



Brief article

Between a conditional's antecedent and its consequent: Discourse coherence vs. probabilistic relevance

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ABSTRACT

Reasoning with conditionals is central to everyday life, yet there is long-standing disagreement about the meaning of the conditional. One example is the puzzle of so-called missing-link conditionals such as “if raccoons have no wings, they cannot breathe under water.” Their oddity may be taken to show that conditionals require a connection between antecedent (“raccoons have no wings”) and consequent (“they cannot breathe under water”), yet most accounts of conditionals attribute the oddity to natural-language pragmatics. We present an experimental study disentangling the pragmatic requirement of discourse coherence from a stronger notion of connection: probabilistic relevance. Results indicate that mere discourse coherence is not enough to make conditionals assertable.

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1. Introduction

Indicative conditionals, that is, sentences of the form “If p , then q ,” are everywhere. We utter them in everyday conversations, in political or legal debates, or in scientific discourse, for instance:

- (1) a. If I don't leave in five minutes, I will be late for the meeting.
- b. If we keep emitting greenhouse gases at our current pace, the oceans will rise and many cities will be flooded.

It is unsurprising then that there has been huge interest in conditionals from psychology (Evans & Over, 2004; Johnson-Laird & Byrne, 2002), linguistics (Declerck & Reed, 2001; Elder & Jaszczolt, 2016; Kratzer, 1986), and philosophy (Adams, 1975; Bennett, 2003; Douven, 2016; Edgington, 1995). Despite long-standing interest, many basic questions about how to interpret conditionals remain unresolved. One puzzle is the oddity of so-called missing-link conditionals, for instance:

- (2) a. If Russia never joined the European Union, Bogota is the capital of Colombia.
- b. If raccoons have no wings, they cannot breathe under water.

A natural response is to claim that an indicative conditional conveys some kind of connection between antecedent, p , and consequent, q . In its strong form, this view takes such a connection to be part of the semantics of conditionals. However, the most common approach has been to attribute the “weirdness” of missing-link conditionals to pragmatics—non-literal, speaker-intended meaning that makes “Can you pass the salt?” a request for salt, not a question about an ability. As Grice (1989) observed, pragmatic considerations may make a true sentence unassertable in context. For instance, the sentence:

- (3) Some horses are mammals.

is a strange thing to say, because it suggests, or *implicates*, that not all horses are mammals. Someone asserting (3), however, would not be saying anything false (from a purely semantic perspective).

A whole host of otherwise divergent theories which do not posit an intrinsic connection between antecedent and consequent have appealed to pragmatics to explain the oddity of missing-link conditionals, alongside other deviations between theory and

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participant's response. In particular, most theories of conditionals render valid an inferential transition from two true statements (such as “raccoons have no wings” and “raccoons cannot breathe under water”) to not only their conjunction (“raccoons have no wings and cannot breathe under water”) but also the conditional (“if raccoons have no wings, they cannot breathe under water”). That is, whenever two statements are true, the conditional combining them is true also. Such inferences, however, are obviously *not* valid, if conditionals require a connection between the clauses. Known technically as “centering”¹ this inference is entailed by most accounts of indicative conditionals in the philosophical and psychological literature, such as the material interpretation (Grice, 1989; Jackson, 1987), Stalnaker's interpretation (Stalnaker, 1968, 1975), Mental Models Theory (Johnson-Laird & Byrne, 2002), and the suppositional theory (Adams, 1975; Edgington, 1995; Evans & Over, 2004).

The proponents of these accounts do not deny that sentences such as (2a) and (2b) are odd, or that people might hesitate to endorse “centering” for them (see, e.g., Cruz et al., 2016; Skovgaard-Olsen et al., 2016a), but claim that the oddity of missing-link conditionals is due to pragmatics (see, e.g., Johnson-Laird & Byrne, 2002, p. 651, or Over, Hadjichristidis, Evans, Handley, & Sloman, 2007, p. 92). Few authors, however, hint at any specific pragmatic mechanism that would explain this phenomenon. An exception seems to be a recent paper by Cruz et al. (2016, p. 1108) who claim that:

... what matters for the intuition that there is something odd in conditionals like “If Hillary Clinton runs for president in 2016, the earth weighs more than 2 kilograms,” is the absence of a common topic of discourse between *p* and *q*, rather than the absence of a specific connection.

This suggests that the connection between antecedents and consequents may be nothing more than what we normally expect of any two statements constituting a coherent piece of discourse. A direct way to test the pragmatic hypothesis is by creating scenarios that pit discourse coherence against a stronger, probabilistic connection, and examine the impact of these two factors on peoples' judgements. The present paper reports a study to this effect.

1.1. Discourse coherence and probabilistic relevance

It is not without merit to argue that antecedents and consequents of indicative conditionals need to be connected, because speakers expect *any* consecutive elements of discourse to be connected in some way. Discourse, after all, is not a random collection of sentences, but has implicit organization. Compare the following sentences from (Hobbs, 1979):

- (4) a. James took a train from Paris to Istanbul. He has family there.
b. James took a train from Paris to Istanbul. He likes spinach.

Both examples consist of two pieces of information, which are not strange in themselves and which we can easily imagine to be true about a particular James. However, while (4a) is a perfectly

¹ The inference from “*p* and *q*” to “if *p* then *q*” is referred to as “one-premise centering” or “conjunctive sufficiency,” and it can be distinguished from (psychologically not equivalent) “two-premise centering,” which takes *p* as one premise and *q* as another premise. Whether or not lay people endorse either form of centering is a matter of controversy. For example, Cruz, Baratgin, Oaksford, and Over (2015), Cruz, Over, Oaksford, and Baratgin (2016) and Politzer and Baratgin (2015) found evidence in favour of one-premise centering. By contrast, a recent paper by Skovgaard-Olsen, Singmann, and Klauer (2016a) finds evidence against.

natural thing to say, (4b) raises eyebrows. The reason seems rather straightforward: spinach does not have much to do with a train trip to Istanbul; the two sentences seem disconnected.

Consecutive elements of discourse, *p* and *q*, can be related in various ways. For instance, *q* may elaborate on, or explain, *p*. In most cases, unless signalled otherwise, *p* and *q* are expected to at least be on the same topic. In (4b), this expectation is violated, unless we can conjure up a link (e.g., the speaker wants to suggest that eating a lot of spinach is correlated with a fear of flying, or that Istanbul is culinary heaven for spinach lovers; cf. Asher & Lascarides, 2003; Kehler, 2002; Stojnić, 2016).

Where *p* and *q* are the antecedent and consequent of a conditional, however, we arguably expect a stronger connection than just any discourse coherence relation. One candidate is probabilistic relevance, conventionally operationalized with the Δp rule²:

$$\Delta p = \Pr(q|p) - \Pr(q|\neg p)$$

Whenever $\Delta p > 0$, we say that *p* is positively relevant for *q*. $\Delta p = 0$ indicates irrelevance, while $\Delta p < 0$ indicates negative relevance (see, e.g., Oberauer, Weidenfeld, & Fischer, 2007; Over et al., 2007; Skovgaard-Olsen, Singmann, & Klauer, 2016b). In other words, probabilistic relevance means that *p* either raises or lowers the probability of *q*.

Though we contrast probabilistic relevance with discourse coherence in this paper it is important to understand that probabilistic relevance itself *gives rise to discourse coherence*. While it is not uncommon for two coherent elements of discourse to be probabilistically independent, whenever *p* actually raises the probability of *q*, *p* and *q* occurring together in a conversation should constitute a coherent piece of discourse. The following examples illustrate this.

- (5) a. John forgot to take his umbrella. My husband Bob never carries an umbrella.
b. John forgot to take his umbrella. He will get wet.

Here, the probability of “Bob never carries an umbrella” would not be expected to be higher under the supposition that John forgot to take his umbrella, but the two sentences together nevertheless appear coherent. They can constitute two consecutive elements of discourse. In (5b), the conditional probability of John's getting wet given that he forgot to take his umbrella is higher than the probability of “John will get wet” on its own. This in itself connects the two clauses. In other words, while it is difficult to envision probabilistic relevance without discourse coherence, it is readily possible to have discourse coherence without probabilistic relevance. This possibility forms the basis of our experimental test.

1.2. The present experiment

We investigated whether people expect a stronger connection between the antecedent and consequent of an indicative conditional than between other consecutive elements of discourse. More specifically, we aimed to disentangle the effect of probabilistic relevance from (mere) discourse coherence. We compared how people evaluate conditionals with how they evaluate the consequents of those conditionals in conversational contexts in which the antecedents have already been asserted (see Figs. 1a and 1b).

Our test factorially combined probabilistic relevance (positive relevance, irrelevance) and discourse coherence (same topic, different topics). However, given that probabilistic relevance, whenever it is salient to interlocutors, establishes discourse coherence, the combination positive relevance/no discourse coherence is practically not possible. This left the following conditions for comparison:

² One could also think of the connection in terms of evidential support (Douven, 2008) or inferential relations (Krzyżanowska, 2015).

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