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► **To cite this version:**

Bridget Copley. The coin toss, the queen, and the princess. Doctoral. Ecole Normale Supérieure, France. 2021. hal-04455966

**HAL Id: hal-04455966**

**<https://hal.science/hal-04455966>**

Submitted on 13 Feb 2024

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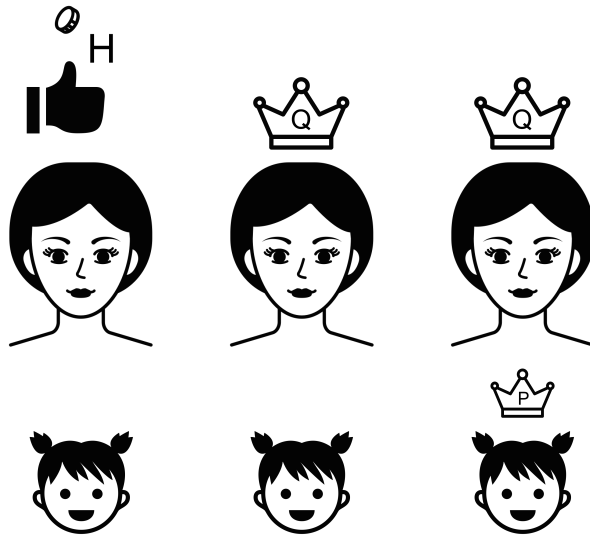
# The coin toss, the queen, and the princess

Bridget Copley, SFL (CNRS/Paris 8)  
ENS Conditionals, 7 April 2020

## 1 A causal puzzle about statives and eventives in conditionals

Suppose that there is a country called Clavarel where the queen is selected from amongst the eligible candidates by a series of coin tosses. In the particular situation we are interested in, it so happens that if the coin comes up heads, Yolanda becomes the queen; and if the coin comes up tails, she does not. Suppose also that if someone becomes the queen, any daughters she may have consequently become princesses; moreover, there is no other way to become a princess of Clavarel. Further suppose that Yolanda has exactly one daughter, named Xanthippe.<sup>1</sup> In such a context, we can see that (1a) is true, while (1b) is false. What's wrong with (1b)?

(1)



- (2)
- If Xanthippe is the princess, Yolanda is the queen.  
 $P(x) \Rightarrow Q(y)$
  - If Xanthippe is the princess, Yolanda becomes the queen.  
 $P(x) \Rightarrow \text{BECOME } Q(y)$

<sup>1</sup> Crown by Alfa Design, coin toss by Ariel Kotzer, Girl Smile by Llisole, baby girl by Milinda Courey, all from the Noun Project.

Attempted analyses . . .

- (3) a. In all the worlds where Xanthippe is the princess, Yolanda becomes the queen.  
b.  $\forall w \text{ s.t. } P(x)(w) : Q(y)(w)$
- (4) a. In all the world-time pairs where Xanthippe is the princess, Yolanda becomes the queen.  
b.  $\forall \langle w, t \rangle \text{ s.t. } P(x)(\langle w, t \rangle) : \text{BECOME}(Q(y))(\langle w, t \rangle)$
- (5) For all predicates of entities  $Q$ , entities  $y$ , world time pairs  $\langle w, t \rangle, \langle w, t' \rangle$ , such that  $t'$  is (just?) after  $t$ , let :  
 $\text{BECOME}(Q)(y)(\langle w, t' \rangle) := 1$  iff  $\neg Q(y)(\langle w, t \rangle)$  and  $Q(y)(\langle w, t \rangle)$  (cf. Dowty (1979))

But where does the causal flavor come from in (6) (compare with (2a)) ?

- (6) If Yolanda becomes the queen, Xanthippe becomes the princess.

And what's wrong (if anything) with (7a) (and compare to (7b))?

- (7) a. If Yolanda becomes/is the queen, Xanthippe is the princess.  
b. If Yolanda becomes the queen, Xanthippe is laughing.

It seems clear that whatever is causing differences in the properties of these conditionals, including presence or absence of the causal reading, it is the difference between the verb *become* and the verb *be*. The major such difference is called variously “the eventive-stative distinction” or “eventuality type”, and is one of several distinctions of “Aktionsart” or “situation aspect” (Smith 1991).

**The big question** Is the puzzle about time or about causation?

- Temporal relations can in part be recovered from causal relations.
- Verb phrases (especially eventive verb phrases) are organized in terms of causal relations (e.g. Dowty 1979, Pustejovsky 1995, Ramchand 2008, Croft 2012, Copley & Harley 2015).
- We can get the causal relation from the verb meaning, whereas with world-time pairs, we have to add it on, but only (in this data set) for eventive verbs in the consequent (and perhaps eventive-like readings of *be*). In any case it is sensitive to the choice of verb, which might be surprising under a time-based analysis.

**Hypothesis:** The puzzle is about causation.

**To-do list:** Compositionality, the difference between eventivity and stativity, map event semantics to causal models, define two kinds of update (*learning* and *happening*) and a simple dynamic conditional.

## 2 Compositionality

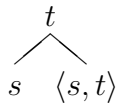
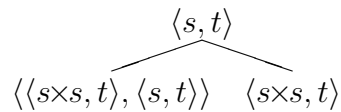
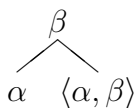
The meaning of the parts of the sentence + how those meanings are “glued” together = the meaning of the sentence (Frege 1948)

**Types** The meanings that will be composed (meanings of words, phrases) can have atomic or recursively defined derived types.

- (8)
- a. Entities: type  $e$
  - b. Situations: type  $s$
  - c. Truth values: type  $t$
  - d. If  $\alpha$  and  $\beta$  are types, then  $\langle \alpha, \beta \rangle$  is a type characterizing the type of functions from entities of type  $\alpha$  to entities of type  $\beta$

### Type-driven composition (Functional Application)

(9)



## 3 What’s the difference between eventives and statives?

### 3.1 Tests for eventivity vs. stativity

- (10) a. Xanthippe must be sick. epistemic reading possible  $\Rightarrow$  stative

- b. Xanthippe must get sick. no epistemic reading possible  $\Rightarrow$  eventive
- (11)
- a. If you care to know, there's beer. relevance reading  $\Rightarrow$  stative consequent
  - b. If you care to know, we get beer. no relevance reading  $\Rightarrow$  eventive consequent
- Statives and eventives are both predicates. But what of?

### 3.2 Some apparent “eventives” in English are actually stative

It turns out that very often in English, predicates that we expect to be eventive actually behave like statives instead. These stative readings of apparently eventive predicates fall into several categories: generic/habitual readings, futurate readings (where there is a future-oriented, “planned” or “settled” reading but no future morphology, (Lakoff 1971, Vetter 1973, Dowty 1979, Kaufmann 2005, Copley 2008, 2018)), and what we will call “storytelling readings”, where the reference is to what happens in a story, play, etc. (cf. the “director’s reading” in Ritter & Rosen (1997)). The fact that generic/habitual readings are stative is well-known, while the behavior of futurate and storytelling readings has not been much talked about (but see Copley (2018)).

- (12) Generic/habitual readings behave like statives
- a. Clavarelian nobles must drink beer.
  - b. If you care to know, Clavarelian nobles drink beer.
- (13) Futurate readings behave like statives
- a. Xanthippe must drink beer with Zelinda tomorrow.
  - b. If you care to know, Xanthippe drinks beer with Zelinda tomorrow.
- (14) Storytelling readings behave like statives
- a. (I haven’t read to the end of the book, but from what I’ve read,) Abelard must drink beer at the end of the book.
  - b. If you care to know, Abelard drinks beer at the end of the book.
- (15) “None-of-the-above” readings do not behave like statives
- a. Yolanda must get sick tomorrow. no epistemic reading
  - b. #If you care to know, Yolanda gets sick tomorrow.
- (16)
- a. It must rain tomorrow. no epistemic reading
  - b. #If you care to know, it rains tomorrow.

What follows from this is that habitual/generic readings, futurate readings, and storytelling readings are just statives; or more precisely, that the highest predication in their structure is stative.

- (17) “None-of-the-above” readings do not behave like statives (to a speaker within the story, so not a storytelling reading)
- a. Yolanda must become the queen.
  - b. #If you care to know, Yolanda becomes the queen.

### 3.3 True eventives are not assertable

True eventives can appear in antecedents but are not assertable.

- (18) True eventive
- a. If it rains tomorrow...
  - b. #It rains tomorrow.
- (19) True eventive
- a. If Yolanda gets sick tomorrow...
  - b. #Yolanda gets sick tomorrow.
- (20)
- a. If Xanthippe is there...
  - b. Xanthippe is there.
- (21)
- a. If Zelinda drinks beer...
  - b. Zelinda drinks beer.
- (22)
- a. If Xanthippe drinks beer with Zelinda tomorrow...
  - b. Xanthippe drinks beer with Zelinda tomorrow.
- (23)
- a. If Abelard drinks beer at the end of the book...
  - b. Abelard drinks beer at the end of the book.

Finally, while in antecedents, true eventives are possible, it seems that in the consequents of simplest conditionals, as long as we resist the temptation to add *will* or similar, true eventives are not possible.

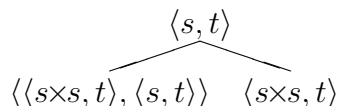
- (24) Generic/habitual reading  
(If Zelinda drinks beer,) Xanthippe drinks beer.
- a. ‘If Zelinda habitually drinks beer, Xanthippe habitually drinks beer.’
  - b. ‘Generally, if Zelinda drinks beer, Xanthippe drinks beer.’
  - c. #‘If Zelinda happens to drinks beer, Xanthippe will happen to drink beer.’

- (25) Futurate reading  
 (If Zelinda drinks beer tomorrow), Xanthippe drinks beer tomorrow. ‘If there’s a plan for Zelinda to drink beer tomorrow, there’s a plan for Xanthippe to drink beer tomorrow.’  
 ‘There’s a plan such that if Zelinda drinks beer tomorrow, Xanthippe drinks beer tomorrow.’  
 #‘If Zelinda happens to drink beer tomorrow, Xanthippe will happen to drink beer tomorrow.’

### 3.4 Assertability has to do with type

So, what is it that distinguishes unassertable antecedents from assertable antecedents in English? I want to suggest that it is *type*. That is, the reason that true eventives are unassertable in English is a formal reason; specifically, they are unable to take a situation argument, because they are of the wrong type to do so.

- (26) Turning an eventive into a stative



- (27) a. Xanthippe is writing a letter.  
 b. Xanthippe must be writing a letter.  
 c. If you care to know, Xanthippe is writing a letter.
- (28) a. Xanthippe has been writing a letter.  
 b. Xanthippe must have been writing a letter.  
 c. If you care to know, Xanthippe must have been writing a letter.
- (29) a. #Oh look—it’ll rain.  
 b. Oh look—it’s going to rain.
- (30) a. #If you care to know, it’ll rain.  
 b. If you care to know, it’s going to rain.

Past tense is interesting ...

- (31) a. Xanthippe left.  
 b. Xanthippe must have left. epistemic reading possible  
 c. If you care to know, Xanthippe must have left.

- (32) a. I walked in. Xanthippe left.  
b. I walked in. Xanthippe was there.

Assertability and non-assertability correlate nicely with eventivity and stativity with the simplest (verb) phrases, but as more material is added, the assertability/non-assertability distinction sticks around, while the “states” get more and more abstract. This general effect looks something like a grammatical bleaching effect (Meillet 1912, Traugott 1980, Sweetser 1988).

Assertability requires more than a mere predication; it additionally requires an act of something like endorsement or commitment from a mind (e.g. Recanati 2007).

On this hypothesis, what goes wrong with our unassertable eventives is that they are not predicates of situations, i.e. they are not type  $\langle s, t \rangle$ , so assertion, which applies a predicate of situations to the current situation, is not available.

### 3.5 What type are eventives, then?

Events are the type that gives transitions between two states:  $s \times s$ . This transition gets an energetic causation interpretation, matching with our intuitions in trying to say where causal readings arise in these conditionals. See Copley & Harley (2015), Copley (2019) for further discussion. Eventives are predicates of type  $\langle s \times s, t \rangle$ .

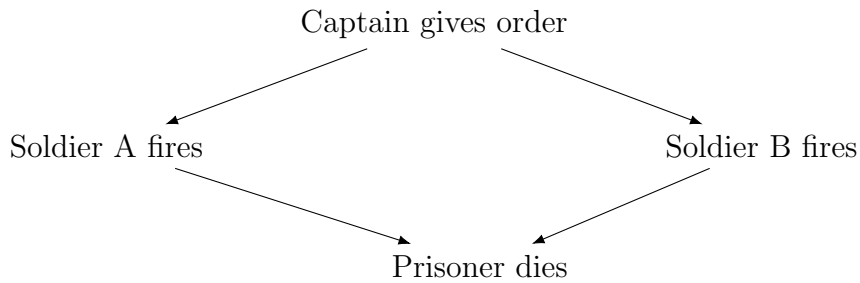
## 4 Causal models

A causal model is a directed acyclic graph used to represent causal influences Pearl (2000), Pearl & Mackenzie (2018). The relations in the causal model behave as in Pearl (2000), where a relation between nodes such as  $(A, B)$  conveys that the second node “listens” to the first node. That is, the second node’s value is sensitive to first node’s value. It is very important to remember that this relation is not always paraphraseable by the main verb *cause*; better words are *influence* or *affect*. The absence of such a relation between nodes conveys that there is no influence from one node to another.

The graph in (33), for instance, is meant to characterize a context where a captain orders two soldiers to shoot a prisoner. The captain has influence on the soldiers, and the soldiers’ actions have influence on whether the prisoner dies or not.

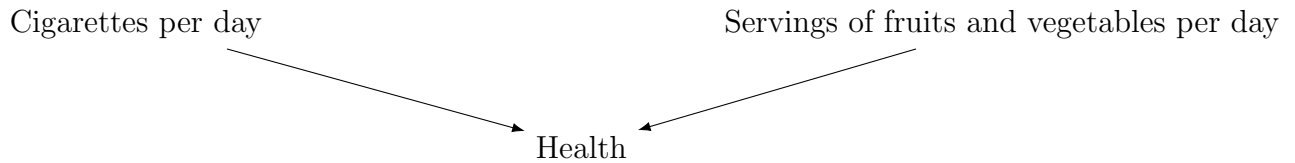


(33)



Similarly, one could represent causal influences on health with a diagram such as the one in (34). Note that although each additional cigarette per day *decreases* the value of whatever measure of health we use, the arrow between that node and the health node is correctly drawn.

(34)



For our puzzle, we have a very simple causal model:

(35)  $C \longrightarrow Q \longrightarrow P$

- (36)  $C := 1$  if heads, 0 if tails  
 $Q := 1$  if Yolanda is the queen, 0 if Yolanda is not the queen  
 $P := 1$  if Xanthippe is the princess, 0 if Xanthippe is not the princess

(37)

	$C$	$Q$	$P$
a.	1	1	1
b.	0	0	0
c.	1	0	0
d.	1	1	0

**“Seeing” vs. “doing”?** Pearl’s formal tool for talking about causation is the “*do*-operator”. The *do*-operator erases all causal influences on the node in question and changes the value of the node to the specified value, as shown in (38):

(38)  $do(X = x)$ : erase all incoming arrows into  $X$  and change the value of  $X$  to  $x$ .

Looking at the difference between seeing and doing in this system, one might hypothesize that this distinction corresponds to the distinction in English between statives and eventives respectively. Could it be leveraged to solve our puzzle? No. The *do*-operator does not correspond to eventive predicates *become the princess* or *become the queen* as in (2b). For suppose it did. Then if the conditional is again treated as , the meaning of (2b) would be expected to be as follows:

(39) All situations where  $do(P(x) = 1)$  are situations where  $do(Q(y) = 1)$

That is, all cases where we erase the arrows into the  $P(x)$  node and set the value of the  $P(x)$  node to 1 are cases where we erase the arrows into the  $Q(y)$  node and set it to 1.

But even then, we do not explain our puzzle. We do get (2b) to be false, but for the wrong reason. Making the reasonable assumption that we have the freedom, as erasers of arrows and setters of values, to apply the *do*-operator to whatever node we want, it is indeed false, as desired, that any case where we  $do(P(x) = 1)$  is a case where we  $do(Q(y) = 1)$ . But although we get the right result, this reason for getting that result is exactly wrong. The problem with (2b) is not that there is no arrow between  $Q(y)$  and  $P(x)$ ; it is that there *is* an arrow going into  $P(x)$  in the causal model, but somehow the conditional seems to require an arrow of causal influence to go the other way. In short, the *do*-operator cannot help us understand here how eventive predicates relate to causal readings in conditionals, because it erases one of the very things that we need to use, namely that incoming arrow.

**In the paper but not in the handout:** we need to map event semantics to causal models so we can go back and forth between them. The causal model will tell us if a particular event is possible.

## 5 How we will solve the puzzle

Statives (as in *being*) and eventives (as in *becoming*) have two different types and involve two distinct modes of update.

- (40)
- a. stative predicate:  $\langle s, t \rangle$ , which is a predicate of situations; maps to nodes in causal models
  - b. eventive predicate:  $\langle s \times s, t \rangle$ , which is a predicate of ordered pairs of situations (i.e., a predicate of a “relation”); maps to arrows in causal models

Accordingly, there will be two ways for the speaker to update the current situation: *learning*, which is an update with a predicate of situations, and *happening*, which is an update with a predicate of relations between situations.

- (41) a. learning = update with a predicate of situations  
 b. happening = update with a predicate of a relation between situations

With a very basic dynamic semantics meaning for conditionals, and using the causal model to index a causal sequence of situations, I will argue that the event in the consequent is, literally, the causal relation that yields the causal reading in (2b).

## 5.1 Dynamic semantics

(Heim 1982, Kamp 1981, Groenendijk & Stokhof 1990): Assertions of propositions in dynamic semantic frameworks update the context they are uttered in; they are “context change potentials”.

- (42) Compatibility/accessibility relation  $R$ : for arbitrary situations  $s, s', sRs'$  just in case all basic predications mentioning  $s$  of the form  $p(x)(s)$  are such that the truth value of  $p(x)(s)$  is equal to the truth value of  $p(x)(s')$ .
- (43) Notation: “ $1_e$ ” is the first member and “ $2_e$ ” is the second member of an ordered pair of an ordered pair  $e$
- (44) Two kinds of update:  
 a. learning:  $s[\varphi_{(s,t)}]^{\mathcal{M}} := \iota s' : sRs' \text{ and } \varphi(s')$   
 b. happening:  $s[\varphi_{(s \times s, t)}]^{\mathcal{M}} := \iota s' \in \mathcal{S}^{\mathcal{M}} : [\iota e \in \mathcal{S}^{\mathcal{M}} \times \mathcal{S}^{\mathcal{M}} : [2_e = s' \text{ and } \varphi(e)]]$
- (45)  $s[\text{if } \varphi, \psi]^{\mathcal{M}} := s[\varphi]^{\mathcal{M}}[\psi]^{\mathcal{M}}$

## 6 Solving the puzzle

- (46) If Xanthippe is the princess, Yolanda is the queen.  
 1. Update current situation  $s$  with information that Xanthippe is the princess.  
 2. Look on causal model to see what situation(s)  $s$  could be.  
 3. Update that situation with the information that Yolanda is the queen.  
 This is possible; conditional is true.
- (47) If Xanthippe is the princess, Yolanda becomes the queen.  
 1. Update (learning) current situation  $s$  with information that Xanthippe is the princess.  
 2. Look on causal model to see what situation(s)  $s$  could be.  
 3. Update (happening) that situation with the event that Yolanda becomes queen.  
 This means that Yolanda is not queen in  $s$  but is queen in the successor of  $s$ ; the

event is that transition.

This is not possible; conditional is false.

## 7 Other examples

- (48) If Yolanda becomes the queen, Xanthippe becomes the princess.
1. Update (happening) current situation  $s$  with the event that Yolanda becomes queen. That means that in  $s$  Yolanda is not queen, and in the successor situation of  $s$  she is.
  2. Look on causal model to see what situation(s)  $s$  could be.
  3. Update (happening) the successor situation with the event that Xanthippe becomes princess. This means that Xanthippe is not princess in the successor of  $s$ , but she is in the successor of the successor of  $s$ .
- This is possible, so this conditional is true.
- (49) If Yolanda becomes the queen, Xanthippe is the princess.
1. Update (happening) current situation  $s$  with the event that Yolanda becomes queen. That means that in  $s$  Yolanda is not queen, and in the successor situation of  $s$  she is.
  2. Look on causal model to see what situation(s)  $s$  could be.
  3. Update (learning) the successor situation of  $s$  with the information that Xanthippe is princess.
- Is this good or bad? I think there are two readings: one in which a stative has to “already” be true (conditional false) and one in which it can inceptively be true (conditional true). Compare with (50):
- (50) If Yolanda becomes the queen, Xanthippe is laughing.
1. Update (happening) current situation  $s$  with the event that Yolanda becomes queen. That means that in  $s$  Yolanda is not queen, and in the successor situation of  $s$  she is.
  2. Look on causal model to see what situation(s)  $s$  could be.
  3. Update (learning) the successor situation of  $s$  with the information that Xanthippe is princess.
- Conditional seems false; suggests that with derived statives, only the “already” meaning is possible (and see Copley (2009)).
- (51) If Xanthippe leaves tomorrow, Zelinda calls Yolanda today.
1. Update (learning) with the information that Xanthippe (has plans to leave tomorrow.
  2. Look on causal model to see what situation  $s$  could be.
  3. Update (learning) that situation with the information that Zelinda has plans to call Yolanda today.

- (52) If Xanthippe becomes princess, Yolanda became queen.
1. Update (happening) the current situation  $s$  with the event that Xanthippe becomes princess. This means that Xanthippe is not princess in  $s$ , but she is in the successor of  $s$ .
  2. Look at causal model to see what situation  $s$  could be.
  3. Update (learning) the successor situation of  $s$  with the information that Yolanda became queen previous to the time of the successor of  $s$ .
- This is possible, so the conditional is true.

## References

- Copley, B. & H. Harley. 2015. A force-theoretic framework for event structure. *Linguistics and Philosophy* 38. 103–158.
- Copley, Bridget. 2008. The plan's the thing: Deconstructing futurate meaning. *Linguistic Inquiry* 39(2). 261–274.
- Copley, Bridget. 2009. *The semantics of the future*. Routledge. *Outstanding Dissertations in Linguistics*, Routledge.
- Copley, Bridget. 2018. Dispositional causation. *Glossa: A Journal of General Linguistics* 3(1).
- Copley, Bridget. 2019. Force dynamics. In Robert Truswell (ed.), *Oxford handbook of event structure*, 103–149. Oxford.
- Croft, William. 2012. *Verbs: Aspect and causal structure*. Oxford University Press.
- Dowty, David. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Frege, Gottlob. 1948. Sense and reference. *The philosophical review* 209–230.
- Groenendijk, Jeroen & Martin Stokhof. 1990. Two theories of dynamic semantics. In *European workshop on logics in artificial intelligence*, 55–64. Springer.
- Heim, Irene. 1982. *On the semantics of definite and indefinite noun phrases*: UMass dissertation.
- Kamp, H. 1981. A theory of truth and semantic representation. In T.M.V. Janssen J.A.G. Groenendijk & M.B.J. Stokhof (eds.), *Formal methods in the study of language.*, vol. 135 Mathematical Centre Tracts, 277–322. Amsterdam.
- Kaufmann, Stefan. 2005. Conditional truth and future reference. *Journal of Semantics* 22(3). 231–280.
- Lakoff, George. 1971. Presupposition and relative well-formedness. In Leon A. Jacobvits Danny D. Steinberg (ed.), *Semantics: An interdisciplinary reader in philosophy, linguistics, and psychology*, 329–340. Cambridge, UK: Cambridge University Press.
- Meillet, Antoine. 1912. L'évolution des formes grammaticales .
- Pearl, Judea. 2000. *Causality: Models, reasoning and inference*. Cambridge University Press.
- Pearl, Judea & Dana Mackenzie. 2018. *The book of why: the new science of cause and effect*. Basic Books.
- Pustejovsky, James. 1995. *The generative lexicon*. MIT Press.
- Ramchand, G. 2008. *Verb meaning and the lexicon: A first-phase syntax*. Cambridge Univ Pr.
- Recanati, François. 2007. *Perspectival thought: A plea for (moderate) relativism*. Oxford University Press.

- Ritter, Elizabeth & Sara Thomas Rosen. 1997. The function of *have*. *Lingua* 101(3). 295–321.
- Smith, Carlota. 1991. *The parameter of aspect*. Dordrecht: Kluwer.
- Sweetser, Eve E. 1988. Grammaticalization and semantic bleaching. In *Annual meeting of the berkeley linguistics society*, vol. 14, 389–405.
- Traugott, Elizabeth Closs. 1980. Meaning-change in the development of grammatical markers. *Language sciences* 2(1). 44–61.
- Vetter, David C. 1973. Someone solves this problem tomorrow. *Linguistic Inquiry* 4:1. 104–108.