). This extra eventuality can be modified by a temporal adverbial, as shown in (28a) (Prince 1973) and (26b).

- (28) a. Yesterday morning I was leaving tomorrow on the Midnight Special.
b. For a moment Mary was building a house next year.

Copley and Harley (2009; 2010) point out that the semantics of futurates is very similar to the semantics of *have* causatives.

These phenomena might make us wonder whether the intermediate step strictly needs to involve an agent if more than one causal relation is to be licensed in the syntactic structure (Cruse 1972). This seems to be the case, but “agent” must, as usual, be understood in terms of teleological capability. Even though a non-teleological entity might *conceptually* be seen as an intermediate causer, as in a situation where John pushes a blue marble and the blue marble’s motion causes the green marble to move (29),⁴¹ the blue marble is not felicitous as an intermediate agent. Rather, a teleologically capable entity is needed, such as a machine.

- (29) a. #John made the blue marble make the green marble move.
b. John made/had the machine move the green marble.

Going just by (29), then, a teleologically capable intermediate agent might seem to be necessary in order to represent causal chains. However, what (29) shows is merely that an agent seems to be necessary for periphrastic or indirect causation. There is another way in which multiple causal relations seem to be visible to the grammar, namely by the representation of an instrument in a prepositional phrase. Croft (1988), for instance, presents instruments as intermediate entities in the causal chain between an agent and a patient. There are indeed differences between cases with intermediate agents and cases with instruments: unlike intermediate agents, instruments don’t give the causation an “indirect” feel and is an enabler rather than a causer. Nevertheless, the fact that they are represented seems to indicate that the grammar has access to the intermediary causal participation of the instrument.⁴²

Given that there is evidence that the grammar appears to be sensitive to the presence of multiple causal relations, the question arises as to how different accounts of causation might handle the representation of causal chains. In the

⁴¹ Note, however, that it is arguable whether the blue marble can be seen as an intermediate causer even conceptually. In the paraphrase it is the blue marble’s *motion* that makes the green marble move, rather than the blue marble itself.

⁴² See also Thomason, Ch. 3, this volume for discussion of this point.

52 2. *Theories of causation*

philosophical literature, the need for chains has been motivated by the belief that causal relations can be derived from transitive reasoning (Hall 2004): if A causes B and B causes C, we can infer that A causes C. As recognized by Lewis (1973), causal relations derived from transitive reasoning can sometimes be problematic for a counterfactual analysis of causation. Such problems arise in cases of late pre-emption. Consider, again, the case of Suzy and Billy; each throws a rock at a bottle, but Suzy's rock hits the bottle first and shatters it. As noted by Lewis (1973) (see section 2.2.1.1), we would say that Suzy caused the shattering of the bottle. The problem for counterfactual theories is that the bottle's shattering does not depend counterfactually on Suzy; in Lewis's (1973) words, the causal dependence here is "intransitive". The problem for a counterfactual analysis is that there can exist a causal relation without causal dependence.

To get around this problem, Lewis proposes that the link between Suzy and the bottle's shattering can be decomposed into a series of steps or links in a causal chain. He argues that while there may not be causal dependence between the first and last event in the chain, causal dependence can hold between individual steps in the chain, and the presence of these causal dependencies can license the inference that there is a causal relation between the first and last events in the chain, i.e. they can license the transitive inference that the first and last events of the chain are connected by a causal relation. While this possible solution looks at first like a viable fix to the theory, even Lewis (1973) recognized that it is vulnerable to the criticism that in the cases of late pre-emption—like the Suzy and Billy case—counterfactual dependence will not hold for at least one of the intermediate steps. This problem led to a revised version of his theory in which counterfactual dependency is said to exist when an alteration in the cause leads to an alteration in the effect (Lewis 2000). However, as we have seen, this new version of the theory brings with it its own set of problems. As noted by Menzies (2008), if Suzy's throw is altered such that she throws after Billy, Suzy might no longer be considered the cause of the shattering, but it would still be the case that an alteration to her actions led to an alteration in the final effect, which according to Lewis's (2000) new criterion, would make Suzy a cause. In sum, a counterfactual approach to causal chains, in the style of Lewis's theories of causation, is fraught with problems and is not likely to be able to serve as a theory of how people represent causal chains.

While counterfactual theories of causation likely cannot serve as theories of how people represent causal chains, other kinds of dependency theories hold greater promise.⁴³ As discussed earlier, a Bayesian network approach to causation is by design specifically formulated for the representation of causal chains and causal networks. As we saw, such an approach is able to handle problematic situations, such as late pre-emption, by representing these situations in terms of a

⁴³ Aside from logical dependency theories, which do not do so well even at representing single causal relations, as noted in section 2.2.1.1 with respect to late pre-emption.

2.3 Relevance to linguistic phenomena 53

network rather than in terms of a chain. As described in Hitchcock (2010), in a network representing late pre-emption, Suzy's throw leads to the hitting of the bottle, which not only leads to the bottle's shattering but also prevents Billy's throw from hitting the bottle, and hence blocks Billy's throw from being the cause of the shattering.

Causal networks raise an interesting issue for the relationship between theories of causation and linguistic theory. The solution to late pre-emption offered by Hitchcock involves a branching causal chain, but according to some linguists, language only encodes non-branching causal chains (Croft 1988; Talmy 1983). If certain kinds of causal relationship require representations specifying causal networks, complications arise with regard to the relationship between linguistic and conceptual representations. It may be that for the sake of language, conceptual representations specifying causal networks are, in some sense, reduced, or simplified into causal chains. Another possibility is that, contrary to Croft and Talmy, representations in language might directly specify causal networks. Yet another possibility is that the nature of the representations specifying causation do not specify causal networks, even in the case of late pre-emption.

According to Hall (2004), production theories of causation are well suited for the representation of causal chains. Unlike dependency theories, production theories do not need to use a network to handle late pre-emption (see Walsh and Sloman 2011). As we saw in section 2.2.2, Suzy's throw causes the bottle to break because she imparts its force or energy to her rock, which imparts its force or energy to the bottle, breaking it. There is no need to consider Billy's throw. This means that Croft's (1988) principle that linguistically represented causal chains are non-branching can be maintained.

One problem, however, with using production theories of causation to represent syntactic causal chains lies in the causal relata they assume. Production theories typically treat causation as relating entities to one another, in terms of how entities exert force on or transfer energy to one another (see Wolff, Ch. 5, this volume; also very much like cognitive linguistic literature on the topic, esp. Croft 1988). Using entities as the causal relata is inconvenient, given that causal chains in syntax are generally assumed to have events as the causal relata. Bayesian theories are inconvenient too, in that they treat the causal relata as variables which have true or false outcomes (with a given level of certainty), which seems to treat them as propositions.⁴⁴ For this reason, counterfactual theories might be preferable, since they take the causal relata to be events. However, even counterfactual theories ultimately define causation in terms of propositions—namely, the proposition that the causing event occurs and the proposition that the result event occurs—and it might be questioned whether propositions as such are really relevant to meaning that is

⁴⁴ See Thomason (Ch. 3) for a critical discussion of Dowty's (1979) use of propositions as causal relata.

located so low in the verb phrase. One alternative would be to rescue the production perspective by using a more abstract notion of force that acts on situations rather than entities, as do Copley and Harley (Ch. 6, this volume; to appear). The similarities between events and situations (Kratzer 2011) mean that this move addresses the basic problem. Another solution could come from Lyutikova and Tatevosov (Ch. 11, this volume), in which the causal relata are essentially properties of events. Properties could arguably stand in for propositions within the verb phrase in such a way as to make the dependency theories more plausible.

2.3.3.2 *Sometimes causal chains are not important to linguistic representations* We have argued that conceptual causal chains are sometimes visible to grammar, and that this point suggests that some causal theories—production theories and possibly causal networking theories—would be more useful than others in accounting for the representation of causation in language. However, quite to the contrary, there are also cases where a conceptual causal chain has intermediate links that are not represented in language; the grammar is apparently indifferent to anything but the beginning and end of the conceptual causal chain.

One such case, as is noted in Thomason’s and Ramchand’s chapters in this volume, is what we might call “conceptual-linguistic causal mismatch”: the fact that virtually any causal relation can be conceptualized as involving an intermediary (Pinker 1989). For instance, lexical causatives can have unexpressed instruments or body parts; if John broke the table, he did so either with an instrument, or with his hand, or another part of his body (Guéron 2005; 2006). Volition itself can be thought of as an extra initial step in the conceptual causal chain (Davidson 1963; Talmy 2000; Ramchand 2008; Ch. 10, this volume; Copley and Harley, Ch. 6, this volume); theories differ as to whether the volition of an agent is represented in the syntax, but if it is not, then it provides another example of a complex conceptual causal chain but a simple morphosyntax. To take another example, it is clear from Sichel’s (2010) nominalization data presented in (17) that the nominalization *justification* places a requirement of more direct participation on the subject than does the verbal form *justify*; the possibility of having *the hurricane* as a subject of *justify*, but not of *justification*, indicates that the former, but not the latter, must allow a conceptually complex causal chain. So even though we perceive *justify* to be more “direct” than, e.g. *cause to justify*, this intuition of directness does not necessarily correspond to a simple (one-link) conceptual causal chain, because the nominalization has a requirement for an even simpler causal chain.

So what is “direct causation” as we perceive it in lexical causatives? In Ramchand’s chapter, she argues that this direct causation has to do with lexicalization of two heads with one morpheme. On the other hand, for Lyutikova and Tatevosov (Ch. 11, this volume), the directness/indirectness distinction stems from different kinds of causal/temporal structure, as represented in the semantics. If the latter, production

2.3 Relevance to linguistic phenomena 55

theories should be preferred again as they necessarily represent spatio-temporal information, while dependency theories need it to be added on.

A better case for dependency theories can be made if we consider lexical connectives such as *because (of)*, *since*, *as a result of*. *Because of*, for instance, is apparently not sensitive to how far away in the causal chain an agent is, or if there are any intermediate agents or causers in the chain. The sentence in (30a) is felicitous and true even if Mary opens the window and the wind blows the door open, or if she tells John to open the door and he complies; in these cases (30b) is not. And when Mary opens the door herself, (30a) is still felicitous and true.

- (30) a. The door opened because of (what) Mary (did).
b. Mary opened the door.

Because, unlike the verb *cause*, is also indifferent to the type of causal relationship. As noted by Talmy, the notion of cause seems to be a family of notions that includes CAUSE (in the narrow sense), ENABLE/ALLOW, PREVENT, and DESPITE. These different notions of causation are often differentiated in verb meaning. In causal connectives, in contrast, they are generally not differentiated. For example, it has been observed that *because* can refer to enabling conditions instead of a single most important cause, unlike the main verb *cause*. This is demonstrated by the fact that the sentence in (31a) with *because of* is true, because drugs were an enabling condition of Armstrong's seven victories (though not "the" cause), while a similar sentence with *cause* in (31b) is false.

- (31) a. Lance Armstrong won seven Tours de France because of drugs.
b. Drugs caused Lance Armstrong to win seven Tours de France.

The existence of a connective like *because of* might be slightly unexpected under a theory of causation where causing and enabling are necessarily represented differently. The surprise increases once we consider that it is likely that all causal connectives are apparently indifferent to the distinction between CAUSE and ENABLE (Wolff et al. 2005).⁴⁵

Some production theories necessarily distinguish CAUSE and ENABLE. For example, in Talmy's (1988) theory of force dynamics, CAUSE is reflected by an agent vector opposing the patient vector, while ENABLE is represented by the removal of a preventive force (see also Wolff, Ch. 5, and Ilić, Ch. 7, this volume). So the nonexistence of causal connectives that differentiate these notions is surprising in such a theory. In dependency theories, however, causes and enabling conditions are represented similarly (but see Sloman et al. 2009). Dowty (1979) and Eckardt (2000) make this point for Lewis's (1973) theory, for instance, and in Bayesian causal models, the arrows can represent either causing or enabling

⁴⁵ Some verbs also are vague in this way, e.g. *influence*, *affect*, *lead to*, *link to*.

relations. So on a dependency theory of causation, the fact that causal connectives do not make the distinction is expected.

2.4 Conclusion

We have argued that certain theories of causation are more suited to certain sets of linguistic data and should therefore be utilized in developing theories of these data. This story we have been telling is thus a familiar Occam's Razor story, but the appeal to Occam's Razor is meant to be understood in a quite practical and preliminary way: we have not argued that in every case the most plausible theory of causation is the correct one. Rather, we suggest simply that one needs to be aware of the range of theories of causation while collecting, organizing, and analyzing data. Questions to be asked are: how does a particular theory of causation help in formulating linguistic hypotheses and the linguistic theories that arise from them? How does a particular theory of causation tell us which things language might care about? Does the causal theory allow us to make the semantics simple by putting any meaning in the conceptual system instead of having to represent it in (syntax-visible) semantics, in places where it seems as though the syntax cannot see that meaning? If we can investigate the possibilities afforded by different theories of causation for the data we are interested in, the choice will likely lead to different and (dare we say) better explanations, as well as interesting avenues for further research. Of course it must be emphasized that even a theory of causation that is not particularly well suited to a particular set of data still can be adequate, and could even be right. We have surely not thought of every way in which every theory could be extended. Still, if theories are to be compared, the burden of proof is, as always, on whichever theory is less obviously suitable for the data.

Much of this chapter has focused on how theories of causation might inform linguistic theory. However, the potential benefits of this conversation also extend in the other direction. To the extent that philosophers and cognitive scientists use language-related data to support claims about cognition, such research will benefit from insights from linguistic theory. Linguistic theory reveals syntactic and semantic distinctions that are likely to reflect conceptually significant categories. Consider, for example, the Minimalist Program (Chomsky 1995) principle that the properties of language depend in part on the need for language to interface with phonology on one hand and the conceptual system on the other. (Cognitive linguistics, true to its name, has always viewed representations as having cognitive reality.) Any philosopher or psychologist who last looked at linguistics as recently as the early 1990s and decided it was not germane to their research should know that the development of Minimalism, among other advances, has made syntactic theory both more cognitively plausible and more amenable to questions of meaning.

2.4 Conclusion 57

We have made no claims about the particulars of the interface between language and mind in this chapter, but predictions should emerge quite naturally from the juxtaposition of theories of causation, linguistic theory, and data. For example, we have observed an interesting relationship between structural height and the specificity of the causal expression. We have seen that volition, temporal-spatial considerations, and complex causal chains are relevant to the semantics of the verb phrase, which tends to point toward a production theory of causation. We have also seen, however, that it is less clear that production theories are relevant to higher structural domains, as in lexical connectives like *because* which occur outside the verb phrase and take propositions as their arguments. In fact, the lack of specificity of these expressions seems to indicate that a dependency theory would be preferable higher in the structure. Could this structural disparity reflect a causally pluralistic mental representation, where production theories are relevant to the lower part of the tree, and dependency theories are relevant to the higher part of the tree? Might linguistic structure even suggest a way to relate the two kinds of theory to each other or define one in terms of the other?

We do not yet know the answers to these speculative questions. But we hope that linguists, philosophers, and cognitive scientists will see fit to ask and answer such questions together. Although interdisciplinary ventures are never automatically fruitful merely by virtue of being interdisciplinary, we think that a cognitive and linguistic conversation on causation is now possible, and that this conversation is likely to advance the long-term goal of integrating linguistic theory with the science of the mind.



A force-theoretic framework for event structure

Bridget Copley · Heidi Harley

Published online: 28 April 2015
© Springer Science+Business Media Dordrecht 2015

Abstract We propose an account of dynamic predicates which draws on the notion of *force*, eliminating reference to events in the linguistic semantics. We treat dynamic predicates as predicates of forces, represented as functions from an initial situation to a final situation that occurs *ceteris paribus*, that is, if nothing external intervenes. The possibility that opposing forces might intervene to prevent the transition to a given final situation leads us to a novel analysis of non-culminating accomplishment predicates in a variety of languages, including the English progressive. We then apply the force-theoretic framework to the composition of basic Vendlerian eventuality types within a lexical-decomposition syntax. The difference between predicates of forces and predicates of situations is argued to underlie the dynamic/stative contrast, and also to allow for a formal treatment of the difference between *be* and *stay*. Consequences for the relationship between language and cognition are discussed.

Keywords Event · State · Davidson · Force dynamics · Aktionsarten · Progressive aspect · Culmination · Syntax–semantics interface

Despite the very significant advances in understanding the semantics of eventualities since the Davidsonian revolution, the representation of Accomplishments in *ceteris non paribus* contexts where the telos is not reached remains problematic. In this paper we propose that non-culminating or defeasible cases of Accomplishments are the base case in a reconceptualized semantics for event structure. The core

B. Copley (✉)
SFL (CNRS/Paris 8), Paris, France
e-mail: bridget.copley@cnrs.fr

H. Harley
University of Arizona, Tucson, USA
e-mail: hharley@email.arizona.edu

concept that we use in our reconceptualization is ‘force’, an input of energy that arises from the objects and properties in a situation. This approach cashes in the intuition behind the traditional (physics) concept of dynamicity, which has been an important descriptor in event semantics but which has not usually been expressly encoded in accounts of the syntax/semantics interface. Force arguments replace event arguments in dynamic predicates, and situation arguments replace event arguments in stative predicates. The resulting type distinction also yields new insight into the distinction between dynamic and stative predicates.

We motivate our use of the concept of force as the answer to the empirical problem of non-culmination. We note that previous attempts to account for non-culmination fall into two general categories: they either assume a causal relation between two subevents and require the additional machinery of possible worlds (e.g., Dowty 1979), or they treat a non-culminated event as bearing some, possibly scalar, relation to a culminated event, but fail to adequately address the origin of judgments underlying that relation (e.g., Parsons 1989, 1990). We preserve insights from both of these previous approaches, proposing that there is a kind of causal relation, understood in force-dynamic terms, between two subarguments, but that something like scalarity (i.e., the fact that the endpoint need not be reached) is involved as well. We propose that non-culmination should not be understood as a derived phenomenon, but rather as the basic one: a dynamic verb refers to a force, rather than an event, and the existence of a force does not entail any necessary effect, because forces are naïvely understood to be inherently defeasible and to interact with each other in deterministic ways. To make the link between conceptual forces and semantic type theory, we map conceptual forces to Davidsonian arguments that are functions from an initial situation to a final situation that occurs *ceteris paribus*.

We then demonstrate how this framework encodes the characteristics of familiar verb classes at the syntax–semantics interface, explicating the way in which the syntactic argument structure is interpreted to produce force-theoretic denotations which can express the insights achieved over the past two decades of research into the relationship between argument structure and event structure. We propose strictly compositional denotations for the substructures of change-of-state verbs, incremental theme verbs, manner verbs, resultatives, activity and semelfactive predicates. We go on to argue that the force-theoretic approach can naturally distinguish between agent and causer arguments, and propose an analysis of source-introducing *from*-PPs.

Finally, the type-theoretic distinction between forces and situations takes center stage, as we examine the consequences of the proposed framework for dynamic predicates (predicates of forces) and stative predicates (predicates of situations) with respect to adverbial selection (as per Katz’s 2003 Stative Adverb Gap) and coercion. The framework allows as well for a natural account of predicates that have been resistant to analysis in event-theoretic approaches, namely verbs of maintaining like *keep* and *stay*.

1 Motivating forces

We begin with a difficulty encountered in the representation of Accomplishments in *ceteris non paribus* contexts where the telos is not reached. We argue that treating

(certain) Davidsonian arguments as referring to forces addresses these issues in a more satisfactory way.

1.1 A *ceteris non paribus* problem with accomplishments

A popular line of analysis investigating the internal structure of events has concluded that certain events—Vendlerian Accomplishments, most saliently—are composed of two sub-events, chained together in a causal relationship: *John opened the door*, for example, is argued to have a causing sub-event e_1 , and a result sub-event e_2 of the door being open (other views of Accomplishments, of course, exist, see e.g. Van Valin and LaPolla 1997, p. 118). Causal event decomposition theories allow a straightforward expression of the insight that *John* is the Agent of only the first, causing, sub-event, e_1 ; this event then is ‘chained’ with e_2 , which is itself related to the Theme (Pustejovsky 1991, 1995; Higginbotham 2000; Folli 2003; Giorgi and Pianesi 2001; Kratzer 2005; Ramchand 2008, a.o.). The nature of this chain is typically either implicitly or explicitly assumed to be that of a causal relation of the form $\exists e_1 \exists e_2: e_1 \text{ CAUSE } e_2$, assuming Dowty’s (1979) (admittedly non-neo-Davidsonian) treatment of causation, itself derived from Lewis’s (1973) theory.

If indeed there is a causal relation of this kind in Accomplishments, a problem arises. For e_1 to cause e_2 in Lewis’s theory, both events must exist. This requirement is reflected in the existential binding of e_1 and e_2 . However, there are many cases in natural language where e_1 appears to have this kind of causal relation to e_2 , at least *ceteris paribus*, but e_2 does not necessarily occur, because *ceteris non paribus*. We will discuss two such cases here.

The more well-studied of these cases is the so-called “imperfective paradox” in imperfectives and progressives (especially the English progressive; Dowty 1979; Parsons 1989, 1990; Landman 1992; Portner 1998 among many others). It is perfectly possible to say that Mary was painting the dresser without entailing that the result state occurred:

- (1) a. #Mary painted the dresser black, but she didn’t finish.
 b. Mary was painting the dresser black, but she didn’t finish.

Many theories of the progressive have addressed the contrast in (1). One category of theories involves quantification over a normal or “inertial” set of possible worlds or situations, so that e_1 causes e_2 , and e_2 indeed exists, but only in these worlds or situations; the actual world or situation need not be in this set. Dowty (1979) was the first to propose this solution, based on a suggestion from David Lewis. However, Dowty was well aware that inertia worlds represented a powerful complication of the model, and therefore adopted them only “reluctantly” (Dowty 1979, p. 148) (see also Landman 1992; Bonomi 1997; Portner 1998; Naumann and Piñón 1997; Abusch 1985; Engelberg 2002, a.o. for possible worlds, Cipria and Roberts 2000; Del Prete 2012, for possible situations). This move was a direct consequence of the problematic conjunction of two premises: (a) that Accomplishments have a causal

relation, based on Lewis's theory of causation, and (b) that the causal relation, as defined by Lewis, requires that the result occur. The adoption of possible worlds does alleviate the problem. However, there are two different strategies that can be used to obviate the problem entirely.

The first strategy, call it "causal skepticism", is to deny premise (a), namely, that there is a causal connection between an e_1 and an e_2 in Accomplishments. Essentially this position posits the existence of "partial events": an event e can either hold without culminating (hence it is partial) or it can culminate (Vlach 1981; ter Meulen 1985; Bach 1986; Parsons 1989, 1990; Kearns 1991; Landman 1992;¹ Smith 1991/1997, among many others). In these theories, a principle characterizing the intensional relation between partial and total events, where the total event is the normal or inertial continuation of the partial event, is assumed, or, in the case of Landman (1992), defined via possible worlds. Another way to define this principle is via a mapping to a scale along which an event is measured, from the least culminated to the most culminated (Bohnenmeyer and Swift 2006; Koenig and Chief 2007; Piñón 2008; see also Beavers 2011a on the 'Affectedness Hierarchy'). A third way to think about the same principle is to map parts of events to thematic roles or objects (e.g., Krifka 1998; Filip 2008). A rather different approach to the causal skepticism strategy, represented by Asher (1992) and Glasbey (1996), is to take the progressive to apply to inferences that speakers and hearers make about utterances. Such theories avoid the problem with Lewis's theory of causation. However, they for the most part give up the straightforward association between agents and initiating events (Krifka 1998; Filip 2008 excepted), and they all abdicate on the question of how to tell that one event is related to a more maximal or culminated event.

There is a second strategy for avoiding the problem introduced by the two premises above, which has not been utilized, as pointed out by Copley and Wolff (2014).² Namely, one could deny premise (b), that the existence of a causal relation entails that the result occurs. While many theories of causation, similarly to Lewis' (1973) counterfactual theory, propose a causal relation that is result-entailing,³ not all of them do. Copley and Wolff observe that "non-result-entailing" theories of causation exist: namely, probabilistic theories of causation (Reichenbach 1971; Suppes 1970; Eells 1991, e.g.), and force-dynamic theories of causation (e.g. Dowe 2000; Kistler 2006; Mumford and Anjum 2011). The latter is related to cognitive linguistic treatments of force-dynamics as constituting an important part of verb meaning (Talmy 1976, 1981, 1985a, b, 1988, 2000, e.g.; Croft 1990, 1991, 1998; Gärdenfors 2004, 2005, 2007); this line of inquiry seems to have developed independently from the philosophical debates on causation. See also Rappaport

¹ As Portner (1998) points out, Landman's theory falls into this category even though it also uses possible worlds.

² Beavers (2011a, p. 359, note 19), discussing non-result-entailing lexical items, also notes the existence of this type of strategy without making reference to theories of causation per se.

³ Result-entailing theories include non-probabilistic causal modeling theories as in Pearl (2000), Woodward (2009); see also Hobbs (2005) for an application to language, as well as some theories based on energy transfer (Kistler 2006).

Hovav and Levin (2001) for a detailed application of the insights provided by a force-dynamic viewpoint to the problem of English resultatives.

In this article we pursue the force-dynamic version of this strategy. As far as the defeasibility of Accomplishments is concerned, our strategy is in a way causation-affirming, to the extent that force dynamics interprets the relation as supervening on physical causal mechanisms, rather than stopping at the level of observational correlations, as scales and probabilities do. However, it should also be palatable to those skeptical of the idea that there is a causal relation in all Accomplishments, since force dynamics describes more relations than just causation (in fact, among causal skeptics the notion of “force recipient” is often appealed to, usually without formal development, though see Beavers 2011b). In this paper we develop a syntax–semantics interface theory of Accomplishments based on a force-theoretic perspective, and extend it to the rest of event structure. We thus eschew the use of possible worlds for non-culmination, although we remain agnostic as to whether possible worlds should be used for “true” modals (see also Copley and Wolff 2014).

Although the problem posed by the English progressive has been the central case in the literature, it is important to note that empirical problems for the two premises above extend beyond the progressive. So-called ‘non-culminating accomplishments’ pose a very similar problem. In a number of languages, there are constructions that are not imperfective in which telic predicates routinely fail to have a culmination entailment, so that the analogue of the sentence in (1a) above, for instance, is acceptable. Malagasy, for example, has an agentive infix, *-an-*, which according to Travis (2000) indicates the presence of an initiating event and an active Agent, but forms with the infix do not entail the result of the caused event—the occurrence of the result is implied, but defeasible, as described by Travis (2000, p. 173), and illustrated in (2) below.⁴

- (2) namory ny ankizy ny mpampianatra
 PST.AGENT.meet the children the teachers
- ...nefa tsy nanana fotoana izy.
 ...but NEG PST.have time they
- “The teachers gathered the children but they didn’t have time.”
 (Travis 2000, p. 173)

Similarly, the neutral form of the verb in Tagalog does not entail the result, but rather merely implicates it (Schachter and Otones 1972; Dell 1987); the result can be explicitly contradicted.⁵

⁴ In the data below that we have taken from previous articles, we adopt the author’s abbreviations in each case. We will footnote those abbreviations that seem non-self-explanatory. In Dell’s (1987) paper, “N” stands for the “neutral” form of the verb and “A” for the “abilitative” form of the verb.

⁵ Notice the different form of the verb *naalis*, ‘A-pf-remove’ in the continuation here; this form of the verb carries a completion entailment, i.e. an entailment that e_2 occurs, here explicitly negated. In Malagasy there are also two such verb forms, one that entails completion and one that does not (see, e.g. Travis 2000, p. 172).

- (3) Inalis ko ang mantas, pero naubusan
 N-PF-remove GEN-I NOM stain, but run-out-of
- ako kaagad ng sabon, kaya hindi ko naalis.
 NOM-I rapidly GEN soap hence not GEN-I A-PF-remove
 ‘I tried to remove (lit. ‘I removed’) the stain, but I ran out of soap, and couldn’t.’
 (Dell 1987, p. 186)

In the Salish languages St’át’imcets and Skwxwú7mesh, according to Bar-El et al. (2005), the culmination of Accomplishments in otherwise unmarked forms is only implicated, not entailed.

- (4) a. k’ul’-ún’-lhkan ti ts’lá7-a,
 make-TR-1SG.SU DET basket-DET
- t’u7 aoy t’u7 kw tsukw-s
 but NEG just DET finish-3POSS
 ‘I made the basket, but it didn’t get finished.’ (St’át’imcets)
- b. kw John na kw’el-nt-as ta skawts
 DET John RL cook-TR-3ERG DET potato
- welh haw k-as 7i huy-nexw-as
 CONJ NEG IRR-3CNJ PART finish-LC-3ERG
 ‘John cooked a potato but never finished.’ (Skwxwú7mesh)
 (Bar-El et al. 2005, p. 90)

Examples can be multiplied further, but we will just provide one final one here. Karachay-Balkar, a Turkic language spoken in Russia, also has non-culminating accomplishments (Tatevosov 2008):

- (5) Kerim ešik-ni ac-xan-dī, alaj boša-ma-ʋan-dī.
 Kerim door-ACC open-PFCT-3SG but finish-NEG-PFCT-3SG
 (Context: The lock is broken, and Kerim tries to open the door.)
 Lit. ‘Kerim opened the door, but he did not succeed.’

As should be clear from the disparate families represented by these languages, this is not an isolated phenomenon; indeed it may be the unmarked option crosslinguistically. See Singh (1998) for discussion of similar facts in Hindi, Altshuler (2013) for Hindi and Russian, Giannakidou and Staraki (2010) for Greek, Koenig

and Muansuwan (2000) for Thai, Koenig and Chief (2007) for Mandarin, and Paramasivam (1977) for Tamil (the last as cited in Koenig and Chief 2007).

Just as in a progressive, in all of these non-culminating accomplishments the agent does something that normally leads to a result but can still be unsuccessful in getting the intended result to happen. Not surprisingly, analyses of these facts have appealed to exactly the same technologies as analyses of the progressive. One group of theories exploits possible worlds for the rescue of a result-entailing theory of causation, e.g., Matthewson (2004), Tatevosov (2008). We find the possible world approach problematic because it requires a more complicated logical form for the non-culminated case, which runs counter to the observation that cross-linguistically, if either of the two cases is more morphosyntactically marked, it is the culminated case (Copley and Wolff 2014). The other major group of theories denies that there is a causal relation, and instead relate partial events to culminated events, e.g., Koenig and Chief (2007), Singh (1998), and Altshuler (2013). Dell's (1987) description of Tagalog neutral verbs as denoting a "maneuver" to achieve a "result" is a significant outlier, being a non-result-entailing, force-dynamic strategy, and is very much along the lines of what we will propose.

1.2 Forces as functions: interaction and intervention

The way that we propose to incorporate force dynamics into formal semantics is to understand forces as *conceptual entities* that are mapped to *functions* from situations to situations. We say a few words here about how we approach this, before developing the idea further below.

As we have seen, the fact that Lewis's theory is result-entailing is reflected in the existential binding of e_2 in the logical form. We have seen that e_2 should be introduced into the logical form, and one should be able to refer to it (i.e., it *exists*, as a possible event), but that its *occurrence* should not be asserted. We propose to accomplish this by treating the causal link as mapping to a function between an input and an output argument, where the latter is understood to be the unique result that obtains if all else is equal, proceeds normally, etc.; i.e., all the considerations that have gone into defining inertia worlds and the relation between partial and culminated events in the literature. The initial argument is bound existentially, as usual. The output argument, however, is defined as the output when the causal function is applied to the input argument. In this way, the output argument is defined, and thus can be referred to, without having to actually be asserted to occur.

We then might consider the input argument to be e_1 , and write in our denotations the following statement of the causal link between e_1 and e_2 :

$$(6) f_{\text{CAUSAL}}(e_1) = e_2$$

This move could accommodate the cases of non-occurrence of e_2 that we address above within an event-chaining view. However, it should be noted that such an account would be successful only to the extent that f_{CAUSAL} could be defined at all over events. It is not trivial to ensure that there is a unique result e_2 of a given e_1 . Of course possible worlds could be recruited to define f_{CAUSAL} , but then face the

objection to possible world approaches to non-culmination raised by Copley and Wolff (2014).

Instead, we propose that the input and output arguments of a causal function are situations. The use of situations instead of events will provide for a unique output for any given input to the causal function, allowing the function to be properly defined. The input is an initial situation including all relevant causal conditions—the entities and their properties in the situation. If the input argument is a different s_0 , a different s_1 will result.⁶

$$(7) f_{\text{CAUSAL}}(s_0) = s_1$$

On this view of the causal relation, the causing event e_1 has disappeared from the calculus. What, then, is actually taking us from the initial to the final situation? Formally, it is the causal function that plays this role. The question here arises as to whether it is legitimate to interpret the causal function in some sense *as* the event.

There is a line of thought associated in large part with a tradition in computer science, that equates events with transitions between static representations of situations, as in motion pictures or comic books (Moens and Steedman 1988; Naumann 2001; Fernando 2004, 2005; ter Meulen 1990).⁷ Dahl (2007) also views events as transitions from one static situation to another.⁸ For causal skeptics, there is no problem with interpreting events as defeasible; Moens and Steedman 1988, pp. 18–19), in fact, follow such a line in their account of the English progressive (asserting the superiority of such a theory to a possible worlds account). However, we think that such a move—mapping the causal function to the conceptual event—is missing an important fact about the world: there is already a fundamental concept in the relevant domain that is itself not result-entailing when *ceteris non paribus*, namely *force*, which can be thought of as a directed input of energy that may or may not provoke an effect, depending on the circumstances.

The key advantage of force and energy talk over event talk lies precisely in the ability of forces to interact with each other. It is natural to think of a force summing with another force to create a larger impetus to an end; similarly, it is natural to

⁶ In this our proposal will end up having a similar flavor to Asher's (1992) and Glasbey's (1996) theories of the progressive; see also Engelberg (2002). Asher characterizes a 'perspective' as a "subset of information about a state." For Asher, the inference from $\text{Prog}(\phi)$ to ϕ is defeasibly valid; it can, in particular, be defeated by the inclusion of additional information from the speaker's perspective. The difference between these theories and ours is that while theirs deal with information states, ours deals with states of affairs in the world. Inferences can be thought of as the informational analogue of forces. It also assumes determinism if the speaker has perfect knowledge.

⁷ Davidson (1967) expresses skepticism that events can be represented by transitions from one state to another, remarking that there are any number of ways to go from San Francisco to Pittsburgh (by foot, by air, by mule, ...) and all these are different kinds of events although the initial and final state are the same. This objection does not, however, pertain to the idea of events as functions from one state (situation) to another. There are any number of ways to get from the integer 2 to the integer 4 ($x + 2$, $x*2$, x^2 , ...) by way of distinct functions; likewise, there are in general different ways to get from one situation to another by way of distinct functions.

⁸ In a related vein, the analytic tradition that includes Discourse Representation Theory and Dynamic Semantics (Kamp 1981; Heim 1982; Groenendijk and Stokhof 1991; Kamp and Reyle 1993; Beaver 2001, etc.) also formally implements causal transitions between information states.

think of defeasibility as stemming from a case where a force counteracts another force which, without that intervention, would have led to some particular end. In contrast, it is not clear how one event might perturb or sum with another, especially if an event corresponds formally to the adjustment of a value on a scale. Neither is it altogether clear in what sense two events might help, oppose, prevent, or maintain one another. What is missing from event-talk is a clear notion of just how something external to the event can intervene to change the adjustment of the value along the scale; we certainly don't have a model of how values on various scales might interact with each other. An event-theorist might object that they are not in the business of modeling such interactions, which is fine, but we will argue below that this ability to model interaction allows for a perspicuous approach to several thorny empirical problems.⁹

This ability of forces to model intervention is especially appropriate in the analysis of a long-standing puzzle in the event-structure literature concerning the status of verbs of maintaining like *keep* and *stay* (Jackendoff 1975, a.o). They are clearly dynamic, as diagnosed by the usual eventuality tests; for example, the progressive gets an 'ongoing-now' reading.¹⁰

- (8) a. The rock is keeping the door open.
b. The door is staying open.

Their occurrence in the progressive shows that these verbs *can* be dynamic. However, the fact that they are interpreted habitually in sentences such as those in (9) with the simple present indicates that they *must* be dynamic:

- (9) a. The rock keeps the door open.
b. The door stays open.

In an event-based framework, it is difficult to understand what distinguishes such dynamic eventualities from stage-level statives such as *The door is open*. In standard neo-Davidsonian approaches, both kinds of predicates take a Davidsonian argument, and both make reference to a situation in which the *The door (is) open* holds, so there is no obvious formal rationale for their distinct aktionsart types. Further, in a semantics in which the Davidsonian argument is an event and events are characterized by change (see Lombard 1979; Cleland 1991, p. 245 for philosophical

⁹ It is interesting to note that facts (information, inferences) can interact in a defeasible fashion as well (Asher 1992, and see footnote 8 above). However, if we work only with facts, we give up the advantages of Davidsonian modification. We think forces are a good compromise between the Davidsonian evidence that make us want to anchor our ontological entity in the physical world (i.e., what events are good at), and the ability of these entities to interact with each other, even to construct different possibilities that proceed from a present situation selected by the speaker (i.e., what facts are good at; and see Kratzer 2013, e.g. for an indication that mainstream modal theory is moving in that direction).

¹⁰ Note that here we are using 'dynamic' to refer to predicates that in other literature are termed 'eventive', not in the more restricted sense employed in, e.g. Maienborn (2005) et seq. where 'dynamic' is reserved for the 'process' or 'happening' subclass of eventualities, those involving change. See discussion at the end of Sect. 5.3 below for discussion of why we believe this is the correct place to make the type-theoretic cut.

perspectives on how to characterize events in this fashion), it is difficult to understand the notion of a “eventive” eventuality like *keep* or *stay* in which nothing changes.

In contrast, the discussion of such verbs in the cognitive linguistics literature (Talmy 2000, e.g.) points out that the key difference between *The door was open* and *The door stayed open* has to do with the fact that the latter lexically encodes the presence of a force that intervenes to counteract the *ceteris paribus* result of an existing force; without the staying force, the door would not have remained open. The dynamic character of these predicates, we argue, reflects the fact that they involve a force, not that they involve an event or change of any kind.

To capture the notion of intervention that will allow us to account for cases of perturbation and maintenance, we will map conceptual forces to functions that have the form of the causal function described above in (7), with one small but important change: if we are to interpret the causal function we described above as an actual force—that is, as a token, rather than a type of force—it will necessarily have to have a single situation in its domain. So instead of a single broad causal function with many situations in its domain, we now have many small causal functions, each with a single situation in their domain, and each meant to map to a force token.

Intervention is then easily modeled using such force functions: two functions operating on the same situation can be summed to yield a different result than the result that one would get just from one of the two functions. Moreover, the ability to represent intervention is just one of the properties that make the notion of force suitable for addressing the empirical challenges we lay out above. Forces are intuitively spatially and temporally located, in that they arise from objects and their properties, which are themselves the components of spatially- and temporally-locatable situations. Lastly, forces can transform objects and/or their properties—that is, they create new situations from old situations. For any given situation, we can sum the forces acting in it to arrive at a net force, whose *ceteris paribus* effect will be to lead to the subsequent situation. ‘*Ceteris paribus*’ now means exactly that no outside forces intervene, where ‘outside forces’ are those that arise at least partially from entities outside the situation under consideration.

2 A selective tour of theories involving forces

In this section we take a very brief tour of some relevant existing work. We note that many researchers working on verbal semantics have turned to concepts such as ‘force’ and ‘energy’ even when they have not explicitly used these intuitions in their theories, or, when they have, have not provided a formal interpretation of them. Psychologists investigating intuitions about causation have developed a consensus that causal reasoning is driven by the perception of physical causal mechanisms connecting entities; this finding implicates forces. Finally, we address the state of the art within formal linguistics, especially the only existing formal framework we know of to use the notion of forces (van Lambalgen and Hamm 2003, 2005), and detail how our approach relates to it. This review serves to situate our proposal, developed in the following sections, that the causal function itself maps to a

conceptual force in the mental representation of the world, and ultimately, that the causal function takes the place of the event argument for dynamic eventualities.

2.1 Generalizing forces for verbal meanings

One might wonder whether the notion of ‘force’ can be generalized or abstracted in a useful way to all dynamic verbal meanings. We draw an analogy to a more familiar (at least to formal linguists) abstraction, one that abstracts away from physical motion to abstract motion, i.e., other kinds of change. This kind of abstraction is already present in Aristotle’s *Physics* (V.2):

...there can be motion .. in respect of Quality, Quantity, and Place... Motion in respect of Quality let us call alteration.... Motion in respect of Quantity ... is called increase or decrease.... Motion in respect of Place ... we may designate ... by the general name of locomotion....

As we have noted above, this insight has been incorporated into modern event semantics via the concept of a scale.¹¹ However, like physical motion, physical forces can be abstracted in the same way. Indeed, the prototypical cases of physical forces are those that may (or may not) produce motion of an object: think billiard balls. It seems reasonable, therefore, for a model of physical forces to be generalized to other domains in a similar sense, representing inputs of energy that may or may not cause changes of an abstract kind.

In the cognitive linguistic tradition, forces have been generalized in this way to form the core of all dynamic verbal meanings. Talmy (1976, 1981, 1985a, b, 1988, 2000) was the first to systematically apply the notion of force to meanings, starting from the common-sense insight that the meanings of certain expressions (e.g., *keep*, *help*, *prevent*, *despite*, etc.) are easily characterized in terms of force-dynamic interactions. Talmy’s insight has been explored and developed at length by others. Croft (1990, 1991, 1998, e.g.) follows Talmy in treating active verbal predicates as denoting force-dynamic relations, and in understanding causation through this lens. In a prototypical causal scenario, for example, “one participant acts on another participant and transmits its force to the other participant, which then undergoes a change” (Croft 1998, p. 83). Langacker (1991, p. 118) expresses this same idea in his ‘billiard-ball’ model of causation. Gärdenfors (2007) similarly extends the Talmian project to characterize verbal concepts as patterns of forces:

Even though our cognition may not be built precisely for Newtonian mechanics, it appears that our brains have evolved the capacity for extracting the forces that lie behind different kinds of movements and action.... In accordance with this, I submit that *the fundamental cognitive representation of*

¹¹ Aristotle does not extend this analysis to verbs of creation and destruction (V:1): “those which take the form of ‘becoming’ and ‘perishing’, that is to say those which imply a relation of contradiction, are not motions...” We assume, however, that it applies to all predicates; see our treatment of incremental theme verbs in Sect. 4.2 below. This generalization to change along a scale is pervasive in the lexical semantic, cognitive linguistic and formal literatures on events (see, among very many others, Levin and Rappaport Hovav 2008; Jackendoff 1975, 1991; Talmy 2000; Croft 1991; Ramchand 1997, 2008; Hay et al. 1999; Kennedy and McNally 2005; Kennedy and Levin 2008, etc.)

an action consists of the pattern of forces that generates it. (Gärdenfors 2007, p. 254)

The idea of a force is also represented in the formal literature as an intuition even where it has not been developed in a formal sense. Consider the following characterizations of intervention: “[W]e assume in reasoning ... that...other outside forces don’t intervene.” (Asher 1992, p. 491); “Landman points out that sometimes the forces out to stop an event are just too strong to allow a progressive sentence to be true.” (Portner 1998, p. 766; Landman does not actually use the word “force” in his 1992 article.) And of event structure: “The causal chain represented in an event structure is essentially a representation of the event as a series of force-dynamic relations.” (Rappaport Hovav and Levin 2001, p. 787).

Similarly, the idea of energy, closely related to the idea of force, has long been understood to be fundamental to the relationship between states, events, and to transitions from one to another.¹²

With a state, unless something happens to change that state, then the state will continue.... With a dynamic situation, on the other hand, the situation will only continue if it is continually subject to a new input of energy. [...] To remain in a state requires no effort, whereas to remain in a dynamic situation does require effort, whether from inside or outside. (Comrie 1976, p. 49)

Events and states also differ in *energeia*, or dynamism. Events require energy... [s]tates consist of an undifferentiated period, and continue unless something happens to change them. (Smith 1991/1997, p. 36)

The notions of force and energy, then, have been repeatedly implicated in the study of verbal meaning.

We turn now to psychological research on causation, which also suggests that the use of forces to account for verbal meaning is cognitively plausible. This suggestion stems from findings demonstrating the primacy of forces in causal reasoning, including when causal interactions are described linguistically using verbal predicates.

2.2 Research on causation implicates physical causal connections

There is a consensus in the psychological literature on causation that, as cognitive linguists would predict, people’s representations of physical reality do include information about causation physically anchored in space and time, over and above basic spatio-temporal properties such as motion. Michotte (1946/1963) hypothesized the existence of a dedicated causal perception mechanism, based on the results of experiments manipulating the temporal and spatial distance between interacting

¹² In related discussion, Bohnemeyer and Swift (2006) recognize the importance of force in the semantics of the English progressive for certain predicates, though they characterize ‘change’ rather than energy or force as the defining property of dynamic predicates. Many others have also described dynamic predicates as crucially involving ‘change’, including Dowty (1979), Kearns (1991), and McClure (1994). We address the question of whether dynamic predicates always entail change in Sect. 5.3 below, in our discussion of verbs of maintaining.

objects in animated sequences. Subsequent work building on his results confirm the primacy of causal perception, in adults and also in infants. For example, Leslie and Keeble (1987), using a preferential looking paradigm, showed that infants as young as six months old perceive causation. Subjects were shown a sequence where a hand is moving together with an object, in two conditions, either where the hand contacts the object or where the hand does not contact the object. When the sequence was run backwards, the infants were habituated in the non-contact condition, but looked more in the contact condition. This suggests that the infants interpreted (only) the contact condition as a causal event, which would seem quite different if run backwards in time.¹³ Walsh and Sloman (2011) present experimental evidence that adults tend to attribute causation only when there is the possibility of a physical causal mechanism between two events; in the absence of such a possibility, causation is attributed much less, even when there is a correlation between the two events. This result strongly suggests that in people's mental representation of a scene, they have access to the notion of a physical causal mechanism. Indeed, work by Wolff and others (Wolff and Song 2003; Wolff 2007; Barbey and Wolff 2007; Wolff et al. 2010, 2011; Wolff, *in press*) has extensively argued for the psychological validity of these proposals using experimental methods. These experiments show that the magnitudes and interaction of physical forces in a virtual environment can be very precisely predictive of speakers' choice of lexical items for causal predicates, and that the effects transfer unproblematically to psychosocial contexts.

Force dynamics allow us to model causal information as physically anchored in space and time. In fact, to the extent that causal information is always thusly anchored, force dynamics may be the best way to model causal information, since spatio-temporal information is crucial to forces, but not to other theories of causation. Copley and Wolff (2014) argue that the fact that spatio-temporal information is relevant to causal attribution indicates that a production/mechanistic theory such as force dynamics should be used to explain mental representations of causation, since alternative theories that represent causation in terms of dependencies (counterfactual, probabilistic, e.g.) do not in and of themselves anchor causal relations in time, but generally have to add a separate temporal variable.

Although the relevance of forces for models of causation is coming to be recognized in the psychological literature, investigation of the relationship between cognizing about forces and cognizing about causation is ongoing. White (2011), for instance, concludes that forces and causation are independent of each other, based on experimental results showing that subjects' impression of force magnitude in animated sequences is influenced by the size of a gap between two interacting objects, as well as by the presence of an intervening third object, but their impression of causation is not.¹⁴

¹³ See also Saxe and Carey (2006) for an overview of research on infants' representations of causation. This research tends to elaborate on the kind of causal knowledge that infants have, rather than questioning the idea that infants have causal knowledge.

¹⁴ There are two reasons why White's results do not derail the current project. One is that it is perfectly possible for there to be forces acting without the source of those forces being a subject of the main verb *cause* (used in White's instructions to subjects). The second is that, following ongoing debate in the philosophy of causation, we are happy to remain agnostic on the question of whether a single theory of

2.3 Forces in formal linguistics

Despite the ubiquity of the concept of ‘force’ in cognitive linguistics, and its usefulness in psychological investigations of causation, as far as we know, there have not been many formal linguists who have explicitly deployed the concept of force in the analysis of natural language phenomena. Those who have, have not gotten as far as providing a formal interpretation (we have in mind Vecchiato 2003, 2004; Zwarts 2010).

The only formal semantic framework to systematically employ the concept of ‘force’ that we are aware of is work by van Lambalgen and Hamm (2003, 2005). The latter authors share several convictions with the present approach. One such shared conviction is that the concept of *ceteris paribus*—their notion of ‘inertia’—is central to the treatment of verbal predicates, is ultimately derived from representations of causation, and should be treated directly in the model: possibilities are derived from causation, instead of the other way around as Lewis (1973) proposes. Another shared idea between the present approach and van Lambalgen and Hamm is that there is a kind of local determinism such that there is always a single “next thing” that happens:

We interpret fluents as sets of intervals of the form $[0, b]$ or $(a, b]$, where a is the instant at which an initiating event occurs, and b is the instant where ‘the next’ terminating event occurs. Talk about ‘the next’ seems justified due to the inertia inherent in fluents. (van Lambalgen and Hamm 2005, p. 47)

This same assumption underlies our contention (above) that it is appropriate to represent causation as a function, with a unique output.

However, it is important to note some differences between our proposal and van Lambalgen and Hamm’s as well. One basic ontological distinction in van Lambalgen and Hamm’s model is a temporal distinction, between instantaneous *events* and time-dependent (non-instantaneous) *fluents*. A fluent can either be a state such as “have momentum m ” or a force that continuously causes another fluent. The ontology of their system groups states and continuous forces together, but does not identify dynamic eventualities as a natural class distinct from states, which is needed to account for the adverbial data from Katz that we discuss below in Sect. 5.1. A more conceptual point is that while van Lambalgen and Hamm are of the opinion that it does make sense to talk about events “intervening” to change properties, we feel, as we have said above, that in the absence of a mechanism which can explain how an event (understood as a ‘change’) can itself initiate ‘change’, event-talk does not further our understanding of intervention in the same way that forces can. Thus we do not adopt van Lambalgen and Hamm’s model.

Footnote 14 continued

causation can account for *all* causal impressions (Anscombe 1971; Hall 2004; Copley and Wolff 2014, and especially Godfrey-Smith 2009 for an overview of the topic). Copley and Wolff 2014, suggest that spatio-temporal anchoring may be most relevant in the verb phrase, but less relevant outside it. In this paper we remain inside the verb phrase, for the most part, but leave open the possibility that other notions of causation operate outside of it.

We should also point out that, in contrast to both the cognitive tradition and van Lambalgen and Hamm's work, we seek to elucidate how the representation of force in the semantics interfaces with the syntax, taking into account recent models of the syntax–semantics interface. With a view towards this goal, we implement the notion of force in the next section.

3 A scaffolding for a force-theoretic semantics

Overall, despite the longstanding interest in, and inherent plausibility of, the idea of force, the difficulty of expressing force in current model-theoretic approaches has inhibited further development of this idea at the syntax–semantics interface. More than one researcher has expressed their interest, however, in a formalized theory of forces that would integrate naturally with what we have learned about the syntax–semantics interface (see, e.g., Dowty 1991, p. 575; Rappaport Hovav and Levin 2001, p. 785, n. 21, Beavers 2011a, p. 357). We provide a sketch of such a theory here; for a full model-theoretic treatment, and more detailed discussion of the philosophical and conceptual underpinnings, see Copley and Harley, [in preparation](#). For the brief presentation here, we will concentrate on force functions and situations, but a few words must be said first about the mapping between conceptual forces and conceptual situations on the one hand, and force functions and situations on the other.

3.1 Forces and situations

A conceptual force ϕ —a force as it is perceived and mentally represented—is an input of energy that arises from individuals and property attributions (or tropes) in an initial conceptual situation σ . A situation may have many such forces, indeed even a *pattern* of forces in the sense of Gärdenfors (2007). For simple spatiotemporal forces we can think of the representation as similar to a free-body diagram with one or a number of vectors, but such representations can be extended to more abstract cases—one of the central precepts of cognitive linguistic analysis.

The force summation calculation for a situation may be abstracted in a way that is massively multidimensional, including forces acting in directions other than the purely spatial. In our model, forces (inputs of energy) are what produce change. As noted above, we therefore conclude that forces are appropriate to model predicates denoting any type of change, not only change of location. Thus forces can arise that produce any of the kinds of changes that Aristotle alludes to: a 'grow' force (an input of energy that *ceteris paribus* provokes an increase in size), a 'redden' force (an input of energy that *ceteris paribus* provokes a change in color qualia), a 'straighten' force (an input of energy that *ceteris paribus* provokes a change in linear configuration), etc. In this way, we generalize from forces with purely spatiotemporal effects to those with all kinds of other effects.

We assume, then, that the cognitive system calculates the trajectory or development of that situation as a whole; Zacks et al. (2011) show, by observing

behavior and brain activity during near-future prediction tasks, that prediction of the development of a situation is psychologically real and is sensitive to transitions. This calculation may occur either by means of a truly force-based simulation or in a more abstract sense, recognizing that both modes may be interleaved (Hegarty 2004, e.g.). We refer to this calculation as ‘force summation’, recognizing that it takes into account the predicted consequences of all the forces represented in σ , not just those acting on a single entity.

The result of the summation is a force which produces the single situation σ' that happens next. We will call this force the ‘(conceptual) net force’ of the initial conceptual situation. The estimated outcome of the predicted trajectory is itself a situation, which may or may not differ from the initial situation; this is the mapping from situations to situations that corresponds to our formal treatment of force as a function.¹⁵

A conceptual net force ϕ is mapped to a (linguistic) force function f . Force functions are functions from linguistic situations to linguistic situations, where a linguistic situation s is a representation at the linguistic level of a conceptual situation σ on the conceptual level. A force function maps an initial linguistic situation to the linguistic situation that (represents the conceptual situation that) occurs if nothing external intervenes, i.e. the situation that occurs *ceteris paribus*. Note that our formal force function differs from the conceptual forces detailed in Croft (1990, 1991) and other cognitive linguistic approaches, in that force functions act on entire situations rather than acting on a particular object (the ‘force recipient’).

We can summarize our conception of situations and force functions in language as in (10) and (11) below:

(10) *(Linguistic) situations:*

A (linguistic) situation s corresponds to a conceptual situation σ , which is a spatiotemporally bounded “annotated snapshot” of individuals and their property attributions.

We stress that situations of both kinds in this sense can be *possibilia*: they may exist in a set of possible situations without necessarily occurring. We mean for (10) to be in line with interpretations of situation semantics/DRT approaches in which situations/DRSs are representations of mental models. We construct representations

¹⁵ Note that some forces are produced not by the behavior or motion of particular entities or objects, but are the result of the application of natural laws and generalizations, for example, the interaction of objects with mass and a gravitational field. Forces associated with gravity have been shown to be relevant to mental representations, especially in linguistic contexts (Freyd et al. 1988; Holmes and Wolff 2010, 2013). We consider the collected set of natural laws and generalizations to be the ‘normal field’: the propensity of certain individuals and properties to generate forces in particular circumstances unless prevented from doing so. An object with mass in a normal gravitational field will have weight and fall unless prevented from doing so; similarly, an object (e.g. foodstuffs) with organic material in a normal temperate climate will have rotting potential and degrade, unless prevented from doing so, etc.

of conceptual forces within the mental model of the state of affairs, by relating a conceptual situation σ to a conceptual force ϕ , as in (11) below. This conceptual force ϕ is mapped to a force function:

(11) *(Linguistic) force functions:*

A (linguistic) force function f is a function from an initial (linguistic) situation s to the (*ceteris paribus*, linguistic) final situation s' , which corresponds to a conceptual net force ϕ . The conceptual force ϕ is a (mental representation of) an input of energy that arises from all the individuals and their property attributions in a conceptual situation σ .

To represent situations in a Montagovian semantics (Montague 1970), we assign them the primitive type s .

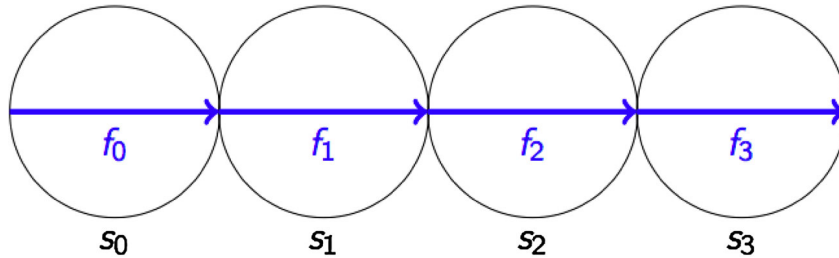
(12) *Type of situations: s*

Type of forces: $\langle s, s \rangle$

As we have said above, we propose to represent forces as functions from situations to situations. The idea behind the $\langle s, s \rangle$ type is again an assumption that we share with van Lambalgen and Hamm, that there is such a thing as the next situation (see also Kamp 1979; Bittner 1998 for an event-based version of this point). That is, if you have an initial situation and a force is applied, and no stronger force intervenes, the final situation results—not a different *set* of situations but a single situation, since a single physical force can only lead from a situation to another, possibly similar situation, and never to a set of situations. This means that the only functions of type $\langle s, s \rangle$ that can be mapped to conceptual forces in our system are those with a single situation in their domain and a single situation in their range. For convenience we will abbreviate type $\langle s, s \rangle$ as type f .

Because conceptual forces arise from individuals and their properties in conceptual situations, we can relate forces to situations, not only on the conceptual level, but on the linguistic level as well. When a force arises from all the individuals and properties in a situation, it is the net force of the situation. The net force, as discussed above, yields a unique output situation. Since we assume local determinism, we may speak of causal chains of situations or forces, with the net force of one situation, when applied to that situation, resulting in a unique successor situation. The diagram below depicts a causal chain made up of situations (the vectors are depicted *in* the bubbles because the conceptual forces arise from the conceptual situations represented by the bubbles).

(13) Causal chain of situations with net forces



We assume that for a given linguistic situation s_n , we can always recover its net force f_n .

(14) $net(s)$ =: the *net* force of s

By means of the inverse of the function net , net^{-1} , we can define two other functions that will be useful when we refer to forces and situations in denotations, as we will see below in Sects. 4 and 5. Given a (particular, spatiotemporally bounded) force f , we can refer to both the situation of which it is a net force, and the situation that follows. The initial situation of f is simply the situation s of which it is a net force. The final situation is the situation that results when f takes s as its argument.¹⁶ The functions $init$ and fin are defined with respect to the inverse function of net .¹⁷

- (15) a. $init(f) = net^{-1}(f)$
 b. $fin(f) = f(net^{-1}(f))$

We define as well a situation's successor and predecessor situation:

- (16) a. $suc(s) = fin(net(s))$
 b. $pred(s) = suc^{-1}(s)$

As usual, individuals will be represented by variables x, y, z, \dots and will have type e . Predicates are represented by lowercase Roman letters p, q , etc. When they are (stage-level) statives, they are predicates of situations, type $\langle s, t \rangle$, and when they are dynamic, they are predicates of forces, type $\langle f, t \rangle$.

When an individual's property has a leading role in generating a conceptual force, we will say that the individual is the *source* of the corresponding linguistic force. We discuss the notion of 'source' in further detail in Sect. 4.5 below, although

¹⁶ As noted by a reviewer, the job done by $fin(f)$ could equally be described in terms of the $init$ function, as $fin(f_0) = init(f_1)$; we could thus define a single function that takes forces and returns situations, instead of two such functions as in (23). However, we retain the distinct names for their intuitive ease when relating with the initial and final situations of a force to a lexical entry; cf. the 'beg(e)' and 'end(e)' functions in Kennedy (2012).

¹⁷ For any function F whose domain is over x and range is over y , a function G is the inverse function of F (written as F^{-1}) iff for all x , $G(F(x)) = x$, or equivalently, $F(x) = y$ and $G(y) = x$.

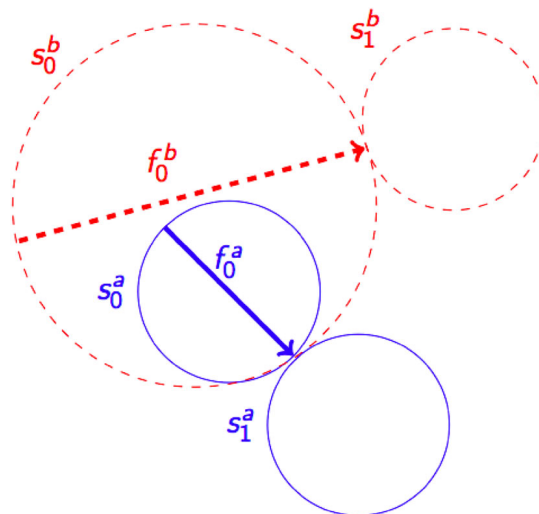
without coming to an exhaustive definition of “leading role”. In any case, the ‘source’ relation will serve the same purpose in our denotations as ‘agent’ or ‘causer’ serves in event-based frameworks.

3.2 Efficacy and the *ceteris non paribus* cases

We argued above that the notion of intervention seems to be key to understanding the *ceteris non paribus* cases. Built into this notion is a distinction between internal (or judged relevant) circumstances and external (or unexpectedly relevant) circumstances; an intervention is an interaction where a force arising at least partially from external entities and/or properties interacts with internal forces. This distinction can be modeled quite easily by exploiting the speaker’s judgment as to which entities and properties go into the initial situation. Not incidentally, the categorization of entities and properties as internal or external to the initial situation will also be crucial to reconciling our assumption of local determinism with branching possibilities.

We begin with a definition: a situation s_0 is *efficacious* just in case its *ceteris paribus* successor situation occurs. Consider the diagram in (17) below. When choosing an initial situation s_0 , the speaker chooses (the) one that she judges to be efficacious. For example, she may judge that s_0^a is the efficacious situation; in that case, given her conception of the contents of that situation, she is judging that no forces arising at least partially from outside s_0^a will perturb f_0^a , so that s_1^a will indeed occur. Of course, something from outside s_0^a may well intervene, in which case perhaps the efficacious initial situation is s_0^b and what will occur is *its* successor s_1^b . So while there is local determinism, what eventually happens is not determined by the situation the speaker picks. This diagram exemplifies how the force-theoretic framework deals with non-determinism; the causal chains picked out by superscripts a and b correspond rather well to “histories,” as in Thomason (1970).

(17)



The notion of efficacy will allow us to better understand our *ceteris non paribus* cases, that is, the non-culminating accomplishments and the English progressive.

We propose that the difference between forms that entail culmination of accomplishments (that is, entail that s_1 comes about, as in an English perfective) and forms that do not (like the Tagalog neutral form) is that the former presuppose that the initial situation is efficacious, while the latter introduce no such presupposition.¹⁸ As we mentioned above, this makes the non-culminating forms illustrated in (2–5) above more basic than the forms that entail culmination, contra inertia world treatments of non-culminating accomplishments such as Koenig and Muansuwan (2000), Matthewson (2004), and Tatevosov (2008), and this is consistent with their comparatively unmarked morphological structure.

The meaning of the English progressive in (1) is different from that of non-culminating accomplishments. We assume that Aspect maps from predicates of forces to predicates of situations, so it is type $\langle\langle f,t \rangle, \langle s,t \rangle\rangle$ (this assumption is analogous to the common assumption that aspect maps from event predicates to temporal predicates; Klein 1994; Kratzer 1998). As a proposal, we suggest a denotation for progressive sentences that takes a predicate of forces (π , the denotation of the vP), and a situation (s_0 , the situation provided by tense), and says that, according to the speaker, π holds of the net force of s_0 .

$$(18) \llbracket \text{progressive} \rrbracket = \lambda\pi\lambda s . \pi(\text{net}(s))$$

The efficacy entailment that is otherwise apparent in perfective sentences seems to disappear in the progressive. The question, then, is whether this presupposition is somehow cancelled in these progressive sentences, or whether, perhaps, it actually arises from perfective or some other aspect (as in Singh 1998; Altshuler 2013, e.g.) rather than in the vP , so that the presupposition is simply not introduced in the case of the progressive. We set investigation of these and other options aside for the purposes of this paper.

This concludes our brief sketch of what a force-theoretic semantic model should, at minimum, include. In the remainder of the paper we will investigate how this force-theoretic framework can be implemented at the syntax–semantics interface, given a specific set of assumptions about the structure of the relevant syntactic representations. The logical forms (i.e., meanings) we propose could easily be recast in an alternative representation of lexical-semantic structure, even if one does not wish to make the specific assumptions we make about the syntax (or indeed any assumptions at all about the syntax). However, we feel strongly that the use of syntactic evidence to constrain and inform theories of meaning enhances the relevance of both semantic and syntactic theorizing.

¹⁸ In fact, we have proposed elsewhere that there are forms which presuppose that the initial situation is *not* efficacious: ‘frustratives’ in Tohono O’odham (Copley and Harley, *in press*). Futures and futurates also seem to have a presupposition related to the success of the eventuality (Copley 2002, 2008, 2009). In the cases at hand, not all of the presupposition tests give clear results to decide whether efficacy is part of the assertion or a presupposition. However, in these other cases the analogue of efficacy (or non-efficacy, in the case of frustratives) is more clearly a presupposition, in that it survives questioning, negation, etc. So on balance, we think that also in the cases discussed here, efficacy is probably a presupposition.

We will first consider how force-theoretic representations integrate with syntactic argument structure, and subsequently, in Sect. 5, we will show how this integration accounts for distinctions between dynamic and stative predicates.

4 Argument structure and event structure

We now turn to the integration of the force-theoretic framework with one current understanding of verbal argument and event structure, focusing on the representation of different eventuality types and their argument-structural properties. We will first consider how the various subclasses of dynamic predicates are composed, beginning with changes of state. Recall that we have proposed that the foundational distinction between stative and dynamic predicates is that stative predicates are predicates of situations, type $\langle s,t \rangle$, while dynamic predicates are predicates of forces, type $\langle f,t \rangle$.

4.1 Changes of state

The recent explosion of work on the argument structure/event structure interface has resulted in the development of a broadly accepted syntactic decomposition of the VP, into two or more phrasal projections, the maximal one typically labelled 'vP'. We adopt several core assumptions of the decomposition approach in our proposal below, mostly those which have to do with the view that the internal structure of vP is generally isomorphic with the internal structure of events. However, any analysis which approaches subeventual structure in terms of hierarchically structured lexical-conceptual representations will easily be able to interpret our proposed recasting of the key components in force-theoretic terms. For change-of-state predicates in particular, we assume that each of the various subpredicates involved project independently in the syntax, and compose to generate the vP's denotation (Van Valin 1990; Hale and Keyser 1993; Marantz 1997; Borer 1998, 2005; Kratzer 1996; Ramchand 2008, among many others). For the most part, the syntactic literature treats change-of-state predicates like *melt* as having (at least) two components: a causing event and a result state (though cf. Piñón 1997 and Marín and McNally 2011, where it is argued that some inchoative predicates are truly instantaneous). In the current proposal, the causing event corresponds to a force which is applied to a situation of which the resulting stative predicate does not hold. This force, *ceteris paribus*, yields a situation where the resulting stative predicate does hold, following Dowty (1979).

Since each subcomponent of a change-of-state predicate is introduced in a separate syntactic projection, a change-of-state-denoting vP minimally contains two phrasal projections.¹⁹ The lower portion of such a complex vP is taken to denote the resulting stative predicate. We assume it has the syntax of a small clause (SC) (see, among others, Hoekstra and Mulder 1990; Harley 2005; Ramchand 2008), which

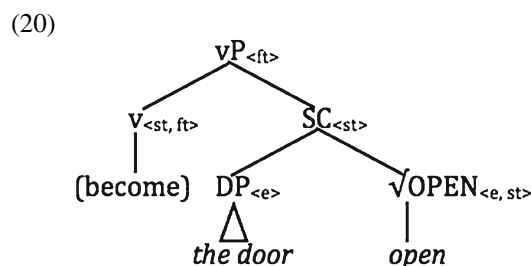
¹⁹ One perspective on the historical development of theories about the syntax/event-structure relationship can be found in Rosen (1999), as well as in many of the references cited above.

denotes a predicate p of situations (type $\langle s,t \rangle$). The head of the upper portion of the complex vP , v° , thus takes a predicate of situations p as its argument and ensures that the vP node denotes a predicate of forces (type $\langle f,t \rangle$). The v° head introduces a force f and asserts that p holds of the final situation of that force—that is, it identifies $fin(f)$ as a p situation. The v° head of a change-of-state predicate further imposes the requirement that the initial situation of the force is a $\sim p$ situation²⁰ (recall that by the definition in (15a) $init(f) = s$ if and only if $net(s) = f$, so the initial situation of f is the situation of which f is the net force).

An inchoative sentence such as *The door opened*, for example, will contain a BECOME v° head with the denotation below. In a language like English where sentences with telic predicates systematically entail completion, we propose that v introduces the presupposition that $init(f)$ is efficacious; that is, that $fin(f)$ occurs, as in (19).

- (19) $\llbracket v_{\text{BECOME}} \rrbracket = \lambda p \lambda f . p(fin(f))$
 presupposed: $\sim p(init(f))$, $init(f)$ is efficacious

The structure of the vP in this case is as in (20); the highest node is a predicate of forces which is destined to be taken as an argument by aspect. Recall that aspect is itself of type $\langle \langle f,t \rangle, \langle s,t \rangle \rangle$, so the combination of aspect with (20) yields a node at AspP (not shown) that denotes a predicate of situations, type $\langle s,t \rangle$ (i.e., a proposition).



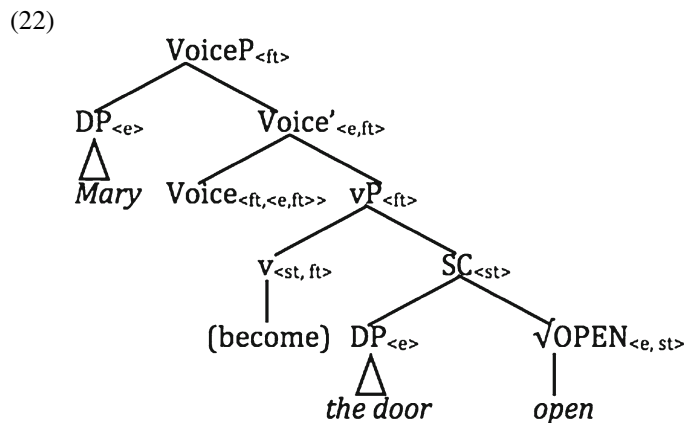
In the transitive alternant (*John opened the door*), we assume that the external argument is introduced by a Voice head, as argued by Kratzer (1996), Pylkkänen (2002), Cuervo (2003), Harley (2012a), among many others. This head takes a

²⁰ We are here abstracting away from the fact that most such small clauses are headed by scalar predicates which denote relations between degrees, individuals and situations; see Hay et al. (1999), Kennedy and McNally (2005), Kennedy and Levin (2008), Levin and Rappaport Hovav (2010), a.o. Nothing relevant to the discussion here hinges on the adaptations necessary to fully represent the scalarity of the embedded predicate; however, such machinery is certainly necessary to capture (at least) the interpretation of open-scale degree-achievement changes of state such as *warm, cool* for which a binary $p/\sim p$ opposition is intuitively problematic. Bobaljik (2012) shows that deadjectival verbs of this class always behave morphologically as if a comparison of degrees is involved, and argues for an embedded comparative element within the vP . In such cases we assume that the small clause predicate includes this element; $\sim p$ is 'x does not have property q to a degree greater than d in s_0 ' and p is 'x has property q to a degree greater than d in s_1 ', where q is the property denoted by the embedded predicate. See also Kennedy (2012) and Copley and Harley (2014) for related discussion.

predicate of forces as its complement and returns a function from individuals to a predicate of forces; it then composes with the external argument and returns a predicate of forces which asserts that said individual is the source of the force, whether by virtue of its inherent properties or (if animate) its intention to act.

$$(21) \llbracket \text{Voice}_{\text{ACTIVE}} \rrbracket = \lambda \pi \lambda x \lambda f . \pi(f) \ \& \ \text{source}(x, f)$$

The structural representation of the relevant portion of the transitive alternant (below AspP and TP) is below:



Examining the types associated with each node in the trees in (20) and (22) above, we note that no special composition operation need be invoked to bring together the different parts of the complex vP (compare, e.g., the rule of Event Identification introduced by Kratzer (1996) and widely deployed elsewhere).

Note that the vP and VoiceP in these change-of-state predicates have the type $\langle f,t \rangle$, which is the type of a predicate of forces, that is, a dynamic predicate. As noted above in Sect. 3.2, we assume that what aspect applied to dynamic predicates does is to take a predicate of forces (VoiceP) and relate it to a (reference) situation, so that the resulting AspP projection has the type $\langle s,t \rangle$. This is analogous to the familiar event-theoretic idea (e.g., Klein 1994; Kratzer 1998) that aspect takes predicates of events and relates them to times, though we leave open the question of how, or indeed whether, times are introduced higher in the structure. Projections higher than AspP also have the type $\langle s,t \rangle$, with Tense relating the situation introduced by Aspect to the situation of utterance.

This hypothesis about the relationship of Aspect to predicates of forces provides us with our treatment of the standard observation that certain adverbials produce ambiguity in combination with change-of-state predicates. In the analysis here, sentences containing such predicates will contain at least two maximal projections of type $\langle s,t \rangle$: the small clause denoting the result state (the predicate of $fin(f)$), and the AspP that is the result of composing Aspect with the predicate of forces. Adverbials which compose with predicates of situations, then, will be able to modify either of these projections, and two interpretations will result. Standard

cases are *again* adverbials and *for X time* adverbials, which both compose with predicates of situations:

- (23) a. The cup was on the table again.
 b. The cup was on the table for three hours.
- (24) Mary put the cup on the table again.
 a. restitutive: It was on the table, then off it, then Mary put it on the table again.
 b. repetitive: Mary had put it on the table before. She did the same thing again.
- (25) Mary put the cup on the table for two minutes.
 a. low reading: The cup was on the table for two minutes.
 b. high: Mary put the cup on the table several times in the space of two minutes.

We assume that adverbials such as *for two minutes* compose via Predicate Modification, though nothing particularly hinges on this choice.

- (26) a. $\llbracket \text{again} \rrbracket = \lambda p \lambda s . p(s)$
 presupposed: $\exists s'$ prior to $\text{pred}(s) : p(s')$
 b. $\llbracket \text{for two minutes} \rrbracket = \lambda s . \text{duration}(\tau(s)) = \text{two minutes}$

Given these denotations, these predicates will adjoin freely to the embedded small clause predicate of situations in (20) and (22) above to yield the low reading. Similarly, they will adjoin to the higher AspP, following the composition of aspect with VoiceP, to yield the high reading.

A brief note on the derivation of surface form from these abstract syntactic structures: We adopt a ‘realizational’ view of the traditional Y-model of syntactic derivation, essentially that of Distributed Morphology (Halle and Marantz 1993), according to which phonological content is inserted into terminal nodes of the morphosyntax on the phonological branch of the derivation. Syntactic operations apply to transform the base-generated structures that are subject to interpretation illustrated here; for example, the $\sqrt{\quad}$ (‘Root’) node in (22) above undergoes head-movement to v , and the resulting complex X° constituent $[\sqrt{\quad} v^\circ]_{v^\circ}$ is realized as the verb *open* (in some languages, the v° node receives an overt morphological instantiation, as it does, perhaps, in English forms like *clar-ify*). In other cases, as in (33) below, the root is combined with v° via m-merger, rather than head-movement, via what we might call the Matushansky gambit (Matushansky 2006). See Marantz (1984), Bobaljik (1994) for earlier applications of this idea, and Folli and Harley (2013) for an application to manner of motion predicates. See Harley (2012b) for a recent overview of the implications of a Distributed Morphology view of surface realization for semantic analysis.

With our approach to change-of-state predicates in place, we can turn to an analysis of other predicate types.

4.2 Coming into and going out of existence

Change-of-state accomplishments are not the canonical accomplishment predicate. The cases which have been the subject of the most investigation (Verkuyl 1972; Krifka 1989 et seq.) are accomplishments with an 'incremental theme' as an internal argument, as with the creation verbs below:

- (27) a. Mary made a painting.
b. Mary made music.

In these cases, the direct object comes into (or, in the case of verbs of destruction or consumption, goes out of) existence, and it is the complete existence (or non-existence) of the object which determines the endpoint of the transition. In the current framework, one possibility we might consider is to treat these cases as involving a predicate of forces where the final situation is one in which an existence predicate holds. If we include this null existence predicate in the syntactic structure, as the predicate of a small clause as in (20, 22) above, however, we would predict a low-scope reading for the sentence in (28a) where *for two hours* would take the temporal trace of the existence of the painting as its argument; compare (28b) to (25a):

- (28) a. Mary made a painting for two hours.
b. A painting existed for two hours.

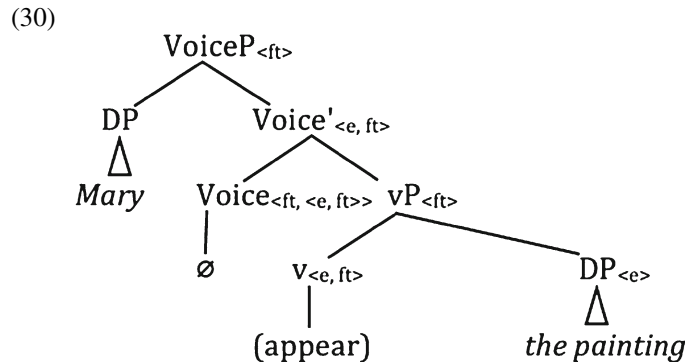
There is no reading for (28a) in which a painting exists for two hours. The only reading available is the high reading, where *for two hours* adjoins to the AspP. We take this to indicate that there is no lower node of type $\langle s, t \rangle$ to which the adverbial phrase *for two hours* can adjoin.

The assertion of the existence of an incremental theme, or its non-existence in the case of destruction/consumption verbs, must therefore be semantically, rather than syntactically introduced. These verbs must be predicates of a force which has the effect that an individual which does not appear in the initial situation exists in the final situation. We have said before that situations are composed of individuals and their properties; we now characterize this relationship between situations and individuals for the grammar as a part-of relation $<$. We will say that $x < s$ holds if and only if the individual corresponding to x is in the conceptual situation corresponding to s .

An incremental theme, then, will be the complement of a v head which takes an individual and introduces a predicate of forces whose initial situation is one in which the individual does not exist and whose final situation is one where it does. Note that we are still assuming that the external argument is introduced by the Voice head above, asserting that some (other) individual is the source of the force; the v head itself merely asserts that an individual comes into existence. We therefore gloss it as 'appear', rather than 'make'. The denotation of this v head is given in (29) below. It ensures that the entity corresponding to x is not in the initial situation of the force, and is in the final situation of the force. As before, in English there is an efficacy presupposition associated with the v head.

- (29) $\llbracket V_{\text{APPEAR}} \rrbracket = \lambda x \lambda f . [x < \text{fin}(f)]$
 presupposed: $\sim[x < \text{init}(f)]$, $\text{init}(f)$ is efficacious

The structure of the VoiceP in a sentence like that in (27a) or (28a) above, then, is illustrated in (30) (the full sentence would have at least an AspP and TenseP projection above VoiceP, contributing the content that ensures that the verb is ultimately realized as *made*):



The VoiceP of the sentence in (27b) has the same structure as the sentence in (27a), but with *music* as the complement of the *v* head. (27a) and (27b) however contrast in an important way that we have not yet addressed: with a bounded object such as *a painting* the predicate is telic, while with a unbounded object like *music* the predicate is atelic. One test for telicity is that telic predicates are acceptable with *in* phrases, as in (31a) while atelic predicates are marginal, or receive an inchoative reading (Vendler 1957); thus (31b), if it has any acceptable reading, means that Mary started to make music at the end of an hour (see also fn. 27 below).

- (31) a. Mary made a painting in an hour.
 b. Mary made music in an hour.

The difference between the “bounded” and “unbounded” nature of the events in (27a,b) has been accounted for in the event-theoretic literature via Krifka’s (1992) homomorphism function, which maps subparts of incremental theme objects to subparts of events; unbounded objects thus yield unbounded creation/destruction events. Within the force-theoretic framework, this relationship will hinge on the nature of causation and its interaction with the (non-)cumulative nature of the entity whose existence is the result of the force.

To implement this idea, we first must specify what *in* phrases mean. We propose, following Higginbotham (2000) and Giorgi and Pianesi (2001), that *in* phrases specify the time between the beginnings of the temporal traces of two Davidsonian arguments; for us these arguments will be the situations referred to by *init*(*f*) and

$fin(f)$.²¹ The *in* phrase adjoins to the vP which is type $\langle f,t \rangle$ (and thus, incidentally, is not compatible with stative predicates, which are type $\langle s,t \rangle$). Let “ $\tau(s_0) - \tau(s_1)$ ” be the part of the temporal trace of s_0 that does not overlap any part of the temporal trace of s_1 .

$$(32) \llbracket \text{in an hour} \rrbracket = \lambda f . \textit{duration}(\tau(\textit{init}(f)) - \tau(\textit{fin}(f))) = \textit{an hour}$$

In (31a), this works exactly as one might expect: for (31a) to be true, s_0 , the initial situation of the *Mary-make-a-painting* force, lasts an hour, until a painting exists, and it is at this point in time that s_1 begins.

To see how *in an hour* interacts with *Mary make music* in (31b), we have to go into a little more depth. For this explanation, it is crucial that we have nowhere claimed that a result occurs after its cause, despite any temptation one might have to read temporal relations into our bubble diagrams of causal chains of situations. Aside from the discussion of *for* and *in* adverbials, where we had to appeal to a temporal trace function and a *duration* function, the force-theoretic framework says nothing about times at all, and in particular, nothing about the temporal relationship between a situation and its successor; our notion of succession of a situation is a causal notion (s_1 is the result of s_0), not a temporal notion (s_1 is after s_0). In short, temporal structure and causal structure are different, although related.

They are not entirely independent of each other, however. As Shibatani (1973) and Talmy (1976) point out, there are two temporal relationships that can exist between a cause and its effect. Either the cause provokes an effect that happens after the cause, or the cause provokes an effect that happens at more or less the same time as the cause (with at most a slight lag). Shibatani calls the first “ballistic causation” and the second “controlled causation”. Jackendoff (1990, p. 138) points out the same notions were identified much earlier by Michotte (1946/1963), who called them ‘launching’ and ‘entraining’ causation. Talmy makes the same distinction, between “point” and “extent” causation; McCawley (1976, p. 119) distinguishes “continuous causation”, and van Lambalgen and Hamm (2005, pp. 43–45) propose “instantaneous” versus “continuous” causation. In entraining (or continuous, or controlled, or extent) causation, temporal parts of causes are mapped to temporal parts of their effects. This mapping is analogous to Krifka’s (1992) homomorphism between events and affected objects.

We assume, then, that it is perfectly possible for the (causal) successor of a situation s_0 to happen at more or less the same time as s_0 . In (31b), for example, the initial situation s_0 (i.e. *init*(f)) includes Mary and certain of her properties, such as her intention to make music. The consequence of these properties is that she is the source of a *Mary-make-music* force such that some music starts to exist. But because of the mass nature of *music*, the moment there is a bit of music, then s_1 , that is, *fin*(f), the result of the *Mary-make-music* force, is occurring as well; s_1 includes

²¹ Note that definition of force allows reference to *fin*(f) without having to look down further in the tree than the denotation of the $\langle f,t \rangle$ node (either VoiceP or vP) that it is adjoined to; thus we avoid having either to violate compositionality (see Dowty 1979, p. 136 on exactly this issue, in his discussion of Tedeschi’s 1973 account of progressive), or to explicitly chain Davidsonian arguments together (as Higginbotham 2000 does). It is exactly for this kind of case that we need to be able to identify a situation in terms of a force f through the use of the functions *init* and *fin*.

this music. Thus the reason that the *in* phrase is unacceptable is that there is usually taken to be no interval between the beginning of s_0 and the beginning of s_1 , because of nature of the existence criteria for a non-quantized individual like music.²²

For coerced inchoative readings for stative predicates, such as *The door was open in an hour*, where the door is understood to become open at the end of an hour, we implement a standard coercion account driven by the type difference between the *in* phrase and the stative. Namely, we add a head that introduces a force whose final situation is a door-open situation, so that the *in* phrase can be adjoined to a type $\langle f, t \rangle$ node (for more on type-driven coercion in our framework, see Sect. 5.2 below).²³ Type-driven coercion is not, however, available for the inchoative reading of Activities with *in* phrases, such as *Mary made music in an hour*, since the vP *Mary made music* is already of type $\langle f, t \rangle$. On the other hand, nothing in our world knowledge prevents the onset of s_0 , the causing situation of Mary's music, from beginning somewhat before the onset of s_1 . For example, Mary could have the intention to make music for a while (an hour perhaps) before starting to make music. Her intention is one of the properties in s_0 from which the Mary-make-music force arises. Then, as desired, the temporal difference between the beginning of s_0 and the beginning of s_1 is indeed an hour; in this way the inchoative reading of dynamic predicates is derived.

4.3 Manner verbs, resultatives, and motion predicates

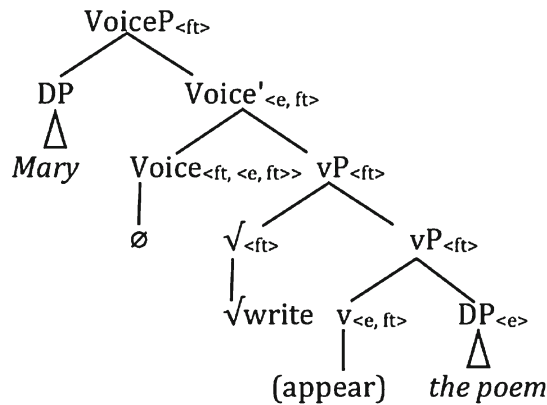
Verbs of creation and destruction are typically not as simple as 'make' or 'destroy', in which nothing is specified about how the creation or destruction transpires. In an articulated subevent syntax, more complex verbs are considered to modify the initiation or causation subevent (see, e.g. Levinson 2007; Ramchand 2008; Embick 2010). In the present framework, the lexical content of such verbs will be treated as predicates of forces, adding information about the nature of the force which is causing the creation or destruction of the incremental theme object.

We propose to adjoin such verb roots as manner modifiers of the vP, composing with it via Predicate Modification (as described above at the end of 4.1, postsyntactic m-merger will conflate the $\sqrt{\text{write}}$ node with the v node to produce the surface form):

²² Some incremental theme verbs, such as *read*, do not entail the creation or destruction of an object; for *read*, the relation which holds in the initial and final situation is not one of inclusion or exclusion but one of being read. The crucial claim is that the absence of a low-scope reading for *for-an-hour* adverbials in such cases indicates the absence of an embedded small clause in their syntactic argument structure representation, so that they necessarily do not involve the v_{BECOME} predicate.

²³ Why must the coercion stop with v_{BECOME} ? Why can't a VoiceP be added to introduce a source for the coerced inchoative force? I.e., why can't we then create **Mary is the door open in an hour* with the meaning 'Mary opened the door after an hour'? Part of the answer is surely that coercion only *needs* the lower v head; the higher Voice head is superfluous. But strictly speaking, we cannot rule this structure out.

(33)



The verbal root $\sqrt{\text{write}}$ denotes a property of forces as in (34a), in particular the property that is shared by certain *patterns* or *configurations* of force (in the sense of Gärdenfors 2007) that speakers agree to be writing (recall that multiple forces in the same situation can always be summed together abstractly to yield a single force). The denotation of the higher vP will be as in (34b); the poem does not exist in the initial situation, and does exist in the final situation, and the kind of force that brings it thus into existence is a writing force.

- (34) a. $\lambda f. \text{WRITE}(f)$
- b. $vP = \lambda f . \llbracket \text{the poem} \rrbracket < \text{fin}(f) \ \& \ \text{WRITE}(f)$
 presupposed: $\sim[\llbracket \text{the poem} \rrbracket < \text{init}(f)]$

The semantics of manner modification is thus straightforward. Indeed, this approach will suffice to analyze manner modification in contexts other than creation/destruction; since manner verbs are predicates of forces, they will always be eligible to adjoin to any node of type $\langle f, t \rangle$, and if the conditions on morphological Merger are met, thence be able to conflate with the v head and become the main verb of the clause. Resultatives and manner-of-motion constructions in English, as in (35a) and (35b) respectively, can be productively treated in exactly the same way. Instead of adjoining to type $\langle f, t \rangle$ predicates headed by v_{APPEAR} , such manner expressions will adjoin to type $\langle f, t \rangle$ predicates headed by v_{BECOME} :

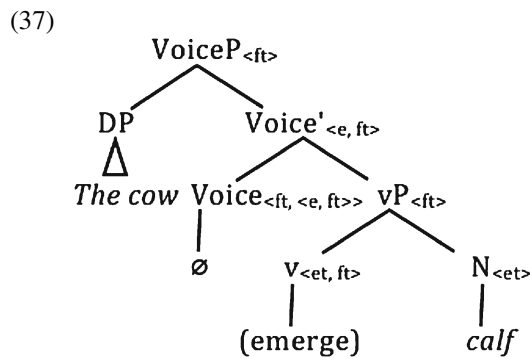
- (35) a. Mary hammered the metal flat.
- b. Mary slouched toward Jerusalem.

We now turn to address activities, semelfactives, and their fellow-travellers, the verbs of birthing.

4.4 Activity predicates, or, what *calving* has in common with *dancing*

We begin by examining a relatively narrow verb class first considered in detail by Hale and Keyser (1993, e.g.): denominal verbs of birthing. They propose that such predicates involve an incremental theme object which is syntactically incorporated to become the root of the verb itself, as in *The cow calved*, *The mare foaled*, *The otter pupped*.²⁴ We adopt this approach, incorporating a bare nominal predicate into a v head which is semantically the equivalent of v_{APPEAR} except in that it selects a predicate of individuals rather than an individual as its internal argument:

- (36) $v_{\text{EMERGE}} = \lambda p \lambda f . [\exists y < \text{fin}(f) : p(y)]$
 presupposed: $\sim[\exists y < \text{init}(f) : p(y)]$, *init*(f) is efficacious



Treating such objects as incorporated equivalents of incremental themes is motivated by the fact that the telicity of these predicates is sensitive to the sortal quality of the incorporated predicate of individuals: incorporated count nouns produce telic verbs and incorporated mass nouns produce atelic ones (Harley 2005). For verbs describing types of birthing, the key contrast arises between *calve* (telic) and *spawn* (atelic), but verbs such as *bleed*, *sweat* and *drool* illustrate the same point: when the produced individual is a substance, rather than a spatially-bounded item, the resulting predicate is atelic, as expected if the incorporated nominal is behaving as an incremental theme:

²⁴ The object coming into existence in transitive cases of v_{EMERGE} comes out of the body of the source of the force. That is, although one can *bleed* or *calve*, one cannot *poem* or *cake*. This fact suggests that there is something about the incorporation into v that requires the source to be the literal physical source of the object, not merely the source of the energy which provokes the coming into being of the object. We don't know why this should be so, but it will be relevant to investigation of the nature of the Source relation in future work. See Folli and Harley (2008) for discussion of the notion of 'teleological capability', which may also be relevant here.

- (38) a. The cow calved in an hour.
 b. The mare foaled in an hour.
 c. #The baby drooled in an hour.
 d. #The wrestler bled in an hour.

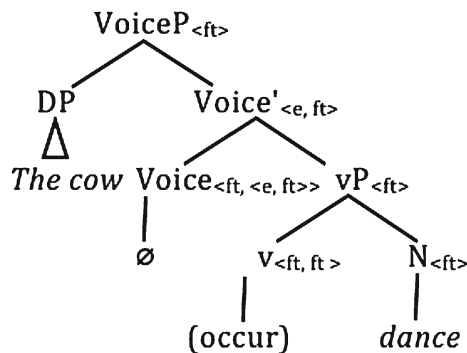
Harley (2005) claims that the Agentless analogue to such predicates (lacking the Voice projection) are denominal weather verbs, where the verb is formed from the noun denoting the emergent precipitation: *rain, snow, sleet, hail*, etc.

We are now in a position to consider the force-theoretic treatment of Activity predicates. Again, we follow Hale and Keyser (1993) in observing that such predicates are typically associated with a cognate noun (e.g., *sing/song, work/work, dance/dance*), and that their cross-linguistic counterparts are frequently complex predicates, composed of a light verb and a bare nominal. We treat these in the same way as the incremental theme and verb-of-birthing cases above, again with a type-theoretic difference in the argument selected by the light verb. In these cases, we assume that the incorporated nominal is a predicate of forces, and we gloss the verbal predicate as ‘occur’, rather than ‘emerge’. We assume that a force can be “in” or “part of” a situation the same way an individual can:²⁵

(39) $[[\text{dance}]] = \lambda f . \text{dance}(f)$

(40) $v_{\text{OCCUR}} = \lambda \pi \lambda f . [\exists f' < \text{fin}(f): \pi(f')]$
 presupposed: $\sim[\exists f' < \text{init}(f): \pi(f')]$, *init*(f) is efficacious

(41)



Verbs of emission, such as *glimmer, gleam, beep, ring*, etc. are also predicates of forces in this same sense, derived from their cognate nouns. Again, the few such

²⁵ We assume that transitive Activities like *push the cart* are based on a root of type $\langle e, \langle ft \rangle \rangle$, see Harley (2005) for discussion.

predicates which occur without a source-specifying Voice head are weather predicates; *thunder* is the best example of this in English.²⁶

This analysis of Activities, it should be noted, refers to a similar causal structure as the analysis of Accomplishment predicates: the predicate refers to a force that provokes another situation. However, our Activities differ from our accomplishments in two ways. The first is that the N complement of *v* is a predicate describing a force that is instantiated in the result situation, rather than a result-state predicate of that situation, like [the door open]_{SC}; this in turn means that v_{OCCUR} is type-theoretically distinct from v_{BECOME} .

The second way in which Activities differ from Accomplishments in the force-theoretic framework is that the temporal relationship between the causing force and the effect is different, as we proposed above in Sect. 4.2. We propose that continuous causation is what happens in Activities: the result happens simultaneously with the causing force, instead of afterward. The temporal simultaneity is crucially not expressed in the semantics; the logical form makes no reference to temporal structure at all. Rather, it is a fact about the world that the particular force has a result that occurs either after or at the same time as the force itself.²⁷

This dissociation of the causal structure from the temporal structure may not be plausible in a theory based on events, to the extent that it is implausible to think that there are two distinct events going on at the same time during an (e.g.) dancing event (one theory with two Davidsonian arguments in Activities, that of Ramchand (2008), crucially places the events in a temporal sequence). However, in a force-theoretic framework, it is not implausible to think that there is an exertion of energy in a dance-like manner, that results, more or less simultaneously, in a situation where there is a dance.

Semelfactives such as *knock*, *flash*, and *pat* (Smith 1991/1997) are like Activities in that they name predicates of forces, and occur as complement to v_{OCCUR} . Semelfactives, however, impose an additional requirement on the subsequent

²⁶ It is possible to make v_{BECOME} more like v_{EMERGE} and v_{OCCUR} . All three take a predicate as an argument: v_{BECOME} takes a predicate of situations *p*, v_{EMERGE} takes a predicate of entities *P*, and v_{OCCUR} takes a predicate of forces π . In the latter two cases, we have existentially bound a variable (*x*, and *f*, respectively) of which the relevant predicate is predicated. We could treat v_{BECOME} the same, and existentially bind a situation *s* such that *p*(*s*); it requires only the assumption that a sub-situation can be part of a situation in the way an individual or a force can be part of a situation. This equivalent v_{BECOME} would then have the denotation in (ib) instead of the one we proposed above in (19), repeated here as (ia):

- (i) a. $v_{\text{BECOME}} = \lambda p \lambda f . p(\text{fin}(f))$
presupposed: $\sim p(\text{init}(f))$ (= (20))
- b. equivalent $v_{\text{BECOME}} = \lambda p \lambda f . [\exists s < \text{fin}(f): p(s)]$
presupposed: $\sim [\exists s < \text{init}(f): p(s)]$

However, we continue to prefer (ia) because it is simpler.

²⁷ As is well-known, there is a coerced reading of Activities with *in an hour* modifiers, (e.g., *Mary ran in an hour*) to the effect that there is a specifically planned satisfactory amount of running that Mary did in an hour. This is a case, like ordinary incremental-theme telics, where the result—here the point where Mary's running reaches an agreed-upon or accommodated standard—occurs at the conclusion of the application of the Mary-running force. That is, a sortal/quantized interpretation is imposed on the incorporated predicate of forces. The same would apply to *Mary made music in an hour*, etc.

situation s_1 : The s_1 of the force named by a semelfactive verb is required *not* to be a situation with an instance of a verbing force in it; this requirement gives semelfactives their ‘cyclic’ quality, as noted by Talmy (1985a). Activity predicates do not have such a requirement.

Again, as predicates of forces, these roots are predicted by virtue of being type (f,t) to participate freely as manner predicates (composing with vP via Predicate Modification) in change-of-state and resultative constructions (i.e., with v_{BECOME}), and are equally expected to appear as activity predicates (i.e., with v_{OCCUR}), a pattern which has long been observed in the lexical-semantic literature:

- (42) a. She hammered.
 b. She hammered the metal flat.
 c. She laughed.
 d. She laughed him out of the room.

Indeed, they can also combine as manner predicates in incremental theme constructions (i.e., with v_{APPEAR}), as expected given their type, producing the well-known hyponymous object and cognate object cases:

- (43) a. She danced a jig.
 b. She sang a song.

Verbs of birthing can also participate in cognate object/hyponymous object incremental theme constructions, as in *She calved a beautiful heifer* or *She sweated bullets/blood/Gatorade*; similarly, in robust manner-incorporating languages like English, they can occur as manners in change-of-state structures:

- (44) a. She sweated her way to Carnegie Hall.
 b. He bled to death.

In the framework here, the well-formedness of such cases (which are subject to cross-linguistic parameterization) must result from a type-coercion operation which lifts these predicates of individuals into predicates of forces, enabling them to behave as manner modifiers.

This latter observation raises the possibility that all of these nominal verb roots (including *dance*, *sing*, etc.) are predicates of individuals that are type-shifted to predicates of forces when they appear as manners. In that case, v_{EMERGE} would be used for both the birthing and activity verb classes. However, there are empirical reasons to think that the ontology of nominal predicates needs to include both predicates of individuals and predicates of forces. Activity roots in the event-based literature are treated as predicates of events (see, e.g. Marantz 2001; Levinson 2007; Embick 2010) because the corresponding nouns interact differently with predicates like *begin*. Nouns like *dance* can serve as subjects of *begin*: *The dance began (at 2 o'clock)*. Nouns like *calf* or *cake*, however, cannot: *#The calf began (at 2 o'clock)* (see Pustejovsky 1995; Pykkänen et al. 2009 for further discussion of *begin* as a rigid type selector). In this framework, such facts motivate our

treatment of activity roots like *dance* or *sing* as predicates of forces, type $\langle f,t \rangle$.²⁸

A welcome result of treating activities as referring to the final situation of a force is that it suggests a characterization of Japanese *-te iru*. As, e.g., Ogihara (1998) shows, *-te iru* tends to be translated as the English progressive in combination with activities, as in (45a), and to be translated as an English resultative in combination with telic predicates, as in (45b).

- (45) a. Taroo-wa warat-te iru.
 Taroo-TOP laugh-TE be.PRES
 'Taroo is laughing.'
 b. Taoru-wa kawai-te iru.
 towel-top dry.INTR-TE be.PRES
 'The towel has dried.'

Ogihara's unification of these readings takes advantage of partial events, saying that a *-te iru* sentence is true when an event occurs at the reference time and *e* is a part of a larger event. A more recent account of *-te iru* (Nishiyama 2006) is rather similar to Ogihara's, but uses both partial events and inertia worlds as per Portner (1998). However, as we have argued above in Sect. 1.1, the move to partial events is problematic in that nothing is said about the conditions under which one event can be 'part of' another, when the culmination of the larger event may or may not happen. The move to inertia worlds may be problematic in the other direction: there is semantics in the logical form that could (and, we think, should) be put into the cognitive system.

In our framework, the denotation of *-te iru* need only say of the reference situation that it is the final situation of a force with the desired property. Recall that "*pred(s)*" picks out the predecessor situation of *s*.

$$(46) \llbracket -te\ iru \rrbracket = \lambda p \lambda s . \pi(\text{net}(\text{pred}(s)))$$

For a telic predicate, the final situation is the result state that begins after the initial situation, yielding the resultative interpretation, while for an Activity, the final situation is a situation that is almost entirely cotemporaneous with the initial situation, so these cases receive an ongoing reading.²⁹ Such an account of *-te iru* fits

²⁸ Roy and Soare (2013) present an argument that the event involved in such nouns is at the conceptual or lexical level, while grammatically they are predicates of individuals (type $\langle e,t \rangle$). We will not take up this idea here although we find it interesting, especially as, given the dual nature of forces as functions (in the linguistic system) and inputs of energy (in the conceptual system), we also need to make reference to a mapping from logical form to a conceptual level that is not the lexicon. See Copley and Harley (in preparation).

²⁹ A third reading is an 'experiential perfect' (Comrie 1976) reading:

- (i) Taroo-wa zyuk-ken-mo ie-o tat-te iru.
 Taro-TOP 10-CL-as.many.as house-ACC build-TE be-PRES
 'Taro has built as many as ten houses.'

Nishiyama's theory accounts for this perfect reading, in addition to the other readings, via a free property variable, which is asserted to hold of the present situation and whose value is determined pragmatically. This free variable is intriguing in light of the fact that some cases that Talmy brings under the umbrella of

very well with the idea (Hasegawa 1996) that *-te* acts as a link between clauses conveying that the *-te* linked clause describes a situation that precedes the situation described by the main clause in a causal or intentional sequence, an idea that is mysterious if *-te* is held to have a partial-event imperfective reading as in (45b).

4.5 Agents and Causers as sources of forces

Thus far, we have treated the external arguments of all Aktionsart types identically, namely, as the subject of a ‘source’ predicate expressing a relationship between an individual and a predicate of forces, introduced by the Voice head.³⁰ We now provide some explication of our notion of ‘source’, connecting it to the literature on external argument thematic relations more generally, and to the launching/entraining causation distinction from the force-dynamic literature which has already been alluded to above.

Animate and inanimate external arguments can exhibit distinct interactions with argument-structure and Aktionsart classes. The literature on thematic relations has examined this distinction in detail, without coming to any consensus on the qualia that underlie these interactions. A common distinction is made between volitional and non-volitional entities, which are often termed “Agents” and “Causers” respectively (of course, a volitional entity can be a Causer if its action is non-volitional). The Agent/Causer distinction also bears on the Aktionsart type of the predicate: Causers seem to be more restricted, in that they typically only appear as the external arguments of change-of-state predicates, while Agents can also be the external arguments of Activity and Semelfactive predicates.

Analyses differ, however, on whether such distinctions are taken to be visible in the grammar. Ramchand (2008), for example, subsumes all external arguments under a single ‘Initiator’ role. Hoekstra (1984) and Higginbotham (1985) deny any particular relational content to the external argument role at all: external arguments are simply notationally designated as such, without giving an event-structural or thematic ‘name’ to their relationship with the predicate. In contrast, Beavers and Zubair (2013) propose that the Agent/Causer distinction depends on whether the effector of a change is a dynamic or a stative event.

So far in our development of the force-theoretic framework we have made a similar assumption, treating both Agents and Causers as sources of forces. We use the term ‘source’ in quite a literal sense to indicate that in both cases, the argument

Footnote 29 continued

forces, such as but not limited to intentions, require reference to propositions. Elsewhere (Copley 2010; Copley and Harley, *in press*) we have proposed a “second-order” force function of type $\langle s, \langle s, t \rangle \rangle$ (cf. “first-order” force functions of type $\langle s, s \rangle$) to account for these. In this case, we find it plausible that Taroo’s building of houses may have irreducible and indeed force-like relationships with propositions, such as the fact that Taroo has built as many as ten houses. This is a good example of the fact that a force-theoretic approach need not always conflict with existing proposals about aspect and telicity; it has the potential, however, to provide reasons *why* certain temporal and causal relationships would be expressed in language the way they are, namely because they are related to a certain representation of causal structure.

³⁰ Note that we do not appeal to syntactically-expressed chains of subevents: the difference between a causative and an inchoative verb is simply the explicit inclusion of a source argument, introduced by an active Voice head. Anything that looks like chaining emerges from the semantics for forces.

introduced by Voice is the origin of the energy that is put into the situation; they thus play a ‘leading role’ in determining the net force of the situation. There is at least one way in which Agents are distinct from Causers, which is that they become the sources of forces by virtue of their intentions, rather than by virtue of their physical properties. Copley and Harley ([in press](#)) formulate a Law of Rational Action to mediate the relationship between having an intention and generating a force (see also [Kamp 2007](#) and [Copley 2010](#) for explicit proposals for linking intentions to actions). Agents are subject to the Law of Rational Action because they have the ability to intensionally represent a goal. Another obvious difference is that Agents have the ability to create energy spontaneously, as if by “magic”, while, for instance, a thrown object is dependent on its motion and mass for the (kinetic) energy it provides to the situation. In general, we expect that distinctions which in previous work have been ascribed to the distinction between Agents and Causers have their basis in facts about the relative abilities of Agents and Causers. We discuss the two aforementioned special abilities of Agents here, beginning with the notion of energy-generation and its connection to launching versus entraining causation and Aktionsart classes, and then returning to briefly investigate some consequences of volitional Agents’ ability to intensionally represent goals.

Agents can be the external arguments of Activities as well as change-of-state predicates, as in (49a). In contrast, Causers cannot be the external argument of Activities, as reflected by the need for the telicizing resultative adjective *raw* in (47b), or the particle *up* in (47d) (see [Folli and Harley 2004](#) for extensive discussion, among others).

- (47) a. John rubbed his skin.
 b. The saddle rubbed his skin *(raw).
 c. The cow chewed its cud.
 d. The washing machine chewed the laundry *(up).

Recall that Activities in the force-theoretic framework involve what McCawley ([1976](#)) and van Lambalgen and Hamm ([2005](#)), e.g. call “continuous causation,” where a result situation occurs at more or less the same time as the initial situation, perhaps with a brief initial lag. We would like to suggest that the explanation for the contrast in (47) turns on the idea that the ability to generate energy throughout a situation is necessary for continuous causation (compare the notion of ‘event-to-event’ homomorphism from Levin and Rappaport Hovav [2005](#); Rappaport Hovav [2008](#); or the notion of ‘entraining’ causation in contrast to ‘launching’ causation Michotte [1946/1963](#); Shibatani [1973](#), etc.). Beavers and Zubair ([2013](#)) show that in Sinhala, so-called ‘volitive’ marking depends on exactly the property of being able to generate a dynamic eventuality, which maps naturally to the notion we are discussing here.

Volitional entities have the ability to generate energy quite generally; Folli and Harley ([2008](#)) have argued that the notion of Agent should be extended to include certain special inanimate objects which are ‘teleologically capable’ of generating the energy needed to produce certain specific forces (e.g., *The kettle whistled*, *The wind moaned*). This energy arises also in a kind of magical way, in that it is not

perceptibly transmitted spatiotemporally from other objects. However, unlike for volitional Agents, it is not generated in response to the interaction of intentions with the Law of Rational Action. Consequently, such inanimate but teleologically capable Agents are more constrained in the kinds of forces they can generate; in typical examples it is only the one or two kinds of forces they were designed to produce (in the case of artifacts) or stereotypically do (as in the case of the wind, the sea, etc.).

Like the ability to generate energy, the ability to represent a goal will also have repercussions for the kinds of forces that can be generated by an entity. It is the Agent's representation of the goal that unifies the disparate sub-forces of picking up a pen, cogitating, writing, redacting, etc. into something we understand as a "write-a-poem" force with a final situation in which a poem exists; a Causer cannot write a poem because it lacks the intention that would glue these subforces together as goal-directed action (see also Tovena 2011, e.g. for a related idea). Likewise, an activity of getting paint on something is only 'painting' if there is an Agent that intends it to be (#*The explosion at the paint factory painted it*, Kiparsky 1997, see also McCawley 1971; Fodor 1981). The ability to intensionally represent goals also proves crucial to futurates such as *The Red Sox play/*defeat the Yankees tomorrow*, as in Copley (2008, 2014), and *have-causatives* (Copley and Harley 2010).

The properties that Agents have of being able to generate energy and (for volitional Agents) being able to represent a goal can therefore account for contrasts between Agents and Causers. For the cases we have discussed, we need not posit that the grammar has access to these properties; rather, these are simply constraints on the kinds of forces that can be produced by any particular entity, on the basis of its abilities. Copley and Wolff (2014) further develop this point to argue that the key property that subsumes both Agents and Causers is that of causal disposition, where volitions are a special kind of disposition.

If this conceptual story is the whole story, we would expect that argument structure would not be sensitive to any distinction between Agents and Causers, in particular, the ability to represent goals intensionally should not be visible to the grammar. So far, the only thing the grammar sees is the *source* relation, which pertains to Agents and Causers alike. If this is the case, however, something more should be said about the status of a certain body of empirical evidence that seems to suggest the need for an Agent/Causer distinction in the grammar.

4.6 Cause-introducing PPs

One set of arguments for a distinct Causer or Cause role comes from the debate over anticausativization approaches to inchoative predicates. As we will see, it has been argued that certain data from adjoined PP phrases pick out all and only Cause arguments in dynamic predicates.³¹

³¹ Causes, as discussed in the event structure literature, seem to be a subset of the argument which in the thematic role literature are called Causers; in particular, Causers include all non-volitional initiators of changes of state, while Causes are specifically only the events which are the first argument of a CAUSE relation.

The *by*-phrase in a passive introduces exactly the set of external arguments that active Voice can (Williams 1981), and is ill-formed with unaccusative predicates (see Bruening 2012 for a recent account). In contrast, *from*-phrases seem to introduce only Cause external arguments, and are well-formed with unaccusatives. This range of facts is illustrated in (50). The *by*-phrase can introduce anything that can be the external argument of the corresponding transitive active clause, but cannot co-occur with the unaccusative. In contrast, *from* can only introduce non-agentive external arguments: the sentence in (48c) is not felicitous in a case where John is the Agent of an action that warms up the sidewalk (though it is acceptable if it is his body heat that warms the sidewalk).

- (48) a. The sidewalk was warmed up by John/by the sun.
 b. The sidewalk soon warmed up from the sun.
 c. #The sidewalk warmed up from John.

This compatibility of *from*-phrases with inchoatives, and the special constraints on the kind of arguments that *from*-phrases can introduce, have been taken to show the need for causing events in the semantic representation of inchoative predicates, and such data has been central to the anticausativization versus causativization debate over the causative/inchoative alternation (Chierchia 1989/2004; Piñón 2001; Alexiadou et al. 2006; Kallulli 2006; Schäfer 2007, among many others).

Along the same lines, Chierchia (1989/2004), introduces another test which he claims picks out all and only sentences with either Agent or Causer subjects: the availability of *by Xself* adverbials. Levin and Rappaport Hovav (1995), Koontz-Garboden (2009) and Beavers and Zubair (2013) also adopt this diagnostic. Since *by Xself* is possible with inchoative predicates such as the one in (51), Chierchia concludes that inchoatives are underlying two-place causative relations with the external Causer role bound by reflexivization to the internal Theme role (with reflexivization overtly marked in languages like Italian).

- (49) The door opened by itself.

We argue, in contrast, that neither *from*-PPs nor *by Xself* PPs actually indicate the presence of a causer or causing event in the semantics of these predicates. With respect to *from*-PPs, our contention is based on the little-commented-upon fact that such PPs can modify stative predicates, as well as dynamic ones:

- (50) a. The sidewalk was warm from the sun.
 b. John was pink from embarrassment.

It would seem implausible to analyze stative predicates like *be warm* or *be pink* as introducing a causing eventuality argument in addition to the eventuality argument representing the state; they do not behave like dynamic eventualities (*#The sidewalk was being warm*; *#John was being pink*., etc.) Consequently, it seems clear that *from*-PPs do not *diagnose* the presence of a Cause argument in the semantics of the predicates to which they adjoin (though they may *introduce* one).

Similarly, Alexiadou et al. (to appear), in line with the conclusions of Piñón (2001), Alexiadou et al. (2006), Schäfer (2007) a.o., argue at length that *by Xself* phrases do not diagnose all and only predicates with Agent or Causer subjects. They give examples where the antecedent of *by Xself* cannot be a causer, as in adjectival copula constructions:

- (51) 300 million years ago the climate became warmer by itself and without human intervention.

They conclude, with Reinhart (2000), Pykkänen (2002), among others, that *by Xself* simply denies the participation of any identifiable Agent or Causer; in the current framework, it would deny the existence of a Source argument for the net force of the preceding situation. They conclude that anticausative predicates lack an implicit external argument of any kind (see also Schäfer and Vivanco 2013 for explicit argumentation against Koontz-Garboden's reflexivization approach).

While we will not provide a full treatment of the properties of these PP adjuncts here, the tools made available in the force-theoretic framework do suggest an intuitively plausible line of analysis for the *from*-PPs. The event-theoretic literature has argued that the DP argument introduced by a *from*-PP names a causing event; this corresponds here to the natural idea that such a DP names a force (remember we used a similar idea above in Sect. 4.4 in discussing the meaning of NPs such as *dance*). In this light, consider the data in (52) below. (52a) and (52b) contain DPs that seem like good candidates for names of forces; both DPs are felicitous in a *from* PP. *The ball* (52c) seems to just possibly be elliptical for *the action/motion/energy/force of the ball* and with that interpretation, the *from* phrase is just possible. (52d) is infelicitous, even if we try to understand it thus elliptically; *the elephant* cannot be elliptical for *the force exerted by the elephant*. The ill-formedness in (52e) is similar to the ill-formedness in (52d). In the last two (or three) examples, the name of an Agent cannot be elliptical for the name of a force exerted by that Agent.³² In short, *from*-phrases require as arguments DPs that name forces.

- (52) a. The window broke from the earthquake
 b. The window broke from the ball's hitting it.
 c. ?The window broke from the ball.
 d. The floor broke from the *(weight of the) elephant.
 e. The window broke from John*('s hitting it).

It is also worth noting that such *from*-phrases are compatible not just with causative change-of-state predicates (as suggested by the 'cause' analysis in the event literature) but also with unergative predicates, as in (53), as long as the force

³² The exact conditions on this kind of ellipsis require further investigation, but we note that it seems to be impossible to understand an individual-denoting DP as an elliptical name for a force when the force is produced by the interaction of the individual with the normal field (footnote 16) via either the gravitational field, as in (52d), or the Law of Rational Action, as in (52e), as opposed to a (more) direct transmission of energy. These constraints are like the conditions on the application of 'reference transfer functions' discussed by e.g. Jackendoff (1997, p. 54), with respect to cases like 'The ham sandwich wants a cup of coffee', referring to a restaurant customer, not a ham sandwich.

named by the DP argument of *from* directly provokes the force described by the predicate (f_0). Call this provoking force f_{-1} , as it (and the situation s_{-1}) are directly causally precedent to s_0 (and thus to f_0). There are two ways that this can happen, depending on whether source of f_0 generates the force by virtue of the Law of Rational Action (i.e., voluntarily), or by some other means (i.e., involuntarily). If the source is voluntary, as in (53c, d), then f_{-1} can only be a desire or volition; this is the same as saying that in voluntary action, the most immediate “cause” of the force is always volition. If, on the other hand, the source is involuntary, then f_{-1} can be something other than a desire, as in (53a,b).

- (53) a. Mary cried out from anger.
 b. John groaned from the pain.
 c. Sue called John from a desire to see how he was/#from the pain.
 d. The university was shut down (by the governor) from a desire to protect the students/#from the riots.

Insofar as it is plausible for DPs to be names of forces as well as individuals (just as, in the event-theoretic literature, DPs can name events, pronominally refer to events, etc.) the force-theoretic framework gives us the tools needed to address the range of facts here. A *from*-PP adjoins to a predicate of situations (presumably AspP, as do *for*-PPs, see Sect. 4.1 above) and introduces a relation between the force named by its internal argument and a situation s , namely that the force was the net force of the situation preceding s :

$$(54) \llbracket \text{from} \rrbracket = \lambda f \lambda s . \text{net}(\text{pred}(s)) = f$$

Such force-naming DPs can also serve as external arguments introduced by the Voice projection, as in *The earthquake broke the window*. In event-theoretic approaches (e.g. Bach 1986) events are analogous to individuals; in the present framework the same will be true of forces (though see footnote 46 for further discussion).

5 Dynamic and stative predicates

Now that we have presented our implementation of the syntax–semantics interface for verbal argument structure, we take a step back to consider the relationship between the technical apparatus presented here and Davidson (1967)’s original data. One of the major kinds of evidence supporting the reification of events was the interpretation of adverbial modifiers. We differ from Davidson in what we think the arguments he discovered really are—as we have argued above, we consider them to be reified forces rather than reified events—but we are good (neo-)Davidsonians in supporting modification by means of arguments.

While Davidson’s article explicitly treated only what he called “action sentences”, it was evident that certain stative sentences can also pass many of his

modification tests; this has been taken to show (e.g. Kratzer 1995) that such statives have to have a Davidsonian argument as well, as shown in (55):

(55) Mary was happy in the living room.

However, it is clear that not all modifiers are created equal. Thomason and Stalnaker (1973) pointed out that certain adverbials that are good modifiers of action sentences (e.g. *quickly*) cannot modify stative sentences, and proposed to distinguish the two types of predicates with a diacritic to which adverbial modification is sensitive. However, they did not introduce a clear type-theoretic contrast to distinguish these two classes of eventualities.

We would like to draw attention to the fact that the force-theoretic framework provides a more fine-grained ontology for Davidsonian arguments.³³ We have two types of arguments that can serve Davidson's purposes, situation arguments and force arguments. In fact, we have already made use of this distinction in accounting for the distribution of two temporal adverbial phrases: *for*-phrases (see (26b)) take situation arguments, while *in*-phrases (see (32)) take force arguments. This gives us the ability to attack the so-called 'eventive' versus 'stative' distinction with type-theoretic tools, though for reasons that should be evident, we will prefer the term "dynamic" to the term "eventive" when referring to non-stative predicates.

In this section, we will analyze several of the conundrums related to this distinction in terms of our type-theoretic difference between forces and situations. We will first show that it is easy to analyze Katz's (2003) generalization about Thomason and Stalnaker's two classes of adverbials. We then provide an analysis of aspectual coercion in response to type clash with the selectional requirements of progressives and imperatives. We subsequently demonstrate that the force/situation distinction gives us the tools needed to propose a novel formal analysis of a mainstay of the force-dynamic literature: 'maintaining' predicates such as *keep* and *stay*.

5.1 Adverbial selection

As alluded to above, Thomason and Stalnaker (1973) observed that certain adverbial modifiers (what they called 'VP-adverbs') are incompatible with stative predicates, although others ('S-adverbs') can modify both stative and dynamic predicates:

³³ Of course, we need to consider as well whether it is *too* fine-grained. An anonymous reviewer reminds us that one of the attractions of Davidson's proposal was a simplified mapping between nominal and verbal modification: adjectives and adverbs are both predicates of a basic-type argument, either an individual or an event. The ontology we adopt here is more complex. On reflection, we expect mappings between predicates of individuals and predicates of situations to be as straightforward as it was for Davidson. The only issue arises when we consider how modifiers of predicates of *forces* might map to the nominal domain. But note that the adjectival form *quick* of the predicate of forces *quickly* combines only with nominals which themselves are felicitously treated as predicates of forces, as diagnosed by, e.g., the *begin* test (see discussion in Sect. 4.4 above). Compare, e.g., *a quick lunch* with *#a quick calf*. This being the case, it seems that the finer-grained division we propose here are likely to be appropriate in the nominal domain as well as the verbal domain.

- (56) a. *John loved Mary quickly.
b. John kissed Mary quickly

- (57) a. John probably loved Mary.
b. John probably kissed Mary.

They proposed that the sensitivity of VP-adverbs such as *quickly* to the difference between stative and dynamic predicates indicates that there is a need to distinguish the two classes via a diacritic visible to VP-adverbs.

Katz (2003) points out that there is a crucial asymmetry in the classes of adverbs which are sensitive to this feature. While there are adverbs which modify dynamic predicates and are incompatible with stative predicates, as in (58), there are no adverbs exhibiting the reverse pattern, compatible with only stative predicates—the pattern illustrated in (59) does not occur, i.e. there is no adverb with the distribution of *blickly*. All adverbs capable of modifying stative predicates can also modify dynamic ones, as in (60). Katz calls this the Stative Adverb Gap.

- (58) a. John kissed Mary quickly.
b. *John knew Mary quickly.

- (59) a. *John kissed Mary blickly.
b. John knew Mary blickly.

- (60) a. John kissed Mary a long time ago.
b. John knew Mary a long time ago.

What's needed to account for the Stative Adverb Gap is for dynamic predicates to share something with stative predicates, so as to enable combination with adverbs like *a long time ago*, but also have an additional property, which stative predicates lack (Galton 1984; Herweg 1991, e.g.), and which allows them to combine with adverbs like *quickly*. The failure to combine should be the product of a type-clash. Katz proposes that statives lack a Davidsonian event argument. From this it follows that only dynamic predicates are compatible with adverbials that select for event arguments (i.e. Thomason and Stalnaker's VP-adverbs). But since both dynamic and stative predicates ultimately become predicates of times higher in the structure, they are both modifiable, at these higher nodes, by temporal adverbs.

The force-theoretic framework also provides a type distinction between dynamic and stative predicates on which such adverbial selectional behavior can depend: dynamic predicates are predicates of forces, while stative predicates are predicates of situations.³⁴ As in Katz's approach, it further automatically provides the shared property, because predicates of forces become predicates of situations via the

³⁴ Beavers and Zubair (2013) also propose to distinguish type-theoretically between states and events, while maintaining the overall notion of a supercategory of 'eventualities'; however, their implementation does not obviously allow for the capture of the one-way implicational relation between the categories that Katz's data requires.

operation of Aspect.³⁵ Consequently, we expect any adverb that can compose with stative predicates to also be able to compose with dynamic predicates, a property we already have seen above in our treatment of *for*-modification (Sect. 4.1).

Because stage-level stative predicates in the force-theoretic approach have a situation argument, it is possible that the present analysis has an advantage over Katz's, in allowing us to maintain Kratzer (1989)'s distinction between stage and individual level stative predicates, which is lost in Katz's approach. In the current proposal, stage-level statives have a situation argument, and hence also a temporal trace, and we can happily assume that individual-level statives are predicates of individuals, as Kratzer proposed.³⁶

5.2 Coercion

As Katz shows, the availability of a type-distinction between stative and dynamic predicates also has significant advantages in accounting for the dynamic readings acquired by some stative predicates in morphosyntactic frames that normally require dynamic predicates. For example, although the English progressive was one of Vendler's original tests for stative versus dynamic predicates (as in (61)), it has long been recognized that certain predicates thought to be stative because they can occur in episodic readings with the simple present, as in (62), can nonetheless occur with the English progressive, as in (63) (Partee 1977; Dowty 1979; Smith 1983; Bach 1986; de Swart 1998; Rothstein 2004, a.o.):

- (61) a. John was smoking.
 b. #John was knowing French.
- (62) a. Mary loves her new neighbors.
 b. John is very smart about this.

³⁵ An anonymous reviewer points out that not all adverbials that combine with both stative and dynamic predicates plausibly combine above Aspect, e.g., *intentionally*, which refers to properties of the subject argument and therefore might naturally be thought to adjoin below Aspect. In that case, such adverbs must have two types, ⟨s,t⟩ and ⟨f,t⟩. We don't see this as a problem, however, since this point pertains only to adverbials that are related to the subject's intentions such as *regretfully*, *considerately*, etc. There is independent evidence that intentions and their results can be either stative or dynamic, and that the stative–dynamic difference, even for intentions, is visible to the grammar. See the discussion on the representation of goals in Sect. 4.5, and the contrast in (i), which shows that *have* causatives (which encode the matrix subject's intention) can be either stative or eventive, and that this difference affects aspectual selection in the usual way.

- (i) a. Mary has/*is having John running errands.
 b. Mary has/is having John run errands. *has on episodic reading

We conclude that it is appropriate to allow adverbials like *intentionally* to modify both stative and dynamic predicates.

³⁶ It is possible, also, that treating stage-level statives as predicates of situations, rather than predicates of times, provides (like Kratzer's) a more perspicuous account than Katz's of certain non-temporal adverbials that can modify such predicates: In a sentence like *Mary was happy in the kitchen*, for example, it seems that the Davidsonian argument being modified by the location predicate is not obviously temporal in character.

- (63) a. Mary is loving her new neighbors.
 b. John is being very smart about this.

Likewise, some stative predicates can occur in imperatives, which are also supposed to select dynamic predicates, as shown in (64) and (65):

- (64) a. Smoke!
 b. #Know French!
- (65) a. Love thy neighbor!
 b. Be smart about this!

Rather than multiply lexical entries to account for the apparently variable eventiveness of these predicates, we assume (with Moens and Steedman 1988; Smith 1991/1997; de Swart 1998, a.o.) that these are examples of coercion. Other prototypical cases of coercion have been profitably treated as type-driven; for example, sentences like *John began the book* arguably coerce an entity into an event (Pustejovsky 1995; Pyllkänen et al. 2009); see also Bale and Barner (2009) on coercion between count and mass readings of bare nominals. In event-based frameworks without a type distinction between stative and eventive predicates, the coercion of a stative to an eventive predicate cannot be treated as type-driven.

We can take advantage of the present type-theoretic distinction between stative ($\langle s,t \rangle$) and eventive ($\langle f,t \rangle$) predicates to motivate an account of coercion in progressive statives. The progressive, we proposed above in (17), selects an $\langle f,t \rangle$ predicate. When a progressive or an imperative is applied to a stative predicate like *John love Mary*, the type mismatch triggers a type shift from $\langle s,t \rangle$ to $\langle f,t \rangle$.³⁷

It is worth noting that although it has been claimed that the subject of coerced stative progressives has to be volitional, this is not actually the case. Rather such subjects are restricted by the usual constraints on the external arguments of Activity predicates discussed in Sect. 4.5 above. While they need not be volitional, they must exhibit teleological capability because the result of such coercion is an activity. In examples like *John is not being smart about this* or *Mary is being silly*, the Activity can certainly be non-intentional; cf. also *The sea is being awfully aggressive today*.

5.3 Verbs of maintaining

The third case in which the force-based treatment provides formal insights into the dynamic–stative distinction involves a classic case from the cognitive force–dynamic literature, namely verbs of maintaining. They are canonical examples of the way in which lexical meanings refer to agonist/antagonist relationships, revealing the need for a Davidsonian argument that refers to a force rather than to an event. Above we outlined the issues raised by such verbs, like *keep* and *stay*, which

³⁷ We here remain agnostic concerning the mechanism by which the type shift is implemented, whether purely in the semantic representation or whether by means of an additional layer of structure. We also leave for future research the question of the conditions under which this shift is possible.

are clearly dynamic (as shown by examples (8, 9) above, repeated below as (66, 67)) but which do not involve a change of any kind.

- (66) a. The rock is keeping the door open.
 b. The door is staying open.
- (67) a. The rock keeps the door open.
 b. The door stays open.

These verbs are paradigm cases in the cognitive linguistics literature on force dynamics, but are not often discussed in event-theoretic approaches.

We can imagine several event-based analyses for *keep*, but they seem unsatisfactory. We assume that *keep* and *stay*, like other causative predicates, take a small clause complement. In a sentence such as *The rock kept the door open*, this complement would be [the door open]. The problem with event-based (68a) (“cause to be”) and (68b) (“cause to become”) is that it is possible to keep something in a location without strictly being the cause of its being there or of its coming to be there. On the other hand, *keep* might instead be “cause to stay,” as in (68c). But in considering an event-based approach to *stay*, as in (68d), we run out of options: there can be no external argument or causing event, and there is no obvious way to combine the caused event and the proposition denoted by the small clause in such a way as to reflect the fact that *stay* is not the same as *be*.³⁸

- (70) a. $\llbracket \text{keep} \rrbracket (p)(x)$: Agent(x, e_1) & CAUSE(e_1, e_2) & BE(e_2, p)?
 b. $\llbracket \text{keep} \rrbracket (p)(x)$: Agent(x, e_1) & CAUSE(e_1, e_2) & BECOME(e_2, p)?
 c. $\llbracket \text{keep} \rrbracket (p)(x)$: Agent(x, e_1) & CAUSE(e_1, e_2) & $\llbracket \text{stay} \rrbracket (e_2, p)$?
 d. $\llbracket \text{stay} \rrbracket (e_2, p) \neq$ BE(e_2, p)

Jackendoff (1987, p. 375) is driven by such considerations to simply posit STAY as a subtype of his ‘primitive conceptual category’ EVENT. He writes, “The arguments of STAY, which denotes stasis over a period of time, are the Thing standing still and the Place where it is located, as seen in *Bill stayed in the kitchen*, for instance.” The difference between STAY and BE for him is that BE is a subtype of the conceptual category STATE, not EVENT, but it is not clear what the ingredients of EVENT-hood are, i.e. whether events are constituted by change, energy input, or some other property.

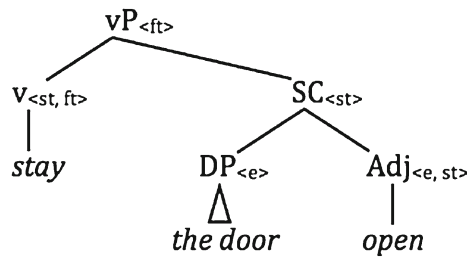
What is needed is a way to represent the idea that *keep* and *stay* involve the input of energy into a situation, rather than a change. Following Talmy (1988), we propose that these predicates describe a force that maintains *p*’s truth between one situation and the successor situation, against a tendency otherwise.

³⁸ Paul Portner (p.c.) suggests the possibility that *stay* = *be* + a presupposition that *p* is true of the *e*’ immediately preceding *e*₂. Although this idea captures the intuition that *stay* describes a proposition that persists, it does not in any way address the aspectual distinctions between *stay* and *be*, such that *stay*, like other dynamic predicates, is compatible with the progressive, incompatible with episodic present tense but compatible with habitual present, etc., while *be*, a stative predicate, shows precisely the opposite characteristics. It would be unusual to attribute such differences to the presence of an additional presupposition.

We follow this intuition informally here, leaving detailed formal denotations and model-theoretic considerations for when we have developed a full semantic model (Copley and Harley, [in preparation](#)). Consider an initial situation s where p holds. If s is a *keeping* or *staying* situation, there is a sub-situation s' identical to the initial situation in all respects except for the absence of the individuals and/or properties that generate the *keeping* or *staying* force. This “antagonist” sub-situation s' has a net force f' which, when not opposed by the “agonist” net force f'' of the rest of s (i. e., the net force of s minus s'), results in a transition to a final situation of which $\sim p$ holds. The net force f_0 of s_0 is equal to $f' + f''$, and can be thought of as having magnitude zero (though strictly speaking magnitudes are not part of the framework). Thus, *keeping* and *staying* involve a net force of a situation s_0 of which a property p holds, and whose successor situation s_1 would, in the absence of the properties that give rise to the agonist component force f' , be a situation of which $\sim p$ holds. *Keep* and *stay* hence introduce predicates of forces with the special property that their initial and final situations are identical with respect to p , but which, without the input of the agonist component force, differ with respect to p . In contrast, a stative predicate such as *The door (is) open* picks out situations to which no force need be added in order for p to endure over time—that is, they describe a situation of which p is true, and whose successor situation also has the property p , *ceteris paribus*.

In the force-theoretic analysis, then, the predicates *keep* and *stay* are very similar to the predicates *open* (transitive) and *open* (intransitive) above, bearing the same relationship to each other that usual causative/inchoative pairs do (following Jackendoff 1975, 1987, among others). Let us consider *stay* first, as in *The door stayed open*. It will take a complement that is a predicate of situations, type $\langle s,t \rangle$, and require that this $\langle s,t \rangle$ complement be true of both the initial situation and the final situation—in effect, a verb-of-maintaining version of v_{BECOME} . Note that the verb *stay* is base-generated here in the v head position, and that the present proposal thus treats it as a light verb; this is in keeping with the treatments in Givón (2001, p. 166), Levin and Rappaport Hovav (2008).

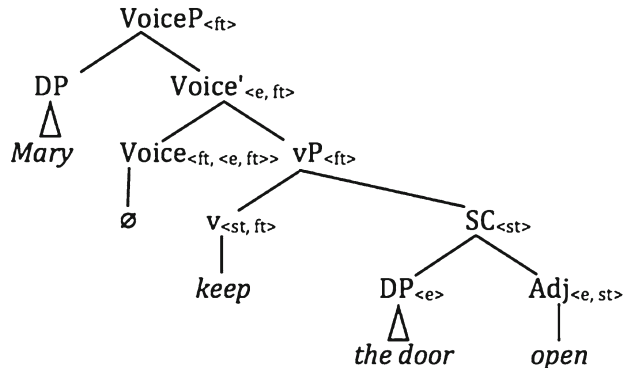
(69)



(70) $\llbracket v_{\text{STAY}} \rrbracket = \lambda p \lambda f . p(\text{fin}(f))$
 presupposed: $p(\text{init}(f))$

Keep and *stay* are then differentiated in the same way as our inchoative/causative pairs above, in that *keep* includes a VoiceP projection which introduces an external argument and asserts that it is the source of the force; and *stay* does not.³⁹

(71)



We thus treat *keep* as a transitive suppletive variant of *stay*, in the same way that *raise* is allomorphically related to *rise*, *lay* to *lie*, *teach* to *learn*, and *feed* to *eat*. Both *keep* and *stay* are dynamic predicates, but do not provoke a change. The initial situation s_0 has net force which creates a transition to s_1 but it is a zero magnitude net force and a trivial transition.

This treatment of verbs of maintaining provides an important distinction between the present force-theoretic approach to dynamicity and recent literature appealing to the Davidsonian event argument. The distinction is in their analysis of a larger class of predicates which do not entail change but do pattern with more typical dynamic predicates in their interaction with the standard aspectual tests, predicates like *sit*, *stay*, *lie*, etc. (Maienborn 2005, 2007; Rothmayr 2009; Fábregas and Marín 2012; Moltmann 2013a, b). The test *p happened while...* is used (Maienborn 2005, p. 285, e.g.) to distinguish process predicates from ‘Davidsonian’ or ‘concrete’ stative predicates of this kind. Thus if a distinction between kinematics (motion, or more abstractly change) and dynamics (forces) is to be maintained in the terminology (similar to Bach 1986), processes and happenings are not the only predicates which exhibit “dynamicity”, as that would improperly exclude the *keep*, *stay*, *sit...* class.

Our system reifies forces, not changes; Maienborn’s, and other event-based treatments, reify changes, not forces. Where we agree is that predicates like *keep*, *stay*, *sit*, *stand*, etc. have both something in common with “action” predicates like *hit*, *break*, *laugh* (both of us reify this in the type theory) and something in common with Kimian statives such as *know French*, *weigh 1 kg*. For us, this latter similarity is in the truth conditions of a verb like *stay* but it is not reified in the ontology. So there is no problem with a class of Davidsonian states being different from a class of

³⁹ We assume that when *keep* or *stay* takes an apparently eventive predicate as its complement, as in *John kept Bill running around all day*, the aspectual operator represented by *-ing* has applied to map the ⟨f,t⟩ constituent [run around all day] to an appropriate ⟨s,t⟩ predicate.

processes; we just don't think the relevant property here is visible to type-theory. Rather, it is part of encyclopedic/world knowledge. The failure of *happen* predication in #*John was sitting on the porch. This happened while...* is for us a colorless-green-ideas kind of problem.

6 Concluding thoughts

We began the paper with a problem—how to account for the “*ceteris non paribus*” or “defeasible causation” cases in which the cause happens but the effect does not necessarily occur. We proposed a causal function from situations to situations, to allow reference to the effect without having to assert its existence, and we argued that this function corresponds nicely to the idea of *force*. The force argument replaces Davidson's event argument in “eventive” (for us, “dynamic”) predicates.

With this model in mind, we turned to the syntax/semantics interface in order to clarify how the proposed semantics is implemented compositionally in the argument structure, retaining recent advances in the understanding of the substructure of dynamic predicates while accounting for other phenomena which have not previously been amenable to analysis within the event-based framework, including the dynamic/stative distinction and verbs of maintaining. In developing these proposals, an important advantage of the framework was its ability to make a natural type-theoretic distinction between dynamic and stative predicates: stative predicates are predicates of situations, while dynamic ones are predicates of forces.

We would like to conclude by pointing out several ways in which the force-theoretic framework provides natural divisions of labor between linguistic semantics and other domains, making the case that it represents an advance in carving the world at its joints.

One key shift in emphasis is entirely within the semantics: instead of event arguments and world arguments, the force-theoretic framework uses force arguments and situation arguments (the former, effectively, derived from the latter). As we have suggested, force and situation arguments share some of the work that might otherwise be done by event arguments, since dynamic predicates are predicates of forces and stage-level stative predicates are predicates of events. However, in another sense, the force argument takes on some of the work previously done by world arguments, in handling the *ceteris non paribus* cases. One reason why such a redivision of labor may be advantageous is that it allows us to construct possible worlds out of causal chains of situations. It is worth considering whether possible worlds might be constructed using the very same elements used to build causal chains in the vP; see Cipria and Roberts (2000), and Del Prete (2012) for accounts involving situations extending into the future, though not exactly as we have done here.

Incorporating causal chains into the framework also has other consequences ripe for future exploration. For example, it allows reference to one argument in terms of another, without the need to bind the argument existentially; instead it is introduced as the result of applying a function to an argument, whether that function is a force or another function such as *net*, *init*, or *pred*. In such a framework, it is not necessary

to introduce each such argument via its own functional head (e.g. Borer 2005). The semantics can refer internally to such substructure without imposing the need for a corresponding syntactic projection in each case, taking over some of the work done by individual argument-introducing predicates in syntactic approaches to event decomposition.

Finally, the force-theoretic framework invites a deeper investigation of the division of labor between cognition and the grammar. A mapping between linguistic semantics and a cognitive or conceptual representation has always been necessary, though sometimes this mapping is seen as being trivial or even as the identity relation. In the present proposal, because of the dual nature of forces as conceptual forces (perceived inputs of energy) and linguistic forces (functions from situations to situations), there must be a structured conceptual level (“conceptual form”?), that is rather distinct from the logical forms that are the interpretations of linguistic structures. We are pursuing the possibility in other work (Copley and Harley, [in preparation](#)) that model-theoretic tools can be applied to elucidate a distinct conceptual level in the same way that they make possible an explicit evaluation of the linguistic semantic computation. If this can be done, there is the intriguing possibility of simplifying the semantics by pursuing the idea that much linguistically relevant complexity resides in the cognitive system.

Acknowledgments We would like to express our deep gratitude to the many people and institutions that have contributed to the development of this project, first and foremost to Paul Portner and the L&P reviewers on multiple rounds of review and revision; the paper has changed and improved enormously as a result of their comments. Although the content may not reflect it at this point, two philosophically-oriented reviews early on helped us refine our understanding of forces greatly. Extensive discussions with many people have also been instrumental; we cannot list them all here but would like to thank especially Jean-Pierre Koenig and Phil Wolff, as well as audiences in Belfast, Göttingen, Nantes, Stuttgart, Tohoku, Toronto, and at the lab Structures Formelles du Langage (CNRS/Paris 8). This research was supported financially in part by the project *Causalité dans le Langage et la Cognition* of the *Fédération Typologie et Universaux Linguistiques* (FR 2559) of the CNRS. Remaining deficiencies and errors are of course our own. We would also like to thank Google and Skype for making our collaboration possible *à distance*.

References

- Abusch, D. (1985). *On verbs and time*. PhD dissertation, University of Massachusetts at Amherst.
- Alexiadou, A., Anagnostopoulou, E., & Schäfer, F. (2006). The properties of anticausatives crosslinguistically. In M. Frascarelli (Ed.), *Phases of interpretation*. (pp. 187–212). Berlin: Mouton de Gruyter.
- Alexiadou, A., Anagnostopoulou, E., & Schäfer, F. (to appear). *External arguments in transitivity alternations: A layering approach* (pp. 187–212). Oxford: Oxford University Press.
- Altshuler, D. (2013). There is no neutral aspect. *Proceedings of SALT*, 23, 40–62.
- Anscombe, G. E. M. (1971). Causality and determination. In E. Sosa & M. Tooley (Eds.), *Causation* (pp. 88–104). Oxford: Oxford University Press (Reprinted).
- Aristotle. The Internet Classics Archive. Retrieved from <http://classics.mit.edu/Aristotle>.
- Asher, N. (1992). A default, truth-conditional semantics for the progressive. *Linguistics and Philosophy*, 15, 463–508.
- Bach, E. (1986). The algebra of events. *Linguistics and Philosophy*, 9, 5–16.
- Bale, A., & Barner, D. (2009). The interpretation of functional heads: Using comparatives to explore the mass/count distinction. *Journal of Semantics*, 26, 217–252.
- Barbey, A., & Wolff, P. (2007). Learning causal structure from reasoning. In *Proceedings of the twenty-ninth annual conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum.

- Bar-El, L., Davis, H., & Matthewson, L. (2005). In L. Bateman & C. Ussery (Eds.), *NELS 35: Proceedings of the 35th annual meeting of the North East Linguistics Society* (Vol. 1, pp. 87–102).
- Beaver, D. (2001). *Presupposition and assertion in Dynamic Semantics*. Oxford: Oxford University Press.
- Beavers, J. (2011a). On affectedness. *Natural Language and Linguistic Theory*, 29, 335–370.
- Beavers, J. (2011b). An aspectual analysis of ditransitive verbs of caused possession in English. *Journal of Semantics*, 28, 1–54.
- Beavers, J., & Zubair, C. (2013). Anticausatives in Sinhala: Involitivity and causer suppression. *Natural Language and Linguistic Theory*, 31(1), 1–46.
- Bittner, M. (1998). Concealed causatives. *Natural Language Semantics*, 7(1), 1–78.
- Bobaljik, J. (1994). What does adjacency do? In H. Harley & C. Phillips (Eds.), *The morphology–syntax connection*. MIT Working Papers in Linguistics (Vol. 22, pp. 1–32).
- Bobaljik, J. (2012). *Universals in comparative morphology: Suppletion, superlatives, and the structure of words*. Cambridge: MIT Press.
- Bohnenmeyer, J., & Swift, M. (2006). *Force dynamics and the progressive*. Albuquerque: Proceedings of the Annual Meeting of the Linguistic Society of America.
- Bonomi, A. (1997). The progressive and the structure of events. *Journal of Semantics*, 14, 173–205.
- Borer, H. (1998). Passive without theta grids. In S. G. Lapointe, D. K. Brentari, & P. M. Farrell (Eds.), *Morphological interfaces* (pp. 60–99). Stanford, CA: CSLI Publications.
- Borer, H. (2005). *Structuring sense II: The normal course of events*. Oxford, UK: Oxford University Press.
- Bruening, B. (2012). By-phrases in passives and nominals. *Syntax*, 16, 1–41.
- Chierchia, G. (1989/2004). A semantics for unaccusatives and its syntactic consequences. In A. Alexiadou, E. Anagnostopoulou, & M. Everaert (Eds.), *The unaccusativity puzzle. Explorations at the syntax–lexicon interface* (pp. 22–59). Oxford: Oxford University Press.
- Cipria, A., & Roberts, C. (2000). Spanish *imperfecto* and *pretérito*: Truth conditions and aktionsart effects in a situation semantics. *Natural Language Semantics*, 2000(8), 297–347.
- Cleland, C. (1991). On the individuation of events. *Synthese*, 86, 229–254.
- Comrie, B. (1976). *Aspect: An introduction to verbal aspect and related problems*. Cambridge: Cambridge University Press.
- Copley, B. (2002). *The semantics of the future*. Ph.D. dissertation, MIT.
- Copley, B. (2008). The plan's the thing: Deconstructing futurate meanings. *Linguistic Inquiry*, 39(2), 261–274.
- Copley, B. (2009). *The semantics of the future*. New York: Routledge.
- Copley, B. (2010). *Towards a teleological model for modals*. Talk presented at the Paris Working Sessions on modality, goals and events, CNRS/ENS/Paris VIII.
- Copley, B. (2014). Causal chains for futurates. Future Time(s)/Future Tense(s). In M. Kissine, P. De Brabanter, & S. Sharifzadeh (Eds.), *Future Tense(s)/Future Time(s)* (pp. 72–86). Oxford: Oxford University Press.
- Copley, B., & Harley, H. (2010). *Causatives, ability, and dispositions*. Talk presented at the workshop on dispositions, ability, and states of the project ANR GENIUS (Genericité: Interprétation et Usages).
- Copley, B., & Harley, H. (2014). *Telicity is launching and atelicity is entrainment*. Paper presented at the workshop Dog Days 3, University of Toronto, 7 August 2014. Retrieved from <http://bcopley.com/wp-content/uploads/copley.toronto.slides.2014.pdf>.
- Copley, B., & Harley, H. (in preparation). *A force-theoretic semantics*. Ms., CNRS and University of Arizona.
- Copley, B., & Harley, H. (in press). Eliminating causative entailments with the force-theoretic framework: The case of the Tohono O'odham frustrative *cem*. In B. Copley & F. Martin (Eds.), *Causation in grammatical structures*. Oxford: Oxford University Press.
- Copley, B., & Wolff, P. (2014). Theories of causation should inform linguistic theory and vice versa. In B. Copley & F. Martin (Eds.), *Causation in grammatical structures* (pp. 11–57). Oxford: Oxford University Press.
- Croft, W. (1990). Possible verbs and the structure of events. In S. Tsohatzidis (Ed.), *Meanings and prototypes: Studies in linguistic categorization* (pp. 48–73). London: Routledge.
- Croft, W. (1991). *Syntactic categories and grammatical relations: The cognitive organization of information*. Chicago: University of Chicago Press.
- Croft, W. (1998). Event structure in argument linking. In M. Butt & W. Geuder (Eds.), *The projection of arguments: Lexical and syntactic constraints* (pp. 21–63). Stanford: CSLI Publications.
- Cuervo, M. C. (2003). *Datives at large*. Doctoral dissertation, MIT.

- Dahl, Ö. (2007). Towards an ecological semantics of tense and aspect. In D. Monticelli & A. Treikelder (Eds.), *Aspect in language and theories: Similarities and differences* (pp. 111–123). Talinn: Tartu.
- Davidson, D. (1967). The logical form of action sentences. In N. Rescher (Ed.), *The logic of decision and action* (pp. 81–95). Pittsburgh: University of Pittsburgh Press.
- de Swart, H. (1998). Aspect shift and coercion. *Natural Language and Linguistic Theory*, 16(2), 347–385.
- Del Prete, F. (2012). Imperfectivity and habituality in Italian. In A. Mari, C. Beyssade, & F. Del Prete (Eds.), *Genericity* (pp. 222–249). Oxford: Oxford University Press.
- Dell, F. (1987). An aspectual distinction in Tagalog. *Oceanic Linguistics*, 22–23(1–2), 175–207.
- Dowe, P. (2000). *Physical causation*. Cambridge: Cambridge University Press.
- Dowty, D. (1979). *Word meaning in montague grammar: The semantics of verbs and times in generative semantics and in Montague's PTQ*. Dordrecht: Springer.
- Dowty, D. (1991). Thematic proto-roles and argument selection. *Language*, 67, 547–619.
- Eells, E. (1991). *Probabilistic causality*. Cambridge: Cambridge University Press.
- Embick, D. (2010). *Localism vs. globalism in morphology and phonology*. Cambridge, MA: MIT Press.
- Engelberg, S. (2002). The semantics of the progressive. In *Proceedings of the 2001 Conference of the Australian Linguistics Society*. <http://linguistics.anu.edu.au/ALS2001/proceedings.html>.
- Fábregas, A., & Marin, R. (2012). State nouns are Kimian states. In I. Franco, S. Lusini, & A. Saab (Eds.), *Romance languages and linguistic theory 2010*. Selected papers from 'Going Romance' Leiden 2010 (pp. 41–64). Amsterdam: John Benjamins.
- Fernando, T. (2004). A finite-state approach to events in natural language semantics. *Journal of Logic and Computation*, 14(1), 79–92.
- Fernando, T. (2005). Comic relief for anankastic conditionals. In *Proceedings of the 15th Amsterdam colloquium* (pp. 71–76).
- Filip, H. (2008). Events and maximalization. In S. Rothstein (Ed.), *Theoretical and crosslinguistic approaches to the semantics of aspect* (pp. 217–256). Amsterdam: John Benjamins.
- Fodor, J. A. (1981). *Representations: Philosophical essays on the foundation of cognitive science*. Cambridge, MA: MIT Press.
- Folli, R. (2003). *Constructing telicity in English and Italian*. PhD thesis, University of Oxford.
- Folli, R., & Harley, H. (2004). Flavors of v: Consuming results in Italian and English. In R. Slabakova & P. Kempchinsky (Eds.), *Aspectual inquiries* (pp. 95–120). Dordrecht: Kluwer.
- Folli, R., & Harley, H. (2008). Teleology and animacy in external arguments. *Lingua*, 118(2), 190–202.
- Folli, R., & Harley, H. (2013). *Against deficiency-based typologies: Manner-alternation parameters in Italian and English*. Paper presented at WCCFL 31, Arizona State University, 10 February 2013.
- Freyd, J. F., Pantzer, T. M., & Cheng, J. L. (1988). Representing statics as forces in equilibrium. *Journal of Experimental Psychology: General*, 117, 395–407.
- Galton, A. (1984). *The logic of aspect: An axiomatic approach*. Oxford: OUP.
- Gärdenfors, P. (2004). *Conceptual spaces: The geometry of thought*. Cambridge, MA: MIT Press.
- Gärdenfors, P. (2005). *The dynamics of thought*. Heidelberg: Springer.
- Gärdenfors, P. (2007). Representing actions and functional properties in conceptual spaces. In T. Ziemke, J. Zlatev, & R. M. Frank (Eds.), *Body, language, and mind*. Embodiment (Vol.1, pp. 177–196). Berlin: Mouton de Gruyter.
- Giannakidou, A., & Staraki, E. (2010). Ability, action, and causation: From pure ability to force. In A. Mari, C. Beyssade, & F. Del Prete (Eds.), *Genericity* (pp. 250–275). Oxford: OUP.
- Giorgi, A., & Pianesi, F. (2001). Ways of terminating. In C. Cecchetto, G. Chierchia, & M. T. Guasti (Eds.), *Semantic interfaces: Reference, anaphora and aspect* (pp. 211–277). Stanford: CSLI Publications.
- Givón, T. (2001). *Syntax* (Vol. 1). Amsterdam: John Benjamins.
- Glasbey, S. (1996). The progressive: A channel-theoretic analysis. *Journal of Semantics*, 13(4), 331–361.
- Godfrey-Smith, P. (2009). Causal pluralism. In H. Beebe, C. Hitchcock, & P. Menzies (Eds.), *The Oxford handbook of causation* (pp. 326–337). Oxford: OUP.
- Groenendijk, J., & Stokhof, M. (1991). Dynamic predicate logic. *Linguistics and Philosophy*, 14, 39–100.
- Hale, K., & Keyser, S. (1993). On argument structure and the lexical expression of syntactic relations. In K. Hale & S. Keyser (Eds.), *The view from Building 20: Essays in linguistics in honor of Sylvain Bromberger* (pp. 53–109). Cambridge: MIT Press.
- Hall, N. (2004). Two concepts of causation. In J. Collins, N. Hall, & L. Paul (Eds.), *Causation and counterfactuals* (pp. 225–276). Cambridge: MIT Press.
- Halle, M., & Marantz, A. (1993). Distributed morphology and the pieces of inflection. In K. Hale & S. J. Keyser (Eds.), *A view from Building 20* (pp. 111–176). Cambridge, MA: MIT Press.

- Harley, H. (2005). How do verbs get their names? Denominal verbs, manner incorporation, and the ontology of verbs roots in English. In N. Erteschik-Shir & T. Rapoport (Eds.), *The syntax of aspect: Deriving thematic and aspectual interpretation* (pp. 42–64). Oxford: Oxford University Press.
- Harley, H. (2012a). External arguments and the Mirror Principle: On the distinctness of Voice and v. *Lingua*, 125, 34–57.
- Harley, H. (2012b). Semantics in distributed morphology. In C. Maienborn, K. von Stechow, & P. Portner (Eds.), *Semantics: An international handbook of natural language meaning* (pp. 2151–2172). Berlin: Mouton de Gruyter.
- Hasegawa, Y. (1996). The (nonvacuous) semantics of TE-linkage in Japanese. *Journal of Pragmatics*, 25(6), 763–790.
- Hay, J., Kennedy, C., & Levin, B. (1999). Scalar structure underlies telicity in 'degree achievements'. In *Proceedings of SALT 9* (pp. 127–144). Ithaca, NY: Cornell Linguistics Circle Publications, Cornell University.
- Hegarty, M. (2004). Mechanical reasoning by mental simulation. *Trends in Cognitive Sciences*, 8(6), 280–285.
- Heim, I. (1982). *The semantics of definite and indefinite noun phrases*. Ph.D. thesis, University of Massachusetts, Amherst.
- Herweg, M. (1991). Perfective and imperfective aspect and the theory of events and states. *Linguistics*, 29(6), 969–1010.
- Higginbotham, J. (1985). On semantics. *Linguistic Inquiry*, 16, 547–593.
- Higginbotham, J. (2000). Accomplishments. In *Proceedings of 2nd GLOW in Asia* (pp. 131–139). Nagoya: Nanzan University. Also published as Higginbotham, J. (2009). Accomplishments. In *Tense, aspect and indexicality* (pp. 116–125). Oxford: OUP.
- Hobbs, J. R. (2005). Toward a useful concept of causality for lexical semantics. *Journal of Semantics*, 22, 181–209.
- Hoekstra, T. (1984). *Transitivity: Grammatical relations in government-binding theory*. Dordrecht: Foris Publications.
- Hoekstra, T., & Mulder, R. (1990). Unergatives as copular verbs: Locational and existential predication. *The Linguistic Review*, 7, 1–79.
- Holmes, K., & Wolff, P. (2010). Simulation from schematics: Dorsal stream processing and the perception of implied motion. In R. Catrambone & S. Ohlsson (Eds.), *Proceedings of the 32nd annual conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.
- Holmes, K. J., & Wolff, P. (2013). Spatial language and the psychological reality of schematization. *Cognitive Processing*, 14(2), 205–208.
- Jackendoff, R. (1975). A system of semantic primitives. In R. Schank & B. Nash-Webber (Eds.), *Theoretical issues in natural language processing* (pp. 112–117). Arlington, VA: ACL.
- Jackendoff, R. (1987). The status of thematic relations in linguistic theory. *Linguistic Inquiry*, 18(3), 369–411.
- Jackendoff, R. (1990). *Semantic structures*. Cambridge, MA: MIT Press.
- Jackendoff, R. (1991). Parts and boundaries. *Cognition*, 41, 9–45.
- Jackendoff, R. (1997). *The architecture of the language faculty*. Cambridge, MA: MIT Press.
- Kallulli, D. (2006). A unified analysis of passives, anticausatives and reflexives. In O. Bonami & P. Cabredo Hofherr (Eds.), *Empirical issues in formal syntax and semantics* (Vol. 6, pp. 201–225).
- Kamp, H. (1979). Events, instants and temporal reference. In R. Bäuerle, et al. (Eds.), *Semantics from different points of view* (pp. 376–417). Berlin: Springer.
- Kamp, H. (1981). A theory of truth and semantic representation. In: J. A. G. Groenendijk, T. M. V. Janssen, & M. B. J. Stokhof (Eds.), *Formal methods in the study of language*. Mathematical Centre Tracts 135 (pp. 277–322). Amsterdam: Mathematical Centre.
- Kamp, H. (2007). *Intentions, plans, and their executions: Turning objects of thought into entities in the external world*. Ms.
- Kamp, H., & Reyle, U. (1993). *From discourse to logic*. Dordrecht: Kluwer.
- Katz, G. (2003). Event arguments, adverb selection, and the Stative Adverb Gap. In E. Lang, C. Maienborn, & C. Fabricius-Hansen (Eds.), *Modifying adjuncts*. Interface Explorations 4 (pp. 455–474). Berlin: Mouton de Gruyter.
- Kearns, K. S. (1991). *The semantics of the English progressive*. Ph.D. thesis, MIT, Cambridge, MA.
- Kennedy, C. (2012). The composition of incremental change. In V. Demonte & L. McNally (Eds.), *Telicity, change, state: A cross-categorical view of event structure* (pp. 103–121). Oxford: Oxford University Press.

- Kennedy, C., & Levin, B. (2008). Measure of change: The adjectival core of degree achievements. In L. McNally & C. Kennedy (Eds.), *Adjectives and adverbs: Syntax, semantics and discourse* (pp. 156–182). Oxford: Oxford University Press.
- Kennedy, C., & McNally, L. (2005). Scale structure, degree modification and the semantic typology of gradable predicates. *Language*, 81(2), 345–381.
- Kiparsky, P. (1997). Remarks on denominal verbs. In A. Alsina, J. Bresnan, & P. Sells (Eds.), *Argument structure* (pp. 473–499). Stanford: CSLI.
- Kistler, M. (2006). *Causation and laws of nature*. New York: Routledge.
- Klein, W. (1994). *Time in language*. London: Routledge.
- Koenig, J. P., & Chief, L.-C. (2007). Scalarity and state-changes in Mandarin (and other languages). In O. Bonami & P. C. Hofherr (Eds.), *Empirical issues in syntax and semantics 7* (pp. 241–262). Paris: CSSP.
- Koenig, J.-P., & Muansuwan, N. (2000). How to end without ever finishing: Thai semi-perfective markers. *Journal of Semantics*, 17, 147–184.
- Koontz-Garboden, A. (2009). Anticausativization. *Natural Language and Linguistic Theory*, 27, 77–138.
- Kratzer, A. (1989). An investigation of the lumps of thought. *Linguistics & Philosophy*, 12, 607–653.
- Kratzer, A. (1995). Stage-level and individual-level predicates. In G. N. Carlson & F. J. Pelletier (Eds.), *The generic book* (pp. 125–175). Chicago: University of Chicago Press.
- Kratzer, A. (1996). Severing the external argument from its verb. In J. Rooryck & L. Zaring (Eds.), *Phrase structure and the lexicon* (pp. 109–137). Dordrecht: Kluwer.
- Kratzer, A. (1998). More structural analogies between pronouns and tenses. In *Proceedings of SALT VIII*. Ithaca, NY: CLC Publications.
- Kratzer, A. (2005). Building resultatives. In C. Maienborn & A. Wöllstein (Eds.), *Event arguments: Foundations and applications* (pp. 177–212). Tübingen: Max Niemeyer Verlag.
- Kratzer, A. (2013). *Creating a family*. Talk presented at workshop on Little v, University of Leiden, October 2013.
- Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In R. Bartsch, J. F. A. K. van Benthem, & P. van Emde Boas (Eds.), *Semantics and contextual expression* (pp. 75–115). Dordrecht: Foris Publications.
- Krifka, M. (1992). Thematic relations as links between nominal reference and temporal constitution. In I. Sag & A. Szabolsci (Eds.), *Lexical matters* (pp. 29–53). Stanford: CSLI Publications.
- Krifka, M. (1998). The origins of telicity. In S. Rothstein (Ed.), *Events and grammar* (pp. 197–235). Dordrecht: Kluwer Academic Publishers.
- Landman, F. (1992). The progressive. *Natural Language Semantics*, 1(1), 1–32.
- Langacker, R. W. (1991). *Foundations of cognitive science* (Vol. II). Palo Alto: Stanford University Press.
- Leslie, A. M., & Keeble, S. (1987). Do six-month old infants perceive causality? *Cognition*, 25, 265–288.
- Levin, B., & Rappaport Hovav, M. (1995). *Unaccusativity: At the syntax-lexical semantics interface*. Cambridge, MA: MIT Press.
- Levin, B., & Rappaport Hovav, M. (2005). *Argument realization*. Research Surveys in Linguistics Series. Cambridge: Cambridge University Press.
- Levin, B., & Rappaport Hovav, M. (2008). Lexical conceptual structure. In K. von Heusinger, C. Maienborn, & P. Portner (Eds.), *Semantics: An international handbook of natural language meaning* (Vol. 1, pp. 420–440). Berlin: Mouton de Gruyter.
- Levin, B., & Rappaport Hovav, M. (2010). *Lexicalized scales and verbs of scalar change*. Stanford: Stanford University.
- Levinson, L. (2007). *The roots of verbs*. Ph.D. dissertation, New York University.
- Lewis, D. (1973). Causation. *The Journal of Philosophy*, 70, 556–567.
- Lombard, L. (1979). Events. *Canadian Journal of Philosophy*, 9(3), 425–460.
- Maienborn, C. (2005). On the limits of the Davidsonian approach: The case of copula sentences. *Theoretical Linguistics*, 31, 275–316.
- Maienborn, C. (2007). On Davidsonian and Kimian states. In I. Comorovski & K. von Heusinger (Eds.), *Existence: Semantics and syntax* (pp. 107–130). Dordrecht: Kluwer.
- Marantz, A. (1984). *On the nature of grammatical relations*. Cambridge, MA: MIT Press.
- Marantz, A. (1997). No escape from syntax: Don't try morphological analysis in the privacy of your own Lexicon. In A. Dimitriadis, et al. (Eds.), *Proceedings of the 21st annual Penn linguistics colloquium*. Penn Working Papers in Linguistics (Vol. 4(2), pp. 201–225).
- Marantz, A. (2001). *Words*. Ms., NYU. Retrieved from http://ling.ucsc.edu/~hank/mrg_readings/Marantz_words.pdf.

- Marín, R., & McNally, L. (2011). Inchoativity, change of state, and telicity: Evidence from Spanish reflexive psychological verbs. *Natural Language and Linguistic Theory*, 29, 467–502.
- Matthewson, L. (2004). *Cross-linguistic variation and the nature of aspectual classes*. Handout of talk given at Cornell University, February 26, 2004.
- Matushansky, O. (2006). Head movement and linguistic theory. *Linguistic Inquiry*, 37(1), 69–109.
- McCawley, J. D. (1971). Pre-lexical syntax. In R. O'Brien (Ed.), *Report of the 22nd roundtable meeting on linguistics and language studies* (pp. 19–33). Georgetown: Georgetown University Press.
- McCawley, J. D. (1976). Remarks on what can cause what. In M. Shibatani (Ed.), *The grammar of causative constructions* (pp. 117–129). New York: Academic Press.
- McClure, W. (1994). *Syntactic projections of the semantics of aspect*. Ph.D. dissertation, Cornell University.
- Michotte, A. (1946/1963). *The perception of causality*. Methuen: London.
- Moens, M., & Steedman, M. (1988). Temporal ontology and temporal reference. *Computational Linguistics*, 14(2), 15–28.
- Moltmann, F. (2013a). The semantics of existence. *Linguistics and Philosophy*, 36(1), 31–63.
- Moltmann, F. (2013b). On the distinction between abstract states, concrete states, and tropes. In A. Mari, C. Beyssade, & F. Del Prete (Eds.), *Genericity* (pp. 292–311). Oxford: Oxford University Press.
- Montague, R. (1970). Pragmatics and intensional logic. *Synthese*, 22, 68–94. (Reprinted in R. Montague, *Formal philosophy*, Chap. 4, 1974, New Haven: Yale University Press).
- Mumford, S., & Anjum, R. L. (2011). *Getting causes from powers*. Oxford: Oxford University Press.
- Naumann, R. (2001). Aspects of changes: A dynamic event semantics. *Journal of Semantics*, 18(1), 27–81.
- Naumann, R., & Piñón, C. (1997). Decomposing the progressive. In P. Dekker, M. Stokhof, & Y. de Venema (Eds.), *Proceedings of the eleventh Amsterdam colloquium* (pp. 241–246). Amsterdam: ILLC/Department of Philosophy, University of Amsterdam.
- Nishiyama, A. (2006). The meaning and interpretations of the Japanese aspect marker *-te-i-*. *Journal of Semantics*, 23(2), 185–216.
- Ogihara, T. (1998). The ambiguity of the *-te iru* form in Japanese. *Journal of East Asian Linguistics*, 7, 87–120.
- Paramasivam, K. P. (1977). *Effectivity and causativity in Tamil*. Doctoral dissertation, University of Chicago.
- Parsons, T. (1989). The progressive in English: Events, states, and processes. *Linguistics and Philosophy*, 12, 213–241.
- Parsons, T. (1990). *Events in the semantics of English*. Cambridge: MIT Press.
- Partee, B. (1977). John is easy to please. In A. Zampolli (Ed.), *Linguistic structures processing* (pp. 281–312). Amsterdam: North Holland.
- Pearl, J. (2000). *Causality: Models, reasoning, and inference*. Cambridge: Cambridge University Press.
- Piñón, C. (1997). Achievements in an event semantics. In A. Lawson & E. Cho (Eds.), *Proceedings of semantics and linguistic theory VII* (pp. 273–296). Ithaca, NY: CLC Publications.
- Piñón, C. (2001). A finer look at the causative/inchoative alternation. In R. Hastings, B. Jackson, & Z. Zvolenszky (Eds.), *Proceedings of semantics and linguistic theory 11*. Ithaca, NY: CLC Publications, Cornell University.
- Piñón, C. (2008). Aspectual composition with degrees. In L. McNally & C. Kennedy (Eds.), *Adjectives and adverbs: Syntax, semantics, and discourse* (pp. 183–219). Oxford: Oxford University Press.
- Portner, P. (1998). The progressive in modal semantics. *Language*, 74, 760–787.
- Pustejovsky, J. (1991). The syntax of event structure. *Cognition*, 41, 47–81.
- Pustejovsky, J. (1995). *The generative lexicon*. Cambridge, MA: MIT Press.
- Pylkkänen, L. (2002). *Introducing arguments*. Ph.D. thesis, MIT, Cambridge, MA. Distributed by Cambridge, MA.
- Pylkkänen, L., Martin, A. E., McElree, B., & Smart, A. (2009). The anterior midline field: Coercion or decision making? *Brain and Language*, 108, 184–190.
- Ramchand, G. (1997). *Aspect and predication: The semantics of argument structure*. Oxford: Oxford University Press.
- Ramchand, G. (2008). *Verb meaning and the lexicon: A first-phase syntax*. Cambridge: Cambridge University Press.
- Rappaport Hovav, M. (2008). Lexicalized meaning and the internal temporal structure of events. In S. Rothstein (Ed.), *Theoretical and crosslinguistic approaches to aspect* (pp. 13–42). Amsterdam: John Benjamins.

- Rappaport Hovav, M., & Levin, B. (2001). An event structure account of English resultatives. *Language*, 77, 766–797.
- Reichenbach, H. (1971). *The direction of time*. Berkeley: University of California Press. Originally published 1956.
- Reinhart, T. (2000). The Theta System: Syntactic realization of verbal concepts. OTS Working Papers. TL-00.002, Utrecht University.
- Rosen, S. T. (1999). The syntactic representation of linguistic events. *GLOT International*, 4(2), 3–11.
- Rothmayr, Antonia. (2009). *The structure of stative verbs*. Amsterdam: John Benjamins.
- Rothstein, S. (2004). *Structuring events: A study in the semantics of aspect* (Vol. 5). New York: Wiley.
- Roy, I., & Soare, E. (2013). Event related nominalizations. In G. Iordăchioaia, I. Roy, & K. Takamine (Eds.), *Categorization and category change* (pp. 123–152). Cambridge: Cambridge Scholars Publishing.
- Saxe, R., & Carey, S. (2006). The perception of causality in infancy. *Acta Psychologica*, 123(2006), 144–165.
- Schachter, P., & Otnes, F. T. (1972). *Tagalog reference grammar*. Berkeley, CA: University of California Press.
- Schäfer, F. (2007). *On the nature of anticausative morphology: External arguments in change-of-state contexts*. Doctoral dissertation, University of Stuttgart.
- Schäfer, F., & Vivanco, M. (2013). *Reflexively marked anti causatives are not semantically reflexive*. Talk given at Going Romance, Amsterdam.
- Shibatani, M. (1973). *A linguistic study of causative constructions*. Doctoral dissertation, University of California Berkeley.
- Singh, M. (1998). On the semantics of the perfective aspect. *Natural Language Semantics*, 6, 171–199.
- Smith, C. (1983). A theory of aspectual choice. *Language*, 59(3), 479–501.
- Smith, C. (1991/1997). *The parameter of aspect*. Dordrecht: Kluwer Academic Press.
- Suppes, P. (1970). *A probabilistic theory of causality*. Amsterdam: North-Holland Publishing Company.
- Talmy, L. (1976). Semantic causative types. In M. Shibatani (Ed.), *The grammar of causative constructions*. Syntax and Semantics (Vol. 6, pp. 43–116). New York: Academic Press.
- Talmy, L. (1981). *Force dynamics*. Paper presented at conference on language and mental imagery, May 1981, University of California, Berkeley.
- Talmy, L. (1985a). Force dynamics in language and thought. In *Papers from the regional meetings* (Vol. 21, pp. 293–337). Chicago: Chicago Linguistic Society.
- Talmy, L. (1985b). Force dynamics as a generalization over causative. In *Georgetown University round table on languages and linguistics* (pp. 67–85).
- Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive Science*, 12, 49–100.
- Talmy, L. (2000). *Toward a cognitive semantics*. Cambridge, MA: MIT Press.
- Tatevosov, S. (2008). Subevental structure and non-culmination. In O. Bonami & P. Cabredo Hofherr (Eds.), *Empirical issues in syntax and semantics 7* (pp. 393–422). Retrieved from <http://www.cssp.cnrs.fr/eiss7>.
- Tedeschi, P. J. (1973). Some suggestions for a semantic analysis of progressives. *University of Michigan Papers in Linguistics*, 1(2), 157–168.
- ter Meulen, A. (1985). Progressives without possible worlds. In W. Eilfort, P. Kroeber, & K. Peterson (Eds.), *CLS 21* (Part 1, pp. 259–280). Chicago: Chicago Linguistic Society.
- ter Meulen, A. (1990). English aspectual verbs as generalized quantifiers. In *Proceedings of the seventh Amsterdam colloquium* (pp. 303–315). University of Amsterdam, Amsterdam.
- Thomason, R. (1970). Indeterminist time and truth-value gaps. *Theoria*, 18(3), 264–281.
- Thomason, R., & Stalnaker, R. (1973). A semantic theory of adverbs. *Linguistic Inquiry*, 4(2), 195–220.
- Tovena, L. (2011). Accomplishments: Their telos and their structure. In I. Reich, et al. (Eds.), *Proceedings of Sinn & Bedeutung 15* (pp. 1–15). Saarbrücken: Universaar - Saarland University Press.
- Travis, L. (2000). Event structure in syntax. In C. Tenny & J. Pustejovsky (Eds.), *Events as grammatical objects: The converging perspectives of lexical semantics and syntax* (pp. 145–185). Stanford, CA: CSLI Publications.
- van Lambalgen, M., & Hamm, F. (2003). Event calculus, nominalisation, and the progressive. *Linguistics and Philosophy*, 26(4), 381–458.
- van Lambalgen, M., & Hamm, F. (2005). *The proper treatment of events*. Oxford: Blackwell Publishers.
- Van Valin, R. D, Jr. (1990). Semantic parameters of split intransitivity. *Language*, 66, 221–260.

- Van Valin, R. D., & LaPolla, R. J. (1997). *Syntax: Structure, meaning and function*. Cambridge: Cambridge University Press.
- Vecchiato, A. (2003). The Italian periphrastic causative and force dynamics. In F. Nihan Ketz, J. M. Aronoff, M. Cabrera, A. Ciger, S. Ganjavi, M. Petrova, & I. Roy (Eds.), *USC Working Papers in Linguistics* (Vol. 1, pp. 91–109).
- Vecchiato, A. (2004). On intentional causation in Italian. In J. Auger, J. Clancy Clements, & B. Vance (Eds.), *Contemporary approaches to romance linguistics* (pp. 343–360). Amsterdam: John Benjamins.
- Vendler, Z. (1957). Verbs and times. *The Philosophical Review*, 66, 143–160.
- Verkuyl, H. J. (1972). *On the compositional nature of the aspects*. Dordrecht: Reidel.
- Vlach, F. (1981). The semantics of the progressive. In P. J. Tedeschi & A. Zaenen (Eds.), *Tense and aspect*. *Syntax and Semantics* (Vol. 14, pp. 271–292). New York: Academic Press.
- Walsh, C., & Sloman, S. (2011). The meaning of cause and prevent: The role of causal mechanism. *Mind & Language*, 26(1), 21–52.
- White, P. A. (2011). Visual impressions of force exerted by one object on another when the objects do not come into contact. *Visual Cognition*, 19(3), 340–366.
- Williams, E. (1981). Argument structure and morphology. *The Linguistic Review*, 1, 81–114.
- Wolff, P. (2007). Representing causation. *Journal of Experimental Psychology: General*, 136, 82–111.
- Wolff, P. (in press). Causal pluralism and force dynamics. In B. Copley & F. Martin (Eds.), *Causation in grammatical structures*. Oxford: OUP.
- Wolff, P., Barbey, A. K., & Hausknecht, M. (2010). For want of a nail: How absences cause events. *Journal of Experimental Psychology: General*, 139, 191–221.
- Wolff, P., Hausknecht, M., & Holmes, K. (2011). Absent causes, present effects: How omissions cause events. In J. Bohnemeyer & E. Pederson (Eds.), *Event representation in language: Encoding events at the language cognition interface* (pp. 228–252). Cambridge: Cambridge University Press.
- Wolff, P., & Song, G. (2003). Models of causation and the semantics of causal verbs. *Cognitive Psychology*, 47, 276–332.
- Woodward, J. (2009). Agency and interventionist theories. In H. Beebe, C. Hitchcock, & P. Menzies (Eds.), *The Oxford handbook of causation* (pp. 234–262). Oxford: Oxford University Press.
- Zacks, J. M., Kurby, C. A., Eisenberg, M. L., & Haroutunian, N. (2011). Prediction error associated with the perceptual segmentation of naturalistic events. *Journal of Cognitive Neuroscience*, 23, 4057–4066.
- Zwarts, J. (2010). Forceful prepositions. In V. Evans & P. Chilton (Eds.), *Language, cognition and space: The state of the art and new directions* (pp. 193–214). London: Equinox Publishing.

Force interaction in the expression of causation*

Bridget Copley
SFL (CNRS/Paris 8)

Phillip Wolff
Emory University

Jason Shepard
Emory University

Abstract Causal meanings in verbs such as *cause*, *enable* and *prevent* have been analyzed as having two components that correspond to two interacting forces or tendencies: one associated with the agent and one with the patient (Talmy 2000; Wolff 2007). In this research we extend a force-dynamic analysis to a wider range of causal and quasi-causal expressions such as *lead to*, *because*, and *after*. The “structural causal pluralism hypothesis” (Copley & Wolff 2014) is not supported; instead force dynamics is shown to be relevant to expressions throughout syntactic structure. We find that the applicability of the classical force-interaction analysis depends on (i) whether an Agent/Causer is represented in the syntax, and (ii) what kind of causing entity is conceptually represented: either one that generates its own force or one whose force emerges from an interaction with a *field* in the sense of Copley & Harley (2015) (e.g., a gravitational field). The latter case, we propose, suggests a criterion for force individuation. This account allows us to identify several classes of causal expressions and to further map out the division of labor between the grammatical and conceptual levels.

Keywords: causation, agency, verbs, clausal connectives, force dynamics

1 Introduction

The causal meanings of certain verbs have been argued to involve two interacting forces or tendencies (Talmy 2000; Wolff 2007)¹. One of the forces is associated with the agent and another with the patient, and the kind of interaction between them varies by verb.

For example, the main verb *cause* is analyzed as describing a kind of scenario, call it CAUSE, in which the agent exerts a force that opposes and is stronger than the

* This work was supported in part by a National Science Foundation grant “Causal illusions and the perception of forces” (BCS-1354088) to Phillip Wolff.

¹ The terms *force* and *tendency* refer to the same kind of abstract entity; in different cases one term or the other will be more natural, but this does not correspond to an ontological difference.

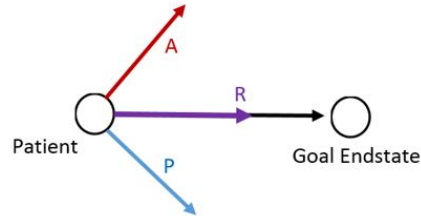


Figure 1 Force-interaction analysis of *cause*: CAUSE

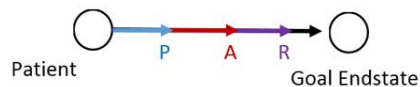


Figure 2 Force-interaction analysis of *enable*: ENABLE

force exerted by the patient. The force associated with the agent is not in concordance with (not oriented toward the same direction as) the force associated with the patient. Forces can be represented with vectors in an abstract space, such that the strength of the force is represented by the magnitude of the vector, and the abstract direction of the force (i.e., toward or away from a goal endstate) is represented by the spatial direction of the vector. The patient (P) and agent (A) vectors are summed to get a resultant vector (R), as in the representation of CAUSE in Figure 1.

Enable, on the other hand is argued to describe a kind of scenario, call it ENABLE, in which the agent's force is in line with the patient's force, so that the forces associated with the agent and the patient are concordant with each other (Wolff & Song 2003; Wolff 2007; contra Talmy 2000). This is shown in Figure 2.

Prevent would describe a kind of scenario PREVENT, as in Figure 3, in which the agent's force is oriented away from the goal endstate, and opposes and is stronger than the patient's force, which itself is oriented toward the goal endstate. As in CAUSE scenarios, the force associated with the agent and the patient are not in concordance with each other.

Support for the psychological reality of such meanings has been shown experimentally. For example, Wolff (2007) showed subjects animations of agents and patients with various configurations of their vectors, and asked subjects whether a given configuration corresponded to certain verbs. The key finding was that participants' descriptions of events were indeed sensitive to the two forces in the expected ways. Descriptions involving *enable* and *prevent* required that the patient force be

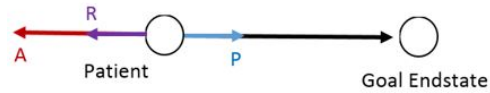


Figure 3 Force-interaction analysis of *prevent*: PREVENT

oriented towards the final result. Finally, descriptions involving *cause* and *prevent* required that there be opposition between the agent and patient forces. Descriptions involving *cause* and *enable* required that the resultant vector be directed towards the final result.

We wondered whether other expressions of causation would show similar interactions between agent and patient forces. For example, does *because*, like *cause*, necessarily make reference to a CAUSE scenario? Intuitively, this does not seem to be the case: *Because* seems at least in some circumstances to be compatible with an ENABLE scenario as well (Copley & Wolff 2014: 55).

To see this, consider (1a) and (1b). Under the assumption that *because* has the same meaning as *cause*, the sentence with *because* in (1b) should also be false. This is because conceptually, the drugs are a mere enabling condition (associated with a force concordant with the Lance Armstrong-associated force) rather than a true cause (which would require Lance Armstrong not to be associated with a force oriented toward winning seven Tours de France). However, (1b) is true. The truth of (1b) seems to indicate that the meaning of *because* is weaker than that of *cause*, i.e., it can be used truthfully in both CAUSE and ENABLE scenarios.

- (1) a. Drugs caused Lance Armstrong to win seven Tours de France. false
 b. Lance Armstrong won seven Tours de France because he took drugs. true

We wondered why *because* has a weaker meaning. There could be two possible hypotheses for why this might be the case. One possibility explains the difference in meaning by means of two different conceptualizations of causal meanings. The other explains the difference under a single conceptualization of causation (force dynamics), but where the key difference between *because* and *cause* is that, unlike *cause*, *because* does not grammatically represent an agent force, and therefore cannot explicitly represent force interaction.

1.1 Structural causal pluralism hypothesis

The first possibility is that the causal meanings in (1a) and (1b) reflect two different theories of causation. Theories of causation can be divided into two kinds. “Dependency theories” define causation in terms of dependencies between propositions

(e.g., Lewis 1973; Dowty 1979; Pearl 2000). All that dependency theories require is that the causal factor in some way make a difference in the result, whether by means of causation or enabling.²

“Production theories” define causation in terms of the eventualities themselves, without reference to propositions, by means of configurations of forces or transmissions of conserved quantities. Force-dynamic theories of causation are thus production theories. Production theories, unlike dependency theories, can make the distinction between CAUSE and ENABLE scenarios as we have seen above. So, if *because* were making reference to a dependency theory of causation while *cause* were making reference to a production theory, this would explain the contrast in (1).

But why would two theories of causation be used for these two different expressions? Copley & Wolff’s (2014) “structural causal pluralism hypothesis” proposes that causal meanings in the cartographic region of phrase structure that deal with events (AspP and below; see, e.g., Ramchand & Svenonius 2014 and references therein) use force dynamics, while causal meanings of connectives, which take propositional arguments, use dependency causation. This would entail, as desired, that *because* would fail to distinguish CAUSE and ENABLE scenarios, while *cause* would distinguish CAUSE and ENABLE scenarios. And in general, other verbs (e.g., *leads to*, *results in*) would be expected to behave like *cause* (because any representation of causation within the verb phrase would have to be force-dynamic), and other clausal connectives would be expected to behave like *because* (because any representation of causation above AspP would have to be constructed from propositions, via a dependency theory).

1.2 Forces-everywhere hypothesis

Another possible explanation for the contrast in (1)—in a sense the null hypothesis—is that there are not two theories of causation relevant to the expression of causation in language but only one. Given the need to sometimes distinguish CAUSE from ENABLE scenarios, it follows that the putative single theory must be a production theory, rather than a dependency theory. But it also must be explained why sometimes CAUSE and ENABLE scenarios are not distinguished, as in the case of *because*.

As can be seen by comparing Figures 1 and 2, the difference between CAUSE and ENABLE scenarios has to do with the relationship between the patient and agent vector. In the case of CAUSE, the agent and patient vectors are not concordant, and in the case of ENABLE, the agent and patient vectors are concordant. The notion of concordance requires the representation of two vectors. Thus, in cases where either the agent or patient force is not specified in the denotation, concordance or its

² See Dowty (1979: 106-109) for an attempt to work around this limitation within a dependency theory framework.

absence can not be determined. So, given that concordance is what distinguishes CAUSE from ENABLE, in such cases, we would not expect CAUSE and ENABLE to be distinguished.

On this hypothesis, there are a number of factors that might be expected to influence whether two forces are represented. Here we will investigate two such factors, one grammatical and one conceptual: first, whether an Agent/Causer role is assigned, and second, whether two forces can be conceptually individuated.

1.2.1 Assignment of an Agent/Causer role

Assigning an Agent/Causer role would seem to be necessary in order to have interacting forces in the denotation. Having interacting forces in the denotation would seem to be necessary to distinguish CAUSE from ENABLE scenarios. Thus, a clausal connective such as *because* would also not be expected to distinguish CAUSE and ENABLE scenarios because it does not assign an Agent/Causer role (not being a verb). We would also expect that verbs that don't assign an Agent/Causer role would not be able to distinguish CAUSE from ENABLE. Two such causal verbs are *lead to* and *result in*. For background, note that some nominals refer to entities as in (2a). Others refer to eventualities as in (2b). Although both are grammatically of type e, they have different kinds of referents on the conceptual level, either entities or eventualities (this is along the lines of Roy & Soare 2013).

- (2) a. Entity-referring: *the officer, the traffic light*
- b. Eventuality-referring: *the storm, the officer's gesture, the traffic light's changing*

The causal predicates *lead to* and *result in*—unlike, e.g., *cause*—do not accept an entity-referring subject at all. Their subject cannot refer to an entity, as in (2a), but rather must refer to an eventuality, as in (2b).

- (3) a. #The officer/#the traffic light led to/resulted in the woman's walking up to the man.
- b. The officer's gesture/the traffic light's changing led to/resulted in the woman's walking up to the man.

The infelicity of (3a) highly suggests that the subject cannot have an Agent/Causer role. Thus, under the forces-everywhere hypothesis, *lead to* and *result in* are predicted to not distinguish CAUSE and ENABLE.

On the other hand, the verbs that do allow entity-referring subjects also allow eventuality-describing subjects.

- (4) a. The officer allowed/enabled/caused/forced/influenced/made us (to) leave.

- b. The storm/The officer('s gesture)/the traffic light's changing allowed/enabled/caused/forced/influenced/made us (to) leave.

On the forces-everywhere hypothesis, we would expect those in (4) to distinguish CAUSE and ENABLE. The idea is that the verbs in (4) explicitly represent an agent force through the Agent/Causer role (whether filled by an eventuality-referring nominal or an entity-referring nominal). The verbs in (3), however, we expect not to represent an agent force in their denotation. Thus, we would expect these verbs not to be sensitive to a CAUSE/ENABLE distinction, since by hypothesis, to express such a distinction, both the agent and patient vectors must be represented, and in these verbs the agent vector is not represented, because there is no syntactic Agent/Causer role.

1.2.2 Force generation and the individuation of forces

On the forces-everywhere hypothesis, another factor that might be expected to influence whether force interaction is represented, and thus whether CAUSE and ENABLE are distinguished, whether two forces are conceptually individuated. This has to do with the way in which the causing force is generated. Some causal verbs, such as *make* and *force*, seem to distinguish between an animate force-generating cause, and an inanimate, non-force-generating cause.

- (5) The officer/The storm/#The traffic light made/forced the woman (to) walk up to the man.

An officer and a storm both qualify as force-generating entities as they generate their own force (Wolff, Jeon, Klettke & Li 2010). On the other hand, a traffic light, while it ultimately has an influence over whether a person crosses the street, does not on its own generate a force that compels the person to cross the street.

But to take a step back, how does the traffic light influence the person if not by generating a force? The answer comes from the notion of a *field* (Copley & Harley 2015). A field is an abstract object that, if an entity of the correct kind is placed in it, generates a force on that entity. For instance, the earth's gravitational field is such that if an entity with mass is placed in it, a force on the entity is created. This force, in the case of gravity, is a physical force proportional to the mass of the entity, and directed toward the center of the earth. This abstract notion of field can be extended to fields that generate other physical forces or tendencies, such as the tendency of fruit to ripen when at room temperature, as well as to fields that psychosocially generate forces such as intentions. For example, a social sense of what other people are doing (the field) generates in a person (the entity) an intention to do what other

people are doing (the tendency).³

Intentions can be modeled with vector-like quantities just like physical forces (Talmy 2000; Wolff 2007). In the case of the police officer, a psychosocial force is generated by the officer; this is the agent force. The officer has a certain intention, and because of the officer's social power, the officer's intention has a greater magnitude than the pedestrian's intention. Generally, in the case of a police officer and a pedestrian, if intention is pitted against intention, it is a CAUSE scenario—the officer wins.

Unlike a police officer, a traffic light cannot have an intention. Nonetheless, there is still a way for a traffic light to influence the scene, through the social significance of red and green traffic lights. This social significance is a psychosocial field. That is, when a person who knows what traffic lights mean is placed at a particular spot in an intersection with a red or green light, that configuration creates a certain kind of intention in the person. So even though the traffic light may do essentially the same job as the police officer, there is a difference: When there is a traffic light, there is no imparting of an external force upon the patient. Rather, the traffic light invokes a field that results in the creation of a force on the person. As a consequence, there are not two entities with intentions, but only one, the pedestrian. Thus, in the traffic light condition, there is no Talmian interaction between two tendencies.

The origin of the force associated with the traffic light is in the woman's mind, not in the traffic light itself. So is the origin of her pre-existing intention to cross the street. We propose that the criterion in (6), reminiscent of proposals for event individuation as in Davidson (1969), forbids us from treating two forces whose origin is in a single entity as two forces. Rather, they must be summed and treated as a single force. So while in the officer condition, there is an interaction between two forces, in the traffic light condition, there is only one force.

- (6) Force individuation criterion: Two forces that have their origin in the same entity must be summed at the conceptual level together into a single force.

The criterion in (6) is a conceptual, not a grammatical criterion. We hypothesize that such force individuation is a factor in determining whether there is force interaction, and thus whether there is a CAUSE/ENABLE distinction. That is, we expect cases with force-generating causes such as a police officer to involve the representation of two forces, and therefore to distinguish CAUSE and ENABLE.

It's not *a priori* clear how force individuation and assignment of an Agent/Causer role should interact, but under the forces-everywhere hypothesis, we expect both

³ Talmy analyzes physical forces and intentions with exactly the same kind of theoretical object. Such a view ignores the propositional content of (many) intentions and the lack of propositional content in physical forces (Copley To appear). This difference can be elided here, however.

of these factors to have an impact on whether CAUSE and ENABLE scenarios are distinguished.

2 Predictions

In order to decide between the structural causal pluralism hypothesis and the forces-everywhere hypothesis, we set out to investigate a number of verbal predicates (*cause, make, force, influence, enable, allow, lead to, and result in*) as well as the clausal connectives *because, and, and after*. As we have seen, predicates such as *cause, make, force ...* seem to take an Agent/Causer, while *lead to* and *result in* do not take an Agent/Causer. The connectives *and* and *after* are of course only “quasi-causal”: a causal scenario can be pragmatically inferred even though they themselves do not supply causal meaning.

- (7) a. Verbs with Agent/Causer: *cause, make, force, influence, enable, allow*
 b. Verbs without Agent/Causer: *lead to, result in*
 c. Clausal connectives: *because, and, after*

Thus, if the structural causal pluralism hypothesis is correct, then the following prediction is made:

- (8) Prediction (structural causal pluralism hypothesis): Verbs should distinguish CAUSE from ENABLE, and connectives should fail to distinguish CAUSE from ENABLE.

If, on the other hand, the forces-everywhere hypothesis is correct, then the following predictions are made:

- (9) Predictions (forces-everywhere hypothesis):
 a. Assignment of an Agent/Causer role should be associated with distinguishing CAUSE from ENABLE.
 b. Force-generating causes should be associated with distinguishing CAUSE from ENABLE.

3 Methods

We tested these hypotheses in an experiment in which people saw animations of various types of interactions. Two main factors were manipulated: (i) the direction of the tendency of the patient (CAUSE vs. ENABLE) and (ii) the manner in which the force was created by the conceptual cause (force-generating entity vs. non-force generating entity).

The animations depicted an urban scene in which a woman (the conceptual patient) approached an intersection of two streets. The woman indicated her proclivity to move in a particular direction, by pointing toward one of two possible corners of the intersection. She either pointed toward a corner in which a man was standing or toward a corner that was empty. The conceptual cause in the situation was either a police officer (force-generating) or a traffic light (non-force-generating).

Six-hundred and sixty Amazon's Mechanical Turk workers participated in the experiment.

Three sets of six animations were generated from the animation package 3D Studio Max. Each animation depicted a city scene in which a woman walked to an intersection, paused, and then crossed a street. In one set of animations, a police officer directed the woman to walk in one of two directions. One direction brought the woman to a man standing at one of the corners. The other direction brought the woman to a corner without the man. Similar animations replaced the officer with a traffic light. Each animation lasted 522 frames and was played at approximately 30 frames/second.

Each participant watched each animation, and was asked after each animation to rate several sentences on a scale of 0 = very unacceptable to 100 = very acceptable. The sentences used were those in (10) and (11) below:

(10) Officer condition:

- a. The officer's gesture caused/enabled/made/forced/allowed/influenced the woman to walk up to the man.
- b. The officer's gesture prevented the woman from walking up to the man.
- c. The woman walked up to the man because/after the officer gestured.
- d. The officer gestured and the woman walked up to the man.
- e. The officer's gesture led to/resulted in the woman's walking up to the man.

(11) Traffic light condition:

- a. The light's changing caused/enabled/made/forced/allowed/influenced the woman to walk up to the man.
- b. The light's changing prevented the woman from walking up to the man.
- c. The woman walked up to the man because/after the light changed.
- d. The light changed and the woman walked up to the man.
- e. The light's changing led to/resulted in the woman's walking up to the man.

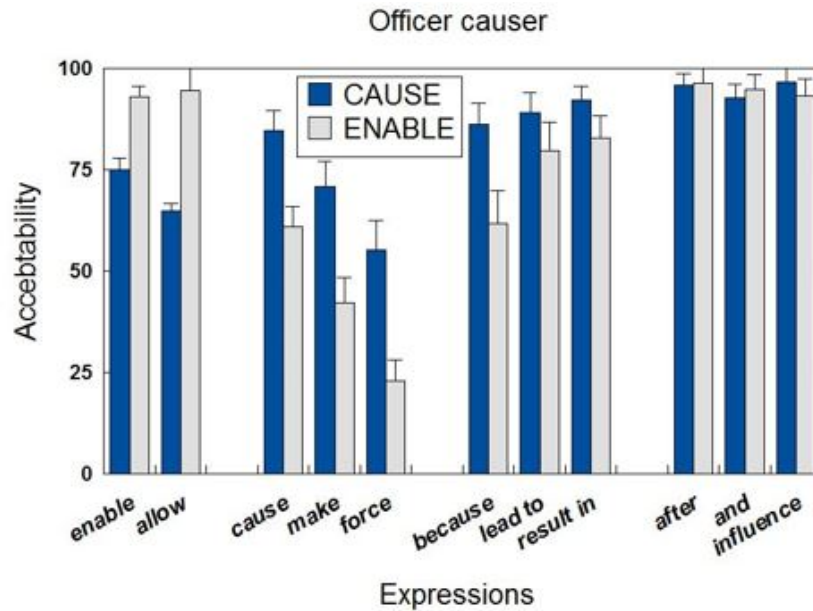


Figure 4 Results: Officer (force-generating cause)

4 Results

Recall that we were interested in whether causal expressions were sensitive to two characteristics of the scenarios: first, the direction of the patient vector compared to the agent vector, and second, the kind of cause (the force-generating officer versus the non-force-generating traffic light). If a causal expression were sensitive to the patient vector, it would show a difference in its acceptability rating between the CAUSE scenario and the ENABLE scenario. If a causal expression were sensitive to the kind of cause, it would show a difference in its acceptability rating in the officer condition versus its acceptability rating in the traffic light condition.

The results⁴ are shown graphically in Figures 4 and 5. To summarize: Only certain verbs were always sensitive to both the direction of the patient vector and the kind of cause. These were the verbs *cause*, *make*, *force*, and *allow*. Other expressions were sensitive to the direction of the patient vector only when the cause

⁴ In what follows, we do not present the results for *prevent* and the PREVENT scenario. Both behaved as predicted by Wolff's (2007) theory: that is, *prevent* was universally judged unacceptable in CAUSE and ENABLE scenarios, and nothing other than *prevent* was judged acceptable in PREVENT scenarios.

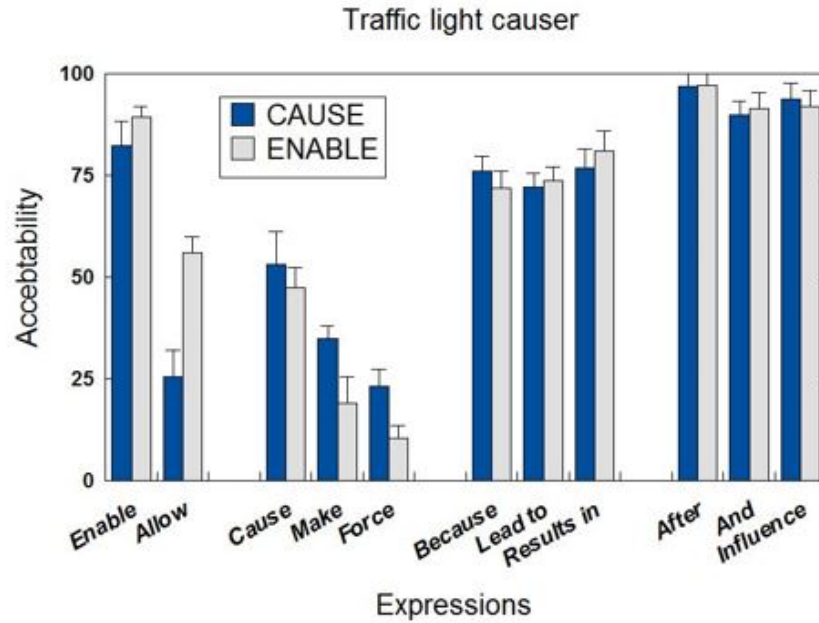


Figure 5 Results: Traffic light (non-force-generating cause)

was force-generating, but otherwise were not sensitive to the kind of cause: *because*, *lead to*, *result in*, and *enable*. Finally, some expressions were sensitive to neither: the quasi-causal connectives *after* and *and*, and the verb *influence*. These generalizations are shown below in Table 1.

5 Discussion

Our results provided evidence against the causal pluralism hypothesis and evidence for the forces-everywhere hypothesis. We will treat these in turn, and then discuss implications for the division of labor at the grammar-cognition interface, as well the denotations of both the cases where the denotation seems to explicitly refer to force interaction (*cause*, *make*, *force*, *enable*) and the other cases, where the denotation seems not to explicitly refer to force interaction.

	CAUSE \neq ENABLE always	CAUSE \neq ENABLE only if cause is fg	CAUSE = ENABLE always
fg cause \neq non-fg cause	<i>cause, make,</i> <i>force, allow</i>		
fg cause = non-fg cause		<i>lead to, result in,</i> <i>enable, because</i>	<i>influence, after, and</i>

Table 1 Results categorized

5.1 Structural causal pluralism hypothesis not supported

The structural causal pluralism hypothesis predicts that causal meanings in the cartographic region of phrase structure that deal with events (AspP and below) represent causation using force-dynamic force interaction as in Figures 1 - 3, while causal meanings of connectives, which take propositional arguments, use dependency causation. This would suggest that verbs should distinguish CAUSE and ENABLE, while connectives should not.

The prediction made by this hypothesis, given in (8), is not borne out by our results. First, verbs did not always distinguish CAUSE from ENABLE scenarios: *influence* never did, and *enable*, *lead to* and *result in* did only when the cause was force-generating. Second, the connective *because* distinguished CAUSE and ENABLE when the cause was force-generating. Our results, therefore, do not support the structural causal pluralism hypothesis.

5.2 Forces-everywhere hypothesis supported

Since the structural clausal pluralism prediction was not supported, we should revert to the null hypothesis where only one theory of causation is used throughout phrase structure. As discussed above, this single theory has to be a production theory, of which a force-dynamic theory is one kind. Our force-dynamic theory makes the predictions in (9) above, namely that assignment of an Agent/Causer role, as well as whether the cause is force-generating or non-force-generating, should be associated with a distinction between CAUSE and ENABLE scenarios.

Both predictions were supported by the evidence. Assigning an Agent/Causer role turned out to be a necessary condition for always distinguishing CAUSE from ENABLE. It was not a sufficient condition, as *enable* and *influence* do not behave like *cause*, *make*, *force* and *allow*; but recall that there was never any expectation that it would be a sufficient condition, since representing the agent vector is not the only factor determining whether two forces can be represented in the denotation.

For example, the patient vector also needs to be represented.

Not surprisingly, the quasi-causal connectives *and* and *after* proved always insensitive to the CAUSE/ENABLE distinction, as would be expected given that their denotations do not seem to represent causation at all. Also in this group is *influence*, which does on the other hand seem to explicitly have a causal meaning and even an Agent/Causer, suggesting that something else is preventing the grammatical representation of force interaction; see Section 5.5 below for a suggestion as to what.

There was also a class of causal expressions that distinguished CAUSE and ENABLE only when the cause was force-generating (the officer). This class consists of *enable*, the non-agentive verbs *lead to*, and *result in*, and the connective *because*. The existence of this class supports the second prediction of the forces-everywhere hypothesis concerning force individuation: the force-generating cause was associated with distinguishing CAUSE and ENABLE.

Thus, the forces-everywhere hypothesis is supported by our results: the two predicted factors, namely assignment of an Agent/Causer and whether the cause is force-generating, have the predicted impact on whether CAUSE and ENABLE scenarios are distinguished.

5.3 The division of labor between grammar and cognition

These results also shed light on the division of labor between the grammatical level (i.e., the denotation) and the conceptual level. They do so by indicating how the aforementioned factors—one grammatical, one conceptual—interact.

A common assumption is that the denotation *is* the representation of conceptual structure. This assumption is held explicitly by cognitive linguists such as Talmy, and is often (though not always) held implicitly by formal semanticists. Our results here suggest that this assumption is not correct.

The reason is that, if the assumption were correct, we would not expect to see a mismatch between the two factors. In particular, we would not expect to see force interaction (a distinction between CAUSE and ENABLE) in the cases where there is no Agent/Causer represented. But we do see exactly this, namely in the case of *lead to*, *result in*, *enable*, and *because*. And in fact we see evidence of force interaction exactly when there is a force-generating cause, i.e., for a conceptual reason—an effect that does not show up in the cases where we would suspect both forces are grammatically represented, namely *cause*, *make*, *force* and *allow*.

Taken in its entirety, this pattern means we have to distinguish between the representation of forces at the grammatical level from the representation of forces at the conceptual level. Whenever a force is represented at the grammatical level (in the denotation), it is necessarily represented at the conceptual level as well. If the force is represented grammatically, it can be individuated (even contrary to the

force individuation criterion in (6)), and compared to another force. However, the behavior of the class consisting of *lead to*, *result in*, *enable* and *because* shows us that there can be forces represented, and compared, at the conceptual level even though they are not explicitly represented in the denotation, and that if such merely conceptually-represented forces are not individuated by the denotation, they are subject to the force individuation criterion.

5.4 Force interaction in the denotation

If *cause*, *make*, *force*, and *allow* really do represent two forces in their denotations, how do they do this? We propose the following claim:

- (12) Only verbal predicates can express the interaction of two forces in their denotation.

Plausible support for this claim can be constructed from a relatively minimal extension of existing theory of “flavors” of the causal head *v* (Folli & Harley 2005).

As background, there has been much work separating the causal meaning from the lexical root meaning in the structure of verbs. Kratzer (1996) and Marantz (1997) use evidence from phrasal idioms to argue that agents do not appear to really be arguments of the verb they appear with. The argument is that particular patients can trigger a particular idiomatic reading of a verb, as in (13), while particular agents rarely if ever do.

- (13) a. throw a baseball, throw support behind a candidate, throw a boxing match
 b. take a book from the shelf, take a bus to New York, take a nap
 c. kill a cockroach, kill a conversation, kill an evening watching TV

These facts are unexpected if agents are arguments of their verbs, as in (14a). However, if the causal meaning is understood as something (syntactically) distinct from the lexical meaning, as in (14b), then these facts make sense: the agent is not syntactically close enough to the lexical root meaning to interact with it. Rather, it is the causal head *v* that takes the meaning of the lexical root and specifies the agent’s causing of the eventuality, represented by the Davidsonian argument *e* (Davidson 1967).

- (14) a. old analysis: $\lambda x \lambda e . \text{throw}(\text{John}, \text{baseball}, e)$
 b. *v*: $\lambda x \lambda e . \text{agent}(\text{John})(e) \ \& \ \text{throw}(\text{baseball})(e)$

This classic proposal for *v*, though it does not mention forces, provides a basis for understanding how agent and patient forces might be represented in verbal semantics,

and why it might be impossible to represent in the denotation both the agent and patient force with causal connectives. If we interpret Davidsonian arguments as forces (f) instead of events (e), as proposed by Copley & Harley (2015) in their semantics for v, we can see how this plays out.

Copley & Harley, following Folli & Harley’s (2005) categorization of meanings associated with v into different “flavors” of v, e.g., v_{do} and v_{become} , adapt Dowty’s (1979) BECOME operator (as in (15a)) to be their v_{become} . Added is the idea that an Agent/Causer-initiated force, arising in an initial situation $init(f)$ in which not-p is true, leads to the final situation $fin(f)$ in which p is true (as in (15b)).

- (15) a. Dowty 1979: BECOME Φ is true at t iff Φ is true at t and Φ is false at t-1.
 b. Copley & Harley’s (2015) $\llbracket v_{become} \rrbracket = \lambda p \lambda f . \neg p(init(f)) \ \& \ p(fin(f))$

So, in (15b), a force provokes a change in whether p is true between the initial situation and the final situation. The Agent/Causer itself is added by a higher Voice head introducing the SOURCE of the force, understood literally as the source of the energy. The predicate π is a predicate of forces.

- (16) $\llbracket Voice_{active} \rrbracket = \lambda \pi \lambda x \lambda f . \pi(f) \ \& \ SOURCE(x,f)$

This makes the denotation of the whole Voice phrase as in (17), where p is the predicate and x is the Agent/Causer (though strictly speaking, p and x would be saturated with lexical items by this point):

- (17) $\llbracket VoiceP \rrbracket = \lambda f . \neg p(init(f)) \ \& \ p(fin(f)) \ \& \ SOURCE(x,f)$

But note that only one force is mentioned: the Agent/Causer force. To represent the diagrams in Figures 1 and 2, at least two forces need to be mentioned, and their result needs to be calculated. In particular the force that represents the patient’s tendency must be mentioned, in addition to the Agent/Causer force. However, mentioning the patient directly in the denotation of the v head would seem to be problematic, as v does not have a direct syntactic relationship with the patient, and therefore should not have a direct semantic relationship with it either.

Copley & Harley’s framework suggests a way out of this difficulty. They propose (2015: 148) a notion of what we might call extraneous forces, namely, forces that are extraneous to the force exerted by the Agent/Causer. To represent these, the notion of a force being “in” a situation is needed, represented with the symbol \lt .

An extraneous force f’ in the initial situation of f (i.e., in Talmian terms, the ground—the situation that is causally prior to the application of f) represents a force that *could* come from the patient, but is not required to. Really, all we know is that it does not come from the agent. The reason why is that an extraneous force f’ that exists in the initial situation of f cannot be identical to f. The initial situation of f is

causally prior to f , and f' is in the initial situation of f ; therefore f' is causally prior to f . Thus, f' can serve as a patient vector—though it could also be a force arising from anything in the initial situation, whether or not it is mentioned in the sentence.

Furthermore, there is a way to represent the resultant vector, by an extraneous force that is in the final situation of f . The final situation of f depends on the application of f ; it is causally subsequent to f . Thus, any force f'' that is in the final situation of f is one that has already taken f into account.

We can thus propose that certain causal verbs have their own Talmian “flavors” of v , each of which represent three forces: the Agent/Causer force f , the “patient” force f' , and the resultant force f'' , as in (18). The only difference between (18a) and (18b) is the negation in (18a).

- (18) a. $v_{opposed}$: $\lambda p \lambda f . \exists f' < (init(f)): [\neg p(fin(f'))] \& \exists f'' < (fin(f)): [p(fin(f''))]$
 b. $v_{aligned}$: $\lambda p \lambda f . \exists f' < (init(f)): [p(fin(f'))] \& \exists f'' < (fin(f)): [p(fin(f''))]$

In (18a), $\exists f' < (init(f)): [\neg p(fin(f'))]$ indicates that there is an extraneous force in the ground (i.e., in the situation $init(f)$) that, if unopposed, would result in a final situation where $\neg p$ was true. For (18b) $\exists f' < (init(f)): [p(fin(f'))]$ indicates that there is an extraneous force in the ground (i.e., in the situation $init(f)$) that, if unopposed, would result in a final situation where p was true. In both (18a) and (18b), the second conjunct $\exists f'' < (fin(f)): [p(fin(f''))]$ indicates that there is a resultant force f'' resulting from the agent force f (i.e., in the situation $fin(f)$) such that, if f'' is unopposed, it results in a final situation where p is true. The denotations in (18a) and (18b) thus parallel the diagrams given in Figure 1 and Figure 2 respectively. Thus, *cause*, *make* and *force* would be expected to use $v_{opposed}$ and *allow* would be expected to use $v_{aligned}$.

If these flavors of v are the right way to think about *cause*, *make*, *force*, and *allow*, we can understand both why not all verbs are in that class, and why no clausal connectives are in that class. For the verbs, not all verbs would be expected to have these particular flavors of v . While every v head’s semantics would be some variation on (15b), not every v head’s semantics would be one of the particular variations given in (18). For the connectives, since they would not be expected to have a v head at all, the Dowtian semantics in (18a) and (18b) would not be possible. They would thus not be able to compare both forces explicitly, which is as desired.

5.5 Lack of force interaction in the denotation

Before we conclude, we will say a few speculative words about the denotations of the causal expressions where there seems to be no force interaction in the denotation.

For verbs without an Agent/Causer such as *lead to* and *result in* (and possibly also *enable*, though it seems to at least have an agentive reading), it’s very tempting

to propose that these also use the flavors of v in (18), but without an Agent/Causer introduced by a Voice head. *Lead to* and *result in* would use $v_{opposed}$ while *enable* would (might) use $v_{aligned}$. If this were true, though, contrary to expectation from our results, a causing force *would* be represented, and in fact even an interaction between forces would be represented—however, the causing force would not explicitly be associated with an Agent/Causer, and that might be significant. For reasons of space we cannot address the consequences of such a proposal here, but it seems worth investigating.

The verb *influence* would be one of the verbs that has a different flavor of v from those in (18). *Influence* cannot use the denotation in (18a) because although it assigns an Agent/Causer, there is no evidence of force interaction, as it is never sensitive to the CAUSE/ENABLE distinction. Instead, *influence* probably describes a force that changes the degree to which a proposition holds of an entity. In that case, it is likely that what is missing is a representation of the patient vector. So, *influence* would need a flavor of v similar to v_{become} as in (15b), and would have a Voice head to introduce the Agent/Causer as in (15b); but unlike v_{become} , it would not itself specify which direction the change is in. We will not develop this idea further here, but see Copley & Harley (Manuscript) for the use of both force and degree arguments for v denotations.

Finally, the denotations of the quasi-causal connectives *and* and *after* must be distinguished from that of *because*. All of these being clausal connectives, their conjuncts are propositional (predicates of situations), but recall that *and* and *after* never distinguish CAUSE from ENABLE, while *because* distinguishes CAUSE from ENABLE when the cause is force-generating.

The conjuncts in *and* and *after* might be expected to refer to two different situations, one in each conjunct. *After*, in particular, would specify a temporal relation between two situations, but not a causal relation. Pragmatically, however, for either *and* or *after*, the two different situations could be understood as two causally-related situations s_n and s_{n+1} (see, e.g., Moeschler 1989). On the other hand, *because* would explicitly represent two causally-related situations, perhaps as in (19), where *pred(s)* picks out the causally preceding situation of a situation s (Copley & Harley 2015):

$$(19) \quad \llbracket \text{because} \rrbracket = \lambda p \lambda q \lambda s . p(\text{pred}(s)) \ \& \ q(s)$$

This difference would capture the fact that *because*, in contrast to *and* and *after*, shows sensitivity to the CAUSE/ENABLE distinction in the case of a force-generating cause. This is because for *because*, we need to understand one situation (the officer's gesture) as causing the next situation (the woman's walking up to the man). This would plausibly trigger a conceptual-level comparison of forces in *pred(s)*. On the other hand, with *and* and *after*, we need not view their two conjuncts'

situations as causally related, so the comparison is not necessarily triggered.

6 Conclusion

The goal of this research was to investigate the application of the force-interaction analysis to a wider range of causal expressions. Two hypotheses were considered: either that force dynamics was relegated to verbal expressions, or that force dynamics was relevant throughout the structure. The second hypothesis proved to be supported, and representation of force interaction was seen to depend on two factors: (i) whether an Agent/Causer is represented in the syntax, and (ii) what kind of causing entity is conceptually represented: either one that generates its own force or one whose force emerges from an interaction with a field. Our findings suggested a partial independence between conceptual representation of forces and grammatical representation of forces. The conceptual-level facts hinged on a criterion of force individuation that requires different forces to have different origins. An addition to the inventory of flavors of *v* allowed us to account for why only (certain) verbs can represent force interaction at the grammatical level, and we speculatively proposed denotations for the cases without grammatical force interaction.

References

- Copley, Bridget. To appear. Force dynamics. In Rob Truswell (ed.), *Oxford Handbook of Event Structure*, Oxford University Press.
- Copley, Bridget & Heidi Harley. 2015. A force-theoretic framework for event structure. *Linguistics and Philosophy* 38(2). 103–158.
- Copley, Bridget & Heidi Harley. Manuscript. Reifying energy and change in the verb phrase using forces and degrees. Unpublished CNRS and University of Arizona ms.
- Copley, Bridget & Phillip Wolff. 2014. Theories of causation should inform linguistic theory and vice versa (Oxford Studies in Theoretical Linguistics vol. 52). In Bridget Copley & Fabienne Martin (eds.), *Causation in grammatical structures*, 11–57. Oxford University Press.
- Davidson, Donald. 1967. The logical form of action sentences. In Nicholas Rescher (ed.), *The logic of decision and action*, 81–95. University of Pittsburgh Press.
- Davidson, Donald. 1969. The individuation of events. In Nicholas Rescher (ed.), *Essays in Honor of Carl G. Hempel*, vol. 24 Synthese Library, 216–234. Springer.
- Dowty, David. 1979. *Word Meaning and Montague Grammar: The Semantics of Verbs and Times in Generative Semantics and in Montague's PTQ*. Reidel.
- Folli, Raffaella & Heidi Harley. 2005. Flavors of *v*. In Paula Kempchinsky & Roumyana Slabakova (eds.), *Aspectual Inquiries*, 95–120. Springer.

- Kratzer, Angelika. 1996. Severing the external argument from its verb. In Johan Rooryck & Laurie Zaring (eds.), *Phrase Structure and the Lexicon*, 109–137. Springer.
- Lewis, David. 1973. Causation. *The Journal of Philosophy* 70. 556–567.
- Marantz, Alec. 1997. No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. *University of Pennsylvania Working Papers in Linguistics* 4(2). 201–225.
- Moeschler, Jacques. 1989. Pragmatic connectives, argumentative coherence and relevance. *Argumentation* 3(3). 321–339.
- Pearl, Judea. 2000. *Causality: Models, Reasoning, and Inference*. Cambridge University Press.
- Ramchand, Gillian & Peter Svenonius. 2014. Deriving the functional hierarchy. *Language Sciences* 46. 152–174.
- Roy, Isabelle & Elena Soare. 2013. Event-related nominals. In Gianina Iordăchioaia, Isabelle Roy & Kaori Takamine (eds.), *Categorization and Category Change*, 123–152. Cambridge Scholars Publishing.
- Talmy, Leonard. 2000. *Towards a Cognitive Semantics, Volume 1: Concept Structuring Systems*. Cambridge, MA: MIT Press.
- Wolff, Phillip. 2007. Representing causation. *Journal of Experimental Psychology: General* 136(1). 82.
- Wolff, Phillip, Ga-hyun Jeon, Bianca Klettke & Yu Li. 2010. Force creation and possible causers across languages. In Barbara Malt & Phillip Wolff (eds.), *Words and the Mind: How Words Capture Human Experience*, 93–110. Oxford University Press.
- Wolff, Phillip & Grace Song. 2003. Models of causation and the semantics of causal verbs. *Cognitive Psychology* 47(3). 276–332.

Bridget Copley
CNRS - SFL
59-61 rue Pouchet
75017 Paris, France
bridget.copley@cnrs.fr

Phillip Wolff
479 Psychology Building
36 Eagle Row
Emory University
Atlanta, GA 30322, USA
pwolff@emory.edu

Jason Shepard
479 Psychology Building
36 Eagle Row
Emory University
Atlanta, GA 30322, USA
jason.s.shepard@emory.edu

Force dynamics

Bridget Copley, SFL (CNRS/Paris 8)

February 10, 2018

PREPRINT

To appear in Truswell, Rob (ed.), *The Oxford Handbook of Event Structure*.

Abstract

This chapter examines the semantics of force dynamics, from its cognitive linguistic origins to recent formal approaches. Force dynamics proves to be a fruitful addition to the ontology, allowing natural representations of the distinction between energy and change, interactions within and between events, and *ceteris paribus* effects, among other phenomena. This makes force dynamics useful, perhaps even indispensable, for a full understanding of event structure and related domains such as aspect, modality, and inference. A debate is just getting underway on how to formally represent forces in ways that are faithful to morphosyntax, compositional semantics, and conceptual plausibility. It may be that lexical-conceptual representations of forces differ from functional (grammaticalized) representations of forces.

The use of force dynamics to explicate meaning has its origin in cognitive linguistics, particularly in the work of Leonard Talmy. In recent years, despite apparent conflicts between cognitive and formal approaches, force dynamics has also made an appearance in formal semantics. This development has the potential to provide new insight into semantic theory and its relationships to both syntax and conceptual representations.

1 Forces for event structure

In this chapter we will examine the use of the notion of force in analyzing event structure, as well as in other domains, such as aspect and modality, that flesh out the rationale for the use of forces in language. As with any proposed ontological entity, we want to begin by asking several basic questions: What is a force? Do we need forces? And what will forces cost us in terms of theoretical economy?

1.1 What is a force?

In defining what a force is, we are not doing metaphysics, but rather naïve metaphysics, reflecting our underlying impression of what is. In this commonsense impression, we can understand forces as inputs of energy that have an origin at which the energy is applied, a direction toward which the energy is applied, and a magnitude which corresponds to the amount of energy applied. These characteristics of forces can be represented by construing forces as vectors. This is a natural way to think of physical forces, and it only then takes a small step to represent other, more abstract forces, namely as an impetus or tendency toward some result (direction) having some intensity (magnitude).

Elements of this definition of force have also been claimed for the commonsense notion of event. Energy, for instance, is routinely claimed for events, although change is a competing notion, and perhaps direction is possible in events, in the form of a path. Magnitude is harder to claim for events, though perhaps intensity is the appropriate notion. So at first glance it seems that event talk and force talk are quite similar. However, force talk allows us to do more than event talk in two ways.

The first has to do with modeling *force interaction*: vectors can be summed with each other to represent the interaction of two forces, whereas events cannot be summed to represent the interaction of two events. Significantly, as we will see, configurations of force interactions are often important to lexical distinctions. The second advantage of force talk over event talk is the *ceteris paribus* property of forces: the fact that a force has a result that happens only when “(all) things are equal”. If I push on a cup, all else being equal, the result is that it moves in a certain way or moves to a certain location. All else is *not* equal when something external to the force intervenes through force interaction—so, for example, if the cup is stuck to the table, the force I apply may not result in any change in location of the cup. Note as well that it is analytically clear how a force, modeled as a vector, has a *ceteris paribus* result—it can be recovered from the vector’s direction, since the direction is by definition toward the *ceteris paribus* result. In contrast, it is not at all analytically clear

how an event has a *ceteris paribus* result.

Where such interaction and *ceteris paribus* characteristics are seen, it is thus a reasonable hypothesis that force dynamics is being recruited at some level.

1.2 Forces are needed

Our second question was whether we need forces in our ontology to explain linguistic phenomena. We will see a number of cases where forces are needed in this chapter, but to begin with here are two. Some of the clearest cases in which forces are needed, and in fact the first ones to be addressed, have to do with force interaction. Cognitive linguist Leonard Talmy was the first to systematically take up the idea of force dynamics as explanatory of the meanings of certain linguistic expressions (Talmy, 1972, 1976, 1985, 1988). For Talmy, forces are seen as occurring within events, where force-dynamic relations are but one particular relationship between participants in an event; others could be (visuo)spatial, perspective-related, possessive, and so forth. So, for example, consider the sentences in (1).

- (1) a. The ball was rolling along the green.
b. The ball kept (on) rolling along the green.

Talmy's insight about the contrast in (1) is that (1b) highlights an opposition between two forces or tendencies (where "force" and "tendency" are equivalent notions; i.e., they are ultimately inputs of energy toward a *ceteris paribus* outcome). That is, in (1b), the ball has a tendency that is being overcome by an external force. This tendency of the ball's could be a tendency toward rest, in which case the external force could be the wind pushing the ball. Alternatively, the ball's tendency could be toward motion, in which case the opposition could be, e.g., from the stiffness of the grass. In either case force is what distinguishes (1a) from (1b).

The ability to have an analysis for verbs of maintaining such as *keep* is a significant benefit of the force dynamic approach, since using Davidsonian event arguments runs into

problems for the decomposition of such predicates, as Copley and Harley (2015) argue.

In a strictly event-theoretic analysis, one could easily analyze *keep* as involving an external causing argument such that the meaning of *keep* is ‘cause to stay’. The question then is how to analyze *stay* without using force dynamics.

As Copley and Harley point out, there is no easy way to decompose the meanings of such verbs with ordinary Davidsonian event arguments; the problem lies in the impossibility of distinguishing *stay* from both *be* and *go (to)* at once. If *stay* is distinguished from *be* by having a causing event, *stay in the room* looks like *go to the room*: $\exists e_1, e_2: [e_1 \text{ CAUSE } e_2]$ and $[[\text{in the room}]](e_2)$. If on the other hand one tries to distinguish *stay* from *be* simply by giving *stay* a presupposition that *p* was true beforehand, that is unsatisfactory as well, since it is not expected that the presence or absence of a presupposition would change the Aktionsart of the predicate, and *stay* and *be* do not have the same Aktionsart. While *be* is stative, *stay* is not, as can be seen from the fact that *Juliet stays in the room* has only a habitual reading.

A force-dynamic perspective thus allows us to decompositionally analyze lexical meanings in verbal predicates that would be impossible, or at least very difficult, to decompose without forces.¹ With force dynamics, however, *stay* can be distinguished from *be* because *stay* involves a force while *be* does not, and *stay* can be distinguished from *go* because there is no change.

Another reason forces are useful is that they allow us to make basic distinctions between *cause* and other verbs related to causation, such as *enable*, and *prevent*, as shown in (2) (Wolff, 2007).

- (2) a. *x cause (y to) p*: x’s stronger tendency toward *p* opposes y’s tendency away from *p*
- b. *x enable (y to) p*: x’s tendency toward *p* is in the same direction as y’s tendency

¹Jackendoff (1987) proposes a primitive STAY subtype of his ‘primitive conceptual category’ EVENT, but without proposing further decomposition. Another non-decompositional approach is to say that staying eventualities are a kind of hybrid of events and (true) states, with some properties of each, as in Maienborn’s “Davidsonian states” (e.g., Maienborn (2007), Maienborn, this volume).

toward p

- c. *x prevent y from p-ing*: x's stronger tendency away from p opposes y's tendency toward p

While a simple causal relation between events (e_1 CAUSE e_2) can be used for *cause* as in (2a), it cannot be used for *enable* and *prevent* in (2b,c). And while a more inclusive causal relation such as *lead to* with event relata (Ramchand, 2008, 2017) can be used in decompositions of both *cause* and *enable*, it cannot easily distinguish them. That is, one can decompose *cause* as something like 'x's action e_1 led to e_2 ', but this paraphrase could equally apply to *enable*. Worse, *lead to* cannot really be used in a decompositional analysis of *prevent*. The reason is that *lead to p* would have to specify x's force toward p, while *prevent y from p-ing* specifies an x's force away from p; this conflict would be difficult to overcome compositionally. A decompositional difference between *cause* and other causal verbs is thus not easy to achieve unless something like force dynamics is utilized at some level.

1.3 Forces come for free

Our third question was how much it would cost us to posit forces in the ontology. There is evidence that force-dynamic representations are already needed in cognition, which means that there is no particular extra cost involved positing them.

First, there is evidence that we perceive forces, in a low-level sense. The contrary has been long argued: Hume's influential theory of causation took forces to be among the things that could not be perceived directly.² Instead, for Hume, regular dependencies are all we can perceive, and it is these that lead us to infer a causal relation. However, as ? convincingly argue, Michotte's (1946) findings that anomalous temporal gaps and directions of movement interfere with impressions of causation support a force-dynamic view, contrary to Michotte's own Humean conclusions. The reason is that time and direction are inherent to forces but

²See Wilson (2007); Massin (2009) for recent discussion on the (non-naïve) metaphysics of forces, which we will not get into here.

not to simple dependencies, so if temporal and directional anomalies perturb our impression of causation, it can only be because we are using force dynamics to infer causation.

This point is in line with the idea that we perceive ‘felt forces’ (Wilson, 2007). Robles-De-La-Torre and Hayward (2001) show that force perception can compete favorably with other kinds of perception. Moving your fingers over a bump, there are two cues that allow you to perceive the bump: the geometry and the force of the bump pushing back on your finger. What they found was that if these cues are dissociated such that there is a geometrical depression but the force of a bump, subjects perceive a bump. Furthermore, force-dynamic information can be recovered from information about kinematics alone (“kinematic specification of dynamics” or “inverse dynamics”), and is difficult to ignore or obscure. For example, a person lifting a heavy box cannot by their motions deceive the onlookers about the weight of the box (Runeson and Frykholm, 1981, 1983), e.g.; see Wolff and Shepard (2013) for more on research in this domain.

Moreover, there is evidence that the information about forces can be packaged in an abstract way to relate to language, as we would expect from Talmy’s work. In a series of experimental studies (Wolff and Zettergren, 2002; Wolff, 2007; Wolff and Shepard, 2013; Wolff and Barbey, 2015), Wolff and colleagues presented subjects with animations depicting force-dynamic configurations and asked them to determine whether a particular configuration matched CAUSE, ENABLE, or PREVENT. And indeed, direction in one dimension and relative magnitude were the important considerations used by subjects in determining whether such predicates could be described as these predicates. Absolute magnitude, on the other hand, was of no use in this task, and subjects could not even reliably distinguish different absolute magnitudes (Wolff and Shepard, 2013).

2 Energy, change, and the word *dynamic*

A note on terminology before we go on to assess force-dynamic theories of meaning: since forces are inputs of energy, we immediately need to distinguish energy from change, which has not always been done explicitly in event semantics. Change and energy are not the same, as evident in our intuitions about what it is to exert a force; one can easily exert a force (an input of energy) against an object that does not move, for instance. This distinction is what motivates, for instance, Croft’s three-dimensional model of verb meaning (Croft, 2012, 2015), with time as the first dimension, change in qualitative states as the second dimension, and force or energy as the third dimension. However, as Bohnemeyer and Swift (2006) note, there is of course a close connection between change and energy. In some sense change cannot happen without energy.

The close connection between energy and change can be seen in microcosm by looking at the use of the word “dynamic(s)” (Massin, 2009; Copley and Harley, 2015), which can mean either ‘characterized by change’ or ‘characterized by energy’.

The ‘change’ meaning of the term “dynamic” can both be found throughout the linguistics literature. For example, Bohnemeyer and Swift (2006): “we propose the basic meaning of dynamicity is change”. Beavers (2008, : 245) defines dynamic predicates as “predicates that involve some ‘change’ or potential change in one participant”. Fábregas and Marín (2014), while differentiating eventivity and dynamicity, treat “eventivity” as having an designated syntactic process head (in the sense of Ramchand (2008)), while “dynamicity” refers to change, that is, “(abstract) movement . . . in some quality space.” Maienborn uses “dynamic” apparently to refer to those predicates that either do not have the subinterval property or have a lower bound on their subinterval property, i.e., non-states (Maienborn, 2007). This could be seen as a version of using “dynamicity” to refer to change, as in practice such a definition excludes predicates such as *sleep* and *stay*.

The ‘energy’ meaning, however, also has its proponents. “With a dynamic situation, . . . the situation will only continue if it is continually subject to a new input of energy . . . (Com-

rie, 1976, 49); “The bounded nature of events can be derived from their dynamicity. Events require a constant input of energy.” (Smith, 1991, 36). Bach (1986) reserves “dynamic” for a subclass of statives such as *sit*, *lie*, which would seem to indicate that he is not using it to refer to change. Beavers (2011, 338) also seems to distinguish dynamicity from change in this way: “I assume that change can only be encoded in dynamic predicates. But which dynamic predicates involve changes . . . ?”³ Copley and Harley (2015, 104) allude to usage in physics, which distinguishes dynamics (the study of energy) from kinematics (the study of motion, which is one kind of change).

Now that we are representing forces as distinct from changes, a terminological distinction between the two becomes more important. My own preference is to reserve “dynamic” for energy, but in any case the choice should be made explicit.

3 Cognitive linguistic force-dynamic theories

In this section we will look at some of the major components of force-dynamic theories within the cognitive linguistic tradition where force dynamics first came to the attention of linguists. The first several components (force opposition, the existence of two possible temporal relations between force and result, and intrapersonal forces) are due to Talmy and are discussed in the first part of the section. The second part of the section discusses the use of forces for modality, proposed by Talmy for root modals and Sweetser (1984, 1990) for epistemic modals, alongside a critique by Portner (2009). In the final part of the section, the usefulness of forces for causal chains is addressed, drawing on work in the cognitive linguistic framework by William Croft, as well as similar points made in the formal literature.

³If dynamicity is about energy, and events are about change, a phrase such as “dynamic event” is sensible, but trivial, in that all events are dynamic, because all cases of change involve forces. However, not all cases of force involve change, so not all cases of dynamicity are cases of eventivity.

3.1 Three components of Talmy's theory

The main organizing principle of Talmy's approach to force dynamics for meaning is *force opposition*, a special case of force interaction. For Talmy, all force-dynamic meanings expressed in language necessarily involve an opposition between two forces that are in opposite directions. Each of these two forces is related to one of two entities that are either expressed in the sentence or understood from the context. One of these entities, the Agonist (usually the agent), is "singled out for focal attention" Talmy (2000, 413), while the other entity, the Antagonist, is considered only insofar as it impacts the Agonist. What is at issue is whether the force associated with the Agonist overpowers the force associated by the Antagonist, or conversely, is overcome by it. In (2b), for instance, the Agonist is the ball, and the Antagonist is the other entity (the wind or the grass), which in this case is provided by the context, and what is at issue is the whether the ball's tendency is stronger (greater magnitude) than the Antagonist force.

Keep, for Talmy, does not by itself specify which opposing force is stronger. We can see this more clearly by expressing the Antagonist explicitly, as in (3a) and (3b):

- (3) a. The ball kept rolling because of the stiff wind.
- b. The ball kept rolling despite the stiff grass.

Because of and *despite*, in addition to introducing the Antagonist, indicate which of the two tendencies is stronger: the Antagonist's tendency, in the case of *because* in (3a), and the Agonist's tendency, in the case of *despite* in (3b).

Talmy's requirement for force opposition works in many cases, but in other cases it is something of a stretch. Talmy sees opposition in (4), where the logs are the Agonist and the Antagonist is the earth, whose tendency to oppose the rolling of the logs is removed.

- (4) Smoothing the earth helped the logs roll down the slope.

However, Jackendoff (1992) and Wolff and Song (2003) argue that such predicates are more

naturally understood as involving a concordance rather than an opposition between forces. Thus the second participant is not literally antagonistic to the Agonist. Accordingly, in (4), the “Antagonist” (which no longer antagonizes on this analysis) is the agent doing the smoothing, who provides an additional force toward or in support of the logs’ tendency to roll down the slope.

A second important component to Talmy’s theory is the point that there are two different *temporal relations* between a force and its result. For Talmy, “onset” causation is where the result begins after the force is applied, as in the sentence *The stirring rod’s breaking let the particles settle*, while “extended” causation is where the result happens as the force is applied, as in the sentence in (3b). Such a distinction had been presented in Shibatani (1973) as “ballistic” versus “controlled” causation and, as pointed out by Jackendoff (1992, : 138), a similar distinction had been independently discussed by Michotte (1946) as “launching” versus “entrainment”; I will use Michotte’s terminology since it is the earliest.

While entrainment, where the cause is cotemporal with the result, is not strictly excluded from an event-theoretic perspective, in practice there are enough difficulties in applying the distinction to Davidsonian verbal predicates that the possibility was never noted in event-theoretic approaches. (We will return to this point in section 5.4.3 below.)

A third significant component that Talmy introduces is *intrapersonal forces*, which provide a way to understand effort or exertion of animate entities in a force-dynamic way. As Talmy notes, physical force manifestations of animate entities are generally understood to arise from their minds rather than from their physical properties alone. So, for example, while in (5a), the dam’s Agonist force is understood to arise from its solidity, etc., the man’s Agonist force is understood to arise not only from his physical properties. Rather, he is consciously and volitionally “maintaining the expenditure of effort” as a “a continuously renewed exertion” to counter the Antagonistic force of the crowd (Talmy 1988: 71; 2000: 433).

- (5) a. The new dam resisted the pressure of the water against it.

- b. The man resisted the pressure of the crowd against him.

For Talmy, exertion reflects a split of the psyche into two parts, a basic or default part that is “repose-oriented” and a more peripheral one that is “goal-oriented”. These parts can play the role of Agonist or Antagonist. Thus, not only do force-dynamic configurations represent physical and psychosocial influences, but they can also represent influences in opposition that are conceived of as occurring within a single mind, i.e., “intrapyschological” forces. Though Talmy does not say so in so many words, it is clear that on this view animate entities need to have a certain—though not unlimited—*ability* to determine the magnitude of the physical force they apply toward the goal. This is one way that animate entities can be distinguished from inanimate entities; the latter have no ability to control the magnitudes of the physical forces that arise from them.⁴

Using this understanding of exertion, a predicate such as *try* can be construed with the physical Agonist force being the result of exertion on the part of the subject. Additionally, the Agonist force for *try* would not necessarily be stronger than the Antagonist force, that is, success would not necessarily occur. So for Talmy, *trying* to do something and *causing* something to happen differ in two respects: whether there is exertion and whether the Antagonist force is stronger than the Agonist force.

It should be noted that Talmy extends the notion of exertion to predicates that arguably do not necessarily refer to exertion. For example, while he also treats *manage to* and *finally* as involving exertion, this cannot be correct, as both can be used in situations where there is no exertion on the part of the subject, e.g. *John managed to break/finally broke his leg*, both perfectly acceptable even when John is assumed not to have wanted to break his leg, therefore could not have exerted himself to do so Baglini and Francez (2016). Compare these to *John tried to break his leg*, which clearly indicates that John wanted to break his leg. Nonetheless,

⁴Animate entities also have an ability to control the *direction* of the physical forces that they apply, namely, that such forces are directed toward the goal the entity has in mind. This point relates to *teleological capability* (Folli and Harley, 2008).

for cases that do involve exertion, Talmy’s insight provides a useful characterization.⁵

3.2 Modality with forces: Talmy and Sweetser

Talmy proposes that modal sentences can make reference to forces. He argues that some modals, such as *can* of ability in (6), involve physical forces (these would correspond to the modals that Kratzer (1991) argues to involve circumstantial model bases).

(6) The ball can’t sail out of the ballpark with the new dome in place.

Here again we can see a force opposition, with the ball’s tendency to leave the park opposed by a force exerted by the dome. The *can* of ability conveys that the ball’s tendency is stronger than the force exerted by the dome.

Talmy also treats deontic readings of modals as force-dynamic, where the forces being referenced are not physical but “psychosocial,” that is, reflecting interpersonal dynamics of desires, intentions, and authority. “[W]anting’ ... seems to be conceived in terms of a kind of psychological ‘pressure,’ ‘pushing’ toward the realization of some act or state” (Talmy 2000, vol. 1: 430). The content of the desire provides the direction of the force, and relative authority (conceived of as a kind of ability) provides the relative magnitudes of the forces. So for instance, on a deontic reading, *may* reflects both a desire on the part of the Agonist subject for the complement of *may*, as well as a non-impingement of a potentially stronger Antagonist psychosocial force; *must*, on the other hand, reflects a non-desire (or no particular desire) on the part of the Agonist subject, with a stronger Antagonist psychosocial force. In neither case does the Antagonist—the authority—have to be explicitly mentioned in the sentence.

As for epistemic modal meanings, these have also been proposed to be amenable to force-dynamic analysis by Eve Sweetser (Sweetser, 1984, 1990). Sweetser proposes that modals should be viewed as ambiguous between “semantically ambiguous between our sociophysical

⁵In the formal literature, Giannakidou and Staraki (2013) characterize the exertion inherent to *try* as a force function in the sense of Copley and Harley (2015).

understanding of force and some mapping of that understanding onto the domain of reasoning” (1990: 58). Epistemic readings of modals make reference to *epistemic forces* applied by a set of premises, which compel or make possible or plausible a conclusion, namely the propositional argument of the modal. While root modal meanings describe force dynamic patterns in the world, epistemic modal meanings describe force-dynamic patterns in the realm of reasoning. “As descriptions, sentences describe real-world events and the causal forces leading up to those events; as *conclusions*, they are themselves understood as being the result of the epistemic forces which cause the train of reasoning leading to a conclusion” (1990: 65).

Portner (2009), in a critique of Talmy’s and Sweetser’s force-dynamic perspective on modals, correctly points out that these views are not nearly as explicit as Kratzer’s proposals (e.g., Kratzer, 1981, 1991, 2012) for modality. One specific problem is the intensionality inherent to modality: the fact that generally, modal sentences do not entail their complement. Where, Portner asks, is this fact explained in the force-dynamic perspective?

This is an appropriate question. For a sufficiently worked-out theory, an answer to this question would surely lie in the *ceteris paribus* property of forces—the fact that forces themselves are in a sense intensional, since the result of a force does not necessarily obtain if other forces block it. However, there is an additional wrinkle. As we have seen, Talmy treats physical forces and intentions in exactly the same way, and Sweetser apparently treats her epistemic forces in the same way as well. Still, while a simple physical force has a result that is a single outcome, not a set of outcomes, an intention or an epistemic force would have to somehow embed a proposition, which would be (at the very least) a set of outcomes, not a single outcome. Gärdenfors seems to recognize this issue when he defines goal vectors (representing an animate entity’s intentional goal) as being “more abstract” than movement vectors (2014:64). The solution to this problem will be to find a way to get propositions into force dynamics, by somehow distinguishing between propositional and non-propositional results. So Portner’s critique, while entirely accurate about existing theories,

is not in principle unaddressable, provided that a more sophisticated taxonomy of forces could be made.

Portner also wonders whether Sweetser’s “epistemic forces,” when made sufficiently explicit, would not reduce to logical relations, either classical or probabilistic. This may be so, but even if so, it is not a problem for Sweetser. In Sweetser’s view, the relations of logical consistence and necessity that are used in Kratzer’s possible worlds analysis—for root modals as for epistemic modals—are essentially epistemic relations between believed propositions, rather than physical or causal relations in the world. Thus the problem is not in using such relations for epistemic modality, but in using them for root modality.

And actually, there is a better formal counterpart to Sweetser’s epistemic forces, which may shed a brighter light on the analogy between physical and epistemic forces. In Sweetser’s force-dynamic perspective on processes of reasoning we can see an echo of the insight according to which all utterances are seen as “context change potentials,” which gave rise to dynamic semantics around the same time (Kamp, 1981; Heim, 1982; Groenendijk and Stokhof, 1991). In dynamic semantics, “meaning is seen as an action” (van Eijck and Visser, 2012), and indeed processes of reasoning are sometimes explicitly treated with a *cause* relation (e.g. Lascarides and Asher, 1991). Moreover, as Copley and Harley (2015) argue, there is a very direct equivalence along the lines of Sweetser’s proposal between force dynamics and the subset of dynamic approaches that hinge on “default” or “defeasible” inferences (Lascarides and Asher, 1991; Asher and Lascarides, 2003; Veltman, 1996). This is the *ceteris paribus* property again: just as forces lead defeasibly to a situation in the world (as other, stronger forces can block this from happening), so too utterances can lead to default information states, but default conclusions are defeated if there is information to the contrary.

3.3 Causal chains: Croft and others

On the heels of Talmy’s initial foray into force dynamics, William Croft’s work (e.g., Croft, 1991) extended the usefulness of force dynamics as an organizing principle for argument

structure. Here we will trace arguments by Croft and others that force-dynamic causal chains are relevant to event structure in the argument realization of thematic roles such as agent and patient, as well as in cases of indirect causation and psych verbs.

Argument realization is the question of which participant in an event is associated with which grammatical position in a clause (see Levin and Rappaport Hovav, 2005, for a detailed overview). A very common way to answer this question is through assigning thematic roles such as agent and patient, and relating those roles to grammatical positions. In theories that offer conceptual criteria for such thematic roles, these criteria can be causal in nature; for example, in Dowty's (1991) Agent and Patient "proto-roles", for example, a prototypical Agent "causes an event or state" and a prototypical Patient is "causally affected by another participant." However, such criteria on their own may not straightforwardly capture the fact that patients need not change, in verbs of surface contact and motion such as *hit* in (7) (Levin and Rappaport Hovav, 1995). It is not entirely clear whether the table in (7) is "causally affected" in terms of change.

(7) Dashiell hit the table.

If instead the causal structure of the event is understood systematically in force-dynamic terms, as proposed variously by Langacker (1987); Croft (1991); Jackendoff (1992); Croft (2012); Levin and Rappaport Hovav (1995); Song and Wolff (2003); Wolff (2003); Beavers (2011); Warglien et al. (2012); Gärdenfors (2014), among others, we can understand agents as being the "source of energy" (as in (Langacker, 1987, vol. 2, 292) and patients as being the recipients of that energy, so that cases like (7) are explained.

Moreover, causal chains, as instantiated in a force-dynamic framework, impose a conceptual organization on thematic roles that is reflected in the syntactic structure, namely that of the transmission of force relationships between participants (Croft, 1991, 2012, 2015). For example, not only do agents initiate the force and appear higher in the structure, and patients receive the force transmission and appear lower in the structure, but instruments,

which are an intermediate part of the force transmission, occur in an intermediate part of the syntactic structure.

In addition to thematic roles, force-dynamic causal chains are useful as part of an explanation as to why and how language distinguishes between direct and indirect causation, especially regarding the lexicalization of verbs. For instance, (8a) cannot really be used to describe a situation where Tate opens the window, which allows the wind to open the door. Likewise, (8b) is perfect in that situation but is odd in a situation where Tate opens the door in the normal way.

- (8) a. Tate opened the door.
b. Tate caused the door to open.

Distinctions between simpler and more complex event structures are therefore grammatically significant (and see, for instance, Levin and Rappaport Hovav (1999); Levin and Hovav (2004); Ramchand (2014), Ramchand's and Siloni's chapters). Roughly, the more complex the event structure, the more indirect the causation. As Levin and Rappaport Hovav (1999) point out, temporality is relevant to the notion of event complexity as well; simpler events involve temporal overlap (as in Tate's force and the door opening in (8a)) while more complex events do not (Tate's action in (8b) precedes the opening of the door). Periphrastic causatives can also themselves be sensitive to direct versus indirect causation (Kemmer and Verhagen, 1994; Verhagen and Kemmer, 1997; Vecchiato, 2003).

It is certainly possible to represent these causal chains with causation understood counterfactually, as in Dowty's (1979) version of Lewis's theory of causation. However, as Copley and Wolff (2014) argue, if causation in verb phrases is based on a counterfactual theory of causation such as Lewis's, it is not really clear why grammar would so often distinguish indirect causation from direct causation. This is because counterfactual theories of causation (like all dependency theories of causation, see section 4.3 below) reduce causation to a kind of correlation or dependency, so that any difference between direct and indirect causa-

tion is neutralized. Moreover, temporal overlap is irrelevant to correlations, without world knowledge of physics to ground it in—which is essentially admitting that a force-dynamic component is necessary. The need for causal relations other than *cause* (e.g., *enable*, *help*) to account for different kinds of instruments’ participations in causal chains (Koenig et al., 2008) also points toward the need for force dynamics.

Croft, for his part, argues that two different kinds of causation are both relevant to causal chains: one with participants as *relata*, and one with events as *relata*. In Croft (2012, 2015) he addresses this issue by breaking the event down into subevents, each with their own participant and state or change in state of the participant, all linked by force-dynamic causation.

Finally, using force-dynamic causal chains in verbal meanings should provide reasons why certain predicates have crosslinguistically variable and atypical linguistic realizations. Croft (1993, 2012) argues that mental events such as emotion, cognition, and perception can be construed as transmission of force in either of two directions: an experiencer exerting a force to direct their attention to a stimulus, or a stimulus providing a force that changes the mental state of the experiencer (he also proposes a third, state-based construal; cf. Chilton (2014, p. 85) who claims that all perception involves forces, at least metaphorically). Perception is in any case a very direct kind of causation (Higginbotham, 1983; Kemmer and Verhagen, 1994); see also Vecchiato’s (2003) “occult” causation). The relevance of eventuality type and directness of causation again suggests force dynamics.

4 Can there be forces in a formal theory?

The fact that theories of force dynamics in language arose within cognitive linguistics might seem to preclude the use of forces in formal theories. However, as Hamm et al. (2006a) argue, there is no real contradiction between cognitive and formal approaches to semantics, despite some apparent conflicts. We disentangle three such apparent conflicts here: the nature of

meaning, the syntax-semantics interface, and intensionality in the treatment of possibilities and causation.

4.1 The nature of meaning

The cognitive linguistic viewpoint, in which force-dynamic theories first arose, treats meaning as non-propositional, subjective, and analog (Lakoff and Johnson, 1999). Meaning “cannot be reduced to an objective characterization of the situation described: equally important. . . is how the conceptualizer chooses to *construe* the situation and portray it for expressive purposes” (Langacker, 1990, 5). Meaning’s connection to the world is thus mediated through our construals of the world, and such construals correspond to the world to the extent that we are “in touch with reality” (Johnson, 1987, p. 203) and are successful in achieving a communicative “meeting of minds” (Warglien and Gärdenfors, 2013).

On the other hand, formal, model-theoretic semantics—traditionally, in any case—follows Frege and Lewis in treating meaning as referring to the world in a direct, objective way, rather than a subjective way. Entities are members of sets, and participate in relations and functions, constructing propositions that are related to truth values by means of contextual indices. Thus meaning is propositional, objective, and digital (true/false, or in a set/not in a set), and it is fruitless to try to understand meaning in terms of psychological and psychosocial phenomena (Lewis, 1972) or in terms of one’s own subjective idea (Frege, 1948).

The question for us is whether the considerable daylight between these two views is pertinent to the use of force dynamics at the syntax-semantics interface. There are in fact two separate, orthogonal issues. First, what does meaning do? That is, does it build construals of the world such as force-dynamic representations, or does it make reference to the world directly, as Frege and Lewis argue? And second, need meanings have “analog” representations to capture the richness of conceptual nuance as in the interactions of forces, or can they be represented using “digital” representations?

As for the issue of what meaning does, while all formal semanticists have adopted the

idea of function-driven compositionality from Frege, they may or may not also be willing to accept that meanings directly refer to the world, without any conceptual structure mediating the relationship. It is perfectly possible to be a formalist and yet believe, as Ramchand (this volume) puts it, that “facts about situations in the world feed, but underdetermine the way in which events are represented linguistically.” Work by Kamp and others in Discourse Representational Theory is the most robust example of formal but conceptual approaches; see Hamm et al. (2006b), as well as Asher’s “natural language metaphysics” as compared to “real metaphysics” (Asher, 1992, 7). In any case the question has not been a major concern for many in the generative tradition, especially in North America (though see Jackendoff (1983, 1997, , e.g.) for an exception). In short, as Hamm et al. (2006b) suggest, this issue could (and should, they argue) be resolved in favor of conceptually-mediated meaning without undermining formal approaches.

The second question is whether formal machinery is appropriate for rich conceptual schemas such as those involving forces. On the cognitive linguistics side, there is an impression that force-dynamic representations, among others, are too fine-grained to be shoehorned into logical representations: Sweetser (1990), seeing a dichotomy between formal and conceptual approaches, places her partly force-dynamic theory on the side in which meaning has its basis in human cognitive experience. For his part, Gärdenfors sees logical denotations of linguistic expressions as involving “a vicious circle of symbolic representations” (Gärdenfors, 2014, 164), much as if such denotations were intended to stand on their own without *any* link to either the world or to a conceptual level, although this has never been the claim of any formal semantic proposal.

The key question is whether “analog” representations of forces can be mapped to “digital” representations of forces; this is a special case of the broad question of whether the “messy” real world can be mapped to “symbolic and categorical” linguistic expressions (Ramchand, this volume). There are several ways to answer this question in the affirmative. One way is already familiar from digital music and photography: namely, that a digital system with

sufficiently small divisions is effectively indistinguishable from an analog system. A formal representation of forces as vectors applied throughout time, for instance along the lines of Zwarts and Winter (2000), is a possible realization of this kind of solution, as we will see below in section 5.1. Another answer is to follow Talmy (2000) and Zwarts (2010), etc. in directly representing force-dynamic relations such as *support*, *attach*, and *oppose* as relations between entities, with or without the language having access to the underlying forces.⁶ Finally, as we will see below in the theories of van Lambalgen & Hamm and Copley & Harley, it is possible for language to represent a simplified or abstract version of force vectors, leaving various details to the conceptual level. Whichever method is used, there is no principled problem to representing forces in a formal system.

4.2 The syntax-semantics interface

An additional issue that arises when considering how force-dynamic approaches can be incorporated into formal (generative) work at the syntax-semantics interface is the difference in how cognitive and formal approaches treat syntax. As we have noted, within the general cognitive approach, force-dynamic meanings are understood as residing within a conceptual structure. Semantics is to be derived from, or indeed identified with, this conceptual structure. Within the cognitive linguistic tradition of force-dynamic approaches, there is considerably more interest in investigating the role of grammatical and lexical material in determining this conceptual structure, than in relating such a structure to a formal, autonomous syntactic structure; syntax can be seen as being rather unimportant. Conversely, in generative approaches, as Croft (2012, p. 28–30) puts it, the mapping between syntax and semantic/conceptual structure is less direct than in cognitive approaches, and the mapping itself is more of an object of study.

Gärdenfors treats conceptual structures as providing “constraints on what syntactic con-

⁶A similar relational approach to force dynamics has also been used in machine classification of events from videos (Siskind, 2000, 2001; Fern et al., 2002). For example, *pick up* is understood as describing an event in which the agent is not supported throughout the event, the patient is supported throughout the event, and the patient transitions from being supported by, e.g., a table to being supported by the agent.

structions are possible or likely” (Gärdenfors, 2014, p. 72) but backgrounds syntax because “syntax is required only for the most subtle aspects of communication—pragmatic and semantic features are more fundamental for communication.” (Gärdenfors, 2014, p. 71)).⁷

Talmy is interested in working out the roles of grammatical and lexical material in determining conceptual structure: “Together, the grammatical elements of a sentence determine the majority of the *structure* of the [conceptual representation], while the lexical elements contribute the majority of its *content*.” Talmy (2000, vol. 1, p. 21); and again, “The closed-class forms of a language taken together represent a skeletal conceptual microcosm.” Talmy (2000, vol. 1: 179). Talmy does refer to syntactic structure, but it is a syntax of the most basic sort, even at times a flat structure within a clause. While in other material he does admit the possibility of a mismatch between conceptual and syntactic structure Talmy (2000, , vol. 1, p. 265, e.g.), syntax does not play a prominent role in his work on force dynamics.

Croft works within a Construction Grammar approach in which there is no strict division of semantic and syntactic components; rather, each particular construction is a stored meaning-form mapping. This said, Croft’s conclusions are sometimes not far off generative approaches, particularly the insight that each participant has its own subevent in the causal chain, a conclusion that has been reached independently in neo-Davidsonian generative approaches for both syntax and semantics (see Lohndahl, this volume).

There is much merit in the heuristic that conceptual structures, if properly understood and structured, should be expected to take over some of the functions of purely formal properties and features; indeed, modern decompositional approaches to verb meaning (Hale and Keyser, 1993; Kratzer, 1996, 2005; Folli and Harley, 2005; Ramchand, 2008) are not such distant cousins to this idea. From a generative point of view, then, Talmian force dynamics is best viewed as a starting point with which to construct possible or plausible meanings,

⁷He also denies a mapping between sentences and propositions, on the grounds that “the meaning of a sentence to a large extent depends on its context,” (Gärdenfors, 2014, 176); I can only see this, and similar objections, as a misunderstanding of modern formal theories of semantics and pragmatics, in which context-dependency is easily implemented.

with work still to be done at the syntax-semantics interface to determine the compositional details in specific cases, and how much of the meaning is available to manipulation by the grammar.

Further, however, force-dynamic perspective has great potential to simplify logical forms, and thereby to clarify and constrain the syntax-semantics interface. This is because, as we saw in section 1.1 above, forces can do more than events, due to the possibility of force interaction and the *ceteris paribus* property, so that complexity that otherwise would have to be spelled out elsewhere in the logical form (or, e.g., in definitions of theta roles) can reside instead in conceptually plausible definitions of forces and how they behave. This can be seen most clearly in the work of Copley & Harley, which we will discuss in section 5.4 below.

4.3 Intensionality: possibilities and causation

A third issue separating cognitive linguistic and formal approaches has to do with intensionality. As we have seen, the *ceteris paribus* property of physical forces introduces intensionality, since the result of the force does not necessarily come to pass. We have seen as well (section 3.2) that there are two different kinds of intentionality which seem to be conflated in cognitive linguistic approaches: one in which the result is a single outcome (ordinary physical forces), and one in which the result cannot be smaller than a set of outcomes (at least intentions, perhaps others). These outcomes are *possibilia*, but they are small, closer to situations than to worlds, and the directedness of the force toward the outcome or set of outcomes is somewhat basic to the idea of a force and not further analyzed. Do these facts pose a problem for the representation of forces in formal approaches? That is, do forces present a conflict with possible worlds?

Possible worlds have a distinguished provenance in philosophy, going back to Leibniz's account of necessity and possibility as involving universal and existential quantification, respectively, over a set of possible worlds. The idea of possible worlds was utilized and

expanded to great success in the modern development of modal logic (see Ballarín, 2010, for an overview), and further cultivated in David Lewis’s foundational works on possibility, causation and counterfactuals (Lewis, 1968, 1973, 1975, e.g.), as well as Stalnaker (1968, 1981, e.g.). It is this perspective that formal linguists have largely inherited, through the lens of important early works such as Dowty (1979), Kratzer (1991), and Kratzer (1986).

The overwhelming explanatory success of this perspective is such that in formal semantics, modality is virtually always identified with the mechanism of quantification over possible world arguments. As we have seen above in section 3.2, however, this picture is manifestly at odds with Talmy’s view of modals, in which modal auxiliaries such as *can* and *must* are essentially force-dynamic in nature. To incorporate forces into the ontology, this apparent conflict must be resolved.

This conflict parallels a long-standing philosophical debate over the nature of causation. Theories of causation can be divided into *dependency* (or “make a difference”) theories and *production* (or “process”, “generative”, or “mechanistic”) theories, the latter including force-dynamic theories (Copley and Wolff, 2014).

Dependency theories define causation as being fundamentally built on a dependency between events. The statement *A causes B* is consequently defined in terms of a dependency of the occurrence of a B-event on the occurrence of an A-event. The particular kind of dependency can be one of logical dependency (Mackie, 1974, e.g.), counterfactual dependency (Lewis, 1973, e.g.), probability raising (Suppes, 1970, e.g.), or intervention (Pearl, 2000, e.g.). Production theories, on the other hand, understand causation as involving a mechanistic relationship between participants, either as a configuration of forces Wolff (2007, e.g.), a transmission of energy (Dowe, 2000, e.g.), or a transference of some other quantity (Mumford and Anjum, 2011, e.g.).

Dependency theories, in short, view causation in terms of possibilities, in the sense that possible worlds or situations are primitive, and causation is defined in terms of propositions which are predicates of these possible worlds. Production theories, on the other hand, take

causal concepts such as force and transmission of energy to be primitive, with the forces themselves defined as being directed toward possibilia. The relevance of the debate on causation to our question about intensionality is therefore that causation and modality are “two sides of the same coin,” as Ilić (2014) puts it. Either causation can be derived from possibilities, as in the dependency perspective, or possibilities (in the sense of possible courses of events) can be derived from causation, as in the production perspective. The production perspective does require primitive possibilia, but organizes them into a course of events (a “world”) only through forces; the courses of events are not themselves atomic.

Both dependency and production theories are, or can be made, powerful enough to describe anything the other kind of theory can, even if some phenomena are better explained with one kind of theory than the other. This point might not at first be obvious; there is often a suspicion that forces are not enough to model causation, that at base some kind of counterfactual statement is needed. Even Talmy is not immune to this worry, proposing (Talmy, 2000, vol. 1: 491) a “causative criterion” which is counterfactual in nature; with his force dynamics he does not need such a criterion. If forces are understood to arise from situations (Copley and Harley, 2015), then merely by varying the size and content of the initial situation under consideration by the speaker, different forces can be brought to bear that result in different outcomes.

In this way, the tools to represent counterfactuality do not reside solely in the linguistic system with propositions true in possible worlds, but rather reside (instead or also) in our knowledge of the world, particularly in our mental simulations of what happens if certain forces are brought to bear. Mental simulation is an important part of our ability to consider what will or may happen next (Gilbert and Wilson, 2007; Suddendorf and Corballis, 2007), and as we saw above, there is indeed evidence from psychology that our knowledge of the world does include knowledge of forces, quite apart from linguistic competence. Such knowledge can be built into the semantic ontology in the definition of forces.

That said, production theories such as force-dynamic theories do not easily account for

all linguistic phenomena. Causal connectives, for instance, are apparently insensitive to intermediate causes, as in (9), nor do they easily distinguish between *cause* and *help*, as in (10) (Copley and Wolff, 2014, : 55):

- (9) The door opened because of Tate.
- (10) a. Lance Armstrong won seven Tours de France because of drugs.
b. \neq Drugs caused Lance Armstrong to win seven Tours de France.

Since these distinctions are necessarily made in a force-dynamic theory, it looks as though force dynamics may not be the correct way to model *because*, contra Talmy.

Independently, a number of philosophers have come to the conclusion that more than one kind of theory of causation may be needed (“causal pluralism;” Hall (2004); Cartwright (2004); Godfrey-Smith (2010)). Copley and Wolff (2014) have hypothesized that the difference between the two kinds of theories may be related to where in phrasal structure we are looking: force dynamics is relevant lower in phrase structure, while dependency theories, which deal in propositions, are relevant higher in phrase structure (“structural causal pluralism”).

There is some evidence (Copley et al., 2015) that, contrary to the structural causal pluralism hypothesis, force dynamics is relevant everywhere in structure. However, if something like the structural causal pluralism hypothesis should turn out to be correct, it would also suggest that modality outside the verb phrase and modality inside the verb phrase should not be analyzed in exactly the same way. Even if possibilities within the verb phrase are constructed by means of a force-dynamic theory (i.e., deriving possible worlds in terms of a force-dynamic understanding of causation) possible worlds at the higher level could still be atomic.

5 Formal force-dynamic theories

We now turn to the discussion of formal theories of force dynamics that have recently been proposed. Two categorical divisions stand out: first, a division between theories mostly concerned with how force vectors interact in space with entities, and which are therefore rather direct descendents of Talmy's work; and theories mostly concerned with the fact that the result of a force only obtains if nothing stronger intervenes *ceteris paribus*—‘*all else being equal*’. Second, there is a division between, on the one hand, one theory (van Lambalgen and Hamm, 2008), whose primary goal is to logically derive all and only the events that would occur, *ceteris paribus*, given certain starting conditions and assumptions; and on the other hand, the other theories whose primary goal is to elucidate the syntax-semantics interface.

In the following table are shown the data each theory concentrates on, how force and event arguments are treated, and the categories the theory falls under.

Table 1: Formal force-dynamic theories

	data	force arguments	event arguments	categories
Zwarts (2010), Gold- schmidt and Zwarts (2016)	force verbs and prepositions	are vectors (Zwarts and Winter, 2000)	are associated with paths along which forces are exerted in time	syntax-semantics interface, vector-oriented
Pross and Ross- deutscher (2015)	conative alternation, other force verbs and prepositions	are atomic, introduced by force head within PP	are atomic, introduced by v head, interpreted as exertions of forces	syntax-semantics interface, vector-oriented
van Lambalgen & Hamm 2008	event structure, viewpoint aspect	are functions from times to truth values ("fluents"), but the <i>Trajectory</i> predicate is closer to a force vector	are atomic; eventualities are ordered quadruples that include events and fluents	calculus that derives only and all the occurring events given starting conditions, <i>ceteris</i> <i>paribus</i> -oriented
Copley and Harley (2015, 2018)	event structure, viewpoint aspect	are functions from situations to situations	are replaced by force or situation arguments	syntax-semantics interface, <i>ceteris</i> <i>paribus</i> -oriented

5.1 Zwarts 2010 and Goldschmidt & Zwarts 2016

Recent work by Zwarts and Goldschmidt (Goldschmidt and Zwarts, 2016) uses vector representations of forces to understand verbs that seem to explicitly make reference to the application of force, such as *schlagen* ‘hit’ and *ziehen* ‘pull’, as well as these verbs’ selection of certain prepositions. This project has its roots in Zwarts (2010) which made the initial connection to Wolff’s vector theory of force dynamics for such verbs and prepositions (through Wolff and Zettergren (2002)), and uses a formal model for vectors given in Zwarts and Winter (2000).

In Zwarts (2010), the case is made that force dynamics is indispensable for many prepositions⁸ and verbs. For example, as a number of authors point out (Vandeloise, 1991; Garrod et al., 1999; Coventry and Garrod, 2004; Zwarts, 2010; Gärdenfors, 2014, a.o.), the preposition *on* cannot simply be understood as referring to a certain geometric configuration in which one object is located higher than another and in contact with it. Rather, the lower object must be supporting the higher object. Support can only be described using force-dynamic terms: not only is one entity above and in contact with another, but also the weight force associated with the first entity is opposed to an equal force by the second entity.

Likewise, the Dutch prepositions *op* and *aan* in Dutch, both glossed as ‘on’ in English, are distinguished respectively by relations of support versus attachment/hanging (Bowerman and Choi, 2001; Beliën, 2002). Notably, *op* is also used in cases of adhesion, which Zwarts argues to have the same abstract force-dynamic configuration as support. The only difference is that the force associated with the subject is not a gravitational force.

In addition to prepositions, Zwarts provides some examples of verbal predicates (“force verbs”) that require a force-dynamic interpretation; he notes that the difference between *push* and *pull* does not correspond to direction of motion, since an agent can push and pull

⁸This point extends to the syntax of prepositions: Roy and Svenonius (2009) use Talmian force dynamics to account for meanings of causal prepositions such as *in spite of*, linking them to a general account of the syntax-semantics interface for prepositions. Case can also have meanings similar to prepositions, and accordingly Svenonius (2012) links the North Sámi illative case to force dynamics.

an object without it actually moving, but rather to direction of force, away or toward the agent. Rather, the difference between *push* and *pull*, as well as that between *squeeze* and *stretch* and between *lean* and *hang*, is one of the direction of the application of the force. So, any decomposition of these verbs must make reference to the direction of application of force in order to distinguish each pair of verbs. This direction of the application of the force, he notes, is distinct from the directions of the arrows in Talmy's force diagrams, since, for example, an agent can pull a patient toward themselves, while in Talmy's diagram such an example would be notated with an arrow from the agent (Agonist) toward the patient (Antagonist).

Finally, Zwarts notes that the prepositional and verbal meanings compose together in combinations that are expected from their force-dynamic meanings, as in (11a,b):

- (11) a. The lamp was attached to the ceiling.
 b. The lamp was hanging from the ceiling.

As these predicates involve no motion or change along a path, the only plausible reason why *to* is selected in (11a) but *from* is selected in (11b) is that the lamp is associated with a force directed towards the ceiling in (11a), but in the opposite direction from the ceiling in (11b).

A fully compositional analysis of force verbs and prepositions is given in Goldschmidt and Zwarts (2016). The main contrast to be explained is in (12) (German):

- (12) a. Maria schlägt auf den Nagel.
 Maria hits on the nail
 'Maria hits the nail.'
 b. Maria schlägt den Nagel in die Wand.
 Maria hits the nail in the wall
 'Maria hits the nail into the wall.'

As part of a critique of a standard (neo-)Davidsonian approach to the contrast in (12), Goldschmidt & Zwarts point out that such an approach, without further elaboration, would incorrectly predict there to be no entailment relation between (12a) and (12b) while in reality

(12b) entails (12a). They propose to solve this and other problems with the event-theoretic account of (12) by adding forces to the ontology.

For Goldschmidt & Zwarts, events have paths along which forces are exerted. This is achieved by having the origin of a force vector (perhaps with zero magnitude) at each moment of time along the path. Hitting, for instance, specifies a path along the surface of a patient with a punctual (one moment in the path) force applied on the path. Verbs describe sets of events while prepositions and adverbs describe sets of paths; this treatment of the syntax-semantics interface gives rise however to some compositional complexity, which they address by proposing two type-shifting operations.

The meaning of the sentence in (12a), according to Goldschmidt & Zwarts, is thus that there is a hitting event of which Maria is an agent, which has a path on which a punctual force is exerted on the surface of the nail. The sentence in (12b) ends up with the meaning that there is a hitting event of which Maria is an agent and the nail is a patient, and this event causes an event of the nail going into the wall (with a Talmian definition of causation involving the configuration of forces as in (2a)). Now (12b) does entail (12a), to the extent that a patient of a hitting event (in (12b)) is indeed hit on its surface, as is also true in (12a).

5.2 Roßdeutscher & Pross 2015

In a 2015 presentation, Roßdeutscher & Pross also allude to Zwarts & Winter's (2000) vector semantics to explain, among other force verb-preposition combinations, the conative alternation as shown in (13) (German), which has an obvious parallel to the case discussed by Goldschmidt & Zwarts above in (12):

- (13) a. Peter zieht an der Rübe.
Peter pull at the carrot
'Peter pulls at the carrot.'
- b. Peter zieht die Rübe aus der Erde.
Peter pull the carrot out the soil
'Peter pulls the carrot out of the soil.'

Pross & Roßdeutscher's ontology is heavily informed by their theory of the syntax-semantics interface. For them, a parallelism between Kratzer's (1996) split VP and Svenonius's (2003) split PP gives rise to the idea of a forceP which plays the same role that a vP plays in verb phrases. The forceP is a predicate of forces while the vP is a predicate of events. To connect events to forces, in a marked departure from Talmy, events are considered "exertions" of forces. The word "exertion" here should probably be read simply as a notation of the idea that the event is the conduit through which the agent or initiator (Ramchand, 2008) of the event is connected to the force. A force has a region in space to which it "attaches" (i.e., a point corresponding to the origin of the vector) and a region to which it is directed, as a "goal".

Their analysis of (13b) is that Peter is the initiator of an event which is an exertion of a pulling force, where the carrot is the force recipient (due to a small clause structure containing the carrot and the force-predicate preposition), and the goal of the pulling force is a region located out of the soil.

Note that we need an entailment that the carrot ends up out of the soil. For Pross & Roßdeutscher, this is part of what it means to be a force recipient, so that the fact that the carrot is the force recipient entails that it moves out of the soil. In contrast with (13b), (13a) for Pross & Roßdeutscher has no force recipient; the internal argument of vP supplies not a patient but a predicate of forces that attach (have their origin) on the carrot. Here again their assumption that force recipients undergo change is useful, as although the force has its origin on the carrot, the carrot is not considered a force recipient, and therefore is not assumed to move.

This notion of "force recipient" in which the entity has to undergo change is an enormous departure from the usual idea of force recipient, in which all that is required is that the entity literally receive the input of energy; there is normally no requirement of change. Yet the idea that the grammatical patient in (13b) undergoes change, but the argument of the preposition in (13a) does not, is obviously crucial to the explanation of the contrast in (13).

One way out of this is of course to change the role of the patient from “force recipient” to something else that involves change. If on the other hand we do not wish to do this, given that not all grammatical patients undergo change, we would need an extra causal element, through a Talmian causal element as Goldschmidt & Zwarts propose (though this is what the grammatical configuration is meant to explain), or a closed-world assumption where *ceteris paribus*, which does similar work to the Talmian CAUSE configuration (about which more later in the sections on *ceteris paribus*-oriented theories, sections 5.3 and 5.4 below).

To sum up the two vector-oriented theories we have seen, we can consider some similarities between them: not only do both use vector semantics and attention to spatial detail, but both theories use events for verb phrases, to which the agent/initiator is related, and forces for prepositions. The theories differ, however, in how the event is related to the force: for Goldschmidt & Zwarts, events have paths over which forces are exerted through time, and for Pross & Roßdeutscher, events are “exertions” of forces. They also differ in their treatment of the syntax-semantics interface, with Goldschmidt & Zwarts proposing two type-shifting operations, as against the functional projection parallelism proposed by Pross & Roßdeutscher.

5.3 Van Lambalgen & Hamm 2012

We move now from the vector-oriented theories to the *ceteris paribus*-oriented theories. While the former are concerned with force verbs and prepositions, the latter make a claim to being comprehensive theories of event structure, Aktionsart, and viewpoint aspect, especially progressive aspect, through an implementation of the *ceteris paribus* property, the fact that results only obtain if all else is equal. The first theory to have gone down this road is that of van Lambalgen and Hamm (2008), a powerful and general treatment of event semantics which crucially includes a representation of forces as a component of some kinds of eventualities.

This work does not build on the cognitive linguistic tradition of force dynamics with its emphasis on vector summation and force interaction—Talmy is never cited, for instance—

but rather represents a development of the event calculus in artificial intelligence. The goal of van Lambalgen and Hamm (2008) is to understand the cognitive underpinnings of tense, Aktionsart, and viewpoint aspect, by constructing a computational theory of planning. A major claim of the work is that time is not basic to human thought but arises from the need to plan actions in the service of our goals. Taking this claim seriously, they propose that the meaning of a natural language expression is an algorithm. While we cannot go into formal details of this proposal here, we can look at the broad lines that are relevant to forces.

Van Lambalgen & Hamm’s core observation about planning is that we cannot foresee what will happen, but can only formulate a plan to the best of our knowledge to achieve our goal. We might echo Burns’ words here: “the best laid schemes o’ Mice an’ Men, / Gang aft agley”. Yet, we still can reason about plans by reasoning about what things will cause other things to happen, as far as we can figure. Accordingly, any such reasoning should be non-monotonic; conclusions can be defeated if unforeseen events arise—if *ceteris* are not *paribus*.⁹

To build in this *ceteris paribus* property, van Lambalgen & Hamm write the conclusions that reflect what happens next in the world given a certain state or event, but they take a closed-world assumption in which anything not mentioned is assumed not to hold. If something unexpected should happen, it must be added. In this way they can model what happens next, *ceteris paribus*, given the occurrence of either a state or an event.

For states, they formulate a ‘commonsense principle of inertia’ in which ‘a property persists by default unless it is changed by an event’ (van Lambalgen and Hamm, 2008, p.42). In their model this principle is given in an axiom (their Axiom 3). This kind of inertia, which also is discussed in Comrie (1976) and Copley and Harley (2014), we might think of as “no pain no gain” inertia: no pain (effort) results in no gain (no change).

For non-stative cases, they bring up results of force fluents through the expression $Trajectory(f_1, t, f_2, d)$, where f_1 is a force fluent, f_2 is a fluent representing a property

⁹This line of thinking about reasoning should remind us of dynamic semantics as in section 3.2, though van Lambalgen & Hamm are talking about events rather than propositions.

that changes under the influence of the force, t is a time, and d is a duration. *Trajectory*(f_1 , t , f_2 , d) expresses that if f_1 holds from time t until $t+d$, then f_2 holds at time $t+d$. Their Axiom 4 expresses that in such a case, f_2 is the default result of f_1 —that is, if nothing intervenes, f_2 happens.

If one is used to representing forces with vectors, it is fair to ask whether this theory really utilizes force dynamics, since van Lambalgen & Hamm represent forces by time-dependent properties rather than by vectors; moreover, their forces do not interact with each other, but only through the intermediaries of events. And indeed something like a vector theory of forces would seem to be needed in addition to this theory. van Lambalgen & Hamm suggest that when they use the broad causal word “affect,” in a paraphrase, they are referring informally to “a kind of causal web which specifies the influences of actions on properties” (van Lambalgen and Hamm, 2008, p. 42). It is exactly this causal web which can be represented in a vector model, but van Lambalgen & Hamm do not make note of this.

Still, van Lambalgen & Hamm’s theory has a number of properties that place it squarely in the realm of forces. The *ceteris paribus* property which is central to their theory is crucial to the understanding of force and the absence of force. Michotte’s two temporal relations for causation are modeled (launching with events that initiate and terminate fluents, and entrainment with *Trajectory*). They moreover stress that causation is a matter of events (which, again, for them sometimes include forces) not propositions (van Lambalgen and Hamm, 2008, p. 43); recall the viability of this move made above in section 4.3. To make an additional bridge between vector-oriented theories and van Lambalgen & Hamm’s theory, we can understand van Lambalgen & Hamm’s *Trajectory* as a kind of abstract or “bleached” vector, with neither magnitude nor origin represented, but which represents direction in an abstract space of fluents. So there is still a measure of continuity between this and the vector-oriented theories.

This theory clearly gets a lot right. Yet it is difficult to reconcile van Lambalgen and Hamm’s ontology with analyses of the syntax-semantics interface. In their ontology there

are variables for (punctual) events alongside variables for fluents (time-dependent properties, including forces and states), and these participate in eventualities, which are themselves quadruples of three fluents and an event. Bittner (2006) and Copley and Harley (2015) argue that this ontology does not reflect the basic ontological difference between dynamic and stative verbal predicates that is cross-linguistically relevant to syntax. For example, as Bittner notes, the distinction between nouns and verbs is elided entirely. Another issue is that their basic typological division is one of temporal duration: there is an *event* type which does not have duration, and a *fluent* type which does, and fluents include both forces and (stative) properties. Consequently, there is no clear typological division between dynamic predicates (which involve either events or fluents or both) and stative predicates (which would involve fluents).

There are also some odd consequences of having fluents as a general time-dependent property. Commonsense inertia holds of fluents, which includes states and forces, so they have to “turn it off” for forces with an axiom. This ontology also means they have to say that anything that decays naturally is not a state to them; so, for example, if sadness ultimately goes away on its own, *be sad* is not a stative predicate.

It is not that the theory is completely insensible to natural language syntax; for example, van Lambalgen and Hamm relate their event types and fluents to different kinds of nominalizations. However, as much as their use of algorithms as meanings of expressions, these ontological issues have arguably also contributed to preventing the more widespread uptake of their framework in the syntactic parts of the field.

5.4 Copley & Harley 2015, 2017

Copley and Harley (2015), like van Lambalgen and Hamm (2008), is a *ceteris paribus*-oriented theory, concerned with the whole of event structure, Aktionsart, and some aspect. Unlike van Lambalgen and Hamm (2008), it is primarily focused on how to use commonsense ideas about forces to explicate and streamline the syntax-semantics interface, reifying energy with

force functions. Here I outline the main points of Copley and Harley (2015) and a follow-up article (Copley and Harley, 2018) that reifies change by adding degrees to the ontology.

Copley & Harley begin by looking at cases of non-culmination of accomplishments with the so-called imperfective paradox (Dowty, 1977, 1979) in (14) and non-culminating accomplishments as shown in (15) (see also Mittwoch's and Travis's chapters, among others, this volume):

(14) a. #Mary painted the dresser black, but she didn't finish.

b. Mary was painting the dresser black, but she didn't finish.

(15) Inalis ko ang mantas, pero naubusan ako kaagad ng sabon,
N-PF-remove GEN-I NOM stain, but run-out-of NOM-I rapidly GEN soap
kaya hindi ko naalis.
hence not GEN-I A-PF-remove
I tried to remove (lit. I removed) the stain, but I ran out of soap, and couldnt.

Dell (1987, p. 186)

There is clearly a sense of *ceteris paribus* in both (14b) and (15), to the effect that the agent is involved in doing something that would normally cause the result, if nothing happens to perturb it. If causation is really involved in these cases, it follows that it is possible to have a causal relation without the result obtaining, contrary to e.g. Lewis (1973), where causation entails that the result happens. Since Dowty's (1977, 1979) treatment of the progressive, one way to account for this issue is to call upon possible worlds, that the result obtains only in certain normal worlds and not necessarily the actual world. But this adds the complication of possible worlds. Another way to get out of trouble is to deny that there is a causal relation at all, and instead to call upon some non-causal notion of maximal events and partial events Parsons (e.g., 1990), but this raises the question of how to relate maximal to partial events, if not by causation.

A third way, which Copley & Harley pursue, is to use a theory of causation in which the result is not necessarily entailed. They propose that the Davidsonian argument refers to an

action that, *ceteris paribus* causes the result, with the understanding that things may not be equal, as something external may intervene. This notion, they note, corresponds to the commonsense notion of force.¹⁰ But it is important to define the notion of force-dynamic causation in order for this move to work. In fact, though Copley & Harley do not note it, the Talmian CAUSE configuration (see (2a) above) is result-entailing: the Agonist (agent) force must overcome the Antagonist’s force. So it cannot be used in these cases.

5.4.1 A force-theoretic framework

The technology that Copley & Harley propose to account for non-culmination has several components, based on the specifications that the idea provides.

A first specification is the *ceteris paribus* property: the occurrence of the result of a force should be defeasible. For this, Copley & Harley use the closed-world assumption that van Lambalgen & Hamm also use; anything not mentioned that is not normally assumed is assumed not to be the case. The closed-world assumption takes on a special importance as Copley & Harley consider how forces arise. A situation σ in the world (as in situation semantics, Barwise and Perry (1983)) can include various entities and their properties. Copley & Harley add the idea that a force φ arises from a situation σ , and in particular, from the entities and their properties. So to take a closed-world assumption is to assume that no forces intervene that arise, totally or partially, from outside the situation one is considering with its particular entities and properties and general laws of nature and rational behavior. When the closed-world assumption is made, the result of the force occurs (Copley & Harley call this “efficacy”), so if there is morphology that is associated with culmination, its meaning boils down to the closed-world assumption.

Second, a consequence of having defeasible results in this way is that we need to make reference to the result without having to assert its occurrence (existence). How is this to be done? Given that a force takes us, *ceteris paribus*, from one situation to another as in

¹⁰An earlier instance of force dynamics for progressives is in Bohnemeyer and Swift (2006); only for certain verbs, however, and in addition to the use of events.

What would it take to tame the verbal hydra? DRAFT February 2018*

Bridget Copley
SFL (CNRS/Paris 8)

Heidi Harley
University of Arizona

Abstract Prominent theories of the syntax-semantics interface in the verb phrase propose multiple verbal heads, either in parallel (Folli & Harley 2005a,b), or in series (Ramchand 2008, 2017). In either case, the need for syntactic heads to select appropriate lexical roots requires that a considerable amount of information is duplicated between the lexicon and the syntax. In this paper we investigate some consequences of proposing a single unified verbal head for dynamic predicates, with the aim of reducing the selection problem to ordinary type-driven semantic composition. To construct the denotation of the unified verbal head, we adopt two recent ontological innovations to the theory of event structure: the use of degree arguments to represent change (e.g. Hay et al. 1999, Kennedy & McNally 1999, Kennedy & Levin 2008, Kennedy 2012) and the use of force arguments to represent energy (Copley & Harley 2015). We explore several departures from strict typological composition (type shifts, rules of composition) that are needed for this account to work for basic dynamic verbal types.

Keywords: verb phrase, syntax-semantics interface, telicity, change, degree arguments, force arguments

1 Introduction

The syntax-semantics interface in the verb phrase has been a topic of intense research for several decades, in large part because verb phrases offer a rich proliferation of phenomena which have both semantic and syntactic reflexes. Some of these are exemplified in (1):

- (1) Splitting
 - a. telic vs. atelic vs. variable telicity
climb the mountain vs. *dance* vs. *eat apples/the apple*
 - b. different paraphrases
CAUSE vs. BECOME vs. DO vs. ...
 - c. intuitive causation vs. no intuitive causation
heat the soup vs. *go to the store*
 - d. intuitive degree scale vs. no intuitive degree scale
heat the soup, eat the apple, go to the store vs. *dance the polka*

* We are indebted to Daniel Altshuler, Hana Filip, and the audience at Düsseldorf in 2015 for providing us with the input of energy to start redeeming this promissory note from our 2015 paper. We're grateful too for their helpful comments, as well as those from audiences in Toronto (Dog Days 2014), Nijmegen (Formal Semantics Meets Cognitive Semantics Workshop 2015) Paris (the project DelimitEvent of the CNRS Fédération Typologie et Universaux Linguistiques, 2015), and Nantes (2018).

- e. delimiting/homomorphic object vs. non-delimiting/non-homomorphic object
eat the apple, mow the lawn vs. *heat the soup, push the cart*
- f. change vs. no change
put vs. *stay*

This list is only the major factors that arise in English; other issues, including those having to do with the onset of the event, arise in other languages (Marín & McNally 2011, Choi 2015).

How one accounts for this proliferation depends on where and how one draws the line of the interface between syntax and semantics. A broad contrast can be drawn between accounts that privilege putting more information into lexical entries Levin & Rappaport Hovav (1995) and those that privilege structural reflexes of these phenomena (Borer 2005). A hybrid way to account for the proliferation is to use multiple verbal heads, either in parallel (i.e., in complementary distribution) (Folli & Harley 2005a,b), or in series, (i.e. in an extended projection) (Ramchand 2008, 2017), where verbs instantiate different heads with unique semantic content and related structural properties.

While all of the theories above pay close attention to the shape of the syntax-semantics interface, there is still room for improvement. For one, multi-headed theories need to duplicate a certain amount of information in the lexicon and the syntax to ensure that the right syntactic heads are associated with the right roots. Perhaps the slenderest syntax-semantics interface would depend on a single mechanism, e.g., either features or semantic types. We could also wish that the proliferation of null syntactic heads could be constrained in a principled way.

With this wishlist in mind, the question we raise here is the following: What would it take to reduce the many-headed hydra of the verb phrase down to a single *v* head? Our answer begins by “exploding” the Davidsonian event argument.

Davidsonian event arguments (Davidson 1967) have been widely adopted in formal approaches to the semantics of the verb phrase. In previous work (Copley & Harley 2015), we proposed that while Davidson was right about there being such implicit arguments, he was wrong in thinking that they correspond to the commonsense idea of an event. Rather, we argued, the arguments of dynamic verbal predicates correspond more closely to the idea of a *force*—an input of energy. We argued this on the basis that although the commonsense idea of an event is a change of some kind, certain Davidsonian arguments do not require change, notably the Davidsonian argument of verbs of maintaining such as *keep* and *stay*. Moreover, this approach aligns the treatment of atelic dynamic predicates (activities and semelfactives) with that of telic predicates.

If we are correct in this move, then change is irrelevant to the individuation of Davidsonian arguments of dynamic¹ verbal predicates. However, irrelevant though it might be to the Davidsonian argument, change is clearly implicated somehow in a host of predicate types; in particular, change along degree scales (Hay et al. 1999, Kennedy & McNally 1999, Kennedy & Levin 2008). Still, if degrees represent change, it would be overkill for the Davidsonian

¹ We use the word *dynamic* in the sense of ‘energetic’, though it is also often used in the sense of ‘involving change’; see Copley (2018). For us it is the opposite of ‘stative’: as dynamic predicates refer to an input of energy and stative predicates refer to situations without energy. We will have nothing to say about any stative flavors of *v* here.

What would it take to tame the verbal hydra?

argument to represent change as well. Thus what seems to be called for is a picture where energy is reified by force arguments and change is reified by degree arguments.

In this paper we do exactly this. We find that the advantages of both forces and degrees are retained, allowing us to account for verbs of maintaining while permitting a natural degree-based account of the classical homomorphisms (Tenny 1987, 1994, Verkuyl 1993, Krifka 1989, 1992, 1998). Moreover, the whole will prove to be more than the sum of its parts. This approach using forces and degrees seems to have the potential to cover all dynamic predicates, not just those that involve variable telicity. We hypothesize that all dynamic verbs have a structure in which a force causes a (possibly zero) difference in the degree to which a predicate holds. This meaning would be contributed by the verbalizing head *v*, so that the multiple verbal heads, at least for dynamic verbs, could be reduced to one.

On the lumping-splitting continuum, our aim here is obviously to lump. Splitters can take heart, however. While our goal is to arrive at a unified compositional semantics that distills what is common to dynamic verbal predicates, the fact that dynamic verbal meanings are so diverse means that the meaning of the *v* head is not the complete picture. Thus, along the way we will note where lexical roots must play a role to elaborate the meaning.

For example, for telicity, we argue that the difference in root meanings that allow telicity or atelicity is due to the temporal relationship between cause and effect, which (following Filip (2008) among others) is not represented in the logical form in English. We will argue that root meanings allow either launching causation (the cause precedes the result, the predicate is telic), entrainment causation (the cause and result happen at the same time, the predicate is atelic), or both launching and entrainment causation (the predicate has variable telicity). In this way, temporality plays a role at the conceptual level, even though it is not represented in the compositional semantics. The contrast between homomorphic and non-homomorphic objects will be argued to involve differences in compositional structure, depending on the type of the root. The reason, then, that homomorphisms show up in some, but not all, verbal predicate meanings will be because quantization is only one of the many kinds of scales invoked in verbal causal relations (see, e.g. Hay et al. 1999, Kardos 2012, Kennedy 2012: for scalar treatments of quantization). The difference between manner and result verbs as well will be due to type, which boils down to two different ways in which roots compose with *v*: change-of-state verbs lexicalize a measure function, while manner verbs lexicalize a property of the force. Finally, verbs of maintaining will be encoded directly in the meaning of the root (contra what we said in Copley & Harley (2015)).

In this way, while the dynamic verbalizing head *v* contributes the similarity among dynamic verbal meanings, roots, and the structures that their properties give rise to via type theory, are expected to contribute the diversity. We will not be able to give a full story for every kind of root, but in pointing out some of the issues, and in attempting to stake out a dividing line between the compositional and the lexical, we hope to provide the inspiration for further investigation.

Finally, we note that in addition to unifying the denotation of *v*, we hope to be able to limit the syntax-semantics interface—i.e., the information that is shared between the lexicon and the compositional system—the evaluation function, along with compositional rules and type theory. If realized, this would represent an advance in simplification not only over multiple-head theories, but also over frameworks that require multiple heads to be listed in

the lexicon; it would be a slimmer interface than anything else on the market (including Borer (2005), who needs both features and semantic types).

We move now to present background on entrainment and launching, and how they reflect the degree-based analysis of telicity as well as the force-theoretic framework of Copley & Harley (2015) (FTF1). We then add degrees to FTF1 to make FTF2, and give the unified analysis of *v*. Subsequently we show what we need to do to the theory of composition to help this framework deal with various predicates: changes-of-state, activities, verbs of consumption and creation, other incremental theme verbs, and verbs of maintaining. We find that one or two type shifts are useful, as well as a rethinking of Predicate Modification, and an assumption that situations are thin.

2 Background

2.1 Telicity is launching and atelicity is entrainment

It has long been noted in both psychology (Michotte 1946) and the cognitive linguistic tradition (e.g. Shibatani 1973, Talmy 1976, Croft 1991), that causes can have either of two temporal relationships to their effects. More recently this fact has been modeled in artificial intelligence-inspired treatments of events (Fernando 2008, van Lambalgen & Hamm 2008). We use Michotte's terms, translated from French, for the two relationships, given in (2):

- (2) a. launching: the cause precedes the effect
 b. entrainment: the cause and the effect happen at the same time

To illustrate these two relationships, we can think of pushing a cup along a table. If you *push a cup to the edge of the table* (a telic predicate), the result that is described is the cup's being at the edge of the table, which happens as you finish applying the energy to the cup. However, if you simply *push the cup* (an atelic predicate), the result that is described is the cup's moving; this result obtains as soon as you impart the pushing force to the cup. That is, there a result that happens at the same time as the causing input of energy. So results are not constrained to occur after their cause—and moreover, they need not be states.

Entrainment, however, poses a serious problem for Davidsonian events as typically understood. One way this can be seen is from the fact that work on Davidsonian event semantics at the interface with syntax has not paid any explicit attention to entraining causation. There is tremendous amount of work on launching causation, corresponding to a subevent analysis of telic eventualities: Pustejovsky (1995), Dowty (1979), Rothstein (2000), Higginbotham (2000), Ramchand (2008), among others.

In all of these, there is a causal relation between at least two temporally sequential event-like elements. However, activities (dynamic atelic eventualities) such as *sing* or *run* are typically treated as simplex events; they are not treated as having results at all.

There are two excellent reasons why activities were not generally treated as having results in such frameworks. One reason is conceptual: Davidsonian events are meant to be individuated on the basis of their participants and their spatiotemporal location. In activities there is one set of participants at a single time and place, so there is no reason to say that there are two events there. Hence, the intuition that activities involve entrainment causation cannot really be cashed in as one Davidsonian event causing another. Another reason why

What would it take to tame the verbal hydra?

no one ever treated activities this way is empirical: activities fail tests that are supposed to distinguish result events from causing events, such as the test for restitutive *again*.

- (3) a. #Mary danced, and later John danced again.
b. #Sheila sang, and later Bruce sang again.

Treating atelic dynamic predicates as simplex events is taken to explain why there are not two scopes for *again* with such predicates. These two issues, event individuation and the scope of *again*, have meant that entrainment was considered something of a non-starter for result event arguments. We will not address the *again* problem in this (version of this) paper, instead concentrating on the event individuation problem.

While Davidsonian event causation for entrainment was stuck on the launch pad as it were, there was a separate development in formal semantics that accurately captured the notion of entrainment for certain predicates, even though causation was not the main focus. This development was the rise of degree scales to explain variable telicity in predicates such as *heat the soup* and extending it to incremental theme verbs (Hay et al. 1999, Kennedy & McNally 1999, Kennedy & Levin 2008, Kennedy 2012).

The idea behind the degree approach is that the predicate makes reference to a scale, and telicity corresponds to the case when satisfaction of the predicate occurs on reaching the maximum endpoint of the scale. Atelicity, on the other hand, corresponds to the case when there is no endpoint specified, and the predicate is satisfied by any minimal amount of change that occurs.

With any given verbal predicate, we thus need to check whether the result begins as soon as the scalar change begins, or whether the result obtains only at the end of the scalar change, to see which relationship we have. Homomorphisms between the event and quantized or non-quantized objects can be relevant to this checking. For instance, if you eat a bowl of soup, the result of the (quantized) bowl of soup being eaten doesn't occur until you are finished eating (launching). On the other hand, if you eat soup, from the very beginning you achieve the result of (non-quantized) soup being eaten (entrainment).

This kind of argumentation is familiar. Our contribution here is to relate this picture to the temporal structure of causation. The specified maximum and unspecified maximum cases reflect the two different temporal relationships between cause and result, launching and entrainment respectively. In cases where the maximum on the scale is specified, a force—an input of energy—causes the current degree to advance along a scale, but the result only occurs in time at the point when the endpoint is reached. Therefore, in these cases, the cause precedes the effect, yielding launching and telicity. However, if a maximum is not specified, and if any amount of change counts for the effect to occur, the effect starts to occur at (more or less) the same instant that the energetic cause starts to occur, yielding entrainment and atelicity. The addition of forces thus deepens our understanding of the connection between reaching a value on a scale and (a)telicity.

This move suggests that a simplification of the semantics of dynamic verbal meanings is possible. They will all involve an input of energy that changes a degree on a scale. In the meantime, the use of force arguments still has the advantages discussed in Copley & Harley (2015). In particular, there is no conceptual problem with an input of energy that simultaneously provokes a result, as in atelic dynamic predicates.

2.2 A force-theoretic framework (Copley & Harley 2015, FTF1)

We adopt the force-theoretic framework from Copley & Harley (2015) in which there is a type difference distinguishing forces and situations. Situations are something like those in situation semantics (Barwise & Perry 1983). Informally, a situation includes individuals and their property attributions. We adopt Barwise and Perry’s distinction between situations in the world and situations in language. Likewise, a force in the world (an input of energy) is represented in language by a function from an initial situation to a *ceteris paribus* final situation. The point that forces in the world and forces in language are not identical is worth underlining, as an input of energy is not a function. But this is nothing new; the same point could be, and has been, made about properties in the world and the predicates that represent them in language, e.g., a property such as color is not a function either (Bealer 1989).

This means we have a dual ontology: on the one hand, a linguistic ontology with functions and variables, and on the other, a conceptual ontology that has in it properties such as color, and also includes inputs of energy (conceptual forces), and conceptual situations. This dual ontology is not new either: the two ontologies correspond to the domain and range, respectively, of the evaluation function $\llbracket \cdot \rrbracket$. It’s just that the difference between the conceptual and linguistic side is typically not at issue, and sometimes not so clearly obvious, to linguists at least. With forces it’s more clear that a conceptual force is different from a linguistic force function, so it’s worthwhile to make explicit the distinction between the two ontologies.²

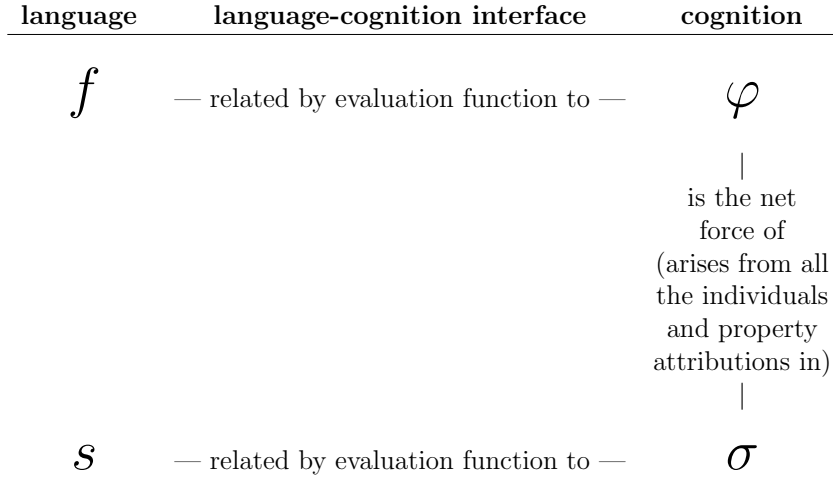
So, a linguistic situation s is mapped via the evaluation function to its corresponding conceptual situation σ , i.e., $\llbracket s \rrbracket = \sigma$. A force function f is mapped, via the evaluation function, to its corresponding conceptual force φ , i.e., $\llbracket f \rrbracket = \varphi$. Force functions are rather boring functions; they have a single situation s in their domain and a single situation s' in their range. Force functions are hence type $\langle ss \rangle$, which we will abbreviate as type f .

The situation in the domain, the “initial situation”, corresponds to the conceptual situation σ from which the conceptual force φ arises. A conceptual force φ is a net force of a conceptual situation σ just in case φ arises from all the individuals and property attributions (or tropes, if you prefer) in σ . So the relevant relations among f, s, φ , and σ are as in (4). There’s one relation missing: there is no direct relationship between f and s . But through the evaluation function which maps f and s to φ and σ respectively, f and s stand in for φ and σ which do have a direct relationship, so it will be possible to define a relationship between f and s .

² We did not always take the dual ontology idea all the way to its logical conclusions in Copley & Harley (2015); we will not even do so in this paper. In particular, roots, being lexical, should take conceptual variables as arguments, since the lexicon resides at the conceptual level. We will not make this move in this paper, to avoid introducing more complexity. Still, the dual ontology is relevant to understanding how force functions work, so we include the discussion here.

What would it take to tame the verbal hydra?

(4)



We still need to explain the “final situation” s' (note that it is the causally final situation, i.e, the result, not the temporally final situation; this is the key point that allows us to model entrainment as well as launching). The function f , when it takes the initial situation s as its argument, yields s' : $f(s) = s'$. The interpretation of this on the conceptual level is as follows. The (linguistic) final situation s' corresponds to the conceptual situation σ' that occurs in the case where no force arising (in whole or in part) from outside σ interferes. The final situation (on either the conceptual or the linguistic level) is thus merely a *ceteris paribus* final situation, as it only occurs if “all else is equal”, i.e., if nothing external to σ intervenes.

Now we define a causal chain based on these constructs. We define two linked sequences, one of situations and one of force functions, as in (5), inductively as in (6):

- (5) a. $\dots s_{-1}, s_0, s_1 \dots$
 b. $\dots f_{-1}, f_0, f_1 \dots$
- (6) a. Let $f = net(s)$ iff $\llbracket f \rrbracket$ is the net force of $\llbracket s \rrbracket$
 b. $f_n = net(s_n)$
 c. $s_{n+1} = f(s_n)$

The function *net* provides the missing link between f and s , via the existing link between $\llbracket f \rrbracket$ and $\llbracket s \rrbracket$.

It will also be useful to define functions that return the initial or final situation given any particular force:

- (7) a. $init(f_n) = s_n$
 b. $fin(f_n) = s_{n+1}$

Finally, a few word about how we will be using all this to represent basic eventuality types and agency. Like some but not all event-theoretic frameworks, our framework provides a type difference between stative and dynamic predicates. Stative predicates such as *be in the room*,

know French are treated as predicates of situations, type $\langle st \rangle$. Dynamic predicates such as *eat* and *stay* are predicates of forces, type $\langle ft \rangle$, aka $\langle ss, t \rangle$. Active Voice, when present, introduces the Agent/Causer as the (main) SOURCE of the energy constituting the force.

3 FTF2: Adding degrees to FTF1

3.1 Adding degrees

Using this framework, we now will show how some basic verbal types can be understood in terms of forces and degrees, and see what the compositional theory would have to look like to support a single unified verbal head. In earlier work (Copley & Harley 2015), building off Dowty’s (1979) BECOME which ensured that $p(t_1) \ \& \ p(t_2)$, we proposed interpretations for several “flavors” of *v* (Folli & Harley 2004), including the at-issue meaning associated with v_{become} as in (8):

$$(8) \quad \text{Copley \& Harley (2015)} \\ v_{become} : \lambda p \lambda f . p(\textit{init}(f)) \ \& \ p(\textit{fin}(f))$$

We proposed other flavors as well. We noted that existing work on scales would need to be integrated into the proposed semantics of change of state verbs, and that the various denotations for the different *v* heads we proposed all have intuitively similar content, but we postponed a full exploration of how that intuition might be cashed out in a unified analysis of *v*.

Now, as we integrate degree scales into the force-theoretic framework, we can formally identify a core meaning for *v*, at least for dynamic verbs in English and languages like English. Recall that given a force *f*, we can name its initial and final situations $\textit{init}(f)$ and $\textit{fin}(f)$ respectively. That is, $\textit{init}(f)$ is the situation from which the energy arises, and $\textit{fin}(f)$ is the result provoked by that energy. Suppose we are interested in a measure function *p* (where $p \in D_{\langle sd \rangle}$) that holds to one degree in $\textit{init}(f)$ and to another degree in $\textit{fin}(f)$. We take degrees and scales to be as in Kennedy & McNally (2005): triples $\langle S, R, \delta \rangle$ where *S* is an (open or closed) set of degrees, *R* is an ordering (increasing for ‘positive’ adjectives like *warm*, decreasing for ‘negative’ adjectives like *cool*, and δ is the dimension of difference).

Now, to integrate degree-talk with force-talk, we define $\Delta(p)(f)$ as the span of the degree scale from the degree to which *p* holds in $\textit{init}(f)$ to the degree to which *p* holds in $\textit{fin}(f)$.³

We also want to define degree-points and degree-intervals, analogous to temporal instants and temporal intervals. As is often done for the temporal case, we’ll use the same type for these (though a different type could be used without problems). We’ll use the notation $[d_1, d_2]$ to notate an interval spanning all the degree-points between d_1 and d_2 inclusive. For ease of reading, descriptions of degree-points will be written with a dotted underline, and descriptions of degree-intervals will be written with a solid underline. These underlines are just a convention for ease of reading and are not a necessary part of the equations.

³ It will become clear in section 3.3 why we define the degree of change in exactly this way; it is based on Kennedy & Levin (2008) but is a bit different.

What would it take to tame the verbal hydra?

Now we can define what we will call the “measure of impelled change,” which forms the heart of the denotation of unified dynamic v . This definition is for convenience only so that we can more easily follow the meaning of v going up the tree by following the deltas.

$$(9) \quad \text{Measure of impelled change:} \\ \underline{\Delta(p_{sd})(f)} =: \underline{[p(\underline{init}(f)), p(\underline{fin}(f))]}$$

The measure of impelled change measures the degree-interval between $p(\underline{init}(f))$ and $p(\underline{fin}(f))$ inclusive. Then the unified meaning of the v head for dynamic verbs is to give a measure of impelled change as in (10). That is, v takes a measure function p and a force and returns the delta measuring the change in p as a result of f .

$$(10) \quad \text{Unified dynamic } v: \\ \llbracket v \rrbracket = \lambda p_{sd} \lambda f . \underline{\Delta(p)(f)}$$

Except for the use of forces rather than events, this unified meaning reflects the verb meaning from the degree literature, in that participation in an event (here, a force) causes the change of a degree on a scale. This proposal is also reminiscent of Koenig & Chief’s (2008) account of non-culminating accomplishments, though here we characterize not only the caused result $\underline{fin}(f)$, but also the causing situation $\underline{init}(f)$, with their corresponding values on a degree scale.

A key part of the analysis, which we will keep in mind as we proceed, is that we apply a criterion to figure out when s_1 begins: whenever the current degree $d_{current}$ equals the degree d_1 specified in the predicate, s_1 begins. If s_1 begins as the force in s_0 is being applied—which will occur whenever the relevant scale is an open scale—we have entrainment and atelicity. If, on the other hand, s_1 begins as s_0 ends—which will occur whenever the relevant scale is a closed scale—we have launching and telicity. The temporal relationship, whether launching or entrainment, is not represented in the denotation, however.

We will now show how this analysis applies to a number of different kinds of predicates, and see what the compositional consequences are.

3.2 Change-of-state verbs

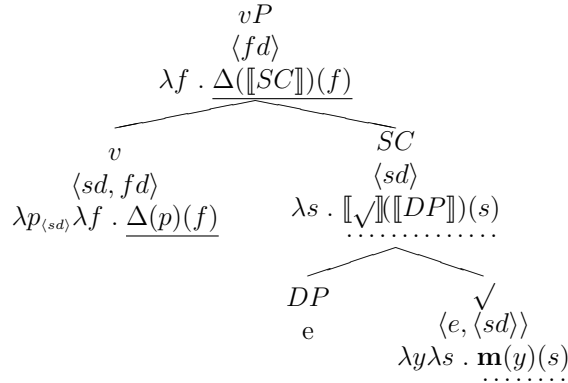
First we will show how change-of-state predicates are accounted for. There will be no surprises here; we closely follow Kennedy & Levin (2008). Recall that telicity emerges when a maximum is specified, either contextually or in the phrase structure, which yields launching, and atelicity emerges when a minimum amount of change is used, yielding entrainment. We assume that adjectives refer to simple measure functions such as in in (11), where \mathbf{m} corresponds to any given scalar adjective, e.g. *flat*, *open*, *hot*, etc:

$$(11) \quad \underline{\mathbf{m}(y)(s)} = \text{the degree } d \text{ such that } y \text{ has the property } \mathbf{m} \text{ in } s \text{ to the extent } d$$

The meanings of such adjectives participate in degree achievements, which are paradigm cases of change-of-state predicates. Such adjectives can be associated either with a closed scale, i.e. one with an inherent endpoint (like *flat*), or an open scale, with no endpoint (like *hot*).

When such adjectives form the basis for change-of-state-denoting verbal structures, they compose structurally as in (12), regardless of whether the adjective is associated with an open or closed scale, and regardless of whether the vP is telic or atelic.

(12) Change of state predicate (telic or atelic)



So, for instance, *v heat the soup* gets the following derivation:

$$\begin{array}{l}
 (13) \quad \llbracket v \rrbracket (\llbracket \text{heat the soup} \rrbracket) \\
 = \llbracket v \rrbracket (\lambda y \lambda s . \mathbf{hot}(y)(s))(\llbracket \text{the soup} \rrbracket) \quad \text{FA} \\
 \quad \quad \quad \text{meaning of } \sqrt{\mathbf{hot}} \\
 = \llbracket v \rrbracket (\lambda y \lambda s . \mathbf{hot}(\llbracket \text{the soup} \rrbracket)(s)) \quad \text{FA} \\
 = \lambda p_{sd} \lambda f . \Delta(p)(f) (\lambda y \lambda s . \mathbf{hot}(\llbracket \text{the soup} \rrbracket)(s)) \quad (10) \\
 = \lambda f . \Delta(\mathbf{hot}(\llbracket \text{the soup} \rrbracket)(s))(f) \quad \text{FA} \\
 = \lambda f . \underline{\underline{\iota d : [\mathbf{hot}(\llbracket \text{the soup} \rrbracket)(\mathit{init}(f))], \mathbf{hot}(\llbracket \text{the soup} \rrbracket)(\mathit{fin}(f))}} \quad (9)
 \end{array}$$

Assuming without analysis that $\llbracket \text{the soup} \rrbracket$ picks out the appropriate individual, and using the definition of measure functions such as **hot** in (11), the entire function then takes a force *f* and returns the degree-interval spanning all the degrees between the degree to which the soup is hot in $\mathit{init}(f)$ and the degree to which the soup is hot in $\mathit{fin}(f)$ inclusive.

The analysis straightforwardly follows the degree and force accounts already given. According to the degree account, the verb *flatten*, built on a closed-scale adjective such as *flat*, is telic because there is a maximum flatness specified. Adding forces, the criterial $\mathit{fin}(f)$ situation—defined by maximum flatness—begins after the force has been exerted, thus it is launching and therefore telic.

Open-scale deadjectival verbs are accounted for as well. For the degree account, they are atelic when there is no maximum specified, so any change counts from the beginning. Forces add the idea that the minimum change is criterial for determining when the result situation $\mathit{fin}(f)$ begins; as soon as there is any change, $\mathit{fin}(f)$ has begun, hence we are in an entrainment, and atelicity. (A maximum can be specified in other ways, as we will see,

What would it take to tame the verbal hydra?

but when it is not specified the verb itself does not provide one, since an open scale does not provide a maximum.)

3.3 Modifying the measure of impelled change

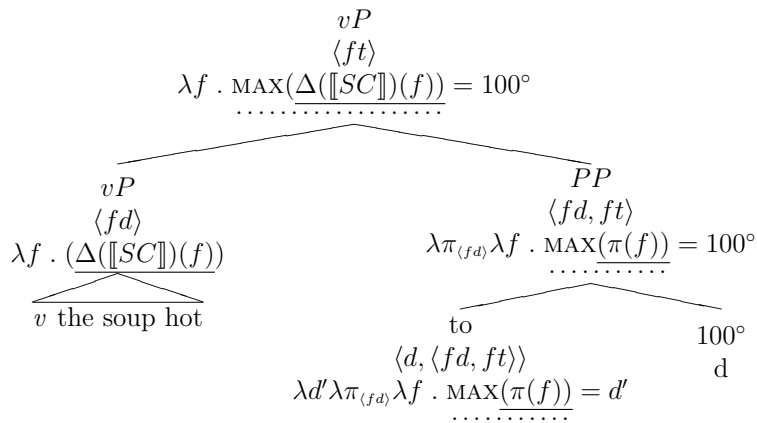
Degrees are frequently modified explicitly by prepositional phrases such as *by*- and *to*-phrases. We capture such facts in the current approach in a way that is very similar to 's proposal. These modifiers can't be as low as the (result-predicate-denoting) small clause, because they refer to the measure of impelled change, so they have to adjoin to vP. *By* picks out the span of a degree-interval (intuitively, the degree-interval's maximum degree-point minus its minimum degree-point), and *to* picks out the maximum degree-point of a degree-interval. (This is why we defined the measure of impelled change as returning a degree-interval, so that both the span and the maximum could be recovered from it.)

- (14) a. For any degree-interval d , $\text{SPAN}(d)$ = the measurement in degrees of the whole of d
 b. For any degree-interval d , $\text{MAX}(d)$ = the maximum degree-point of d

The denotation of *to* is as in (15) below. It takes a degree(-point) d' and a degree-interval (constructed out of π and f) and returns true if d' is the final degree-point of that degree-interval.

(15) $\llbracket to \rrbracket = \lambda d' \lambda \pi_{fd} \lambda f . \text{MAX}(\pi(f))$

- (16) heat the soup to 100 degrees

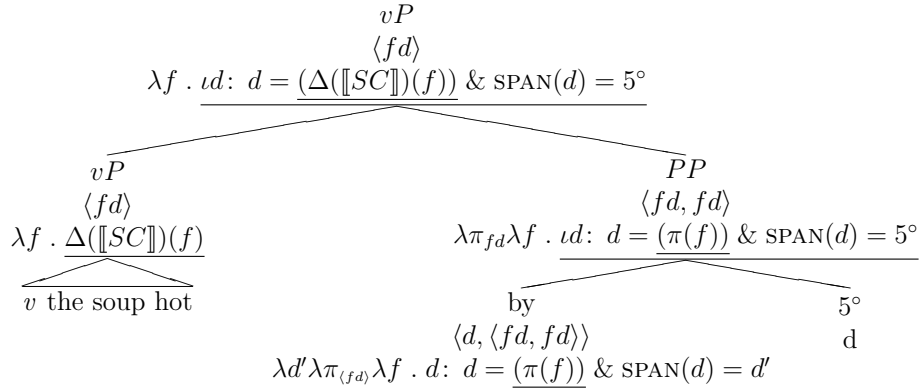


By works similarly, but there is a small difference. *To*- and *by*-phrases cannot be indiscriminately adjoined.

- (17) a. Mary heated the soup by 5 degrees to 100 degrees
 b. *Mary heated the soup to 100 degrees by 5 degrees

This ordering can be accounted for if we make *by* return something of type $\langle fd \rangle$ instead of something of type $\langle ft \rangle$, as below in (18).

(18) heat the soup by 5 degrees



Existential closure could also do the job of *to*, and we assume it does in many cases. This does the job of the pos(itive) operator of Kennedy & Levin (2008): that is, it ensures that there is change, to a certain standard—enough to count as a change, at least.

It's likely that *from* is the minimum-specifying version of *to*, but there are some puzzling differences. For example, *Bill heated the soup from 20 degrees* sounds somewhat odd. This may well be a hint that the measure of impelled change might better be represented as a vector instead of a degree-interval, with the minimum not being as informative as the maximum. We will let this issue lie for now.

3.4 *In* and *for* phrases

Here we confirm that the logical form given above in (12) for change-of-state verbs yields the correct results when combined with *in* and *for* adverbials. We adopt the denotations for these from Copley & Harley (2015). Only atelic predicates should be able to combine with *for an hour*, and only telic predicates should be able to combine with *in an hour*.

For an hour is as in (19):

(19) $\llbracket \text{for an hour} \rrbracket = \lambda s . \text{duration}(\tau(s)) = 1 \text{ hour}$

This denotation takes only type *st*, so right off the bat we are constrained to statives: lexical statives, aspectualized dynamic predicates (since aspect takes a type *ft* argument and returns type *st*) and stative readings of dynamic predicates such as generic, habitual, and futurate readings. Telic predicates such as *build a house*, even when they have aspect on them, are somewhat odd unless they can be coerced into more of an atelic feeling (e.g. *#Mary was building a house for an hour* improves with the idea that she was doing some building on a house). We propose that this is because *for an hour* only measures the duration of the initial situation *s*, which leaves out the final situation of telics, so that it then does not really succeed in measuring the whole duration. This is not a problem with atelic predicates because they

What would it take to tame the verbal hydra?

are cases of entrainment, where the final situation takes place at the same time as the initial situation.

In an hour for Copley & Harley (2015) is as in (20):

$$(20) \quad \llbracket \text{in an hour} \rrbracket = \lambda f . \text{duration}(\text{beginning}(\tau(\text{init}(f))) - \text{beginning}(\tau(\text{fin}(f)))) = \text{an hour}$$

This denotation requires atelic predicates (launching), as desired, as it measures the duration between the beginning of the run time of $\text{init}(f)$ and the beginning of the run time of $\text{fin}(f)$. Atelic predicates (entrainment) are excluded because the beginning of $\text{init}(f)$ and $\text{fin}(f)$ happen at the same time. The denotation in (20) is certainly suggestive of a more decompositional analysis (and see Copley (2018) for a relevant overview of force-theoretic approaches to prepositions), though we will not pursue it here.

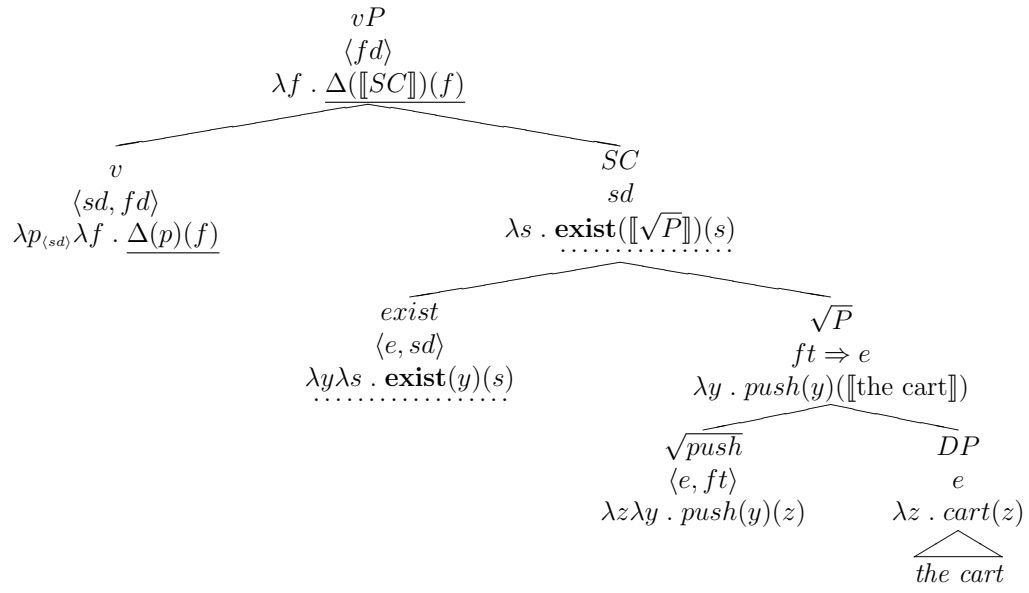
3.5 Activity verbs: null existence predicate, ft to e shift

While change-of-state verbs lexicalize a measure function that measures the difference in degrees between $\text{init}(f)$ and $\text{fin}(f)$, and can be telic or atelic depending on whether that difference reflects a maximal degree or not, predicates such as *dance* and *push (the cart)* that are always atelic are going to be treated differently.

Following Harley (2005) and Copley & Harley (2015), we treat roots like these as introducing entities that are created through the agent's input of energy. In Copley & Harley (2015), for instance, we treated something like *dance* as referring to a dancing force in the final situation that was created through the agent's application of force, so that there were two force arguments in the denotation: one for the agent's force and one for the dance. Here we treat the existence of the dance, or of the push, as provided by a null existence predicate.

This gives the derivation as in (21). We assume that *push* has a categorical scale, so that a positive degree interval represents an interval from 0 to 1. That is to say, the force f takes us from there being no push of a cart to there being a push of a cart; a little push is still a push. The tree for *push the cart* is in (21), showing how *the cart* does not participate in a homomorphism. For us, this means that *the cart* is not involved in providing the measure function to v , except by first composing with *push*. We need a type shift to shift the type $\langle e, ft \rangle$ *push* to type e .

$$(21) \quad \text{push the cart}$$



What would it take to tame the verbal hydra?

3.6 Verbs of maintaining

An advantage of a force-theoretic approach to verbal predicates is the account for verbs of maintaining such as *stay*, *keep*, *endure*, *preserve*, and *maintain*. The idea pursued in Copley & Harley (2015) is that verbs of maintaining denote a force whose $init(f)$ and $fin(f)$ are both described by the relevant predicate—i.e. a force which ensures that that the truth value of that predicate does not change from $init(f)$ to $fin(f)$.

We propose that *stay* is like *eat* in being essentially a manner that is structurally introduced using the Matushansky derivation for head adjunction (this differs from Copley & Harley (2015), where we proposed that *stay* was a flavor of *v*). Thus, like *eat*, *stay* composes with *v* by way of Predicate Restriction. The restriction that *stay* contributes is that the initial situation of the force and the final situation of the force are the same.

$$(22) \quad \llbracket stay \rrbracket = \lambda f . fin(f) = init(f)$$

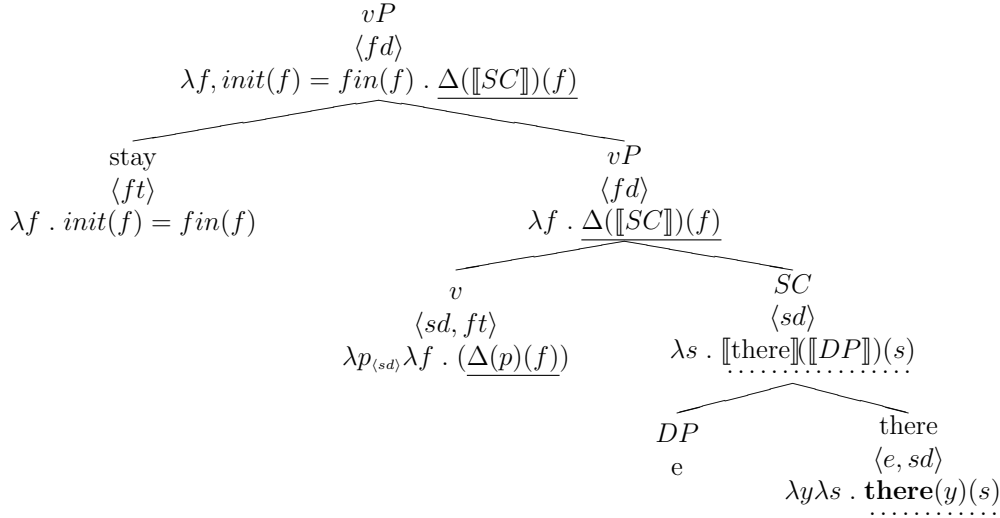
The denotation in (22) may seem like too strong a restriction. It seems to entail that if something irrelevant changes, even if it would otherwise count as a staying, it does not count as a staying. However, this is the only option for *stay* that we can see. We cannot do as we did in Copley & Harley (2015) and say that only the relevant property p changes on the way from $init(f)$ to $fin(f)$, because now *stay* is too high to have access to p . Could it nonetheless be the right denotation?

We could treat the situations as quite thin situations, i.e., only including the staying entity and the staying location, and thereby exclude anything irrelevant. The situations could equally be quite thick ones, and include other entities. Suppose they are. However, even in this case, we think the denotation in (22) excludes the scenario of irrelevant things happening, for this reason. It's certainly possible to imagine something irrelevant happening at the same time as a staying, but it's not possible to include something, say, in $init(f)$ but not in $fin(f)$, since $init(f)$ and $fin(f)$ must be the same.

Here's another try to discredit (22): suppose Mary and John are in a room. John is staying in the room, but Mary is just there. In this case, couldn't we truly say that Mary is staying in the room, on the basis of the force that is keeping John there? This argument goes through. So, in order for (22) to work for *stay*, situations should be thin.

Another reason to like (22) is that it on its own gets us the presupposition for *stay* that we had to stipulate in Copley & Harley (2015). Consider the tree for *stay there*, in (23):

$$(23) \quad \text{stay there}$$



Recall that degrees are eventually existentially closed off by existential closure (not shown in this tree). This entails there is a degree to which the entity is there in both $\textit{init}(f)$ and $\textit{fin}(f)$. We have to be a little tricky to get p 's being true in $\textit{fin}(f)$ to be the assertion and p 's being true in $\textit{init}(f)$ to be the presupposition, but given that $\textit{fin}(f)$ is defined on the basis of $\textit{init}(f)$, so is in a sense newer information, we think this is plausible (and potentially interesting).

3.7 Verbs of creation and consumption; extent coercion and Predicate Restriction

We now return to homomorphisms and variable telicity, to deal with predicates of creation such as *write poetry/a poem* and predicates of consumption such as *eat soup/a bowl of soup*. In the spirit of Kardos (2012), we provide a type-shift to coerce entities into a measure function describing their extent.

- (24) Extent coercion:
- For all nodes X such that $\llbracket X \rrbracket \in D_e : \lceil X \rceil =: \lambda s . \underline{\textit{extent}}\llbracket X \rrbracket(s)$.
 - $\lceil X \rceil$ is used instead of $\llbracket X \rrbracket$ when something of type $\langle sd \rangle$ is needed for the composition instead of something of type e .
 - Quantized entities have categorical (i.e., $\{0, 1\}$) extent scales while non-quantized entities have non-categorical extent scales.
 - We will notate extent coercion's effect on the type of a node as " $e \Rightarrow \langle sd \rangle$ ".

Relating the entity to its extent has to be done via coercion, rather than in the syntax, because of facts from *again/almost* modification which tell us there's a difference between change-of-state verbs like *open* (which permit downstairs modification) and incremental theme verbs like the verbs of creation and consumption (which don't). So, in (25a), the restitutive

What would it take to tame the verbal hydra?

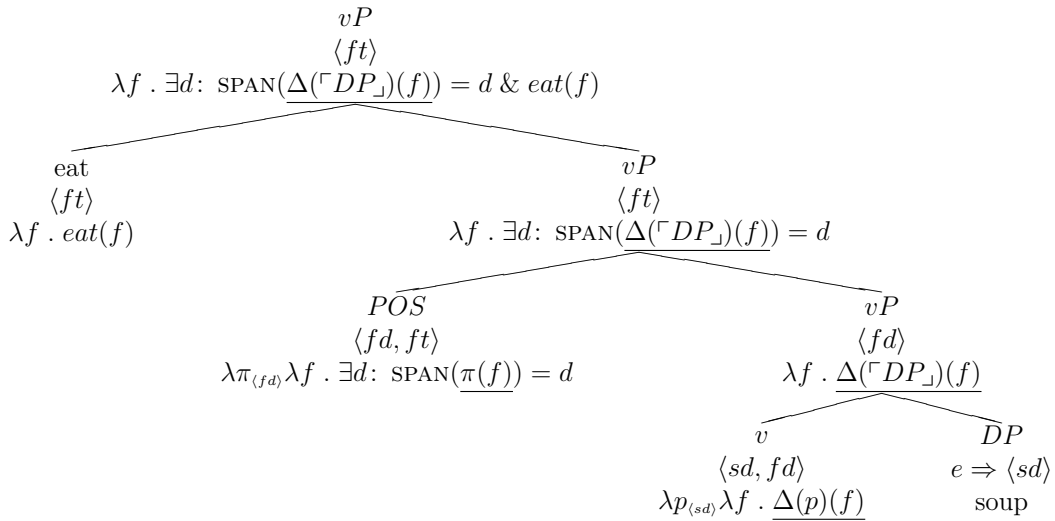
reading is possible, where someone other than Mary opened the door before. But this reading is not possible for the predicates in (25b).

- (25) a. Mary opened the door again.
 b. Mary wrote a poem/ate an apple again.

This tells us that the syntax doesn't know that the DP has been turned into an extent function in incremental theme cases, because otherwise you could modify that constituent. So we conclude that coercion is the right option here (contra Kennedy (2012)). This ensures that a DP denoting an entity can provide the measure function to v , which in turn ensures homomorphism between the extent of the entity and the progress of the change.

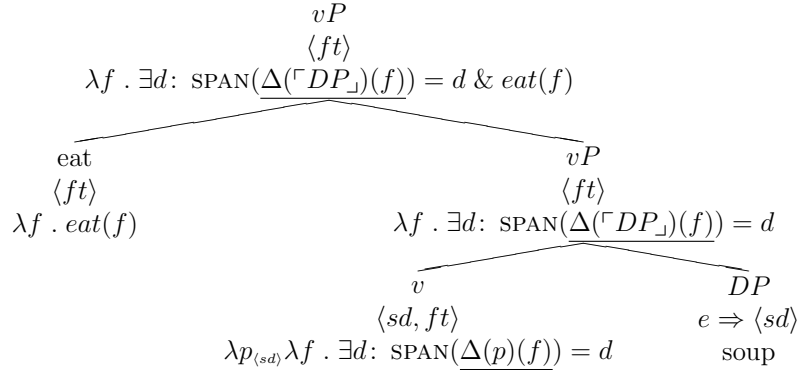
One way to get the right denotation is shown in (26). This attempt uses the SPAN function we introduced above in section 3.3 for the modification of degree arguments, as well as a POS-like operator which ensures that there is a positive degree. However, this version is syntactically implausible, as *eat* is too far from v to structurally combine with it.

- (26) eat soup (version 1: preserves $\langle sd, fd \rangle$ type for v , but syntactically implausible)



We could fix this problem by changing the type of v as in (27), but that is unsatisfying for the current project as it would mean these verbs alone would have a different type for v .

- (27) eat soup (version 2: syntactically plausible, but requires $\langle sd, ft \rangle$ type for v)



And one problem with both of these is that it is not clear that SPAN should be allowed; we used it above for explicit modifiers of degree arguments but perhaps it should not make an appearance in the verb phrase.

Another possibility is to make *eat* type $\langle sd, ft \rangle$ and combine it with *v* by Predicate Modification (Heim & Kratzer 1998). However, Rappaport Hovav (2008) and Levin and Rappaport Hovav (2010) argue, convincingly in our view, that incremental verbs denote simple properties of events (for us, forces). So we're not willing to change the type of these roots to $\langle sd, ft \rangle$.

What we really want is to compose something of type $\langle ft \rangle$ (*eat*) with something of $\langle fd \rangle$ (the result of composing *v* with the direct object). That is, we want the $\langle ft \rangle$ function to provide a restriction on the kind of force that is fed to the $\langle fd \rangle$ function. This seems like an eminently reasonable thing to want to do.

Perhaps the simplest way to do it is to introduce a rule that is a generalization on Predicate Modification.⁴ Predicate Modification (Heim & Kratzer 1998) is as follows:

- (28) Predicate Modification: If a branching node α has as its daughters β and γ , and $\llbracket \beta \rrbracket$ and $\llbracket \gamma \rrbracket$ are both of type η, t then $\llbracket \alpha \rrbracket = \lambda x \in D_\eta . \llbracket \beta \rrbracket(x) \ \& \ \llbracket \gamma \rrbracket(x)$. This formula is of type η, t .

We then generalize on the truth value type to form a new compositional rule. We use the comma in what follows to introduce a restriction on the lambda operator.

- (29) Predicate Restriction: If a branching node α has as its daughters β and γ , and $\llbracket \beta \rrbracket$ is of type η, t and $\llbracket \gamma \rrbracket$ is of type η, θ then $\llbracket \alpha \rrbracket = \lambda x_\eta . \llbracket \beta \rrbracket(x) . \llbracket \gamma \rrbracket(x)$. This formula is of type η, θ .

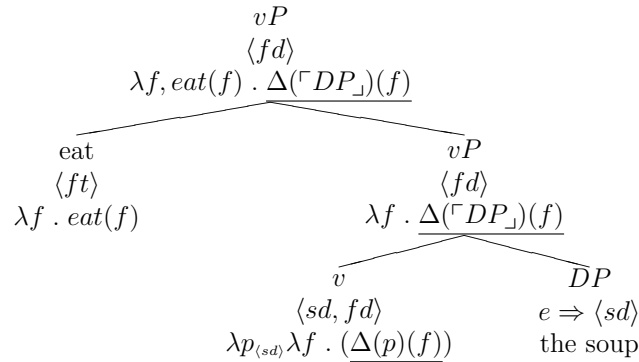
Predicate Modification can be derived from the special case of Predicate Restriction where $\theta = t$, since $\lambda x . \llbracket \beta \rrbracket(x) \ \& \ \llbracket \gamma \rrbracket(x)$ is truth-conditionally equivalent to $\lambda x . \llbracket \beta \rrbracket(x) . \llbracket \gamma \rrbracket(x)$.

On this version, Predicate Restriction is the semantics for the syntax of head adjunction as understood by Matushansky 2006. This allows us to retain a single denotation for the *v* head, while at the same time being faithful to what is known about the syntax of these verbs.

⁴ Another way, we think, might go through the idea that truth values are themselves a categorical scale.

What would it take to tame the verbal hydra?

- (30) eat soup (version 3: syntactically plausible and preserves $\langle sd, fd \rangle$ type for v , uses Predicate Restriction)



3.8 Other incremental theme verbs

Although version 3 works for verbs of creation and consumption, it will not work for incremental theme verbs that are not verbs of creation or consumption, such as *mow* and *read*. The reason is that version 3 uses extent coercion, and that means that the measure of impelled change has to measure a change in extent of the incremental theme. But incremental theme verbs that are not creation or consumption verbs do not involve a change in extent of the object. If you mow the lawn, for example, what changes is the extent of *mowed* lawn, not the extent of the lawn. So, the verb itself as well as *has* to be involved in the type $\langle sd \rangle$ measure function.

How could this be accounted for? We will not be able to account for it here, but one clue is given by the fact that while degree achievements allow *by* phrases, as in (31), incremental theme verbs do not, as in (32):

- (31) a. heat the soup by three degrees
 b. shorten the talk by five minutes
 c. inflate the balloon by six inches
 d. lengthen the tour by seven days
- (32) a. *eat the soup by three spoonfuls
 b. *mow the lawn by three square meters
 c. *read the book by five pages
 d. *walk the Appalachian Trail by sixteen miles

As Tenny (1994) notes, the Appalachian Trail in *walk the Appalachian Trail* names the path itself. The equivalent of the path in our account is the (solid-underlined) degree-interval, not the (dotted-underlined) degree-instants that are its endpoints. This is effectively what is wrong with all of the examples in (32): in each one, the apparent entity-denoting DP is actually something that saturates or existentially closes the degree-interval of change

itself, so there is no room for a *by*-phrase, which would otherwise be a predicate of that degree-interval.⁵

That, in fact, is plausibly why one can have explicit degree-interval-denoting objects for these verbs, as in (33):

- (33) a. eat three spoonfuls of the soup
 b. mow three square meters of the lawn
 c. read five pages of the book
 d. walk sixteen miles of the Appalachian Trail

Conversely, the cases which do permit degree-specifying *by*-phrases, cannot see their object DPs replaced with measure-DPs:

- (34) a. *heat three degrees
 b. *shorten five minutes
 c. *inflate six inches
 d. *lengthen seven days

In effect, these verbs require a small clause and the incremental theme verbs in (33) do not; the small clause is a predicate of degree-intervals, and the object of the incremental theme verbs saturates or binds degree-intervals.

4 Conclusion

In this paper, we have hypothesized a unified denotation for dynamic *v* based on a framework that includes both degrees and forces. The idea is that there is a basic meaning of verbs, encapsulated in the hypothesized denotation of *v*, in which a force (an input of energy) provokes a change (perhaps zero) along a degree scale. The goal is for the syntax-semantics interface of the verb phrase to be no more than type theory and compositional rules. Where verbal predicates have differing properties, we argued that they should follow from compositional considerations. We investigated change-of-state verbs, activities, verbs of maintaining, and verbs of creation and consumption; the tweaks needed were a null existence predicate, a couple of type shifts, a generalization of Predicate Modification and an assumption that situations are thin. Incremental theme verbs that are not creation or consumption verbs (*mow*, *read*) presented a different picture, which we will investigate in the next version of this paper.

References

- Barwise, Jon & John Perry. 1983. *Situations and attitudes*. Cambridge, Mass.: MIT Press.
 Bealer, George. 1989. On the identification of properties and propositional functions. *Linguistics and Philosophy* 12(1). 1–14.
 Borer, Hagit. 2005. *Structuring sense : Volume ii: The normal course of events*. Oxford University Press.

⁵ This would be entirely parallel to how *by*-phrases introduce agents in the passive, but are impossible with active Voice.

What would it take to tame the verbal hydra?

- Choi, Jiyoung. 2015. Etats inchoatifs (de degré) en coréen dans le langage enfantin: Université Nantes-Angers-Le Mans-COMUE dissertation.
- Copley, B. & H. Harley. 2015. A force-theoretic framework for event structure. Linguistics and Philosophy 38. 103–158.
- Copley, Bridget. 2018. Force dynamics. In Robert Truswell (ed.), Oxford handbook of event structure, 103–149. Oxford.
- Croft, William. 1991. Syntactic categories and grammatical relations: The cognitive organization of information. University of Chicago Press.
- Davidson, D. 1967. The logical form of action sentences. In N. Rescher (ed.), The logic of decision and action, University of Pittsburgh Press.
- Dowty, David. 1979. Word meaning and Montague Grammar. Dordrecht: Reidel.
- Fernando, Tim. 2008. Branching from inertia worlds. Journal of Semantics 25(3). 321–344.
- Filip, Hana. 2008. Events and maximalization. In Susan Rothstein (ed.), Theoretical and crosslinguistic approaches to the semantics of aspect, 217–256. John Benjamins.
- Folli, Raffaella & Heidi Harley. 2005a. Consuming results in Italian and English: Flavors of v. Aspectual inquiries 95–120.
- Folli, Raffaella & Heidi Harley. 2005b. Flavors of v. In Aspectual inquiries, 95–120. Springer.
- Harley, Heidi. 2005. How do verbs get their names? denominal verbs, manner incorporation, and the ontology of verb roots in english. In N. Erteschik-Shir & T. Rapoport (eds.), The syntax of aspect: Deriving thematic and aspectual interpretation, 42–64. Oxford University Press.
- Hay, J., C. Kennedy & B. Levin. 1999. Scalar structure underlies telicity in degree achievements. In Proceedings of salt, vol. 9, 127–144. Citeseer.
- Heim, Irene & Angelika Kratzer. 1998. Semantics in generative grammar. Blackwell.
- Higginbotham, James. 2000. Accomplishments. In Proceedings of glow in asia ii, .
- Kardos, Éva. 2012. Toward a scalar semantic analysis of telicity in Hungarian: dissertation. Unpublished doctoral dissertation. Debrecen: University of Debrecen.
- Kennedy, Christopher. 2012. The composition of incremental change, 103–121.
- Kennedy, Christopher & Beth Levin. 2008. Measure of change: The adjectival core of degree achievements. Adjectives and adverbs: Syntax, semantics and discourse 156–182.
- Kennedy, Christopher & Louise McNally. 1999. From event structure to scale structure: Degree modification in deverbal adjectives. In Proceedings of salt, vol. 9, 163–180.
- Kennedy, Christopher & Louise McNally. 2005. Scale structure, degree modification, and the semantics of gradable predicates. Language 81(2). 345–381.
- Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In Peter van Emde Boas Renate Bartsch, Johan van Benthem (ed.), Semantics and contextual expressions, 75–115. Dordrecht: Foris.
- Krifka, Manfred. 1992. Some remarks on polarity items. In D. Zäfferer (ed.), Semantic universals in universal semantics, 150–189. Berlin: Foris.
- Krifka, Manfred. 1998. The origins of telicity. In Susan Rothstein (ed.), Events and grammar, 197–235. Dordrecht: Kluwer.
- van Lambalgen, Michiel & Fritz Hamm. 2008. The proper treatment of events, vol. 6. John Wiley & Sons.
- Levin, Beth & Malka Rappaport Hovav. 1995. Unaccusativity: At the syntax-lexical semantics interface, vol. 26. MIT press.

- Marín, Rafael & Louise McNally. 2011. Inchoativity, change of state, and telicity: Evidence from spanish reflexive psychological verbs. Natural Language & Linguistic Theory 29(2). 467–502.
- Michotte, A. 1946. La perception de la causalité. Louvain: Éditions de l'Institut Supérieur de Philosophie english translation: the perception of causality, methuen, london, 1963 edn.
- Pustejovsky, James. 1995. The generative lexicon. MIT Press.
- Ramchand, G. 2008. Verb meaning and the lexicon: A first-phase syntax. Cambridge Univ Pr.
- Ramchand, Gillian. 2017. Situations and syntactic structure. MIT Press.
- Rothstein, Susan. 2000. Towards understanding progressive achievements. Bar-Ilan University MS.
- Shibatani, Masayoshi. 1973. A linguistics study of causative constructions: University of California, Berkeley dissertation.
- Talmy, Leonard. 1976. Semantic causative types. In M. Shibatani (ed.), Syntax and semantics, vol. 6, 43–116. Academic Press.
- Tenny, Carol L. 1994. Aspectual roles and the syntax-semantics interface, vol. 52. Springer.
- Tenny, Carol Lee. 1987. Grammaticalizing aspect and affectedness: Massachusetts Institute of Technology dissertation.
- Verkuyl, Henk J. 1993. A theory of aspectuality. cambdridge. Cambridge University Press.

Bridget Copley
CNRS-SFL
59-61 rue Pouchet
75017 Paris France
bridget.copley@cnrs.fr

Heidi Harley
Department of Linguistics,
University of Arizona
Tucson, AZ 85728-0021
United States
hharley@email.arizona.edu

Bridget Copley

bridget.copley@cns.fr
bcopley.com

SFL - CNRS
59-61 rue Pouchet
75017 Paris France

Born: April 2, 1974
Nationality: American

Areas of specialization

Formal semantic ontology and its interfaces with syntax and cognition. Causation, forces, agency and events. Conditionals and modality, especially modality within the verb phrase. Futures and future reference.

Current position

2007-now Researcher at the Unité Mixte de Recherche 7023 “Structures Formelles du Langage,” jointly run by the Centre National de la Recherche Scientifique and the Université Paris 8. Recruited level CR1 (chercheur niveau 1/senior level researcher), converted to level CRCN (chercheur classe normale/normal class researcher) following reorganization of CNRS research posts in September 2017.

Previous positions

2005-2007 Post-doc, Unité Mixte de Recherche 7023 “Structures formelles du langage” (Centre National de la Recherche Scientifique/Université Paris 8)
2003-2005 Mellon Postdoctoral Fellow, Department of Linguistics and Department of Philosophy, University of Southern California
2002-2003 Visiting Scholar, Department of Linguistics and Philosophy, Massachusetts Institute of Technology

Education

2002 PhD in Linguistics, Massachusetts Institute of Technology
Dissertation: *The Semantics of the Future*, revised and published as Copley, Bridget (2009). *The Semantics of the Future*. Routledge *Outstanding Dissertations in Linguistics* series: New York.
Committee: Sabine Iatridou (chair), Noam Chomsky, Kai von Stechow, Irene Heim

1996 BA in Linguistics, Yale University
Magna cum laude with distinction in the major, elected to Phi Beta Kappa
Three classes in symbolic logic

Grants

PRINCIPAL INVESTIGATOR

2018-2021 “Ontology as structured by the interfaces with semantics: In search of the roots of our reality” (with Isabelle Roy). International Research Network grant, Centre National de la Recherche Scientifique (France), 60k€. Participants: Université Paris 8, Université Paris 7, Université de Nantes, Queen Mary University of London, Humboldt-Universität zu Berlin, Universitat Pompeu Fabra (Barcelona), Universitetet i Tromsø– Norges arktiske universitet, Massachusetts Institute of Technology, University of Southern California.

2014-2016 “Linguistic hints to causal models of the future” (with Phillip Wolff and Eugene Agichtein). John Templeton Foundation Science of Prospection Awards, \$145k

2010-2014 “La causalité dans le langage et la cognition” (with Maya Hickmann), Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the Centre National de la Recherche Scientifique (France), 15k€

2001-2002 Kosciuszko Foundation Tuition Scholarship

2001 Ken Hale Fund Fieldwork Grant

1996-1999 NSF Graduate Research Fellowship

PARTICIPATION

2014-2018 “Délimitation et identification des événements,” Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS (Marta Donazzan and Lucia Tovena), 15k€

2014-2018 “Ontologie et typologie des états”, Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS (Léa Nash and Elena Soare), 15k€

2014-2015 McMaster University Arts Research Board seed grant Modularity in Language Cognition (Ivona Kučerová and David Harris Smith); CAD 11,245

2010-2014 “Structure aspectuelle / structure argumentale,” Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS (Karen Ferret, Elena Soare, and Florence Villoing), 15k€

2006-2010 “Temporalité : Typologie et acquisition,” Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS (Clive Perdue), 25k€

Publications

BOOK

2009 Copley, Bridget (2009). *The Semantics of the Future*. Routledge *Outstanding Dissertations in Linguistics* series: New York.

EDITED VOLUMES/SPECIAL ISSUES

- 2014 Copley, Bridget and Fabienne Martin, eds. (2014). *Causation in Grammatical Structures* (Oxford Studies in Theoretical Linguistics 52). Oxford: Oxford University Press.
- 2014 Copley, Bridget and Jacqueline Guéron, eds. (2014). *Constructing Aspect: Syntactic Reflections on Aspectual Distinctions*. Special issue of *Recherches Linguistiques de Vincennes*.

JOURNAL ARTICLES

- 2015 Copley, Bridget and Heidi Harley (2015). “A force-theoretic framework for event structure.” *Linguistics and Philosophy* 38(2): 103-158.
- 2009 Copley, Bridget and Heidi Harley (2009). “Futurates, directors, and *have* causatives.” *Snippets* 19.
- 2008 Copley, Bridget (2008). “The plan’s the thing: Deconstructing futurate meanings.” *Linguistic Inquiry* 39:2 (Spring). pp. 261-274.
- 2004 Copley, Bridget (2004). “So-called epistemic should.” *Snippets* 9.

BOOK CHAPTERS

- to appear Copley, Bridget (to appear). “Force dynamics.” In Truswell, Robert (ed.) *The Oxford Handbook of Event Structure*. Oxford: Oxford University Press.
- 2014 Guéron, Jacqueline and Bridget Copley (2014). “Introduction.” In Copley, Bridget and Jacqueline Guéron (2014). *Constructing Aspect: Syntactic Reflections on Aspectual Distinctions*. Special issue of *Recherches Linguistiques de Vincennes*.
- 2014 Copley, Bridget and Heidi Harley (2014). “Eliminating causative entailments with the force-theoretic framework: The case of the Tohono O’odham frustrative *cem*.” In Copley, Bridget and Fabienne Martin (eds.), *Causation in Grammatical Structures* (Oxford Studies in Theoretical Linguistics 52), 120-151. Oxford: Oxford University Press.
- 2014 Copley, Bridget and Phillip Wolff (2014). “Theories of causation should inform linguistic theory and vice versa.” In Copley, Bridget and Fabienne Martin, (eds.), *Causation in Grammatical Structures* (Oxford Studies in Theoretical Linguistics 52), 11-57. Oxford: Oxford University Press.
- 2014 Copley, Bridget and Fabienne Martin (2014). “Introduction.” In Copley, Bridget and Fabienne Martin (eds.), *Causation in Grammatical Structures* (Oxford Studies in Theoretical Linguistics 52), 1-10. Oxford University Press: Oxford.
- 2014 Copley, Bridget (2014). “Causal chains for futurates”. In Philippe De Brabanter, Mikhail Kissine Saghie Sharifzadeh (eds.), *Future Times, Future Tenses*, 72-86. (Oxford Studies of Time in Language and Thought). Oxford: Oxford University Press.
- 2010 Copley, Bridget (2010). “Aspectualized futures in Indonesian and English.” In Cabredo Hoffherr, Patricia and Brenda Laca, (eds.), *Layers of Aspect*, 101-124. Stanford: CSLI.

- 2009 Copley, Bridget (2009). "Temporal orientation in conditionals." In Guéron, Jacqueline and Jacqueline Lecarme (eds.), *Time and Modality*, 59-78. Dordrecht: Springer.

ARTICLES IN PROCEEDINGS OF CONFERENCES

- 2016 Copley, Bridget, Phillip Wolff, and Jason Shepard (2016). "Force interaction in the expression of causation." In Sarah D'Antonio, Mary Moroney Carol Rose Little (eds.), *Proceedings of the 25th Semantics and Linguistic Theory Conference 25*, 433-451.
- 2014 Copley, Bridget and Isabelle Roy (2014). "Deriving the readings of French *être en train de*." In Enoch O. Aboh, Jeannette C. Schaeffer Petra Sleeman (eds.), *Romance Languages and Linguistic Theory 2013: Selected papers from "Going Romance" 2013*, 103-118. John Benjamins Pub. Co.
- 2005 Copley, Bridget (2005). "O'odham *cem*: When the actual world isn't inertial." In Becker, Michael, and Andrew McKenzie (eds). *The proceedings of the third meeting of Semantics of Underrepresented Languages of the Americas (SULA 3)*. Amherst, Mass: University of Massachusetts Occasional Papers in Linguistics.
- 2003 Copley, Bridget (2003). "A conceptual and a grammatical distinction for modals." In *Proceedings of the 35th meeting of the Northeastern Linguistics Society (NELS 35)*.
- 2003 Copley, Bridget (2003). "Aspect, scope, and future conditionals." In *Proceedings of Sinn und Bedeutung VIII*.
- 2003 Copley, Bridget (2003). "Stativity over and under the future modal." *Proceedings of the 33rd meeting of the Northeastern Linguistics Society (NELS 33)*.
- 2002 Copley, Bridget (2002). "Aspect on a future modal." In the online *Proceedings of Perspectives on Aspect*.
- 2002 Copley, Bridget (2002). "A linguistic argument for indeterministic futures." In *Proceedings of the 32nd meeting of the Northeastern Linguistics Society (NELS 32)*.
- 2001 Copley, Bridget (2001). "Be going to as a case of high aspect." In the *Proceedings of Semantics and Linguistic Theory 11 (SALT XI)*. Ithaca, NY: Cornell Linguistic Circle.

WORKING PAPERS

- 2016 Roy, Isabelle, Bridget Copley, Saveria Colonna & Sudha Arunachalam (2016). Grammatical and conceptual knowledge of dispositions in the interpretation of -er nominals : Experimental evidence. *Proceedings of the Workshop on the Morphological, Syntactic and Semantic Aspects of Dispositions*, University of Stuttgart.
- 2005 Copley, Bridget (2005). "Ordering and reasoning." in *MIT Working Papers in Linguistics vol. 51, New Work on Modality*. Jon Gajewski, Valentine Hacquard, Bernard Nickel, and Seth Yalcin, eds. Cambridge, Mass.: MITWPL.
- 2000 Copley, Bridget (2000). "On the syntax and semantics of futurate readings." In *MIT Working Papers in Linguistics, vol. 39: A few from Building E39: Working papers in syntax, semantics, and their interface*. Elena Guerzoni and Ora Matushansky, eds. Cambridge, Mass.: MITWPL.

Presentations

INVITED WORKSHOP TALKS

- 2020 The Semantics of Power and Change, HU Berlin / FU Berlin (funding to be confirmed), March 2020.
- 2017 Semantics and Philosophy in Europe session on ontology, September 4-6 September, 2017 (declined).
- 2017 “The grammatical lightness of being in charge.” Workshop on Morality, Language, and Thought. Institut Jean Nicod, Paris, 24 July 2017.
- 2017 “If conditionals are causal, causation is not propositional.” Linguistic Perspectives on Causation. Hebrew University of Jerusalem, Jerusalem, 28-30 June 2017.
- 2017 “How to do things when you don’t have any energy.” Workshop on the Nature, Representation, and Composition of States, Northwestern University, Chicago, 6-7 May 2017.
- 2015 “Causation by virtue of disposition.” Workshop on the Morphological, Syntactic and Semantic Aspects of Dispositions, University of Stuttgart. 25-27 June, 2015.
- 2013 “On the diversity of future reference.” TRAIT workshop “How categorical are categories?” Uniwersytet Wroclawski, 7-9 January 2013.
- 2011 “Causal chains for futures and futurates.” Talking Heads: 1st Milano-Paris Workshop on Mind and Language, Università degli Studi, Milan, 27-28 June 2011.
- 2009 “Aspect and causality” Sentence and Discourse/Phrase et Discours, colloquium in honor of Carlota Smith, 2-4 April 2009, Université de Paris 3 (with Heidi Harley).

INVITED SEMINAR TALKS

- 2018 “Unifying v.” Université de Nantes, 26 January 2018.
- 2014 “Conditionals are causal.” Université de Genève, 14 October 2014.
- 2014 “Causation and telicity in a force-theoretic framework.” Heinrich Heine Universität Düsseldorf, 8 May 2014.
- 2014 “Talking and thinking about the future.” Emory University Department of Psychology, 21 January 2014.
- 2012 “Composing causation.” Stuttgart Universität, 5 July 2012.
- 2012 “Compositional causality.” University of Toronto, 23 April 2012.
- 2012 “Connecting events.” University of Chicago, 13 January 2012.
- 2011 “Constructing the future.” Université de Nantes, 2 December 2011.
- 2011 “Future reference with causal chains.” University of Ulster, 16 March 2011.
- 2011 “Force-dynamic forays into the future.” Georg-August Universität Göttingen, 8 February 2011.
- 2006 “Causality in modality,” Hebrew University of Jerusalem 16 May 2006.
- 2005 “‘Building blocks’ of meaning: Towards an ontology of tense, aspect, and modality,” Oakland University: February 2005.
- 2003 “Aspects of the future,” University of Southern California Department of Linguistics: February 2003.

SUBMITTED TALKS AND POSTERS

- 2017 “More *have* causatives”. 6th Annual Dog Days Workshop on Syntax, Morphology, and Semantics, University of Toronto, 9 August 2017.
- 2015 “Language as a window into prospection” (with Phillip Wolff). Symposium “Making Sense of the Future: Toward an Integrative Science of Prospection.” International Convention of Psychological Science, Amsterdam, 12-14 March 2015.
- 2015 “Telicity is launching and atelicity is entrainment: A formal semantic proposal” (with Heidi Harley). Formal Semantics Meets Cognitive Semantics, Radboud Universiteit Nijmegen, Nijmegen, 22-23 January 2015.
- 2014 “A compositional analysis of *ap* and verbal predicates in Haitian Creole”. Formal Approaches to Creole Studies (FACS-4), Université Paris 8, Paris, 6-7 November 2014.
- 2014 “Structural causal pluralism” (with Phillip Wolff and Jason Shepard). 22nd Annual Meeting of the European Society for Philosophy and Psychology, University of Messina, Noto, Italy, 16-19 September 2014.
- 2014 “Mapping the conceptual level to the linguistic level: A theory of the progressive using both force dynamics and branching” (with Heidi Harley). 22nd Annual Meeting of the European Society for Philosophy and Psychology, University of Messina, Noto, Italy, 16-19 September 2014.
- 2014 “Linguistic hints to causal models of the future” (with Phillip Wolff and Eugene Agichtein). Templeton Science of Prospection Finalist Symposium, University of Pennsylvania, Philadelphia, 4-5 August 2014.
- 2014 “Using theories of causation to model non-culmination and agency” (poster presentation, with Phillip Wolff). Semantics and Philosophy in Europe 7, Zentrum für Allgemeine Sprachwissenschaft, Berlin, 26-28 June 2014.
- 2014 “Non-culmination and agency: Exploring the hypothesis space” (with Phillip Wolff). Workshop on Agent Control over Non-culminating Events, CHRONOS: 11th International Conference on Actionality, Tense, Aspect, Modality/Evidentiality, Scuola Normale Superiore, Pisa, 18 June 2014.
- 2014 “Future reference: Exploring the hypothesis space”. Workshop on Theoretical approaches to inter- and cross-linguistic variation in futurity, CHRONOS: 11th International Conference on Actionality, Tense, Aspect, Modality/Evidentiality, Scuola Normale Superiore, Pisa, 16 June 2014.
- 2014 “Exploring the hypothesis space for non-culmination” (with Phillip Wolff). Workshop Bridging Formal and Conceptual Semantics, Heinrich Heine Universität Düsseldorf, 12-13 April 2014.
- 2014 “Modeling branching as the origin of imperfectivity in a force-theoretic framework” (with Heidi Harley). Workshop Bridging Formal and Conceptual Semantics. Heinrich Heine Universität Düsseldorf, 12-13 April 2014.
- 2013 “Deriving the readings of French *être en train de*” (with Isabelle Roy). Going Romance 2013, 27th Symposium on Romance Linguistics, ACLC Amsterdam, 27-28 November 2013.

- 2013 “Deriving the readings of French *être en train de*” (with Isabelle Roy). Tenth International Tbilisi Symposium on Language, Logic and Computation, Workshop on Aspect. Gudauri, Georgia, 24 September 2013.
- 2013 “The role of structural information in eliciting the ‘agent’ meaning with -er nominals: Experimental evidence.” (Isabelle Roy, Saveria Colonna, Bridget Copley, and Sudha Arunachalam). JeNom 5, Universitat Pompeu Fabra, Barcelona, 20-21 June 2013.
- 2012 “Wanting good cheese and acting to get it: Anankastic conditionals and intent.” Modality@OttawaU workshop, University of Ottawa, 20-21 April 2012.
- 2010 “Force dynamics in verbal semantics: Verbs of maintaining” (with Heidi Harley). Interdisciplinary Workshop on verbs: The Identification and Representation of Verb Features. Scuola Normale Superiore and Università di Pisa, 4-5 November 2010.
- 2010 “Causal chains for futures and imperfectives.” Workshop “Future Time(s) / Future Tense(s)” at the 43rd meeting of the Societas Linguistica Europaea (Vilnius). 3 September 2010.
- 2010 “Causatives, ability, and dispositions” (with Heidi Harley). Workshop on Dispositions, Ability, and States of the project ANR GENIUS (Genericité: Interprétation et Usages). 23-24 June 2010 .
- 2007 “Antecedent-contained *will*,” Third Conference on Modality of English, Aristotle University, Thessaloniki: May 2007.
- 2005 “Three futures in Indonesian,” Austronesian Formal Linguistics Association meeting, University of California, Los Angeles: April 2005.
- 2005 “When the actual world isn’t inertial,” Semantics of Under-represented Languages of the Americas 3, SUNY Buffalo: April 2005.
- 2005 “What should *should* mean?” Language Under Uncertainty workshop, Kyoto University: January 2005.
- 2005 “The opposite of inertia: O’odham *cem*,” 79th annual meeting of the Linguistics Society of America: January 2005.
- 2004 “A conceptual and a grammatical distinction for modals,” 35th meeting of the Northeastern Linguistics Society (NELS 35): October 2004.
- 2004 “Future reference without future tense,” Texas Linguistics Symposium 8: March 2004.
- 2004 “Futurate meanings,” Penn Linguistics Colloquium 28: February 2004.
- 2003 “Aspect, scope, and future conditionals,” Sinn und Bedeutung VIII: September 2003.
- 2002 Stativity over and under the future modal, poster presented at the 33rd meeting of the Northeastern Linguistic Society (NELS 33), MIT: November 2002.
- 2002 “Perfectivity on modals of ability,” 76th Annual Meeting of the Linguistics Society of America, San Francisco: January 2002.
- 2001 “Perfectivity on auxiliaries and light verbs,” poster presented at Perspectives on Aspect, Linguistics Institute of Utrecht OTS: December 2001.
- 2001 “A linguistic argument for indeterministic futures,” 32nd meeting of the Northeastern Linguistic Society (NELS 32), City University of New York: October 2001.

OTHER TALKS

Talks internal to projects and/or without a selection committee.

- 2017 “Introduction to the OASIS network” (with Isabelle Roy). OASIS 0, SFL, Paris, 9-10 November 2017.
- 2017 “Aspect at the grammatical-conceptual interface” (with Paul Moles). Workshop on the emergence of semantically interpretable formal features OASIS research network CASTL-FISH, Universitet i Troms, 9-10 October 2017.
- 2017 “The ontology of states” (with La Nash and Elena Soare). Journée d’études Fédération Typologie et Universaux Linguistiques du CNRS, Paris, 14-15 September 2017.
- 2016 “On the development of Merge and recursion in the transition from single words to sentences” (with Isabelle Roy). Institut Jean Nicod, Paris, 13 January 2016.
- 2015 Commentator, Workshop on the occasion of the Habilitation de Recherche of Dr. Isabelle Roy, Université de Nantes, Nantes, 20 November 2015.
- 2015 “What can cause what: Futurates and *have* causatives at the interfaces with semantics.” Fourth Annual Dog Days Workshop, University of Toronto, Toronto, 12 August 2015.
- 2014 “Telicity is launching and atelicity is entrainment.” Third Annual Dog Days Workshop, University of Toronto, Toronto, 7 August 2014.
- 2014 “Imperfective branching and perfective non-branching.” Workshop on modality, aspect and time: Model theoretic and discursive aspects. Ecole Normale Supérieure, 15 May 2014.
- 2013 “Le stade de 2-mots : Les premières combinaisons à l’interface syntaxe-sémantique” (with Isabelle Roy). Séminaire de l’équipe Langage, Cognition, et Acquisition, SFL, 13 octobre 2013.
- 2014 “Situation sequences, aspect, and cotermporal results.” Workshop DelimitEvents for the project “Individuation and identification of events” of the Fédération “Typologie et Universaux Linguistiques” (FR 2559), Université Paris 7, 7 March 2014.
- 2013 “The role of structural information in eliciting the ‘agent’ meaning with -er nominals: Experimental evidence.” (Isabelle Roy, Saveria Colonna, Bridget Copley, and Sudha Arunachalam). Boğaziçi Üniversitesi (Istanbul) seminar, 30 September, 2013.
- 2013 “Causal conditionals.” Workshop “How do we know what happens?” SFL/Institut Jean Nicod (Paris), 4-5 April 2013.
- 2011 Three talks with Heidi Harley: “Motivating a force-dynamic theory of event semantics,” “Force-dynamic interactions : Frustratives, aspect, and argument structure,” and “Force dynamics for agents and directors: *have* causatives, futurates, and modality.” SFL (Paris) 18-23 May, 2011.
- 2010 “Towards a teleological model for modals.” Paris Working Sessions on Modality, Goals, and Events, Fédération Typologie et Universaux Linguistiques / Institut Jean Nicod, 23-24 November 2010.
- 2010 “An unusual, yet ordinary, modal.” Journée d’Étude : Vers une typologie des modalités, Fédération Typologie et Universaux Linguistiques, 7 May 2010.

- 2009 “What temporal orientation tells us about conditional modality.” University of Arizona, 29 January 2009.
- 2007 Commentator, Paris-Amsterdam Logic Meeting of Young Researchers V: Dynamic Perspectives on Meaning. Paris, June 2007.
- 2005 Commentator, Syntax and Semantics with Attitude workshop, University of Southern California Departments of Linguistics and Philosophy: April 2005.
- 2004 “Modal immediacy.” University of Southern California School of Philosophy: April 2004.
- 2004 “An entailment of future conditionals,” Cornell University: February 2004.
- 2003 “What’s the difference between an aspect and a modal?” University of Southern California Department of Linguistics: November 2003.

PhD committee

- 2017 Silvia Darteni, Universit Paris 8. “Italian Parasynthetic Verbs: Argument Structure.”
- 2012 Oana Lungu, Université de Nantes. “Le temps en contexte subordonné de la perspective de l’acquisition du français langue maternelle.”
- 2011 Sylvia Schreiner, University of Arizona. “The semantics of grammatical aspect: Evidence from Scottish Gaelic.”

Lecturing

- 2003-2005 Lecturer, University of Southern California: graduate seminar “Time and Tense” (with James Higginbotham), Language, Society, and Culture, Philosophy of Language
- Winter 2003 Teaching Assistant, Harvard University (Dialects of English)
- Spring 2003 Lecturer, Northeastern University, (Introduction to Semantics; Introduction to Linguistics)
- Fall 2002 Teaching Assistant, Harvard University (Knowledge of Language)
- Fall 1998 Teaching Assistant, MIT (graduate Introduction to Semantics)

Service

ORGANIZATION OF CONFERENCES, WORKSHOPS, AND SEMINARS

- 2018 OASIS 1: main conference for the International Research Network “Ontology as structured by the interfaces with semantics: In search of the roots of our reality.” December 2018.
- 2017 OASIS 0: kick-off workshop for the International Research Network “Ontology as structured by the interfaces with semantics: In search of the roots of our reality.” 9-10 November 2017.
- 2015 GLOW workshop: “States and events.” 18 April 2015.

- 2014 Workshop: “Theoretical approaches to inter- and cross-linguistic variation in futurity” (with Alda Mari). CHRONOS: 11th International Conference on Actionality, Tense, Aspect, Modality/Evidentiality, 16 June 2014. Scuola Normale Superiore, Pisa.
- 2014 Workshop: “Modality, aspect and time: model theoretic and discursive aspects” (with Alda Mari). Ecole Normale Supérieure, 15-16 May 2014.
- 2013 Workshop: “How do we know what happens?” (with Alda Mari). 4-5 April, 2013. Ecole Normale Supérieure / Institut Jean Nicod / SFL.
- 2010 Paris Working Sessions on Modality, Goals, and Events (with Alda Mari). 23-24 November 2010, Fédération Typologie et Universaux Linguistiques / Institut Jean Nicod.
- 2010-2014 Seminars, workshops, and afternoons for the project “La causalité dans le langage et la cognition,” Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS.
- 2007 Conference: “Forces in Grammatical Structures”. CNRS/Paris 8, 8-10 January, 2007.
- 2006-2010 Seminars and workshops for the project “Temporalité : Typologie et acquisition,” Fédération de Recherche 2559 “Typologie et Universaux Linguistiques” of the CNRS.

REVIEWING

Journals: *Canadian Journal of Linguistics/Revue canadienne de linguistique*, *Linguistic Inquiry*, *Semantics & Pragmatics* (editorial boards); *Journal of Semantics*, *Journal of Pragmatics* (reviewing award), *Lingua*, *Natural Language and Linguistic Theory*, *Psychonomic Bulletin and Review*

Conferences: CHRONOS, Colloquium on Generative Grammar, JeNom, NELS, RALFe, SALT, Sinn und Bedeutung, WCCFL.

Granting organizations: Israel Science Foundation, National Science Foundation (USA)

OTHER SERVICE

- 2005-2008 Lab webmaster
- 2000-2004 Ask-A-Linguist panel member
- June 2001 Volunteer, University of Arizona American Indian Language Development Institute

Last updated: February 10, 2018