Inferentialism: A Manifesto

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Inferentialism: A Manifesto

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Abstract

In previous publications, we have proposed a new, inferentialist semantics for indicative conditionals. According to this semantics, the truth of a conditional requires the existence of a compelling argument from the conditional's antecedent together with contextually determined background premises to its consequent, where the antecedent is pivotal in the argument. In this paper, we recapitulate the position; report the progress we made over the past years, in particular highlighting the empirical support the position has garnered; and respond to criticisms that have been leveled at it.

Keywords: conditionals; inference; inferentialism; pragmatics; probability; semantics.

[*]The authors contributed equally to the paper and are listed alphabetically.

At various junctures in the history of thinking about indicative conditionals,[1] the idea has surfaced that their truth requires the presence of a *connection* between their antecedent and consequent. The current authors have been working on a new version of this view since 2013. In this paper, we summarize the progress that has been made over the past years and respond to objections that have been leveled at the new position. But first we recapitulate the main tenets of our position.

1 Inferentialism

Most work in the psychology of reasoning is concerned with how normal people respond to normal cases, most notably, normal instances of common inference patterns, or normal conditionals.[2] By contrast, logicians, and also philosophers interested in non-deductive forms of inference, have tended to focus on edge cases: sentences or inferences of which, at least initially, we do not know how to make sense. Paradigm cases are Gödel's (1931) "This sentence is unprovable" and Tarski's (1936) "This sentence is false," or the inference to the conclusion that our lottery ticket will lose, given its low probability of winning, or that there is bound to be some error in our recently finished monograph, given human fallibility—inferences which lead to highly probable conclusions but which, according to mainstream thinking, are to be resisted if we want to avoid ending up with contradictory beliefs (see Kyburg, 1961, and Makinson, 1965).

Both approaches—the psychologists' and the philosophers'—are valuable. We need the former to become clearer about the descriptive adequacy of our theoretical commitments when applied to central cases, while the latter's focus on edge cases helps us develop a feeling for where the limits of our theories may lie.

Recently, both philosophers and psychologists working on conditionals have started paying attention to a type of conditionals that, although not typically encountered in quotidian speech, are not baffling in the way the Gödel or Tarski sentence is. To the contrary, there is no reason why they should be outside the scope of any of the main semantics for conditionals. However, when applied to the said type of conditionals, these semantics yield verdicts which sit badly with pre-theoretic judgments.

The conditionals we have in mind have been dubbed "missing-link conditionals" (Douven, 2016a, 2017a), their characterizing feature being that—as the name suggests—there appears to be no link between their antecedent and consequent. The recipe for constructing such conditionals could not be more straightforward: take any propositions A and B that, for all you know, are entirely unrelated—being informed about the truth value of one of them would not tell you anything about the truth value of the other—and then construct the conditional "If A, B" (or, just as well, "If B, A"). For concreteness, consider

(1) If Eisenhower was the 34th American president, Newton is the author of the *Principia Mathematica*.

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[2]Below, we are more specific about what we mean by "normal conditionals."

This conditional is odd. Given that the truth value of its consequent came to be settled long before that of the antecedent, it appears about as absurd as the notion of backwards causation. Nonetheless, supposing the material conditional account, according to which "If A, B" is equivalent to "not-A or B," (1) is true. Similarly for Stalnaker's possible world semantics, according to which a conditional is true if its consequent is true in the nearest possible world in which its antecedent its true. In this case, that nearest world is the actual world, and (1)'s consequent holds in the actual world.

To delve already a bit deeper into why conditionals like (1) strike us as being odd, note that there is a *reason* why sentences of the form "If A, B" are called "conditionals": we sense that the consequent *is conditional on, depends on*, the antecedent. What (1) and similar conditionals help to bring out is that this sense of conditionality is not adequately captured by the main semantics for conditionals. For the disjunction "not-A or B" to be true, there need not be any kind of connection between A and B. Nor need there be any connection between them for B to be true in the nearest A-world.

In psychology, the advent of the New Paradigm (Over, 2009; Elqayam & Over, 2013) has occasioned a shift of attention from the above semantics of conditionals to the probabilistic semantics as advocated by Adams (1975) and others. Central to this semantics is the probability conditional, which is any conditional whose probability equals that of its consequent on the supposition of its antecedent.[3]

Unfortunately, Adams' proposal does not fare any better than the material conditional account or Stalnaker's semantics when it comes to accounting for the oddness of (1) and other missing-link conditionals. On Adams' (1975) original proposal, conditionals do not have truth conditions and so also, seemingly paradoxically, no probabilities. There is no real contradiction here, however, because for Adams the probability operator, when applied to conditionals, is to be interpreted as measuring those conditionals' degree of acceptability and assertability. On this view, a conditional "If A, B" is highly acceptable/assertable precisely if $Pr(B \mid A)$ is high. But (1) is neither highly assertable nor highly acceptable, despite the fact that most people will assign its consequent unit probability, and will assign unit probability to that consequent also on the supposition of the conditional's antecedent, which is completely unrelated to the truth of the consequent.

More generally, note that $Pr(B \mid A)$ will be high whenever B is highly probable and A and B are probabilistically independent. In fact, it can be high even if the probability of B is (slightly) diminished on the supposition of A. But although probabilistic independence and negative dependence suggest that the truth of B does not depend on that of A, respectively, that B is somewhat undermined, or disconfirmed, by the truth of A, according to Adams' proposal, "If A, B" can still be highly acceptable/assertable.

That on Adams' account conditionals lack truth conditions has repercussions unrelated to the present topic. Most significantly, Adams' account makes it hard to see how conditionals can occur in compound expressions, for instance, how we can account for

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[3]It has been said that the claim that natural language conditionals are probability conditionals is intuitively supported by the fact that we sometimes report conditional probabilities—especially, objective conditional probabilities—using "if" instead of "given that" or "on the supposition that" (see van Fraassen, 1976). Naturally, it does not follow from this (nor has anyone claimed otherwise) that conditional probabilities generally equal the probabilities of the corresponding conditionals.

conjunctions of conditionals, or for nested conditionals. The recognition of this problem inspired work aimed at combining Adams' proposal with de Finetti's three-valued semantics for conditionals. Leaving details aside here, the important observation to make is that, on the resulting account, any conditional with a true antecedent and consequent—such as (1)—still comes out true.

At this point, proponents of the above accounts tend to reach for pragmatics band aid, their point being that any seeming support for the thought that true conditionals require a connection between their component parts is, in actuality, only support for the idea that we have little *use* for conditionals whose components are unconnected—such conditionals can still be true or acceptable, but by *asserting* them we may mislead our audience, given that we normally only assert conditionals whose components *are* connected. Here is, for instance, how Over et al. (2007, p. 92) invoke pragmatics to account for their finding of an effect of probabilistic relevance of antecedent to consequent in their data:

> An Adams conditional [i.e., a probability conditional] is not equivalent to an explicit statement that A raises the probability of B, . . . nor that A causes B . . . A conditional probability $Pr(B \mid A)$ can be high when A does not raise the probability of B and when A does not cause B. For example, $Pr(B \mid A)$ can be high simply because $Pr(B)$ is high. Does this mean that supporters of the view that these conditionals are Adams conditionals cannot account for the weak negative effect of $Pr(B \mid A)$ in the current studies? [This is the just-mentioned relevance effect.] Not necessarily, for they can argue that the use of a conditional pragmatically suggests, in certain ordinary contexts, that A raises the probability of B or that A causes B.[4]

There is nothing wrong per se with the appeal to pragmatics here. As Grice (1989) convincingly argued, what we convey by our assertions is not just the semantic content of those assertions but also what our audience can reasonably be expected to infer from the fact *that* we asserted *what* we asserted *when* we asserted it *in the circumstances in which* we asserted it. To give a well-worn example, when you are attending a party and are being asked what time it is, then by responding "The guests are already leaving" you will be interpreted as suggesting that it is already late and that, moreover, you are not in a position to give any more precise indication of the time. That is not because that is what your response *means*, but because it is the best explanation of why you gave that response to the given question under the given circumstances (Bach & Harnish, 1979; Dascal, 1979; Hobbs, 2004; Douven, 2012a, 2022, Ch. 1). Similarly, the best explanation of why someone asserts a conditional could be that there is some kind of link between its component parts, or at least that the person believes such a link to be present.

Still, there are reasons to be wary of the move Over and colleagues make in the above passage, and that others have made to account for linguistic phenomena apparently going against their favored semantics of conditionals. While our understanding of pragmatics is not nearly at the level of that of logic—we have been studying logic for over 2000 years, the study of pragmatics only seriously took off with the work of Austin, Grice, and Searle in the second half of the past century—by now a number of principles have been identified that guide us in working out the content conveyed by an assertion that goes beyond the semantic content of that assertion. The first candidates for such principles were provided

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[4]Notation slightly altered for uniformity of reading; comments in square brackets are ours.

by Grice and termed "maxims" by him, but they have been refined and supplemented by later authors (see, e.g., Levinson, 2000). However, Over et al. (2007) make no reference to any specific pragmatic principles and, more generally, make no attempt to explain *how* the implicature ("the pragmatic suggestion") of a link (whether causal, probabilistic, or inferential) between a conditional's antecedent and consequent is brought about. May we request anyone wanting to rescue their semantics of conditionals by invoking pragmatics to at least *sketch* how the pragmatic explanation of whatever exactly it is that they are trying to explain pragmatically is supposed to go?

To forestall misunderstanding, there is a maxim of relevance in Gricean pragmatics, and the name might suggest that that is precisely what is needed here. But that is not so. According to this maxim, we should make our contributions to an ongoing conversation *relevant*. What needs explaining, however, is why a conditional whose antecedent is not relevant (in some sense) to its consequent does not relevantly contribute to an ongoing conversation (Douven, 2008, 2016a).

One could conjecture that the relevance requirement applies also to the clauses of complex or compound sentences. It is in fact an assumption of discourse coherence theory that the hearer will always attempt to conjure up connections between any two consecutive elements of discourse, so that it can be interpreted as coherent (Kehler, 2002; Asher & Lascarides, 2003). Any discourse coherence violations might then seem as odd as missing-link conditionals, and if that is the case, the oddness of missing-link conditionals might be explained away in terms of discourse coherence violations.[5] This hypothesis turned out to be false, however. Krzyżanowska, Collins, and Hahn (2017) report a study in which they compared the assertability of conditionals with the assertability of their consequents in the contexts in which the antecedents have already been asserted. They introduced two manipulations: the presence or absence of a common topic of the clauses, understood in discourse-coherence-theoretic terms, and the presence or absence of a stronger, inferential connection.[6] For instance, one of the vignettes used in the experiment introduced a protagonist, Patrick, who plans to take his girlfriend, Sophie, for holidays and discusses his ideas with Matt. Since they have enjoyed hiking in the Alps before, Patrick considers a trip to the Pyrenees. In the conversational exchange condition, Patrick tells Matt "Sophie likes the Alps," and Matt responds with a statement that is either both relevant (i.e., there is an inferential connection between the two statements) and on the same topic: "She will enjoy hiking in the Pyrenees," irrelevant (no inferential connection) and on a different topic: "More and more people in Western Europe care about animal welfare," or on the same topic but irrelevant: "Mountaineering can be dangerous." In the conditionals condition, in the same context, Matt asserts a conditional consisting of Patrick's statement in the antecedent and Matt's response in the consequent, for instance, "If Sophie likes the Alps, then she will enjoy hiking in the Pyrenees" in the same topic relevant condition. The participants are asked to evaluate to what extent Matt's assertion is natural or makes sense in the context. What Krzyżanowska and colleagues found is that while the same topic is sufficient to make B assertable after A has been asserted (e.g., "Mountaineering can be

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[5]Cruz et al. (2016) may be interpreted as hinting at such a possibility.

[6]Krzyżanowska and colleagues operationalized the presence or absence of an inferential connection as probabilistic relevance. In general, this is problematic; see below.

dangerous" in response to "Sophie likes the Alps"), it is not enough to make "If A, B" (e.g. "If Sophie likes the Alps, then mountaineering can be dangerous") assertable in the same context. Conditionals turned out to require a stronger kind of relationship than the presence of a common topic of discourse.

One could also try to argue that the oddity of missing-link conditionals is not due to the lack of a connection between their antecedent and consequent but rather to a violation of Grice's maxim of quantity: "Make your contributions as informative as required (for the current purposes of the exchange)" (Grice, 1989, p. 26). After all, it is typically when the antecedent and consequent of a missing-link conditional are both known to be true, or at least warrantedly assertable, that we are facing a discrepancy between what an account of conditionals renders acceptable, or true, and what we may be compelled to accept as such. A missing-link conditional whose antecedent and consequent are known to be true would not be odd because of its missing link, but because the speaker asserting such a conditional is violating the maxim of quantity—they assert a weaker statement when they are justified in asserting a stronger one, for instance, the consequent on its own, or the conjunction of both clauses.[7] This conjecture has been tested, too. Using different dependent variables in a series of four studies, Krzyżanowska, Collins, and Hahn (2021) compared conditionals, whose antecedents and consequents were known to be true, to the corresponding conjunctions and, in Experiment 2, to materially equivalent disjunctions. When A and B were inferentially connected, participants did not prefer the supposedly more informative "A and B" over "If A, (then) B," and both types of sentences received relatively high ratings. But when there was no connection between A and B, the participants rated conditionals as significantly less assertable, less acceptable, and as making less sense to say. Thus, it is not the case that a true antecedent and a true consequent are sufficient to make a conditional unassertable. The presence or absence of the connection, however, did not affect the corresponding conjunctions, and neither did it affect the disjunctions. Indeed, all disjunctions of the form "not-A or B," regardless of whether A and B were connected, received very low ratings. These results do not only falsify the conjecture derived from Grice's maxim of quality, but they also show that the requirement that the clauses are inferentially connected is specific to conditionals.

The connection between the antecedent and consequent might be conversationally implicated nevertheless. It is possible, after all, that even if we have not yet established how it is supposed to be calculated and which of the Gricean or neo-Gricean maxims missing-link conditionals violate, we might do so in the future. Such a possibility notwithstanding, one could, in principle, test if a certain aspect of meaning is a conversational implicature by testing for its necessary characteristics. Grice (1989) proposed a number of such tests, none of which seems to be conclusive,[8] yet there seems to be a consensus that the least controversial and the most practical one is cancellability (Sadock, 1978; Levinson, 2000).[9] A proposition conveyed by an utterance is cancellable when it can be *cancelled* by

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[7]This argument was put forward by Grice (1989) in the context of a defense of the material account of conditionals, but see Krzyżanowska (2019) for a discussion of how it can be adapted to serve any theory of conditionals that validates and-to-if inferences and thus needs to deal with their counterintuitve consequences.

[8]See Sadock (1978) for a critical discussion of all these tests.

[9]Already Sadock (1978) argues that, while cancellability (and, also, reinforceabilty which Grice does not discuss) are necessary characteristics of implicatures, they are not sufficient to distinguish them from other

the speaker of that utterance or by the context in which it was uttered. In particular, when a speaker's utterance S conveys a proposition P in some context, but the speaker does not intend to convey P in that context, they can follow up S with " . . . but I didn't mean to say / suggest / imply that P." When P is a conversational implicature, such cancellations are felicitous. Take, for instance, a well-worn example of a scalar implicature: when Sally says "Some of my students passed the exam," she conversationally implicates that not all of them did, but if she adds "Oh, I didn't mean to suggest that not all of them passed, I've marked only a couple" that initial implicature is cancelled. By contrast, an attempt to cancel the meaning which is semantically entailed rather than implicated is infelicitous. In fact, the speaker who makes such an attempt appears to be contradicting themselves, as for instance in: "Susan and Steve passed the exam . . . oh, I didn't mean to suggest that Steve passed the exam." If it then turned out that the connection between the antecedent and consequent of a conditional could be cancelled, it would be a strong indication that it may be conversationally implicated, while if it is not cancellable, then the conversational implicature hypothesis is strongly undermined. In fact, Skovgaard-Olsen et al. (2019) tested the cancellability of the connection and demonstrated that a speaker who asserts "If A, then B" and then attempts to cancel the relation between A and B is perceived by participants as saying something contradictory. By contrast, the connection between the conjuncts in a conjunction turned out to be cancellable.[10] Taking all these considerations together, we can be rather confident that the connection or relevance relation between a conditional's antecedent and consequent is not conversationally implicated.

The oddity of missing-link conditionals does not seem to arise due to presupposition failure either. One of the defining features of presupposition is that it projects under embeddings, and under negation in particular. For instance, the sentence "John quit smoking" presupposes that John smoked in the past, and so does its negation, "It is not the case that John quit smoking." If we know that John never smoked in his life, both sentences sound inappropriate. If the inferential connection between a conditional's antecedent and consequent were a presupposition, then a missing-link conditional, "If A, C," and its negation, "It is not the case that if A, C," should receive similarly low ratings. However, Skovgaard-Olsen and colleagues (2019) tested this hypothesis in their Experiment 2 and did not find any evidence supporting it.

Then how about stipulating "if" to generate the *conventional* implicature that the antecedent is relevant to its consequent? In that case, we would not have to rely on any maxims to work out the said suggestion but would simply infer this from the use of "if," which generates the suggestion by convention. There are again several problems to be faced.

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pragmatic phenomena. Others have suggested that there are conversational implicatures that are not cancellable (e.g., Lauer, 2013), though Zakkou (2018) argues that the cancellability test is reliable when restricted to non-figurative use of language.

[10] Implicatures cannot only be cancelled, but also reinforced. For instance, "Some of my students passed the exam" can be followed up with "Not all of them did" and, even though the former utterance conversationally implicates the latter, that extra bit of information is not perceived as redundant or unnecessary, unlike attempts to reinforce semantic entailments. A recently published study by Rostworowski, Pietrulewicz, and Będkowski (2021) shows that when a conditional "If A, B" is followed by a statement emphasizing that there is a causal, deductive, or abductive connection between A and B (e.g., "A will result in B," or "A entails B"), the latter is perceived as redundant. Moreover, Krzyżanowska (2019) argues that the connection does not pass any other test for conversational implicature put forward in the literature.

First, Bach (1999) makes a case against the existence of conventional implicatures generally. According to him, they are theoretical artefacts.[11]

Second, even granting there are conventional implicatures, the number of words that have been said to carry such implicatures is modest at best. So it requires an argument that a given word carries a conventional implicature and does not contribute the supposed implicature to what is *said* (as opposed to what is indicated or suggested).

In the case of the aforementioned examples, the arguments have all pointed at utterances which can be rephrased without the word at issue while retaining their truth value, although not their information content. For instance, it has been said that

(2) She is poor but honest.

is true precisely if

(3) She is poor and honest.

The supposed difference is that (2), but not (3), suggests a contrast between the conjuncts. Indeed, according to Grice (1989) *detachability* is a litmus test for whether a word generates a conventional implicature, which we can conduct by asking: can we say the same thing while avoiding the implicature?[12]

So, is the suggestion of a connection detachable in the case of a conditional? It is difficult to see how we could capture the semantic content of

(4) If global warming continues, London will be flooded.

while somehow abstaining from using "if" and not giving any impression that we see a connection between the continuation of global warming and London being flooded in the future. Here, advocates of the material conditional account might seem to have an advantage. They could claim that the following does the trick:

(5) Global warming does not continue or London will be flooded.

Note, though, that while the intuition that (2) and (3) have the same truth conditions is broadly shared, the claim that (4) and (5) have the same truth conditions is highly contested. Besides, the material conditional account faces a barrage of other problems, not least that it is inconsistent with virtually all known data about how people use conditionals—which is why no one in the psychology of reasoning community takes it seriously anymore.[13]

Setting the detachability question aside, one may wonder whether the connection between antecedent and consequent belongs to the *at-issue* content of a conditional, or to its *not-at-issue* content, where the latter term covers both conversational and conventional implicatures, as well as presuppositions.[14] And this is, indeed, what Skovgaard-Olsen and

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[11]Potts (2015), who does hold that there are conventional implicatures, points out that it is not entirely obvious which side of the semantics–pragmatics divide they belong to.

[12]Admittedly, the usefulness of this test has been questioned by Sadock (1978, pp. 287–290), who has argued that it requires presupposing what it is supposed to be a test for.

[13]Proponents of the suppositional theory might claim that (4) can be paraphrased by, "London will be flooded supposing that/assuming that/provided that global warming continues." But note that these paraphrases would be equally infelicitous when there is no connection between the component clauses.

[14]Note that whether the at-issue versus not-at-issue distinction is determined by semantic or pragmatic considerations itself depends on how implicatures and presuppositions are defined (Potts, 2015).

colleagues (2019) investigated in their Experiment 3, following the diagnostic tests proposed by Tonhauser (2012), who observed that the at-issue content is what can be accepted or denied directly, whereas the not-at-issue content can only be denied in a way that interrupts the flow of a conversation (e.g., "Hey, wait a minute . . . "). The participants were asked to react to an assertion by an English language learner asserting "If A, then C" (or "A therefore C"), choosing the most appropriate justification for their choice. For instance, in a scenario whose protagonists learn that A and C are both true, but A is irrelevant for C, the participants could choose between "Yes, A and C" and "No, A is not a reason that C." If the participants preferred the former choice, that would indicate that the reason relation is not-at-issue. The study showed, however, that the relevance relation is, in fact, perceived as content at-issue. Since the same pattern of responses was obtained for both "If A, then B" and "A, therefore B"—the paradigmatic example of Gricean conventional implicature— Skovgaard-Olsen et al. maintain that their results are compatible with the possibility that the connection is a conventional implicature after all. However, this interpretation of their results is not compatible with treating conventional implicatures as strictly pragmatic phenomena. They are, after all, conventional *and* at-issue.

As an independent reason to be wary of the sort of appeal to pragmatics that Over et al. (2007), and also Over and Cruz (2021), make, note that pragmatics is about *assertion*, while the problem of dealing with missing-link conditionals also concerns their *acceptability*: we are not just disinclined to assert missing-link conditionals, we are also disinclined to incorporate such conditionals into our system of beliefs.

In fairness, we note that probably no party to the present debate (so including inferentialists) can, at this point, make very definite statements about the proper interpretation, qua semantic or pragmatic, of their experimental results. For one, that is because, at least currently, we are far from having a consensus view on where to draw the line between semantics and pragmatics, if such line can be drawn at all. See for instance the schema in Levinson (2000, p. 195), showing the wide variety of views on what should count as semantics and what as pragmatics, also illustrating his claim that "[the Gricean] program . . . renders problematic and 'up for grabs' the correct division of labor between semantics and pragmatics in the explanation of many aspects of meaning" (Levinson, 2000, p. 165). Furthermore, in recent years, many philosophers of language and linguists have been busy identifying aspects of meaning that cannot be easily classified as either semantic or pragmatic, that rather seem to lie *in between* the two. It is not only the aforementioned conventional implicatures that can be seen as having both semantic and pragmatic characteristics. There are also pragmatic processes or contextual contributions that affect the truth-conditional content, including ones that are necessary for the utterance to express a truth-evaluable proposition in the first place (see, e.g., Carston, 2002, or Récanati, 2004).

For another, the experimental results reported in Krzyżanowska and Douven (2018) should discourage anyone from making strong claims about whether they have shown a phenomenon to be semantic, or to be pragmatic. Krzyżanowska and Douven sought to determine whether people distinguish between the truth and the assertability of a sentence, and whether they distinguish between the assertability and the acceptability of a sentence. In their paper, they report the results from two experiments strongly supporting a negative answer to both of their research questions. They used as materials sentences

that, according to standard semantic theorizing, were all true but that, according to standard pragmatic theorizing, also all carried false implicatures. Krzyżanowska and Douven found no reliable differences among assessments of the *truth* of the items in their materials, assessments of those items' *acceptability*, and assessments of their *assertability*. Distinctions among those concepts, theoretically important as they may be, appear to have little significance in the minds of laypeople.

However, as we and other inferentialists have noted, there are strictly theoretical reasons (including simplicity) to favor an account of conditionals that does not require explaining away data by reference to pragmatics, but can explain the oddness of conditionals such as (1) semantically—an account on which such conditionals come out as not being *true*. Any semantics that requires the presence of a link between a conditional's antecedent and consequent will be able to do so. And indeed, semantics of this type go back to the ancient Greek philosophers (Kneale & Kneale, 1962), with later proponents including Mill (1843/1872), Ryle (1950), Mackie (1973), and, in psychology, Braine and O'Brien (1991). In particular, it has been proposed that the consequent must *follow*, in some sense, from the antecedent for the conditional to be true.

With the possible exception of Mill (Skorupski, 1989, p. 73 f), the aforementioned authors meant the sense in which the consequent ought to follow from the antecedent to be deductive. However, as pointed out in Krzyżanowska, Wenmackers, and Douven (2014) and elsewhere, this insistence on a deductive–inferential link between antecedent and consequent makes the proposal open to immediate counterexamples. There are many conditionals we regard as true even though the truth of the antecedent does not guarantee the truth of the consequent. To give an example from Douven et al. (2018), we have no difficulty imagining a context in which we would deem true the statement "If Betty misses her bus, she will be late for the movies," even if, in that context, we are unable to rule out completely that Betty is transported from her present location to the cinema after missing the bus but still before the beginning of the movie.

As we have argued in a number of publications (Krzyżanowska, Wenmackers, & Douven, 2013, 2014; Krzyżanowska, 2015; Douven, 2016a; Douven et al., 2018, 2020), it would be a mistake to insist on "inference" as meaning *deductive* inference. Rather, we should adopt a broader notion of inference which encompasses, besides deduction, also induction and abduction and possibly other forms of inference as well (such as analogical inference, if that is different from inductive inference; see Douven et al., 2021). To illustrate, while

(6) If $x + 1 = 7$, then $x = 6$.

embodies a clear deductive link, as does

(7) If the marble is green all over, it is not red all over.

supposing plausible meaning postulates (Carnap, 1952), the conditional

(8) If John lives in Chelsea, he is rich.

rather features an inductive–inferential connection, on the (to our knowledge, true) supposition that virtually everyone living in Chelsea is rich. Or consider

(9) If Patricia and Peter are jogging together, they have patched up their friendship.

in which antecedent and consequent would appear to be connected via an abductive–inferential link. Supposing—as the conditional suggests—that they had ended their friendship, that they are jogging together is best explained by their having patched up their friendship. As said, there may be other relevant forms of inference still. For instance, Douven et al. (2021) look at conditionals such as

(10) If Jim's son likes ice skating, he will like ice hockey.

where the consequent follows from the antecedent by analogy, in the manner of Carnap (1980) and Paris and Vencovská (2018). It is to be noted that, unlike deductive inference, the forms of inference mentioned are not 100 percent safe, in that the truth of their premise or premises does not guarantee the truth of their conclusion; for instance, a couple of people living in Chelsea may be poor nonetheless, and John may happen to be one of them. Nevertheless, as Schurz and Hertwig (2019) point out, in people's actual reasoning, these non-deductive forms of inference probably play a much bigger role than deduction, for which, in our daily lives, we have limited use.

Specifically, our proposal has been that a conditional "If A, B" is true if there is a compelling argument from A plus contextually determined background premises to B, with A being pivotal to that argument (i.e., with A removed, the argument would cease to be compelling), false if there is a compelling argument from A plus contextually determined background premises to the *negation* of B, and indeterminate otherwise. "Compelling," as we pointed out, does not mean "conclusive." While the steps in a conclusive argument would all have to be deductively valid, an argument can be compelling even if it contains inductive or abductive steps, or other steps (e.g., ones involving analogical reasoning) that we take to transmit justification. An intuitive way to put the broad idea underlying the proposal is that anyone justified in believing A should become justified in believing B upon becoming justified in believing "If A, B," supposing the receipt of the conditional information that if A, B, does not undermine the person's justification for A.[15] That is what we take compelling arguments to do: to transmit whatever justification one may have for their premises to their conclusion.[16]

Thereby, inferentialism gives clear content to the idea of conditionality that was mentioned previously, the idea that the consequent is conditional on the antecedent.[17] In general, being informed of a conditional "If A, B," we can move to accepting B on condition that

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[15]That the latter can happen is demonstrated by the drivers license example from Douven (2012b).

[16]For related ideas, see Oaksford and Chater (2010, 2013, 2014, 2017, 2020), Vidal and Baratgin (2017), and van Rooij and Schulz (2019).

[17]Note that inferentialism is not the *only* way to cash out the idea of conditionality. As said in Douven (2016a, p. 36), to claim that there must be some kind of connection between a conditional's antecedent and consequent leaves the nature of that connection wide open: "[I]t could be logical, statistical, causal, explanatory, metaphysical, epistemic; or the 'connector' could be a second-order functional property, notably, the property that there is some first-order property or other that links antecedent and consequent, much in the way in which some have argued that truth is a second-order functional property, instantiated by correspondence to the facts in some domains of discourse, by assertability or verifiability in other domains, and by yet some other first-order property in yet other domains." Inferentialism is the substantive thesis that the nature of the "connector" is inferential.

we are in a position to accept A. We had already a first stab at explaining why missing-link conditionals like (1) strike us as odd. Inferentialism allows us to expand on this. According to inferentialism, the oddness of those conditionals is not explained simply by those conditionals' perceived lack of truth. Nor is it explained by the fact that we might be unable to *reconstruct* the argument connecting their constituent parts. After all, we have no issue accepting some conditionals as true despite not having effectively identified the connecting argument: being informed that if A, B by someone we trust will normally suffice to convince us of the presence of a compelling argument from A plus background premises to B even if the speaker does not provide that argument or we are unable to see it ourselves. Rather, the problem missing-link conditionals present us with is that it is so exceedingly clear that there is no compelling argument starting from their antecedent and ending with their consequent.

To this philosophical, or computational-level theory (to use Marr's, 1982, terminology), we later added a psychological theory, Hypothetical Inferential Theory, or HIT, to provide an algorithmic-level explanation of how inferentialism is represented in the mind. HIT tops up inferentialism with a couple of psychological principles. According to the *principle of relevant inference*, the relevant mental representation of the conditional is by default the one in which there is an inferential relation between antecedent and consequent; and according to the *principle of bounded inference*, this inferential link between antecedent and consequent need only be strong enough, in the sense of being subjectively supported. Thus, the strength of the connection is bounded by Simon-style satisficing (Simon, 1982).

Note that when we say that, in the case of missing-link conditionals, it is immediately obvious that there is no argument that could reasonably connect their component parts, we mean that this is so given a set of contextually determined background premises. In particular, we do not want to suggest that some conditionals are *intrinsically* or *objectively* missing-link conditionals. Indeed, it was already emphasized in Krzyżanowska, Wenmackers, and Douven (2014) that whether a conditional embodies a deductive, abductive, inductive inferential connection, or no connection at all, is a question that can only be answered relative to a given body of background knowledge. What for one person is a deductive inferential conditional may be an abductive or inductive inferential conditional, or even a missing-link conditional, for another person, or for the same person at a different moment in time, when the person had or will have a different set of background beliefs. That also means that one and the same conditional can be true for one person and false for another, or true and false for the same person at different points in time. Thus, there is a clear perspectivalist aspect to inferentialism.[18]

In Section 3, we respond to Over and Cruz's (2021) criticisms of inferentialism. We already mention here that they have clearly misunderstood the notion of a missing-link conditional. In particular, they appear to believe that such conditionals can be characterized probabilistically. According to them (p. 16), when the probability of the consequent of a conditional given its antecedent minus the probability of the same consequent given

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[18]Confusion could arise on this point given that, for obvious reasons, we have always chosen examples of missing-link conditionals whose status as such is likely to be preserved under all reasonable changes of our background knowledge.

the negation of the antecedent is 0, the conditional is a missing-link conditional. Not so.[19] Consider a coin with unknown bias; the bias could be anything. Then Pr(The coin will land heads | The coin is fair) = 0.5 but also Pr(The coin will land heads | It is not the case that the coin is fair) = 0.5. (If the latter is not clear, integrate the probability of heads over the unit interval—which yields 0.5—and subtract the integral of heads over the single point 0.5, which equals 0.) Nevertheless, "If the coin is fair, it will land heads" is *not* a missing-link conditional. (To forestall further misunderstanding, that does not mean it is *true*. There is an inferential connection between antecedent and consequent alright, but it is too weak to afford a compelling argument from the former to the latter, making the truth value of the conditional indeterminate.)

2   Evidence for inferentialism

Inferentialism has clear empirical content, and over the past years we have been concerned to test that content. Here, we focus on the main experimental work done on inferentialism.

2.1   Soritical series and inference strength

The first evidence for inferentialism in the form we advocate came from an experiment reported in Douven et al. (2018), which concerned the soritical color series shown in Figure 1. In this series, colored patches gradually shift from clearly green to clearly blue, through various shades of blue and green, including borderline blue–green shades. The participants in Douven and colleagues' experiment were asked to evaluate several conditionals pertaining to this series, all having the schematic form

<p align="center">If patch number i is X, then patch number j is X,</p>

with $i \in \{2, 7, 8, 9, 10, 13\}$, and with X standing for either "blue" or "green," depending on whether the participant had been assigned to the blue condition or to the green condition.[20] What values j could take depended on whether the participant had been assigned to the small or to the large condition: if the first, then the patch referred to in the consequent was either one or *two* steps away from the patch referred to in the antecedent; if the second, the distance between the patches was either one or *three* steps.

As Douven et al. explain, one can naturally associate an argument with each of the resulting conditionals. For example, an argument backing

Figure 1: The soritical color series from the materials of Douven et al. (2018).

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[19]We cannot think of a missing-link conditional whose component parts are not probabilistically independent of each other. That does not mean that whenever a conditional's component parts are probabilistically independent of each other, that conditional is a missing-link conditional.

[20]This split was made strictly for control purposes.

(11) If patch number 6 is green, then so is patch number 7,

would look something like this: Patches become greener as we move to the right in the color series; on the supposition that patch number 6 is green, and given that patch number 7 is to the right of patch number 6, patch number 7 must be green. Similarly, we can with

(12) If patch number 6 is green, then so is patch number 5,

associate an argument to the effect that because adjacent patches are very similar in color, and because patch number 5 is adjacent to patch number 6, patch number 5 must be green on the supposition that patch number 6 is green.

For the experiment, it was crucial that the arguments that can be associated with the conditionals in Douven et al.'s materials can vary in strength. For instance, while (11) and (12) both refer to adjacent pairs of patches, in the former the consequent patch is to the "greener" side of the antecedent patch, in the latter it is to the "bluer" side of the antecedent patch. The argument associated with (12) is certainly not weak, but it is not as strong as the argument associated with (11), given that, for the former argument but not for the latter, there is a consideration that at least somewhat weakens the conclusion.

Douven and coauthors were specific about what the main determinants for argument strength in the context of their materials were: direction—is the consequent patch to the left or to the right of the antecedent patch?—and distance: how close is the consequent patch to the antecedent patch? Comparing again (11) and (12) above should be enough to see why they thought direction mattered to argument strength. As for distance, compare (12) with

(13) If patch number 6 is green, then so is patch number 4.

With (13), we can associate an argument that is more or less identical to the one we associated with (12). However, because patches that are two steps away from each other are not quite as similar as patches that are only one step away, the argument associated with (13) is a bit weaker.

In their analysis, Douven et al. found that these factors indeed predicted with great accuracy the rates at which their participants had judged the conditionals to be true, in support of inferentialism.

Another noteworthy finding (replicated across four experiments) was a belief-bias analogue in truth judgments. Belief bias (Evans, Barston, & Pollard, 1983) is the effect of belief on inference, regardless of the inference's validity (for deductive arguments) or strength (for informal arguments). Classic belief bias has two components: a main effect of belief, in which arguments with believable conclusions are endorsed more than arguments with unbelievable conclusions; and an interaction of belief bias and argument validity, in which the difference between arguments with believable and unbelievable conclusions is larger for invalid arguments. Douven et al. drew an analogue between the conditional's antecedent and an argument's premise, and between a conditional's consequent and an argument's conclusion, an analogy not just in line with inferentialism, but necessitated by it. If the analogy is correct, then we should expect to see both belief bias effects in the truth evaluation of conditionals as well. First, we should expect a main effect of consequent, in

which conditionals with a true consequent will be more often evaluated as true. Second, and importantly, we would expect an interaction: this effect should be stronger for "invalid" conditionals, that is, conditionals whose direction was "wrong." This is exactly what was found. We call this the "quacks like a duck" principle: if it quacks like a duck, it *is* a duck; if it behaves like an inference—bias and all—it *is* an inference.

In their (2020), the same authors went a step further and re-analyzed the data from their earlier paper to explicitly compare inferentialism with the main rival semantics of conditionals, including the material conditional account and Stalnaker's possible worlds semantics, finding that inferentialism predicted those data much more accurately than did any of the rivals.

While providing strong support for inferentialism, it is to be admitted that, as Mirabile and Douven (2020) note, the data from Douven et al. (2018) concerned a somewhat artificial setting. While their materials are not entirely abstract, they are not entirely realistic either. Naturally, it is more important to know how well a semantics of conditionals is able to handle realistic conditionals than it is to know how the semantics handles conditionals of a sort we rarely if ever encounter in everyday life.

Therefore, Mirabile and Douven devoted two of their experiments to testing the same hypothesis that had been the focus of Douven et al. (2018)—whether the strength of the argument from a conditional's antecedent to its consequent predicts the likelihood with which it will be endorsed—but now using realistic materials. More specifically, their materials for those experiments consisted of abductive conditionals, that is, conditionals, like (9), in which the connection between a conditional's component parts consists of an explanatory link between those parts: the consequent explains, to a higher or lower degree, the antecedent. For such conditionals, the strength of the argument they embody is a function of *how* well the consequent explains the antecedent (Douven & Mirabile, 2018). Using these materials, Mirabile and Douven tested the said hypothesis both between subjects and within subjects, both tests yielding strongly favoring evidence.

In their final experiment, Mirabile and Douven also looked at the endorsement rates of the conclusions of Modus Ponens arguments. Their aim was to determine whether the strength of the argument embodied by the major premise of a Modus Ponens argument would predict the likelihood with which the conclusion would be endorsed. Not only that: they wanted to know whether argument strength was a better predictor of that likelihood than the probability of the major premise's consequent given its antecedent. To that end, they conducted an experiment in three phases, spaced one week apart. One phase sought to determine conditional probabilities, another phase sought to determine argument strength, and the third sought to determine endorsement rates. For instance, in the phase in which endorsement rates were determined, one of the items was

(14) Dennis tells you that John did well on his exam. Now suppose that if John did well on his exam, then he studied hard.

Participants were then asked to indicate how strongly they agreed that John studied hard. Corresponding to this argument, the participants were, in the phase that sought to determine explanation quality, presented with the following:

(15) Suppose we observe that John did well on his exam. We propose to explain this by the fact that he studied hard.

They were then asked to rate the quality of this explanation. Again corresponding to the same example, the remaining part asked to assign probabilities to the four rows in the truth table of conjunction with "John did well on his exam" and "John studied hard" as atomic propositions; from those probabilities Mirabile and Douven derived the conditional probability that John studied hard on the supposition that he did well on his exam. In their analysis, they found, again in support of inferentialism, that while conditional probability was a good predictor of conclusion endorsement, argument strength was a significantly better predictor.

2.2   Modus Ponens and inference strength

Psychologists have looked not only at how accurately various semantics of conditionals are able to predict truth judgments of conditionals but also at whether the inferences people are willing to make are in line with the commitments of those semantics. The inference rule studied more than any other is, of course, Modus Ponens (MP). In all experiments concerning this rule, it came out as being highly endorsed.

While typically *highly* endorsed, MP was, equally typically, not *universally* endorsed in those experiments. Absence of universal endorsement might be partially just noise. But proponents of the New Paradigm have also pointed out that, when experimenters request their participants to suppose the premises of an argument, they cannot expect those participants to follow suit exactly. Participants may bring their own beliefs about those premises to the experiment, and those beliefs may affect their judgment of whether the argument's conclusion follows from its premises. Most notably, uncertainty about the major premise in an MP argument might diminish a participant's willingness to endorse the conclusion.

Mirabile and Douven proposed an inferentialism-based explanation of the fact that endorsement rates of MP arguments tend not to be entirely at ceiling. As they note, from an inferentialist perspective, one can think of conditionals as *conduits* or *pipes* which, if accepted, allow one to transfer whatever grounds one has for believing the antecedent to the consequent. That, after all, is what compelling arguments do: transferring grounds of belief in the premises to grounds for belief in the conclusion (see Sect. 1). But precisely because compelling arguments need not be conclusive, we should conceive of conditionals as pipes that can, to varying extents, be *leaky*, in that the argument they embody may fail to carry over *all* the support we have or may have for the antecedent to the consequent.

Mirabile and Douven hypothesized that, if the inferentialism-based explanation were true, then endorsement rates of MP arguments with as major premise one of the abductive conditionals from the materials used in their experiments described earlier should be predicted by the strength of the explanatory argument connecting the antecedent and consequent of the given conditional. Experiment 3 in their paper tested this prediction and found again strong support for it. Not only that: Mirabile and Douven compared their hypothesis with the rival hypothesis that endorsements rates would be predicted by the conditional probability corresponding to the major premise—so the probability of the con-

sequent of the premise given its antecedent—finding that the inferentialist predictor was much more reliable than the probabilistic one. That conclusion strongly favored inferentialism over the suppositional account.

2.3   Probabilities of conditionals

No semantics of conditionals is complete if it does not account for the probabilities that people assign to conditionals. In our early work on inferentialism, we had been silent on the matter of probabilities. It was only recently addressed in Douven, Elqayam, and Mirabile (2021). To work out the implications of inferentialism for the probabilities of conditionals, these authors start by unpacking the truth conditions that inferentialism assigns to conditionals, noting that probabilities are probabilities of *truth*, and thus in particular that the probability of "If A, B" is the probability that "If A, B" is *true*, which is the probability that the truth conditions of "If A, B" are realized. As a result, inferentialists must hold that the probability of a conditional is the probability that there is a compelling argument from the conditional's antecedent (plus background knowledge) to the conditional's consequent, in the sense explained above.

As the authors also note, however, it is in general not a priori (in the colloquial sense of this expression) whether we can make a compelling case for a proposition on the basis of another proposition together with background knowledge. For example, we are somewhat confident that we can make a compelling case for the claim that the economy will speedily recover on the supposition that we get the COVID-19 outbreak under control, but we are, at the moment, not entirely convinced of this. We would have to think more carefully about whether other conditions for a quick economic recovery are in place (e.g., whether the pandemic has not done long-term damage to consumer confidence), whether other factors (e.g., Brexit) will not start to have a negative impact on European economies, what the effects of a growing Chinese economy will be in the coming years, and so on. If asked now for the probability we assign to

(16) If we can control the COVID-19 outbreak, the economy will quickly recover.

we will estimate the likelihood that we can make a compelling case for the consequent, starting from the antecedent plus background knowledge, and give that as our answer. Importantly, in making that estimate we use the heuristic of gauging the inferential strength between antecedent and consequent, that is to say, of gauging how strongly the consequent follows from the antecedent.

Douven, Elqayam, and Mirabile (2021) test this "inference heuristic" (as they call it) in two experiments, both presenting participants with three tasks, all of which used the same set of 50 conditionals. In one task, participants were asked to judge the probability of each of those conditionals; in a second task, they were asked to judge the strength of the inferential connection between antecedent and consequent for each of the conditionals; and the third task was meant to determine their conditional probabilities corresponding to the conditionals, where these conditional probabilities were measured via a probabilistic truth-table task in one experiment and by asking participants to engage in suppositional thinking in the other experiment.

In both experiments, inference strength judgments were strongly predictive of probability ratings, in support of inferentialism. Also in both experiments, and so independently of how conditional probabilities were measured, inference strength judgments predicted probability ratings much more accurately than conditional probability ratings did, an outcome strongly favoring inferentialism over the suppositional account.

It is particularly worth noting, also in connection with Over and Cruz's objections to be discussed below, that the materials used by Douven, Elqayam, and Mirabile (2021) included ten missing-link conditionals.[21] Inferentialism and the suppositional account make very different predictions about such conditionals, given that they are characterized by the absence of an inferential connection between antecedent and consequent but can nonetheless have any corresponding conditional probability. The ten missing-link conditionals in Douven and colleagues' materials had been chosen in the hope that the corresponding conditional probabilities would be more or less evenly distributed across the [0, 1] scale, which indeed turned out to be the case. Also, entirely as expected, ratings of inference strength were invariably low. As the authors noted, on the suppositional account, according to which inferential considerations do not matter in the interpretation of conditionals, one expects their probability ratings to be simply correlated with their conditional probabilities. By contrast, from an inferentialist viewpoint, one would expect inferential strength rather than conditional probability to be more strongly correlated with judgments of the probability of a missing-link conditional. The results were again clearly in favor of the inferentialist proposal, revealing a strong correlation between inference strength and probability ratings and a very weak one between conditional probabilities and those same probability ratings.

2.4 Similarity-based arguments

Douven et al. (2021) report experimental work primarily concerned with the study of a specific type of reasoning in the context of the conceptual spaces framework as developed in Gärdenfors (2000). Conceptual spaces are (typically) built on top of similarity spaces of the kind studied by Shepard (1964), Nosofsky (1988, 1989), and Petitot (1989), among many others. A similarity space is a one- or multidimensional metric space that is meant to represent people's judgments of how similar given items are in a specific respect. For instance, color similarity space is a three-dimensional space such that Euclidean distances in that space represent "dissimilarities" among color shades: the further apart two shades are—as represented in that space—the more dissimilar they are in people's perception; conversely, the closer they are in the space, the more similar we perceive them to be (Fairchild, 2013; Jraissati & Douven, 2018). The new proposal in Gärdenfors (2000) was that concepts (i.e., the mental correlates of words) can be represented as regions in similarity spaces. For example, the concept RED is a region in color similarity space, and the concept SOUR is a region in taste space. This opened up the possibility of studying concepts by geometric and topological means, which has led to a research program in its own right. Much of the theoretical modeling undertaken in this program was also recognized to have clear empir-

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[21]That is, in this case, conditionals that relative to any reasonable background premises will be perceived as lacking a connection between their component parts.

ical content. This recognition in turn led to a significant amount of experimental work being devoted to the conceptual spaces framework, virtually all of it yielding supporting evidence.

Douven et al. (2021) used the conceptual spaces framework to study a particular type of non-deductive arguments, to wit, those which project a property from one object onto another, based on the similarity between the objects. Taking their cue from a theoretical proposal in Osta-Vélez and Gärdenfors (2020), they hypothesized that the strength of such arguments would depend on the degree of similarity between the object designated in the premise and the object designated in the conclusion. Their materials involved objects that could be precisely located within a conceptual space whose geometry and topology had been established in Douven (2016b). They found that distances in that space between premise-object and conclusion-object were indeed strongly predictive of how compelling participants deemed the corresponding argument to be.

Given the connection that inferentialism postulates between the truth value of a conditional and the strength of the argument for its consequent based on its antecedent, Douven et al. (2021) realized that they should also be able to predict endorsement rates of the conditionals corresponding to the arguments in their materials on the basis of distances in the conceptual space they had used for testing their hypothesis about argument strength. To clarify, if we can predict the strength of the argument for the conclusion that Jim's son will like ice hockey starting from the premise that the son likes ice skating based on how similar the two sports are, then, supposing inferentialism, that same similarity should allow us to predict the likelihood with which (10) would be endorsed.

This observation inspired Douven et al. (2021) to present participants with a set of conditionals matching the similarity-based arguments in their materials, asking the participants how strongly they agreed that those conditionals were true. In their analysis, they regressed the responses on the argument strength judgments as well as, separately, on the distances in the relevant conceptual space between the antecedent-object and the consequent-objects. Both turned out to accurately predict endorsement rates for conditionals, leading to the overall conclusion that the conceptual spaces framework can be fruitfully mustered for explaining certain non-deductive inferences as well as for the evaluation of conditionals embodying such inferences.

3 Objections and replies

In their contribution to this volume, Over and Cruz (2021) criticize inferentialism, as part of a defense of their own preferred position, which combines Adams' and de Finetti's work on conditionals, yielding a version of the probability conditional coupled with a (non-classical) truth-conditional semantics. The concerns about inferentialism that Over and Cruz raise appear reasonable and might be shared by others. We thus believe it to be worth responding to them in some detail. Generally put, the objections are that (i) inferentialism is incomplete; (ii) it is too narrow; and (iii) it is implausible, for theoretical as well as empirical reasons. We discuss these objections in turn.

3.1 Inferentialism is incomplete

Inferentialism, in the version at issue, is a new semantics for conditionals. As mentioned, we started working on it in 2013. We are the first to admit that there remains important work to be done (see Sect. 4). By contrast, the position Over and Cruz are advocating—a version of the so-called suppositional account—has been in the making for almost a century, starting with Ramsey's and de Finetti's important work from the 1920s, and further building on equally important contributions from Adams made in the 1960s. So it should surprise no one that more is known about their favorite account than is known about inferentialism. That being said, Over and Cruz are right when they point out that, whereas there is a logic of the probability conditional, there is no logic of the inferential conditional. How damaging is this situation?

First, there is recent work by Crupi and Iacona (2020, 2021a, 2021b) and Raidl, Iacona, and Crupi (2020), which is aimed at formalizing the idea that a conditional's antecedent should *support* its consequent for that conditional to be true. In this work, the notion of support is mostly taken as primitive. In the end, one might want to have a logic of conditionals more closely tied to the finer mechanics of the notion of support, for instance, one that is sensitive to the different types of inference that *realize* the support. But of course, one could equally hope for a logic of the probability conditional that is sensitive to the reasons people have for assigning the probabilities they do, which one day we may be able to model formally as well. We do not think it is incumbent on the advocates of the probability conditional to do that work, but similarly, inferentialists might be happy to embrace one of the logics developed by the aforementioned authors.[22]

We are not here committing to any of these logics and indeed could imagine a very different approach to developing the logic of the inferential conditional. From the start, we have taken a rather detailed look at the sort of support the antecedent needs to provide to the consequent for the conditional to be true. First and foremost, this was to highlight the difference between our position and earlier attempts to give content to the idea that the truth of a conditional requires the presence of an inferential link between its component parts. As already pointed out, almost invariably, previous authors assumed that the link had to be deductive, which for the reasons indicated current proponents of inferentialism believe to be a bad idea. Hence, our emphasis on inductive and abductive inference in relation to inferentialism.

Recently, much has been done to clarify both inductive and abductive reasoning; on inductive reasoning, see Schurz (2019), on abductive reasoning, Douven (2017b, 2021, 2022). Neither of these authors offers anything deserving of the name "logic," but suppose we had logics of induction and abduction, and possibly of other forms of non-deductive inference as well. Then it would make a lot of sense to try to build a logic of the inferential conditional on those.

But second, in the absence of such logics, and of a logic of the inferential conditional specifically, we point out that, for all anyone has shown, it is not true that only notions that can be properly formalized can play a role in human psychology. Indeed, we should at least

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[22]The somewhat different approach to developing the logic of an inferentialist type of conditional taken by Berto and Özgün (2021) also appears promising to us.

reckon with the possibility that human psychology is inherently messy, and that neatly formalized notions of inference or support can at best play a marginal role in understanding how the mind works.[23,24]

To underpin this, we mention Douven and Williamson's (2006) proof to the effect that there can be no purely logico-mathematical definition of the notion of (categorical) belief.[25] No one would suggest that the notion of belief cannot do any substantive work in the psychology of reasoning.

Even more to the point, Carnap spent a large part of his career trying to develop an inductive logic. Several published attempts were severely criticized by Goodman, Putnam, Quine, and others, which did not keep Carnap from trying to "get it right." Only in posthumously published work (Carnap, 1980), he gave up, arguing that an inductive *logic* could not be had. In that same work, he presented a theory of inductive reasoning by introducing a precursor of the conceptual spaces framework. Suppose Carnap is right and there will never be an inductive logic (his arguments seem pretty compelling to us). Would that mean all the work that has been done on inductive reasoning (e.g., on category-based induction) was for naught? It seems to us that, to the contrary, that furthered our understanding of how people reason inductively considerably, whether or not we will ever have an inductive logic.

In short: True, there currently is no logic of the inferential conditional, but help may well be on its way. Even if, in the end, it turned out that the logics of conditionals now being developed cannot be brought fully in line with inferentialist commitments, or even if no logic could, it is hard to see why that would be bad for inferentialism. It is simply not a priori that our usage of everyday conditionals is governed by a logic. This is not to say that there are no inferential principles concerning conditionals that people tend to rely on. But those need not amount to anything worthy of the name "logic" (e.g., it might turn out to be impossible to gather them into an axiomatic system). And absent *any* logic of conditionals, we should still be able to make progress on understanding the role conditionals play in people's reasoning.

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[23] From the perspective of the classical computational theory of mind, the idea of a conditional logic makes a lot of sense. If the mind is, at bottom, a Turing machine, then there must be rules for manipulating expressions involving the conditional symbol. Uncovering those rules would yield the logic of conditionals. But in particular in light of the successes of connectionist approaches to the mind, the computational theory has lost much of its erstwhile appeal.

[24] In this connection, we would also like to refer to a remark specifically about counterfactuals that Over and Cruz make, to wit, that we can profitably study such conditionals "for some time" even if we cannot precisely define what counts as a counterfactual and what does not. One could go one step further and omit the "for some time": even if we will *never* have a definition of the said kind, no one can deny that we know much more about counterfactuals now than we did fifty years back, and there is no reason to believe that any further progress can only be made by first finding a precise definition of counterfactuals. The decisive point is that we can identify clear instances of counterfactuals and also clear instances of conditionals that are *not* counterfactuals. If the class of counterfactuals remains vague around the edges, then that might hamper progress somewhat, but probably no more than vagueness does in many other areas of science that have nevertheless managed to report important successes. (Think of color science, which Clark, 1993, p. vii, calls "*the* success story of scientific psychology so far," but in which vagueness is rampant; see, e.g., Douven et al., 2017).

[25] There have been attempts to escape the proof but these have serious drawbacks; see Douven and Rott (2018) and Douven and Elqayam (2021).

3.2 Inferentialism is too narrow

We have made it clear from when we started working on inferentialism that our aim was to develop a semantics for *indicative* conditionals only, and then only for *standard* or *normal* ones.[26] Among the types of conditionals we excluded were so-called non-interference conditionals, such as,

(17) If we triple her salary, Betty will leave the department.

It is important to be clear about the claim we made about such conditionals. According to Over and Cruz (p. x), we "have gone so far as to deny that non-interference conditionals are conditionals." We have done no such thing. What we have done is draw attention to a distinction that linguists have been making for decades between standard and non-standard conditionals, the latter sometimes also being referred to as "nonconditional conditionals" (Geis & Lycan, 1993; Lycan, 2001) or "unconditionals" (Merin, 2007).[27]

Among the non-standard conditionals are, next to non-interference conditionals, so-called relevance or speech act conditionals or biscuit conditionals, such as

(18) If you're hungry, there are biscuits on the table.

and Dutchman conditionals, such as

(19) If Harry passes the exam, I'm a Dutchman.

As said, we have, from the start, limited our proposal to standard conditionals, but not because we thought it would be impossible to account, in inferentialist terms, for conditionals of the aforementioned types, but rather because, in view of how little progress has been made on the semantics of conditionals, it would seem prudent for anyone wanting to develop a semantics for conditionals to start modestly and focus on standard conditionals first. One step at a time!

Even supposing inferentialism will not be able to account for non-interference conditionals, why would that be so bad? We cannot find a real argument in Over and Cruz (2021), except that they appear to think *any* semantics should be able to account for (at least) non-interference conditionals because (17) "looks like an acceptable conditional to us" (p. 20).

Not knowing who Betty is, how are we to tell? Well, the idea is of course to imagine a context in which a fictional colleague is firmly decided to leave our department and that nothing can change her mind. And yes, in such a context (17) may well be acceptable. What follows?

Consider that it is easy to imagine a context in which (18) is perfectly acceptable, but that there is nothing conditional about it: it asserts *unconditionally* that there are cookies on the table (the antecedent mentions the type of circumstance under which that information is relevant). Similarly, (19) may be acceptable in a context, but again there is nothing conditional about it: it expresses that the speaker deems it highly unlikely that Harry will pass his exam. And the same once more with respect to (17). There is nothing conditional

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[26]And really only a *semantics*. At this point, we have nothing to say about conditional threats or conditional promises, which are not the kind of things that can be true or false.

[27]The point is also missed in Mellor and Bradley (2021).

about it: the consequent is asserted unconditionally. In the context we sketched, we understand the conditional as asserting that Betty has decided to leave the department and that tripling her salary is not going to change her mind.[28,29]

We have two further comments on this. First, while we have wanted to focus on *indicative* conditionals, it was already pointed out in Douven (2016a, p. 38 f) that it would take little effort to extend the semantics to cover subjunctive conditionals. Moreover, it would seem equally easy to give an inferentialist account of concessives, by defining "[Even] if A, B" to be true if, and only if, there is a compelling argument for B from background premises alone and also from those premises revised (in the sense of Alchourrón, Gärdenfors, & Makinson, 1985) with A (i.e., given one's current background knowledge, there is a compelling argument from A to B, but A would not be essential to that argument). Finally, an inferentialist account of non-interference conditionals could plausibly look as follows: "If A, B" is true if, and only if, there is a compelling argument from background knowledge alone to B, also from background knowledge revised by A to B, *and* from background knowledge revised by not-A to B. Right now, these are just hypotheses, lacking any empirical support. We leave a full investigation for later, as there is still enough empirical work to be done on the original proposal pertaining to standard indicative conditionals.

Second, suppose inferentialism were forever limited to normal indicative conditionals, so non-interference conditionals never being in its scope. It is a mystery to us why Over and Cruz (2021, p. x) believe that, in that case, inferentialism would be unfalsifiable. Consider, again, the experiments described in the previous section. Which of those was guaranteed to confirm inferentialism, or to favor it over the account Over and Cruz prefer, just because non-interference conditionals were excluded from the materials? For instance, there was no way in advance to tell that inferential strength would come out as being a much stronger predictor of the probabilities of conditionals than conditional probability, as was found in Douven, Elqayam, and Mirabile (2021). Similarly for the results reported in Mirabile and Douven (2020). Could Over and Cruz have predicted that the results would favor inferentialism over their account, just because the materials consisted of abductive inferential conditionals? If so, we would like to see their argument. As far as we can see, the account preferred by Over and Cruz could have prevailed in *all* experiments on inferentialism carried out so far. If it had, that would have been bad news for inferentialism.[30]

3.3   Inferentialism is implausible

As Over and Cruz rightly point out, Modus Ponens (MP) is not valid, given inferentialism. There can be a compelling argument from A to B, and B can still be false even if A is true.

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[28]We should also note that the first author has referred to the standard vs. non-standard distinction in publications long predating the time that we started working on inferentialism (see, e.g., Douven, 2008). So the suggestion that the appeal to the distinction was ad hoc—not made in print but often in discussions—is demonstrably unfair.

[29]For an interesting discussion of what defines a conditional see also Elder and Jaszczolt (2016), whose starting point is an observation (based on the International Corpus of English-GB) of the disparity between the syntactic category of a conditional and the conditional meaning.

[30]Would it have *falsified* inferentialism? We are talking statistics here, so the old Popperian terminology is not very helpful. But it would have *disconfirmed* inferentialism, to an extent depending on *how* badly inferential strength would have failed to yield accurate predictions.

That is a consequence of the fact that "compelling" does not imply "conclusive." Over and Cruz appear to find this quite damning for inferentialism. And indeed, is MP not a rule of inference one would, pre-theoretically, want any semantics of conditionals to validate? Both from our own experience and looking at experimental data from cognitive psychology, it is obvious that we all tend to rely on this rule almost routinely in our reasoning. In light of this, inferentialism would appear implausible.

As explained in previous publications (e.g., Krzyżanowska, Wenmackers, & Douven, 2014), however, that inferentialism invalidates MP is not really a problem, given that it will be *typically* the case that if there is a compelling argument from A to B, and A is true, then B is true as well. Because in daily practice we tend to rely much more on compelling-but-inconclusive arguments than on deductively valid ones (Schurz & Hertwig, 2019), we would be in big trouble if the arguments we judge to be compelling were not highly truth-conducive. But then MP is, from an inferentialist perspective, highly truth-conducive as well. And why should that not suffice to account for people's reliance on that rule of inference? As was already noted by McGee (1985), who argued on independent grounds that MP is invalid for natural language conditionals, we should not expect our intuitions about validity to be sensitive to the difference between a rule of inference that is guaranteed to preserve truth and one that preserves truth in close to 100 percent of its applications.

Another objection involves the fact that, as Over and Cruz rightly remark, there are experimental data showing that people judging A true and B false tend to judge "If A, B" false, even if there is an inferential connection between A and B. For instance, (8) is, as said, generally considered to be an inductive–inferential conditional. Given that the vast majority of people living in Chelsea are rich, we are inclined to conclude that John is rich from the assumption that he lives in Chelsea. Although the inferential connection would appear quite strong, we tend to regard the conditional as false if we know that John is poor, or at least not rich, even if he lives in Chelsea. Over and Cruz appear to think that inferentialism is in tension with these data.

Over and Cruz are conflating two things here. According to inferentialism, a conditional is true if, relative to contextual background premises, there is a compelling argument from antecedent to consequent, where the antecedent is essential to the argument (without the antecedent, it loses its compellingness). Now consider that the kind of case Over and Cruz consider concerns conditionals whose consequent is known, or at least judged, to be false. And we simply do not deem anything a compelling argument for something we know, or judge, to be false. If we are convinced that John is poor, then nothing will strike us as a compelling argument for the claim that he is rich. Even if 99 percent of the people who live in Chelsea are rich, that will not convince us that John is rich, given that we know, or are independently convinced, that he is poor.[31]

To be sure, someone may point out to us that our grounds for believing John to be poor are faulty. Maybe we have been informed of that by an otherwise reliable witness,

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[31]This should also answer Over and Cruz's question of why inferentialists have not produced an intuitive example of a true conditional with a true antecedent and a false consequent (Over & Cruz, 2021, p. 18). It is a bit as if Over and Cruz were challenging someone who holds that there are things she was once firmly convinced of that are no longer among her beliefs simply because they slipped from her memory to give an example of such a thing.

who, however, in this case had a self-serving reason to lie about John's financial status. Then we may abandon our belief that John is poor and we may come to consider his living in Chelsea—if that is where he lives—as being excellent grounds for believing that he is rich. If we are informed that John lives in Chelsea indeed, we may go from suspension of judgment about John's wealth to believing that he is rich. But already in the situation in which we have suspended our judgment on John's wealth, one might regard (8) to be true. (Whether we will may depend on whether we believe purely inductive support can be enough for a compelling argument, which is debatable; see Nelkin, 2000, and Douven, 2003, for discussion.) To emphasize, in the experiments whose outcomes Over and Cruz deem problematic for inferentialism, the participants were *not* in this situation. They believed certain conditionals to have a false consequent, and thus they judged the conditionals to be false, entirely consistent with inferentialism.

To put Over and Cruz's misunderstanding more succinctly, according to inferentialism A can be true, B can be false, and still "If A, B" can be true (from someone's perspective) because there is a compelling argument from A to B (relative to that person's background knowledge). Over and Cruz seem to misread this as: A person can judge A to be true, judge B to be false, and yet judge "If A, B" to be true. The crucial difference is between the consequent *being* false, and the person judging the conditional's truth value *believing* (rightly or wrongly) the consequent to be false.[32]

3.4   Inferentialism is unfalsifiable

Above, we briefly touched upon Over and Cruz' claim that inferentialism is unfalsifiable because it focuses on standard conditionals. They make the same claim in connection with the belief bias analogue that, as mentioned earlier, we found (and replicated several times over). Specifically, we found that conditionals with believable consequent tended to be evaluated as true more often than conditionals with unbelievable consequent. We compared this to the well-documented effect of belief bias, in which inferences with believable conclusions tend to be evaluated as valid more often than inferences with unbelievable conclusion. Over and Cruz argue that this constitutes evidence against, rather than in favor of, inferentialism, and that the conditional probability hypothesis is directly supported by this pattern "without auxiliary hypotheses."

Alas, we think that Over and Cruz fell prey here to a normativist fallacy (Elqayam & Evans, 2011): the idea that a theory of thinking must be backed by a normative system. This inevitably leads researchers to narrow their focus to where a normative system can be found. This is also the source of Over and Cruz's subsequent argument, that inferentialism cannot be empirically tested because it does not specify a logic. These are related arguments, and they lead Over and Cruz to argue that inferentialism is not falsifiable, or has limited falsifiability.

We beg to differ.[33] As argued, formal logic is neither necessary nor sufficient for an effective theory of conditionals, or for its empirical testing. Inferentialism has a very simple

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[32]Skovgaard-Olsen et al. (2017) also miss this point.

[33]We find the term "falsifiable" rather puzzlingly Popperian and will instead refer to testability, and to evidence for or against the theory.

basic tenet: for agent A, the truth of a conditional, C, is a function of A's estimate of her ability to draw a compelling argument from C's antecedent to its consequent, given background knowledge. This tenet can be simply and directly tested by asking participants to draw an inference from antecedent to consequent, and measure the predictive power of this inference to the truth value of the conditional. Evidence against inferentialism can be entirely straightforward, if this predictive power fails. So far we found no such evidence.

It is not, by any stretch of the imagination, an auxiliary hypothesis to expect inference to behave like inference. After more than half a century of empirical science of reasoning, we know a fair few things about how people draw inferences. Belief bias is a prominent feature of this knowledge. Moreover, this is not an isolated one-off, but rather a persistent pattern found across studies, and, more to the point, across other psychological patterns of inference. The similarity-based study in Douven et al. (2021) is a case in point. In both cases, understanding how people draw inference generates unique, testable predictions.

One final observation: Over and Cruz only refer to inferentialism, but as early on as Douven et al. (2018), we presented a rounded theory of conditionals, Hypothetical Inferential Theory (HIT), with inferentialism as the computational-level theory, supported by a suite of psychological principles constituting the algorithmic-level theory. What we say about inferentialism and the psychological patterns of inference is even more relevant to HIT as a psychological theory. This makes the argument that our belief bias hypothesis serves as an auxiliary even more unsustainable.

4   Conclusion

We hope to have shown that inferentialism, in the version we have been advocating for a number of years now, has already much going for it. Not in the least, it holds the promise of accounting for what is probably our most fundamental intuition about conditionals, to wit, that there is a dependency of the consequent of a conditional on its antecedent. Supposing inferentialism, there is no need to explain away this intuition as being somehow mistaken, nor for waving our hands in the direction of pragmatics, hoping that someday someone will come up with a detailed explanation of how the suggestion of a connection between a conditional's component parts is brought about pragmatically (or just hoping that readers will be happy enough with the hand-waving and not ask for details). In addition to this, inferentialism is backed by the outcomes of several experiments that have been undertaken in the past years, using a wide variety of materials and methodologies.

The position has not remained without criticism, as we saw. As argued, however, these criticisms have largely sprouted either from misunderstandings of inferentialism—concerning its scope, for instance, or concerning the role background knowledge plays in the semantics—or from (implicitly) making unreasonable demands, like that there are still open questions about the logic of the inferential conditional (as if the critics could honestly claim that their own position saw the light of day with all details fully worked out). We welcome the research on conditional logics that take seriously the idea of their being a connection between a conditional's component parts and find much of this research to be promising. At the same time, we noted that it is not a priori that there *must* be a logic of the conditional as used in everyday language. In our view, there is a real possibility that

this usage is not governed by principles that can be regimented into anything worthy of the name "logic." We also noted that inferentialism was first presented as a semantics of normal indicative conditionals. We may well be able to extend it beyond those, but—to repeat—we prefer to take one step at a time.

Naturally, this is already to acknowledge that there is still work to be done. This is so even if, at least for a while, we keep confining ourselves to normal indicative conditionals. For example, Mirabile and Douven (2020) based predictions about endorsement rates of MP arguments on inferentialist tenets, but that work should be expanded to cover other argument forms involving one or more conditional premises as well—and there are many more than are usually considered in the psychology of reasoning literature (see Douven, 2016a, Ch. 5). We also need to develop our processing account more fully. Although we made some progress by postulating an inference heuristic, we still lack a model of how this inference works.

Besides, we have so far only looked at simple conditionals, that is, conditionals whose antecedent and consequent are not themselves conditional in form. There are many conditionals not of that sort—so-called nested conditionals—which make perfect intuitive sense yet which have proven a stumbling block for some of the main semantics (e.g., they pose well-known problems for the suppositional account). At least theoretically, inferentialism has no difficulty accounting for nested conditionals. Here is, for instance, one of our favorite examples of a both left- and right-nested conditional (i.e., a conditional whose antecedent and consequent are both conditional in form):

(20) If your mother gets angry if you come home with a B, then she'll get furious if you come home with a C.

According to inferentialism, (20) is true precisely if there is a compelling argument for the claim that your mother will get furious if you come home with a C from the premise that your mother gets angry if you come home with a B, which can be further analyzed as: there is a compelling argument for the conclusion that {you can compellingly argue that your mother gets furious from the premise that you come home with a C} from the premise that {you can compellingly argue that your mother gets angry from the premise that you come home with a B}. Whether this analysis would stand experimental scrutiny remains to be seen, however.[34]

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