True Clauses and False Connections

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Abstract

Indicative conditionals—that is, sentences typically, though not exclusively, of the form "If p, (then) q,"—belong to the most puzzling phenomena of language. One of the puzzles that has recently attracted attention of psychologists of reasoning stems from the fact that on the majority of accounts of indicative conditionals, "If p, (then) q" can be true, or at least highly acceptable, even when there is no meaningful connection between p and q. Conditionals without such a connection, dubbed *missing-link conditionals*, however, often seem very odd. A standard pragmatic account of their oddity rests on an observation that, whenever missing-link conditionals come out as true, these are situations in which speakers are justified in asserting stronger, more informative statements. Asserting a less informative statement is odd because it is a violation of the Maxim of Quantity. This paper reports four experiments that present a challenge to the Gricean explanation of why missing-link conditionals are odd. At the same time, we will argue that these findings can be reconciled with general principles of Gricean pragmatics, if the connection is treated as a part of a conventional, "core" meaning of a conditional.

Keywords: indicative conditionals, missing-link conditionals, conjunctions, relevance, assertability, Gricean pragmatics, then

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Data sets and other supplementary materials are available at: https://osf.io/uyk6e/.

1. Introduction

When we make decisions or plans, solve problems or give advice, we phrase a lot of what we say or think as indicative conditionals, that is, sentences typically, though not exclusively, of the form "If p, then q," where p, the *if*-clause, is called
5 *the antecedent*, and q, the main clause, is called *the consequent*.[2] We use such sentences in our everyday conversations, in the context of science, in public debates—in all contexts in which we might communicate reasons, talk about causal relations, or make inferences. For instance, someone preparing a dinner party might think:

10 (1) If I add too much chilli to the curry, John will complain.

A politician could argue that:

(2) If we lower taxes, we will not have sufficient resources to fund social security benefits.

Similarly, a biologist teaching about marine animals might state:

15 (3) If an animal has gills, it can breathe under water.

What the three sentences above have in common is that their antecedents express a condition under which their consequents occur or from which they can be derived. More specifically, (1) conveys that too much chilli in the curry would cause (be a reason for) John to complain. Likewise, (2) conveys that
20 lower taxes would result in insufficient funds for social security. And (3) conveys that gills allow breathing underwater. In other words, these everyday uses of conditionals seem to be about connections between their antecedents

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[2]Indicative conditionals are usually distinguished from *subjunctive* or *counterfactual* conditionals, such as, "If it were the case that p, then it would have been the case that q." Since these conditionals fall beyond the scope of this paper, we will use the term "conditionals" to refer specifically to indicatives throughout.

and consequents—connections that are, for instance, inferential, evidential, or causal.

²⁵ Despite these widespread intuitions, very few theories of conditionals take the connection to be part of the "core" meaning of the conditional. In fact, most well-established philosophical and psychological theories of conditionals validate a principle that leaves no room for the connection, the *Principle of Conjunctive Sufficiency*, also known as *Centering* or *and-to-if* inference. This ³⁰ principle allows us to infer conditionals from conjunctions. On the theories that validate it, knowing that "p and q" is true suffices to establish that "if p then q" holds. This inference is allowed whether or not there is a meaningful link between p and q. For instance, if someone knows that great white sharks are predators and that they can breathe under water, they are committed to ³⁵ accepting the following conditional:

(4) If great white sharks are predators, then they can breathe under water.

The Principle of Conjunctive Sufficiency has recently attracted attention in the psychology of reasoning (see, e.g., Cruz et al. 2016; Vidal and Baratgin 2017; Krzyżanowska and Douven 2018; Skovgaard-Olsen et al. 2019b), because, ⁴⁰ despite its counterintuitive consequences, it is validated by many of the most prominent accounts of conditionals such as the material account (Jackson 1987; Grice 1989), and possible worlds account (Stalnaker 1968, 1975). It is also *probabilistically valid*, or *p-valid* on the Suppositional Theory (Adams 1975; Edgington 1995; Evans and Over 2004; Cruz et al. 2016). At the same time, ⁴⁵ the departure from Conjunctive Sufficiency is characteristic of *inferentialist* approaches which place the connection between a conditional's antecedent and its consequent at the core of the meaning of the conditional, although what that means exactly depend on the particular account (see, e.g., Douven 2008; Douven et al. 2018, 2020; Krzyżanowska et al. 2013, 2014; Skovgaard-Olsen et al. ⁵⁰ 2017b, 2016; van Rooij and Schulz 2019; the inferentialist view on conditionals can also be attributed to earlier philosophers such as Mill 1843; Strawson 1986; Mackie 1973, and even Ramsey 1929/1990.)

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It bears emphasis that the proponents of the inferentialist accounts do not claim that their analysis applies to all sentences whose subordinate clause is introduced by "if" (see, e.g., Krzyżanowska 2015, pp. 11–14, 24 or Douven 2016, pp. 11–14). In particular, they explicitly exclude as requiring a different treatment sentences that look like conditionals but have been argued to be semantically different, labelled *nonconditional conditionals* by Geis and Lycan (1993), such as, for instance, *biscuit conditionals* ("There are biscuits on the sideboard if you want them"), in which the antecedent provides the condition under which the speaker's utterance of the consequent is pragmatically relevant, and whose consequent can be asserted on its own (Declerck and Reed 2001, pp. 320-321). Another example of a nonconditional conditionals are *concessive* or *non-interference* conditionals (e.g. "Even if she is starving, Mary won't eat those biscuits"). As in the case of biscuit conditionals and unlike in genuine indicative conditionals, a speaker who asserts a non-interference conditional seems to be asserting its consequent, too. Moreover, there is clear empirical evidence that non-interference conditionals are interpreted differently than indicatives: more specifically, people's probability and acceptability ratings of these conditionals are not affected by the same factors (Skovgaard-Olsen et al. (2016)). Importantly, however, non-interference conditionals should not be perceived simply as acceptable missing-link conditionals that inferentialism conveniently rules out; these are not conditionals whose antecedents can be replaced by anything whatsoever. In fact, these sentences too can be treated in a broadly inferentialist vein. Such a treatment was proposed by Skovgaard-Olsen (2016) who analysed non-interference conditionals as conveying that the antecedent is *not* a *sufficient reason against* the consequent.

While the inferentialist accounts differ in how they construe the connection, none renders a conditional like (4) acceptable unless one can show that there is some kind of relationship between the contents of its clauses—in this case: between being a predator and the ability to breathe under water. For this reason,

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inferentialist theories consider Conjunctive Sufficiency invalid.[3] It should be noted, however, that invalidating Conjunctive Sufficiency does not necessarily lead to the emphasis on the connection between antecedents and consequents.

The new revised version of the Mental Models Theory (Johnson-Laird et al. 2015; Khemlani et al. 2018), for instance, does not validate inferences from conjunctions to conditionals, yet missing-link conditionals, such as (4), can come out as true on this account.

Must the theories that validate Conjunctive Sufficiency, or the Mental Models Theory, then, hold that sentences such as (4) are perfectly normal? Not necessarily. Such a theory can say that from "Great white sharks are predators and can breathe under water" one can infer: "If Great white sharks are predators, then they can breathe under water," and, consequently, that the conclusions of such inferences are acceptable as true (on truth-conditional accounts) or highly probable (on non-propositional, probabilistic accounts). But the theory can add that sentences that are, in principle, highly probable or true can be, at the same time, *unassertable*, that is, they can be odd things to utter in normal conversations. Interestingly, the data seem inconclusive about people's endorsement of Conjunctive Sufficiency, with different studies pointing in different directions (see, e.g., Cruz et al. 2016; Vidal and Baratgin 2017; Krzyżanowska and Douven 2018; Skovgaard-Olsen et al. 2019b). However, even those researchers who found evidence supporting Conjunctive Sufficiency acknowledge that people might hesitate to accept a conditional whose clauses are not connected, though they attribute it to the way people *use* conditionals in natural conversations (Cruz et al. 2016; see also Over et al. 2007).

Conversation is governed by natural language pragmatics, that aspect of

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[3]How the validity is precisely defined here depends on the specific theory. Note that what matters for our purposes is the contrast between theories on which one can infer a conditional from a conjunction, and those on which the conjunction is not sufficient to infer a conditional. This is why, in this paper, we abstract away from any particular details of the formal systems that underlie discussed theories.

language that allows speakers to express more than they literally say and allows hearers to infer what the speakers mean (Grice 1989; see also Birner 2012 for a helpful introduction). For instance, imagine a speaker who says "it is a bit

110 cold in here, isn't it?" The speaker *literally* makes a statement about the temperature, followed by a question inviting agreement. The statement is true or false, on some value of "cold." But beyond the literal meaning, the speaker might intend to convey a request to close the window. This intended meaning would have no bearing on the truth value of the literal statement. Similarly, if a

115 professor asserts "some of my students passed the exam" she might be implying (more technically, "implicating") that not all of her students did, although, from a logical point of view, the sentence would be true in the situation in which all students passed. But if the professor uttered this sentence in a context in which we know that she had only marked, say, two out of many exam scripts, and

120 both received a passing grade, the implicature would not arise (e.g. Bott and Noveck 2004).

Pragmatics offers a set of possible explanations for why conclusions of sound and valid inferences, or true statements in general, are not always assertable in conversation. In principle, then, pragmatics may also be able to explain

125 why we find missing-link conditionals unassertable, and why we perceive conditionals as conveying a connection between their antecedents and consequents. What this would mean is that the connection is non-literal, non-conventional, context-dependent, inferential, and not truth-conditional (on this understanding of pragmatics, see, e.g., Birner 2012). Traditionally, pragmatic meaning is

130 contrasted with the *semantic* meaning. If the perceived connection were semantic, it would be literal, conventional, truth-conditional and independent of the context of the utterance.[4]

Along these lines, (Over et al. 2007, p. 92) proposed that anyone who takes

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[4]From a linguistic point of view, this is a somewhat old-fashioned way to introduce the semantics-pragmatics distinction. We will discuss this point in detail in the General Discussion.

the natural-language conditional to be probabilistic—its meaning closely tied

¹³⁵ to *the Equation*, that is, the equality between the probability of a conditional, $Pr(\text{"If } p, q\text{"})$, and corresponding conditional probability, $Pr(q \mid p)$—can argue that:

> . . . the use of a conditional *pragmatically suggests*, in certain ordinary contexts, that p raises the probability of q or that p causes q.

¹⁴⁰ A similar take on the connection between p and q might be found in the Mental Models Theory:

> We do not deny that many conditionals are interpreted as conveying a relation between their antecedents and consequents. However, the core meaning alone does not signify any such relation. (Johnson-
> ¹⁴⁵ Laird and Byrne 2002, p. 651)

Information can be added about different temporal, spatial, or causal relations between antecedents and consequents through a processes of pragmatic modulation (Johnson-Laird and Byrne 2002; Quelhas et al. 2010; Khemlani et al. 2018). However, the proponents of the Mental Models Theory argue that many ¹⁵⁰ missing-link conditionals, like the sentence below, should be perfectly acceptable:

> (5) If there was a circle on the board, then there was a triangle on the board, though there was no relation, connection, or constraint, between the two— they merely happened to co-occur. (Johnson-Laird and Byrne 2002, p.
> ¹⁵⁵ 651)

Later in the paper, we will discuss the Mental Models account in greater detail.

If a pragmatic explanation is to be persuasive, we need to know what specific pragmatic phenomenon is at work. While it has been argued that no *satisfactory* pragmatic account of the oddity of missing-link conditionals has been developed ¹⁶⁰ (Douven 2017), some suggestions have been made nonetheless. One possibility is that, when a conditional lacks some kind of relevance between antecedent

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and consequent, it violates discourse coherence (Cruz et al. 2016 made a related suggestion). After all, any two consecutive elements of discourse will sound odd if they are not on the same topic. However, Krzyżanowska et al. (2017a) showed

165 that even if the discourse establishes a coherence relation between the clauses of a conditional, that is not enough to make the conditional a sensible thing to say. A stronger relationship is required, for instance, that of the positive probabilistic relevance which holds whenever the antecedent raises the probability of the consequent.

170 Another, influential pragmatic explanation was suggested by Grice (1989), who did not deny that conditionals convey the presence of a strong, inferential connection between their clauses, but he insisted that their semantic, conventional meaning is fully captured by the material account of conditionals. The connection is, according to Grice, nonconventionally implicated (Grice 1989,

175 pp. 76-78). In developing the explanation of the oddness of missing-link conditionals, Grice was thus concerned with explaining away the so-called paradoxes of material implication, but a pragmatic explanation devised for those can be extended to deal with the counter-intuitive consequences of Conjunctive Sufficiency. Grice proposed that:

180 To say that "$p \supset q$" is to say something logically weaker than to deny that p or to assert that q, and is thus less informative; to make a less informative rather than a more informative statement is to offend against the first Maxim of Quantity, provided that the more informative statement, if made, would be of interest. There is a

185 general presumption that in the case of "$p \supset q$," a more informative statement would be of interest (Grice 1989, p. 61).

Since conditionals with a true antecedent *and* consequent are obviously instances of conditionals with a true consequent, if one supports a theory that endorses Conjunctive Sufficiency, one could explain the oddness of missing-link condi-

190 tionals with true clauses in exactly the same way. (In fact, the same strategy could be used, in principle, in defence of the Mental Models Theory.) In such

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cases, one could argue that when a speaker is justified in asserting the conjunction of the antecedent and consequent, they should assert that conjunction because it is more informative than the conditional, and hence the conditional

¹⁹⁵ is unassertable. For instance, (4) is rendered true, or, on the Suppositional Theory, highly acceptable, since both "great white sharks are predators" and "great white sharks can breathe under water" are true. But precisely because the speaker knows that both clauses are true, they should assert the conjunction and not the conditional. That is, they should assert: "Great white sharks

²⁰⁰ are predators and they can breathe under water." If they choose to assert the conditional instead, they violate the maxim of Quantity.

The Maxim of Quantity might prevent speakers from asserting conditionals that have true antecedents and consequents—which we will henceforth call *TT conditionals*—such as (4). However, it does not explain why those sentences

²⁰⁵ seem to suggest that their clauses are connected, that is why, e.g., (4) suggests that being a predator has something to do with the ability to breathe under water. Furthermore, as observed by Douven (2008, p. 23), if this approach is correct, we should not assert *any* TT conditionals, including those that are, intuitively, perfectly felicitous, for instance:

²¹⁰   (6) If great white sharks have gills, then they can breathe under water.

Yet, contrary to (4), that both "great white sharks have gills" and "they can breathe under water" are true does not make the above conditional a strange thing to say at all. In fact, it could be asserted by someone explaining, say in the context of a classroom, anatomy and physiology of marine animals. Moreover,

²¹⁵ in such context, it might be even preferable to the corresponding conjunction, since "great white sharks have gills and they can breathe under water" does not convey the information about the dependence of the ability to breathe under water on being equipped with gills. In other words, there is a crucial difference between (4) and (6) which makes the former odd and the latter assertable, and

²²⁰ which is completely overlooked by the Gricean approach to the conditionals with true clauses. What has been missing is that conditionals whose clauses are

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reasonably connected may be assertable even if the conjunction of these clauses is assertable too.

We should note here that we have chosen to refer to the above proposal as "Gricean" rather than "Grice's" carefully, as we have extrapolated from Grice's own writings. Firstly, Grice was not concerned with Conjunctive Sufficiency but rather with the paradoxes of material implication. Secondly, Grice himself discussed a demand for non-truth-functional evidence for a conditional to be assertable. The above cited passage purports only to explain why people might be reluctant to accept missing-link conditionals that are true in virtue of their underlying semantics; it is by no means Grice's last word on conditionals. But this passage is nonetheless an attractive proposal, especially in the context of the psychology of reasoning debate on Conjunctive Sufficiency and its counterintuitive consequences, and as such it merits an empirical investigation.

The connection between antecedent and consequent can be construed in a number of ways. Probabilistically, it can be construed in terms of probabilistic relevance (e.g. Over et al. 2007; Oberauer et al. 2007; Skovgaard-Olsen et al. 2016; van Rooij and Schulz 2019) or through an evidential support relation (Douven 2008, 2016).[5] Alternatively it can be characterised in terms of inferential relations (see, e.g., Declerck and Reed 2001; Verbrugge et al. 2007), which could be deductive, inductive, or abductive, or any combination thereof (Douven and Verbrugge 2010; Krzyżanowska et al. 2013, 2014). Relatedly, the connection can be understood as a strong argument from the antecedent (together with contextually salient background premises) to the consequent, possibly involving multiple inferential steps (Douven et al. 2018, 2020). Since all these proposals seem to aim at capturing a pre-theoretic notion, we do not assume any particular formalism and rely on an intuitive understanding of the connection.

The presence or absence of a connection between p and q might not be the only factor that can influence whether or not we find conditionals with true clauses felicitous. In fact, extensive overviews of different types of conditionals

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[5]See Skovgaard-Olsen et al. (2017b) for an experimental comparison of these two measures.

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that can be found in the linguistic literature (see, e.g, Declerck and Reed 2001) reveal that conditionals can be characterised and classified in many different ways. Traditionally, most psychological and philosophical research has focused on the broad category of *indicative conditionals*, of which a prototypical exam-

₂₅₅ ple would be "If Oswald didn't kill Kennedy, someone else did," as opposed to *subjunctive conditionals* such as "If Oswald hadn't killed Kennedy, someone else would have." However, linguistic data suggest that the broad category of indicative conditionals is not a homogeneous class and far too general to be useful in understanding how people use and reason with conditionals in natu-

₂₆₀ ral language. One pragmatically relevant distinction that has been emphasised in the psychology of reasoning literature (see, e.g., Evans et al. 2003; Cruz and Oberauer 2014; Gazzo Castañeda and Knauff 2018; Khemlani et al. 2018) might be whether the antecedents and consequents of conditionals are about specific individuals, or if they are generics, that is, about whole classes of object (cf.

₂₆₅ Papafragou 1996). There is evidence for the significance of this distinction in extant experiments on Conjunctive Sufficiency: conditionals might be more or less acceptable or assertable depending on the content of their clauses. For instance, some of the stimuli used in these experiments are about specific objects, e.g., "If the next Amri bird you see on Liaku will eat arb seeds, then the next

₂₇₀ next Amri bird you see on Liaku will build its nests on arb trees" (Cruz et al. 2016), while others are generic statements, for instance, about whole classes of objects, e.g., "If birds are animals, some animals can fly" (Krzyżanowska and Douven 2018).

Following the example of Evans et al. (2003), most experimental studies ₂₇₅ on conditionals and conditional probability have been focused on conditionals with specific, and not generic, content. This lacuna has been addressed recently by Cruz et al. (2015) who investigated whether the Equation also holds for conditionals that are equivalent to statements of the form "all ps are qs." In a more logical setting, also, Gazzo Castañeda and Knauff (2018) observed that ₂₈₀ the endorsement rates for conditional arguments was affected by the phrasing of the premises and conclusions. The conclusions of both valid (Modus Ponens and

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Modus Tollens) and invalid (Acceptance of the Consequent and Denial of the Antecedent) inferences were accepted to a greater extent when they involved specific terms. We hypothesise that such differences in phrasing might also ₂₈₅ influence people's endorsement of and-to-if inferences, and, consequently, their evaluations of TT conditionals. In particular, if the felicity of conditionals with true clauses is affected by their specificity, we might be able to explain some of the discrepancies between different studies on the Conjunctive Sufficiency.[6]

This paper considers four research questions. (1) are TT conditionals less ₂₉₀ assertable than corresponding conjunctions—that is, conjunctions of their antecedents and consequents—in the same contexts, as follows from Gricean pragmatics? (2) Does an inferential connection between antecedent and consequent increase the assertability of TT conditionals—and how assertable are these inferentially connected conditionals? (3) Is any such increase in assertability spe- ₂₉₅ cial to conditionals or does it hold also for corresponding conjunctions (in all experiments) and disjunctions (in Experiment 2)? (4) Does the assertability of a conditional depend on whether it concerns sentences with generic content (types) or their specific instances (tokens)? Finally, we will discuss the implications of our results in the context of other recent experimental findings on the ₃₀₀ semantics and pragmatics of conditionals, and how they relate to recent debates concerning the semantics-pragmatics interface.

2. Experiment 1

As we have explained above, on Gricean grounds, when a speaker knows both clauses of a conditional to be true, they should not assert that conditional, since, ₃₀₅ by asserting it, they violate the Maxim of Quantity. In such situations, a conjunction of the antecedent and consequent should be preferable to a conditional. In this experiment, we probe whether people really judge TT conditionals to be unassertable, or, at least, less assertable than the corresponding conjunctions.

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[6]Cf. Krzyżanowska et al. (2017b). See also Khemlani et al. (2018, pp. 14-15) for a discussion of different verification strategies for generic and specific assertions.

We compared how people evaluate conditionals with how they evaluate conjunc-
tions consisting of the same true clauses, in the same conversational contexts.
Furthermore, we were interested in factors that may affect people's evaluations
of the assertability of a conditional: the presence of an inferential connection
between antecedent and consequent and the type of content the clauses of the
conditional express.

The content of a sentence is generic when it is a generalisation about types
of objects, or their classes, such as roses, sharks, or microwave ovens (e.g. Leslie
and Lerner 2016). The content is specific when it is about an object token,
such as a particular rose or a particular microwave oven the participants of
a conversation have in mind or see in front of them. The specificity of the
object can be marked by a demonstrative, such as "this." Consequently, we can
distinguish between type (specific) and token (generic) conditionals:

Type: If roses are plants, then roses need water.
Token: If this rose is a plant, then it needs water.

For our experiments we chose sentences consisting of clauses that expressed
known, uncontroversial facts, e.g., "roses are flowers" or "no one used microwave
ovens in the 19th century." Moreover, we provided participants with a con-
text in which two speakers exchanged information about the relevant subject
matter. The contexts established that the truth of these clauses was known
to both speakers. Additionally, the contexts were accompanied by a picture
of (an example of) the object the conversation was about to give the phrase
"this [noun]" in the Token condition a clear referent. To make the exchange of
information about well known facts more realistic, we used a context of a class-
room in which a teacher and pupils first discussed a certain topic, and then the
teacher encouraged the pupils to summarise what they had learned. The pupil
asserted a conjunction of two true statements on the given topic, "p and q," and
the teacher acknowledged the correctness of the pupil's assertion by responding
with "Yes, p and q" or "Yes, if p then q." Figure 1 shows an example of an item

used in the experiment.[7] The full list of experimental items can be found at: https://osf.io/uyk6e/.

Our test followed a $2 \times 2 \times 2$ factorial design with sentence type (conditionals, "If" vs. conjunctions, "And"), content of the clauses (generic, "Type" vs. specific, "Token"), and the inferential connection (Connected vs. Unconnected) manipulated between participants. We used a between-participants design to reduce the chance of demand characteristics resulting from an explicit contrast between conditions.

These are examples of sentences belonging to each of the resulting eight groups:

Connected:

Type	**If**	If roses are plants, then roses need water.
Type	**And**	Roses are plants, and roses need water.
Token	**If**	If this rose is a plant, then it needs water.
Token	**And**	This rose is a plant, and it needs water.

Unconnected:

Type	**If**	If roses are plants, then roses have thorns.
Type	**And**	Roses are plants, and roses have thorns.
Token	**If**	If this rose is a plant, then it has thorns.
Token	**And**	This rose is a plant, and it has thorns.

Finally, we asked participants to evaluate the extent to which the test sentences are reasonable things to utter in given contexts by means of two different questions:

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[7]The photograph of the rose is by Forest & Kim Starr (http://www.starrenvironmental.com) licensed under Creative Commons Attribution 3.0 Unported Licence (https://creativecommons.org/licenses/by/3.0/). Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File%3AStarr_070402-6236_Rosa_sp..jpg [retrieved on March 13, 2017].

Robert is teaching a class of 8-year-olds about plants. They are discussing what is common to all plants, for instance, that they require water and sun to live. They are also talking about some particular plants like the rose in the picture below.

Robert encourages the children to sum up what they have learned in the class. Alice, one of the pupils, points at the picture and observes:

This rose is a plant, and it has thorns.

In this context, would it make **sense** for Robert to **say**:

Yes, if roses are plants, then roses have thorns.

- ○ Definitely yes
- ○ Yes
- ○ Leaning towards yes
- ○ Undecided
- ○ Leaning towards no
- ○ No
- ○ Definitely no

Figure 1: An example of a vignette used in Experiment 1. The item belongs to the If-Type-Unconnected condition.

Assertability:

"In this context, would it be natural for [the teacher] to assert: . . . "

Sense:

"In this context, would it make sense for [the teacher] to say: . . . "

Participants were asked to mark their responses on a 7-point Likert scale, la-
belled from "extremely natural" to "extremely unnatural" for the assertability
question, and from "definitely yes" to "definitely no" in the sense question.

2.1. Methods

Participants. 245 individuals participated in the online survey posted on the
MTurk platform (https://www.mturk.com/) and received a small remuneration
for their effort. We removed 7 participants' data: 6 whose first (native) language
was not English, and one whose data was incomplete. Of the remaining 238
participants, 129 identified as female and 109 identified as male. The mean age
of the participants was 38.45.

Materials and procedure. After giving informed consent, each participant was
randomly assigned to a condition. Participants in each condition were presented
with 8 blocks, one at a time. The order of presentation was randomised. Each
block contained one of four vignettes consisting of a conversational context
followed by a question about the assertability of a sentence for the speaker. Each
vignette was presented twice: once followed by the question phrased in terms of
how natural it would be to assert the sentence—henceforth "assertability"—and
once in terms of how much sense it would make to say it—henceforth "sense".

2.2. Results

Firstly, we note that the Assertability and Sense dependent variables yielded
highly similar results, as can be seen in Figures 2 and 3. Indeed, the analyses
were so similar that, for brevity's sake, we report only the Assertability findings
here. Readers may find the analysis for the Sense variable in the supplementary
materials, available at: https://osf.io/uyk6e/. We note here that, in terms

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of the pattern of significance, the findings were identical, and that estimates of all differences were very similar.
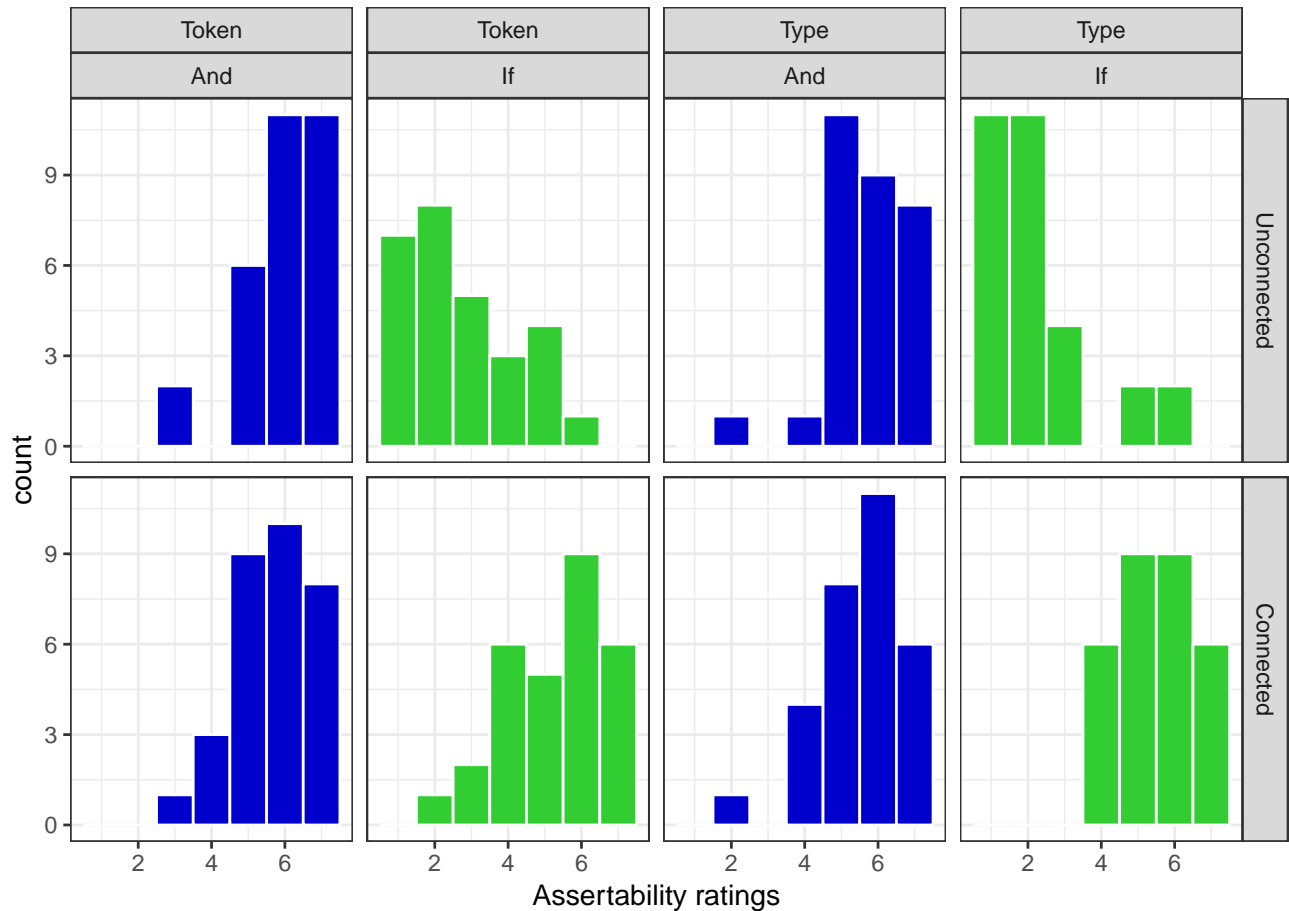

Figure 2: Distribution of the responses to the "assertability" question in the Experiment 1.

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Assertability. Figure 2 shows the descriptive data. Note that here, and throughout, we recoded participants' responses so that the lowest category (e.g. "definitely no") is 1 and the highest category (e.g. "definitely yes") is 7. At first glance, the figure suggests some support for Grice: in the top row, conjunctions are more assertable than conditionals. However, this difference disappears in

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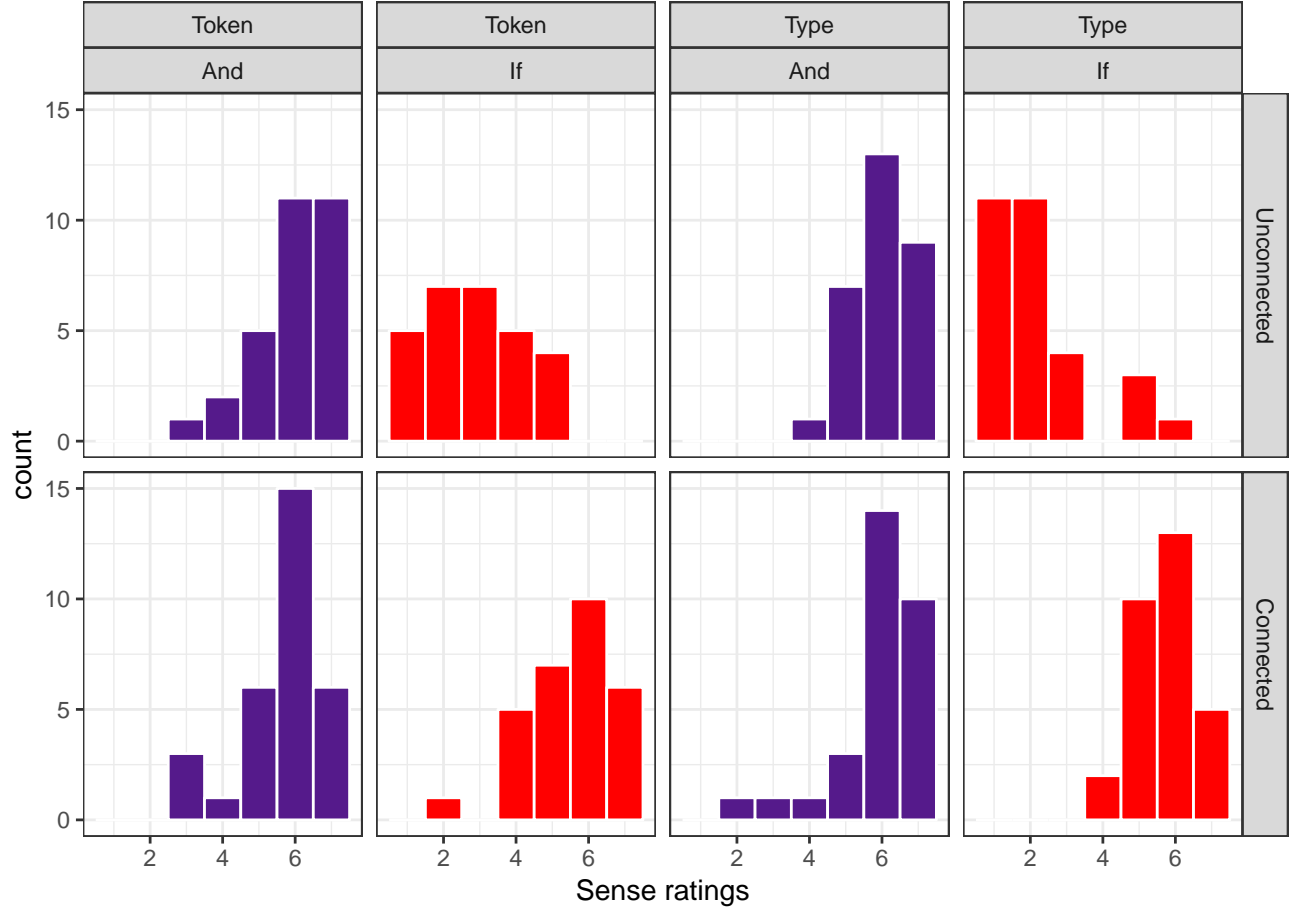
Figure 3: Distribution of the responses to the "sense" question in the Experiment 1.

the bottom row. 6 out of 8 conditions received high ratings, the exceptions being conditionals without an inferential connection. This pattern suggests an interaction between connection and sentence type, with no obvious effect of connection on conjunctions. Finally, the data suggests a similar pattern in Types and Tokens. Table 1 reports the descriptive statistics.

We explored the data further with a mixed effects model. The model included main effects of Clause Content (Type / Token), Connection (Connected / Unconnected) and Sentence (And / If), all two-way interactions and the three-

		Token		Type	
		Unconnected	Connected	Unconnected	Connected
And	mean	6.12	5.77	5.78	5.62
	sd	1.28	1.56	1.40	1.57
If	mean	2.84	5.41	2.31	5.53
	sd	1.83	1.77	1.67	1.47

Table 1: Descriptive statistics for assertability data from Experiment 1.

way interaction. We attempted to fit a model with the full random-effects struc-
ture justified by the design, including random slopes of the independent variables
and their interactions by item and random intercepts by item and their corre-
lation (i.e. (Content * Connection * Sentence | Item)). However, this model
did not converge. The maximal converging model included the random slopes
of the independent variables by item, random intercepts by item, but not their
correlation (i.e. (Content + Connection + Sentence ‖ Item), as well as random
intercepts by participant. All analyses in this paper were run in R (R Core
Team 2016), using the afex package (Singmann et al. 2018) and with follow-up
analyses—in this case, pairwise comparisons—on the estimated marginal means
in the emmeans package (Lenth 2018).

Table 2 reports the fixed effects from the model. We first note that, unsur-

Effect	df	χ^2	p
Clause Content	1	1.58	.21
Connection	1	11.59	$< .001*$
Sentence	1	11.91	$< .001*$
Clause Content*Connection	1	1.84	.18
Clause Content*Sentence	1	.02	$< .89$
Connection*Sentence	1	87.09	$< .001*$
Clause Content*Connection*Sentence	1	.62	.43

Table 2: Fixed effects of model for Experiment 1

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prisingly, sentences were rated significantly more assertable with an inferential connection ($M = 5.58$, 95% CI $[5.23, 5.94]$) than without ($M = 4.26$, 95% CI $[3.91, 4.62]$). The remaining effects are more relevant to our research questions. For *Research Question 1* the key findings are the main effect of Sentence and the interaction between Connection and Sentence. As the estimated marginal means show, participants rated "and" sentences ($M = 5.82$, 95% CI $[5.43, 6.21]$) significantly more assertable than "if" sentences ($M = 4.02$, 95% CI $[3.63, 4.41]$). But contrary to the Gricean account, this difference interacted with an inferential connection. Figure 4 plots the estimated marginal means, and shows the interaction of Connection and Sentence.

We followed up the interaction of Connection and Sentence with comparisons on the estimated marginal means, averaging over the levels of Content. These comparisons were treated as a family of 4 tests, with the significance level set at $p = .013$. These comparisons provide further detail on the answer to *Research Question 1*. These comparisons demonstrated that, without an inferential connection, "And" sentences were rated significantly more assertable than "If" sentences ($M_{Difference} = 3.38$, $SE = .31$, $t(14.8) = 10.95$, $p < .001$), a difference of almost half the response scale [8]. But with a connection, "And" sentences were rated only very slightly and non-significantly more assertable than "If" sentences ($M_{Difference} = .23$, $SE = .31$, $t(14.5) = .74$, $p = .47$). The parameter estimate for the difference and its standard error indicate that the data are compatible with small differences, both positive and negative, between sentence types. This finding seems to contradict the Gricean account.

For *Research Question 2*, the data showed that "If" sentences were rated substantially and significantly more assertable with a connection ($M_{Difference} = 2.90$, $SE = .27$, $t(25.1) = 10.80$, $p < .001$). That difference corresponded to some 41.43% of the response scale. "If" sentences with an inferential connec-

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[8] Degrees of freedom were approximated for Experiment 1 with the Kenward-Roger method. Note that in all remaining experiments, since there were many more items, the asymptotic method was used, with z ratios rather than t ratios.
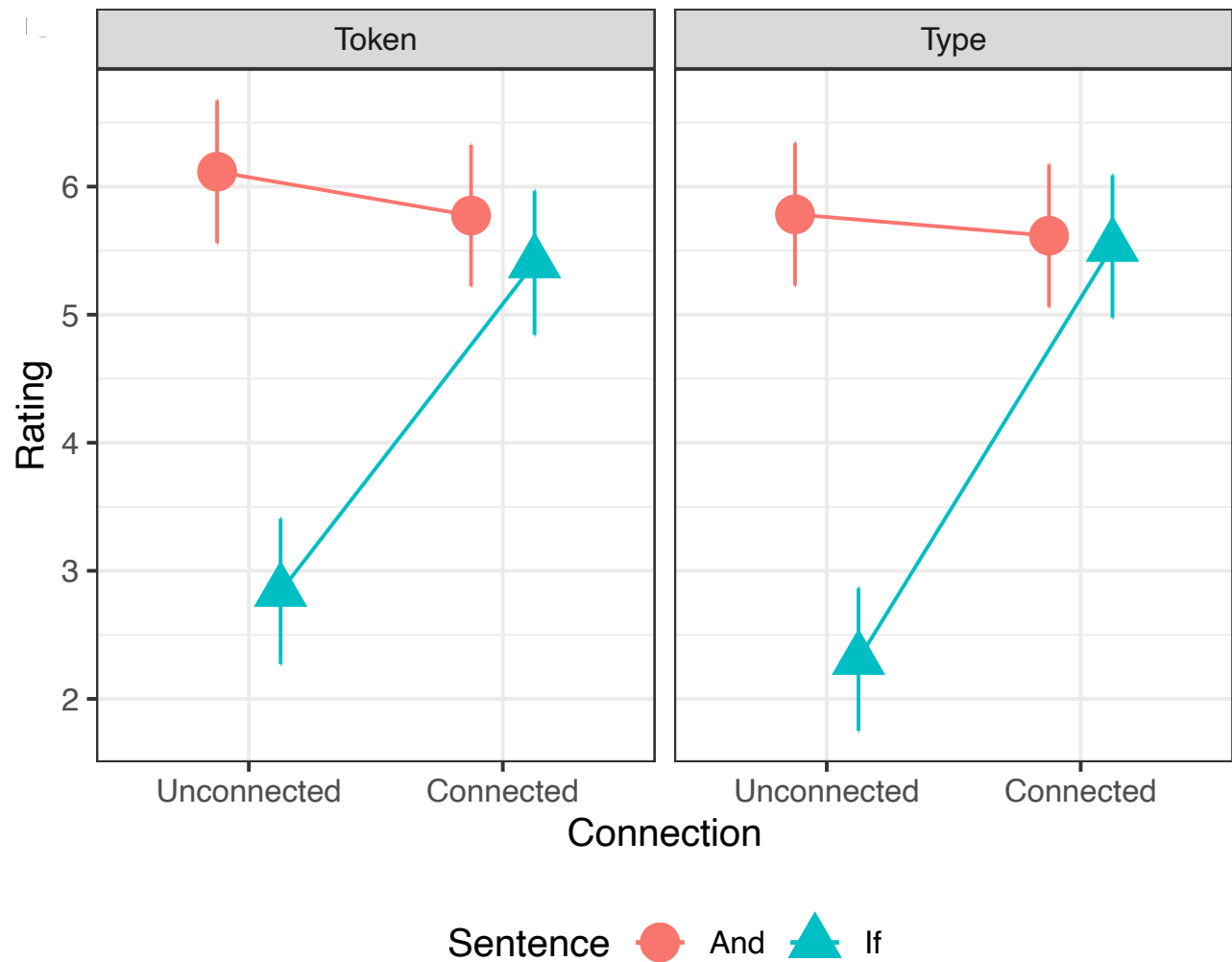
Figure 4: Estimated marginal means for the assertability data from the Experiment 1. The figure shows the interaction of Connection and Sentence.

tion received assertability ratings comfortably above the midpoint of the scale, suggesting that they were assertable, as shown by the estimated marginal mean $(M = 5.47, 95\%$ CI $[5.00, 5.93])$. For *Research Question 3* the data showed that an inferential connection did not benefit sentence types equally, since "And"

sentences were rated very slightly and non-significantly less assertable with a connection than without ($M_{Difference} = .25$, $SE = .27$, $t(23.9) = .96$, $p = .35$).

For *Research Question 4*, the data showed no clear effect of the type of content of the clauses. The main effect of Clause Content was non-significant. As the estimated marginal means show, Type sentences ($M = 4.81$, 95% CI $[4.48, 5.14]$) were rated non-significantly less assertable than Token sentences ($M = 5.03$, 95% CI $[4.70, 5.37]$). The confidence intervals suggest that Type and Token sentences had broadly similar assertability. The Clause Content variable did not enter into significant interactions.

2.3. Discussion

Experiment 1 provided two sets of analyses (including those in the supplementary materials) that give consistent answers to our research questions. They suggest that TT conditionals need not be less assertable than corresponding conjunctions (*Research Question 1*). When there was an inferential connection between antecedent and consequent, conditionals and conjunctions received similar ratings. In other words, TT conditionals were assertable in our experiment as long as there was an inferential connection. Inferential connections had a reliable effect with conditionals, leading to ratings comfortably above the midpoint of the scale (*Research Question 2*), but this effect was confined to conditionals, as there was no clear effect for conjunctions, suggesting the effect is somewhat special to the conditional (*Research Question 3*). Finally, the data provide no clear evidence for an effect of type of content (*Research Question 4*).

The experiment challenges the traditional Gricean explanation of why missing link conditionals are odd. For a TT conditional to be infelicitous it is not enough that the speaker could assert a conjunction of the antecedent and consequent instead. The TT conditionals were only judged infelicitous when they lacked the relevant connection between antecedent and consequent.

We could interpret this finding as showing that English speakers happily assert a weaker statement even when a stronger one is warranted. This speaker behaviour would undermine Gricean views on communication in general by show-

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ing that informativeness does not guide our intuitions about the assertability of various sentences. But while wrong in detail, our results suggest the Gricean approach may nevertheless be right in spirit.

⁴⁷⁵ The Gricean prediction about TT conditionals rests on specific assumptions about the semantics of the conditional. More specifically, it is presupposed that, whatever the conditional expresses, it is less informative, or weaker, than the conjunction of its clauses. If we rethink this assumption about the meaning of the conditional, we could maintain the Gricean view on language and ⁴⁸⁰ communication. That is, we could treat conditionals as expressing information which is not conveyed by the conjunctions of their clauses. The conditional would not then be weaker than the conjunction, but it should not be stronger either—we do not want conditionals to entail the truth of their antecedents and consequents. What could that piece of information be? Our findings hint at ⁴⁸⁵ an answer. What conditionals, but not conjunctions, convey is an inferential connection between their clauses. Consequently, our missing-link conditionals are judged unassertable because they both lack an inferential connection and assert one. They convey something false.

The results of the Experiment 1 surprised us in one respect. Contrary to ⁴⁹⁰ previous findings (Krzyżanowska et al. 2017b), the type of content expressed by the clauses did not have an effect on how assertable the sentences were or to what extent they made sense. We thus sought a replication while also increasing the number of items. Additionally, to limit the effect of any particular context of conversation, we presented the test sentences on their own in the Type condition ⁴⁹⁵ or just accompanied by a picture of a relevant object in the Token condition.

3. Experiment 2

Experiment 2 increased the number of items to 16 (including versions of the items from Experiment 1) and presented the items without contexts. We constructed test sentences with clauses whose truth we could expect participants ⁵⁰⁰ to know, such as "Laptops are computers" or "Professional basketball players

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have lungs" (and, in the Token condition: "This laptop is a computer" and "This professional basketball player has lungs," accompanied by a picture of a laptop and a basketball player, respectively). To ensure that participants indeed knew the clauses of the test sentences to be true, we carried out a manipulation check at the end of the experiment and asked participants about the truth values of all clauses used in the study.

Fixing contexts (as in Experiment 1) and eliminating contexts (as in Experiment 2) are reasonable strategies to reduce the chance that our effects rest solely on the pragmatics of the embedding experimental context.

Additionally, Experiment 2, compared conditionals not only to conjunctions of their clauses but also to disjunctions. On the original Gricean account of the oddity of TT conditionals, a disjunction of the negation of the antecedent and the consequent conveys exactly the same meaning as the corresponding conditional, as that disjunction is logically equivalent to such a conditional on the material account of the conditional that Grice was seeking to salvage, e.g.:

(7) a. If I don't have this book in my office, then I left it at home.

b. I have this book in my office, or I left it at home.

If the Gricean explanation of the oddity were indeed accurate, and the conditional were best understood as the material conditional (at least for TT cases), then we would expect similar patterns for both types of construction. Experiment 2 put this prediction to the test.

As in the Experiment 1, we also manipulated the type of content the clauses of the test sentences expressed, and the presence of the connection between the clauses. Consequently, our test followed a $3 \times 2 \times 2$ factorial design with sentence type (conditionals, "If," vs. conjunctions, "And," vs. disjunctions, "Or"), the type of content expressed by the clauses (generic, "Type" vs. specific, "Token"), and the inferential connection (Connected vs. Unconnected) manipulated between subject. These are examples of sentences belonging to Type condition:

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Connected:

If If smartphones are telephones, then smartphones can be used to make phone calls.

And Smartphones are telephones, and smartphones can be used to make phone calls.

Or Smartphones aren't telephones, or smartphones can be used to make phone calls.

Unconnected:

If If smartphones are portable, then smartphones can be used to make phone calls.

And Smartphones are portable, and smartphones can be used to make phone calls.

Or Smartphones aren't portable, or smartphones can be used to make phone calls.

The Token items were constructed analogously to those in the Experiment 1: the clauses of the test sentences involved a noun phrase with a demonstrative, e.g., "this smartphone," while the accompanying pictures provided the referents. The picture was preceded by the instruction: "Please look at the picture and answer the question below." Unlike in the Experiment 1, the sentences were not embedded in a conversational context, but, instead, the sentences were presented on their own (Type) or accompanied only by a picture (Token). See Figure 5 for an example of a vignette in the Token-And-Connected condition of the Experiment 2.[9]

Since we did not observe any difference in the pattern of responses to the two measures we used in the Experiment 1, in this experiment we only asked about

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[9]The photograph of the shark belongs to the public domain. Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Carcharodon_carcharias.jpg [retrieved on July 11, 2017].

Please look at the picture and answer the question below.

To what extent would it be natural to assert the following sentence:

This great white shark is a predator, and it can breathe under water.

○ Very unnatural

○ Unnatural

○ Slightly unnatural

○ Neither natural nor unnatural

○ Slightly natural

○ Natural

○ Very natural

Figure 5: An example of a vignette used in the experiment 2. The item belongs to the And-Token-Connected condition.

the naturalness of assertion. That is, the participants were asked to answer the
following question:

Assertability:

"To what extent would it be natural to assert the following sentence:
..."

3.1. Methods

Participants. 482 individuals participated in the online survey posted on the
MTurk platform (https://www.mturk.com/). We removed 4 participants whose
first (native) language was not English. Of the remaining 478 participants, 243
were female and one was agender. The mean age of the participants was 37.71.
All participants received a small remuneration for their time and effort.

Materials and procedure. After giving informed consent, each participant was
randomly assigned to a condition. Participants in each condition were presented
with 16 blocks, one at a time. The order of presentation was randomised.
Each block contained one question about the assertability of a sentence. The
participants were asked to mark their responses on the 7-point Likert scale, from
"Very unnatural" to "Very natural."

3.2. Results

Before outlining the data, we note that, on average, participants classed 95.30%
($SD = 7\%$) of clauses as true, a proportion we consider high enough to class
our items as TT conditionals, conjunctions, and disjunctions.[10] Table 3 reports
summary statistics, averaged across items. As with Experiment 1, "And" and
"If" sentences show similar ratings, where there is an inferential connection,
but "And" sentences show higher ratings than "If," where there is no inferential
connection. "Or" sentences show low ratings across the board. This pattern
suggests an interaction between Connection and Sentence, but no clear effect of
Clause Content.

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		Token		Type	
		Unconnected	Connected	Unconnected	Connected
And	mean	5.18	5.16	4.88	4.90
	sd	1.79	1.83	1.72	1.74
Or	mean	2.42	2.34	2.71	3.00
	sd	1.49	1.53	1.58	1.81
If	mean	3.48	5.58	2.67	5.67
	sd	1.88	1.51	1.56	1.55

Table 3: The summary of the descriptive statistics for Experiment 2, averaged across items

The analysis comprised a mixed-effects model on ratings of assertability. The model included main effects of Clause Content (Type / Token) × Connection (Unconnected / Connected) × Sentence (And / Or / If), all two-way interactions, and the three-way interaction. As in Experiment 1, we attempted to fit the full random-effects structure justified by the design, hence one allowing the interaction terms and main effects to vary across items, and including the random intercepts of items and participants. But because of convergence problems the final model included only the random intercepts of items and participants.

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[10]Note that we did not use the manipulation check to exclude any items or participants.

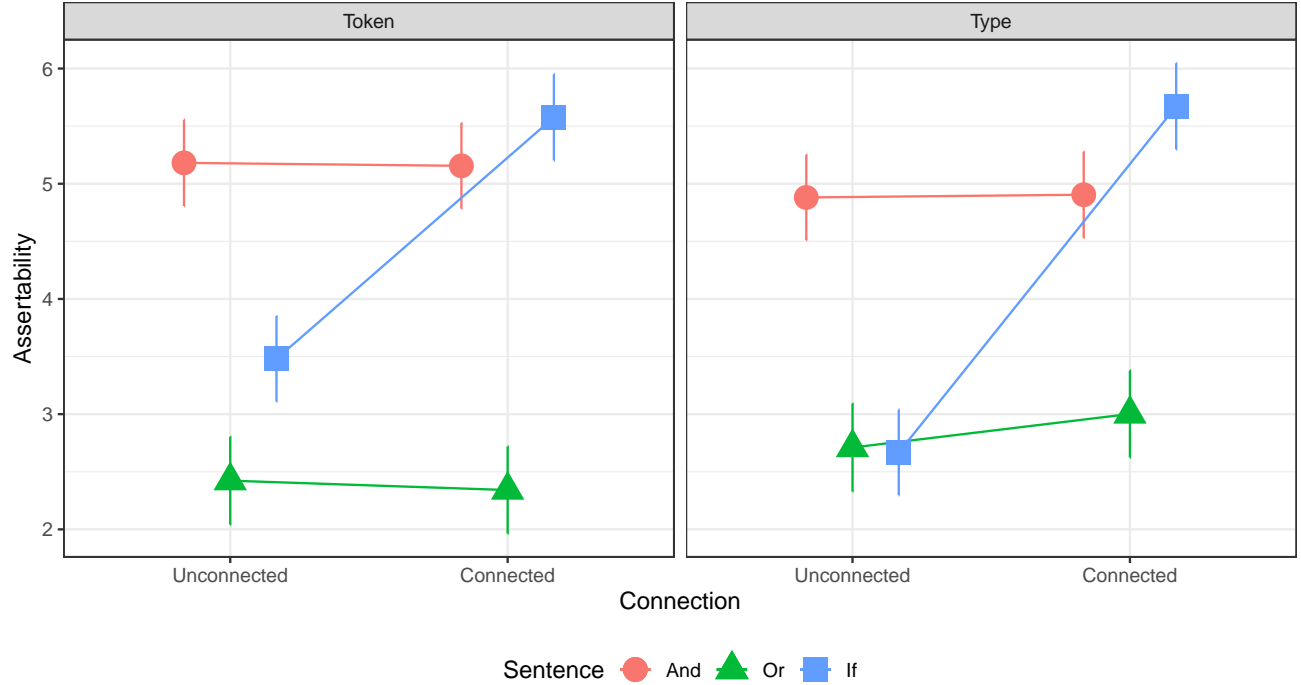| Effect	df	χ^2	p
Clause Content	1	.34	.56
Connection	1	86.03	$< .001*$
Sentence	2	336.85	$< .001*$
Clause Content*Connection	1	5.88	.02*
Clause Content*Sentence	2	16.33	$<.001*$
Connection*Sentence	2	144.64	$< .001*$
Clause Content*Connection*Sentence	2	3.82	.15

Table 4: Fixed effects of model for Experiment 2

Figure 6: Estimated marginal means for all conditions in the Experiment 2.

Here and throughout, the model was fit with the maximum-likelihood method, significance being determined with likelihood-ratio tests against reduced models. When interactions were significant, there was follow-up analysis with tests on the estimated marginal means. Table 4 summarizes the results.

Figure 6 shows the estimated marginal means for all conditions. We start by noting that sentences were rated significantly more assertable with an inferential connection ($M = 4.44$, 95% CI $[4.20, 4.69]$) than without ($M = 3.56$, 95% CI $[3.31, 3.80]$). We turn to *Research Question 1*, for completeness also reporting data for "Or" sentences. We see that the type of sentence significantly influenced ratings: "And" sentences were given the highest ratings ($M = 5.03$, 95% CI $[4.77, 5.29]$), then "If" sentences ($M = 4.35$, 95% CI $[4.09, 4.61]$), and lastly "Or" sentences ($M = 2.62$, 95% CI $[2.36, 2.88]$). However, this effect was qualified by an interaction of Sentence and Connection.
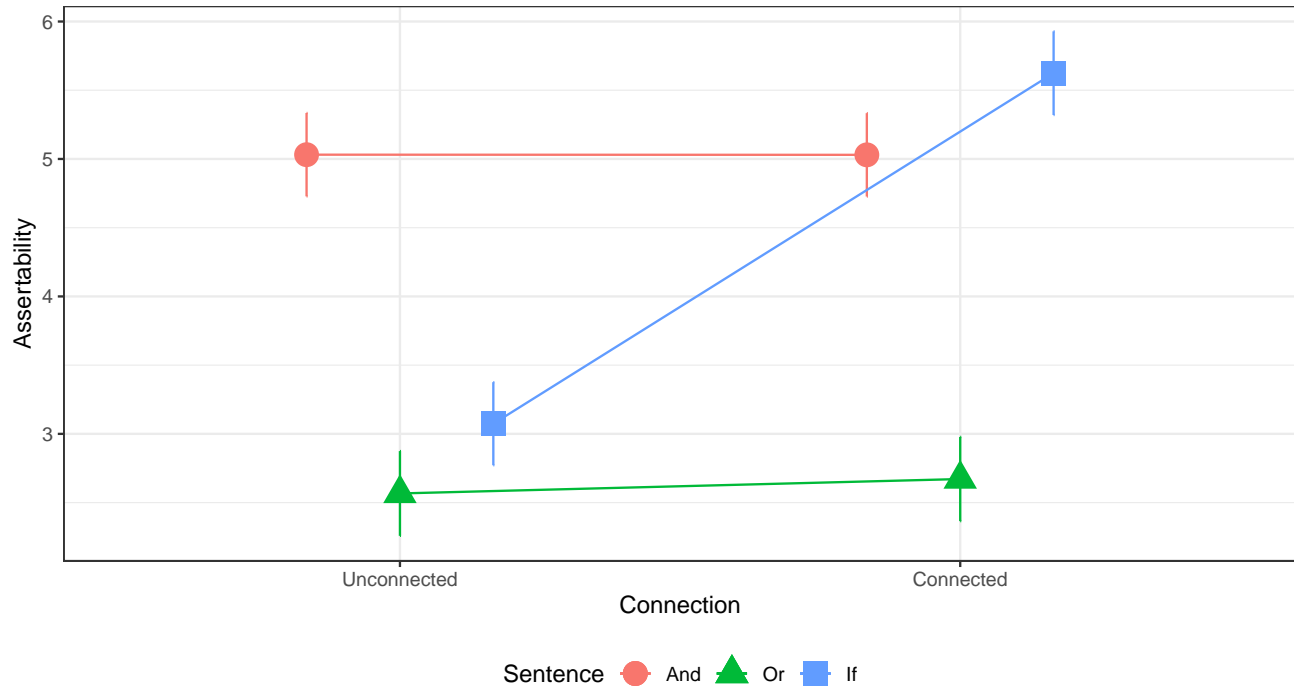
Figure 7: Estimated marginal means for interaction of Connection and Sentence

We followed up this interaction with comparisons on the estimated marginal means, averaging over the third variable, as shown in Figure 7. As we also followed up two further two-way interactions (reported below), we treated all follow-up analyses as a family of 9 tests[11] and applied a significance level of $p = .006$. We start by looking at the differences between sentence types for sentences with and without an inferential connection. These differences provide further detail on *Research Question 1*. Again we report analyses on the "Or" sentences for completeness.

Table 5 summarizes the relevant (Tukey-corrected) comparisons. When

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[11]2 tests for Connection ∗ Clause Content, 2 (after Tukey correction) tests for Sentence ∗ Clause Content, 3 for Connection ∗ Sentence from the point of view of Connection, and 2 (after Tukey correction) from the point of view of Sentence.

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Connection	Contrast	$M_{Difference}$	SE	z	p
	And > Or	2.47	.16	15.50	< .001∗
Unconnected	And > If	1.96	.16	12.55	< .001∗
	If > Or	.51	.16	3.20	.004∗
	And > Or	2.36	.16	14.93	< .001∗
Connected	And < If	.59	.16	3.79	< .001∗
	If > Or	2.95	.16	18.64	< .001∗

Table 5: Tukey-corrected comparisons for interaction of Connection and Sentence Type

there was no connection, "And" sentences were rated highest and significantly and substantially more assertable than "If" sentences and "Or" sentences. Next highest were "If" sentences, which were also significantly more assertable than "Or" sentences. When there was a connection, "If" sentences received the high-est ratings. "If" sentences were rated slightly but significantly more assertable than "And" sentences, and substantially and significantly more assertable than "Or" sentences. "And" sentences were rated significantly more assertable than "Or" sentences.

For *Research Question 2*, we see that inferential connections clearly benefited "If" sentences, with these sentences rated substantially and significantly higher with a connection than without ($M_{Difference} = 2.55$, $SE = .16$, $z = 16.30$, $p < .001$). Moreover, "If" sentences with an inferential connection received assertability ratings comfortably above the midpoint of the scale, as shown by the estimated marginal mean ($M = 5.62$, 95% CI [5.32, 5.93]). For *Research Question 3*, we see that inferential connections did not benefit sentence types equally, since "And" sentences showed essentially no change in assertability according to the presence of a connection ($M_{Difference} = .001$, $SE = .16$, $z = .007$, $p = .99$). "Or" sentences were rated slightly but non-significantly more assertable with a connection ($M_{Difference} = .10$, $SE = .16$, $z = .65$, $p = .51$).

Turning to *Research Question 4* we see the following. Token sentences ($M = 4.03$, 95% CI [3.78, 4.27]) were rated slightly and non-significantly higher than
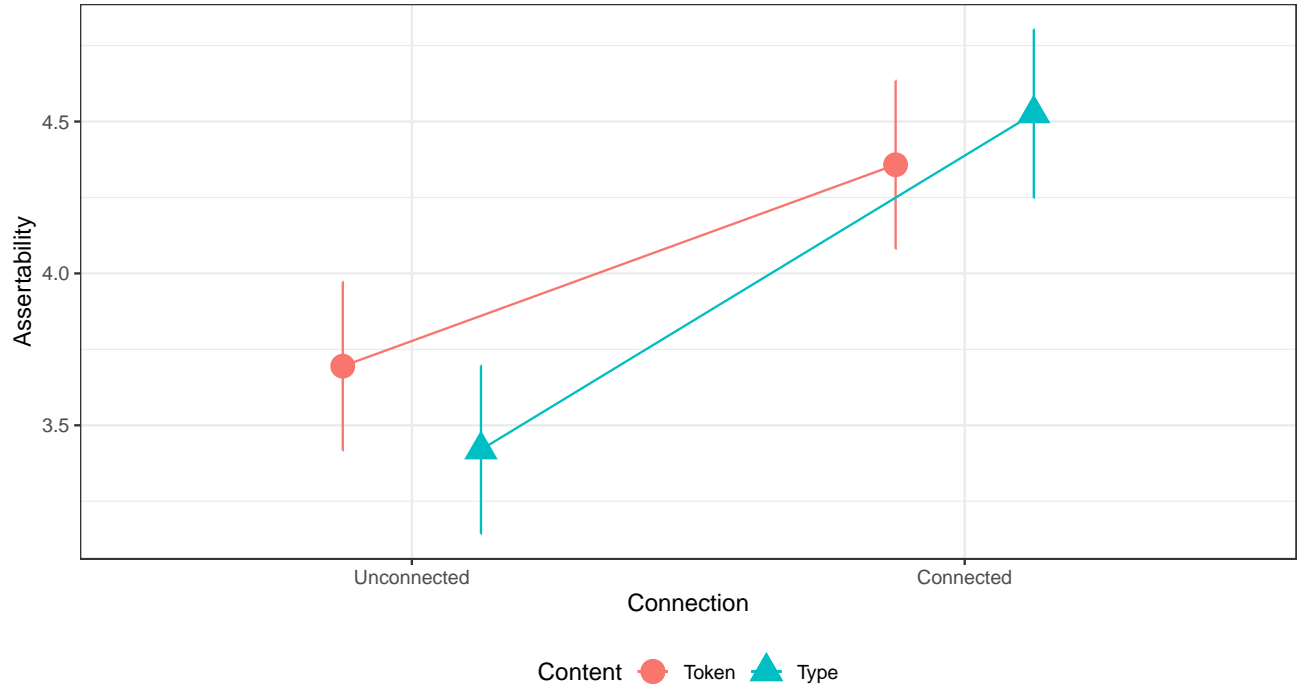
Figure 8: Estimated marginal means for Connection and Content

Type sentences ($M = 3.97$, 95% CI $[3.73, 4.22]$). However, the Clause Content variable (Type, Token) entered into significant interactions. Take, first, the interaction of Clause Content and Connection shown in Figure 8. Sentences were rated significantly more assertable with a connection than without, but this effect was rather larger for Type sentences ($M_{Difference} = 1.11$, $SE = .13$, $z = 8.59$, $p < .001$) than for Token sentences ($M_{Difference} = .66$, $SE = .13$, $z = 5.15$, $p < .001$.

Take, next, the interaction of Clause Content and Sentence as shown in Figure 9. This interaction resulted from including the "Or" sentences in the design. Sentence types maintained their order across the levels of Content, but note the narrowing of the gap between, on the one hand, "And" and "If" and, on the other hand, "Or." "Or" sentences received higher ratings with Type than Token. Table 6 shows the Tukey-corrected comparisons.

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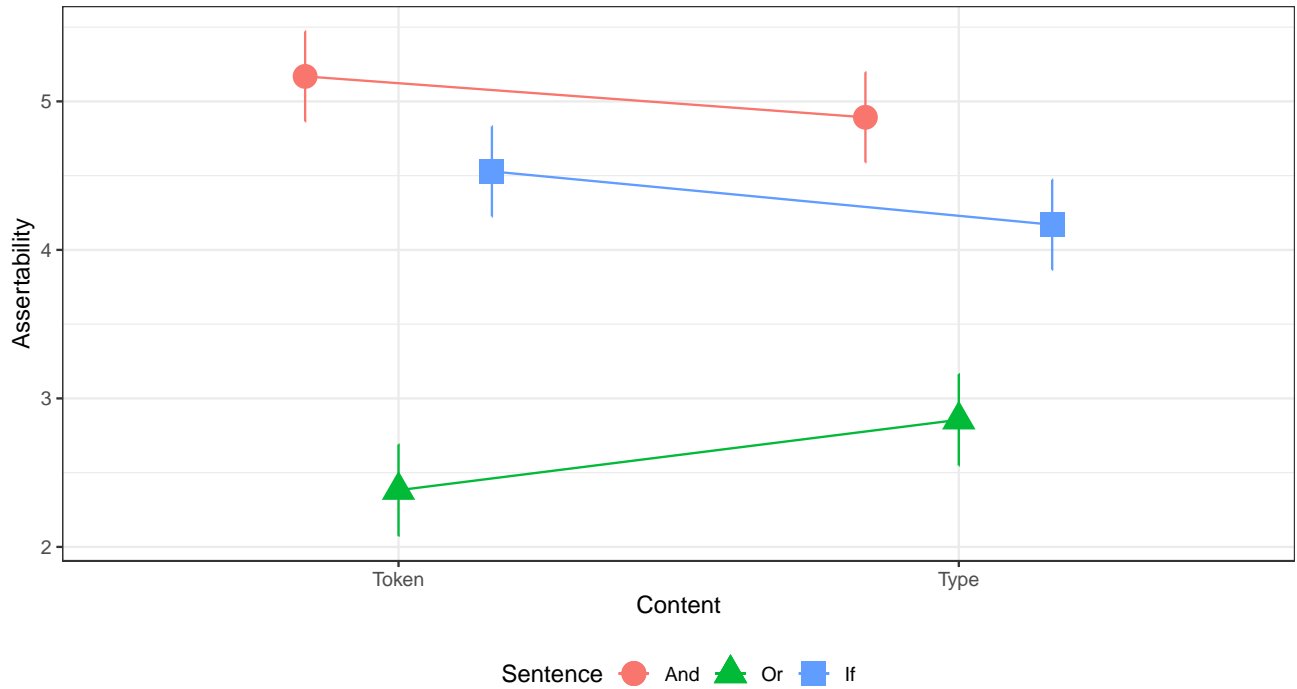
Figure 9: Estimated marginal means for Content and Sentence

3.3. Discussion

Experiment 2 replicated the key findings from Experiment 1. The data once again suggested that TT conditionals need not be less assertable than corre-

Clause Content	Contrast	$M_{Difference}$	SE	z	p
	And > Or	2.79	.16	17.58	$< .001*$
Token	And > If	.64	.16	4.09	$< .001*$
	If > Or	2.15	.16	13.54	$< .001*$
	And > Or	2.04	.16	12.85	$< .001*$
Type	And > If	.72	.16	4.62	$.001*$
	If > Or	1.31	.16	8.29	$< .001*$

Table 6: Caption Tukey-corrected comparisons for interaction of Clause Content Type and Sentence Type

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sponding conjunctions (*Research Question 1*). When there was an inferential connection, conditionals and conjunctions again received similar ratings, with
⁶⁵⁰ conditionals rated comfortably above the midpoint of the scale. The inferential connection had a clear effect with conditionals (*Research Question 2*), but the effect did not extend to conjunctions or disjunctions (*Research Question 3*). This time, however, the data suggested an effect of content expressed by the clauses (*Research Question 4*). Inferential connections had more of an effect with type
⁶⁵⁵ sentences than token sentences. And there was an interaction between the content of the clauses (Type vs. Token) and the type of sentence ("If" vs. "And" vs. "Or"). This latter interaction was driven by the "Or" sentences, which received higher ratings in type sentences than in token sentences.

It bears emphasis that, in Experiment 2, we have found that conditionals
⁶⁶⁰ and materially equivalent disjunctions had different patterns of assertability. Indeed, the disjunctions were generally rated very poorly, both in the Connected and Unconnected conditions. These low ratings are not surprising given that constructively justified disjunctions, that is, disjunctions inferred from the truth of one of the disjuncts, tend to be infelicitous. A speaker who says "*p* or *q*"
⁶⁶⁵ when they know that *q* is terribly unhelpful; they violate the (first) Maxim of Quantity, "Make your contribution as informative as is required (for the current purposes of the exchange)" (Grice 1989, p. 26). Unlike in the case of conditionals then, here the standard Gricean explanation does the job: asserting a true disjunct means making a stronger claim than asserting a disjunction, be
⁶⁷⁰ it in the Connected or Unconnected case. Note also that the inference from *p* to "*p* or *q*" is actually invalid in some systems that have been recently very influential in psychology, such as Coherence Based Probability Logic (Gilio and Over 2012) or the Mental Models Theory (Johnson-Laird et al. 2015).

Our disjunctions may also have been infelicitous because of the truth values
⁶⁷⁵ of the disjuncts. One disjunct—the consequent of the corresponding conditional —was known to be true. The other—the negated antecedent of the corresponding conditional—was known to be false. We also constructed our materials using clauses that were supposed to be known to the speaker and that could be as-

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sumed to be common knowledge. It is hard to imagine a context in which it
₆₈₀ would be felicitous to assert such a disjunction at all.

It makes sense, then, that our disjunctions were not assertable, but their
unassertability does not undermine two key points. Firstly, disjunctions (even
with low assertability) could have benefited from an inferential connection and
did not. Secondly, disjunctions reacted differently to the Clause Content ma-
₆₈₅ nipulation.[12] Disjunctions were given higher assertability ratings in Type than
Token sentences, the opposite trend from that seen with conjunctions and con-
ditionals.

A final point concerns the lack of conversational contexts. Experiment 2
dropped the conversational contexts used in Experiment 1, having participants
₆₉₀ instead rate the assertability of sentences in isolation. This design change re-
duces the chance that our effects arose from specific conversational contexts.
The design still leaves open the possibility that the effect of the connection
originated in more general conversational pragmatics. But if our findings are
taken in connection with philosophical and empirical literature on assertion,
₆₉₅ they make a pragmatic explanation less plausible. The literature on asser-
tion suggests a number of factors that contribute to whether a sentence can be
asserted—i.e. the constitutive rules of assertion. The most important of these
factors are epistemic in nature, such as the speaker's knowledge that what they
assert is the case (e.g. Williamson 1996; DeRose 2002; Pagin 2011), the truth
₇₀₀ of the given sentence (e.g. Turri 2013), or its rational credibility (e.g. Douven
2006). We argue that, without clear pragmatic cues, participants judge a sen-
tence's assertability based on its content. That being the case, we interpret
Experiment 2 as providing indirect evidence that the connection might not be
a merely pragmatic phenomenon. Naturally, such evidence is never ultimately

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[12]This is not to say that the Clause Content manipulation only affected disjunctions. Note
the significant two-way of interaction of Clause Content and Connection: inferential connec-
tions had a bigger effect with Type than Token sentences, averaged over the levels of the
Sentence variable ("If," "And," "Or").

conclusive, and we cannot rule out a possibility that the connection can be modelled pragmatically in a way that would be consistent with our findings as well as other related studies (see the General Discussion). Our results, nevertheless, hint at the possibility that the connection belongs to the literal, conventional meaning of the conditional, its semantics, but not to the literal, conventional meaning of conjunctions and disjunctions. We will explore this possibility later in the paper.

4. Experiment 3

We have suggested that Experiments 1 and 2 can be taken as evidence, however indirect and, admittedly, on its own inconclusive, that the connection between a conditional's antecedent and its consequent is not merely a product of conversational pragmatics. The connection certainly does not seem to arise as a conversational implicature in the way described in the famous passage by Grice. If it did, we would have observed conditionals being judged unassertable when a speaker is warranted in asserting a conjunction of their antecedents and consequents. Since we have eliminated contextual differences across conditions, it is plausible that what has affected participants' assertability judgments is due to semantic content of the test sentences. After all, while pragmatics does often play a role, whether a sentence is assertable hinges upon its truth value or on the evidence a speaker has to justify that it is true, to wit, the semantic aspects of that sentence, and the speaker's epistemic stance towards its content.

Yet a critic could object that participants in our studies were asked to judge the extent to which the test sentences were natural to assert, so our data can only be interpreted as showing what makes a sentence a good thing to say, without establishing anything about its semantic meaning. We remind the reader, however, that we also asked whether the sentences "made sense," with virtually identical results, so that it seems unlikely that our dependent variable taps only into "pragmatics" as standardly conceived. Nevertheless, we sought to provide further evidence to this effect by eliciting judgments from participants

that were tied explicitly to truth. We avoided using truth value judgments as

⁷³⁵ our dependent variable directly, because it is a vexed question—one beyond the scope of this paper—whether conditionals can be true or false at all.[13] Instead, we asked participants to indicate the extent to which they agreed with the sentences presented to them. We did, however, explicitly instruct participants that they should consider truth or falsity of given sentences when forming their

⁷⁴⁰ judgments. These are the specific instructions they have received:

> In this study, you will be asked to read a number of sentences. Your task will be to evaluate to what extent you agree with these sentences. Think of it this way: you might want to strongly agree with a sentence when, in your opinion, what the sentence states is cer-
> ⁷⁴⁵ tainly the case or, to put it differently, definitely true. If you think that what the sentence states is certainly false, you might want to strongly disagree with it. Please read the sentences and the questions carefully.

Once again, the sentences were not embedded in conversational contexts ⁷⁵⁰ but presented to participants in isolation or, for Token items, accompanied by a picture. Figure 10 shows an example item used in this experiment.

Apart from using a different measure, we introduced the following changes to the design of the Experiment 3 as compared to that of the Experiment 2. First, since disjunctions were unassertable in all conditions and as such did ⁷⁵⁵ not contribute to the current debate at all, we excluded them from this study. Furthermore, given that the control questions of the Experiment 2 allowed us to establish that the clauses of the test sentences are known to participants to be true, and making the survey longer than necessary raises methodological concerns (i.e. participants may get tired or bored with the survey, and, conse-⁷⁶⁰ quently, read the questions in an careless manner), here the main survey was not followed by a manipulation check.

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[13]See, e.g., Bennett (2003) for a discussion.

To what extent do you agree with the following sentence:

If tigers hunt and eat animals, then tigers are carnivorous.

Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Figure 10: An example of a vignette used in the Experiment 3. The item belongs to the If-Type-Connected condition.

Finally, due to the fact that the design of both Experiment 1 and 2 was completely between participants, each individual saw sentences belonging to just one condition. Consequently, they saw series of vignettes asking them to evaluate sentences which might have been all equally natural to say, or equally strange. Hence, participants might have become used to the weirdness of some of the test sentences, and evaluated them as more assertable than they would have otherwise. At the same time, participants might have increased their ratings for some unassertable sentences or decreased them for some assertable sentences just to introduce some variance to their responses. For this reason, for Experiment 3, we designed a set of filler items to create natural variation and conceal from participants the factors that we were interested in. The ratio of filler items to test items was 2 to 1, that is, next to the 16 test items, each participant saw 32 filler items. The filler items were similar to the test items in the following respect: they were complex sentences that were built using the same clauses as the test items, such as "roses have thorns" or "smartphones can

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be used to make phone calls." Half of the filler items were knowledge ascriptions, such as "Barack Obama knows that roses have thorns," and the other half were sentences with relative clauses, e.g.: "Smartphones, which can be used to make phone calls, are popular."

4.1. Method

Participants. 323 participants completed the online survey posted on the MTurk platform (https://www.mturk.com/). We removed 7 participants who were not native English speakers. Of the remaining participants, 145 were women and 1 indicated other gender. The average age of the participants was 37.97. All participants received a small remuneration for their time and effort.

Materials and procedure. After giving informed consent, each participant was randomly assigned to a condition. After the introductory block followed by three questions asking for basic demographics, and a block explaining the task, participants in each condition were presented with 48 blocks with test questions and filler items, one at a time. The order of presentation was randomised. Each block asked to what extent participants agree with a given sentence. The participants were asked to mark their responses on the 7-point Likert scale, from "strongly disagree" to "strongly agree."

4.2. Results

Table 7 reports summary statistics, averaged across items. The data suggest a similar pattern to Experiments 1 and 2. Where there is a connection, conjunctions and conditionals have similar ratings—this time of agreement. But where there is no connection, conjunctions have higher ratings than conditionals. This pattern suggests an interaction between Connection and Sentence. There is no clear sign of an effect of Clause Content (Type vs. Token).

The analysis followed the same template as for Experiment 2, comprising a mixed-effects model on ratings of agreement. The model included main effects of Clause Content (Type / Token) × Connection (Unconnected / Connected) × Sentence (And / If), all two-way interactions, and the three-way interaction. As

		Token		Type	
		Unconnected	Connected	Unconnected	Connected
And	mean	6.46	6.53	6.57	6.57
	sd	.93	.96	.82	.96
If	mean	3.85	6.21	4.03	6.39
	sd	1.96	1.21	1.87	1.09

Table 7: Descriptive statistics for the data from Experiment 3, averaged across items.

in Experiment 2, the maximal converging model included only random intercepts by item and participant. Table 8 summarizes the results.

Figure 11 shows the estimated marginal means by condition. We start by noting that sentences received significantly higher agreement ratings when they had a connection ($M = 6.43$, 95% CI $[6.22, 6.63]$) than when they did not ($M = 5.23$, 95% CI $[5.02, 5.44]$). Turning to *Research Question 1* we see that "And" sentences received significantly higher agreement ratings ($M = 6.53$, 95% CI $[6.33, 6.74]$) than "If" sentences ($M = 5.12$, 95% CI $[4.91, 5.33]$). But this effect was qualified by the significant interaction between Connection and Sentence.

The interaction of Connection and Sentence was explored with comparisons on the estimated marginal means averaging over the levels of Clause Content.

Effect	df	χ^2	p
Clause Content	1	2.36	.12
Connection	1	159.43	$< .001*$
Sentence	1	204.96	$< .001*$
Clause Content*Connection	1	.05	.83
Clause Content*Sentence	1	.38	.54
Connection*Sentence	1	152.61	$< .001*$
Clause Content*Connection*Sentence	1	.05	.81

Table 8: Fixed effects for the Experiment 3.

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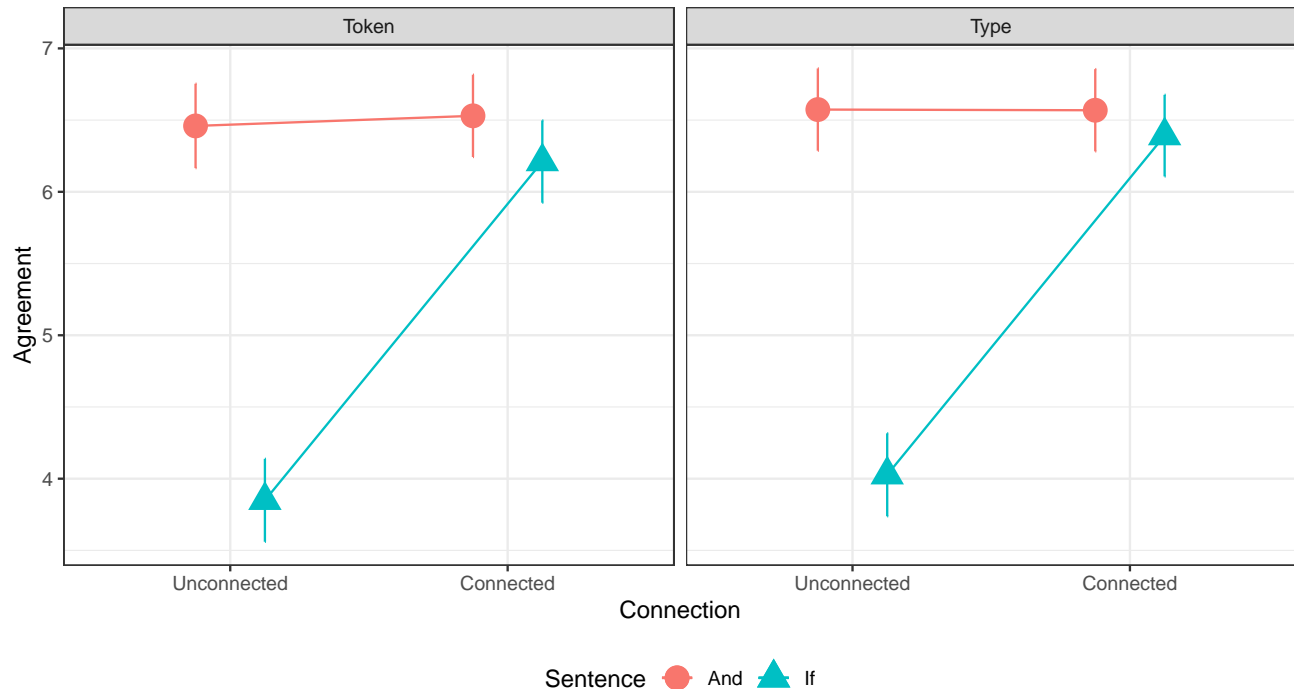
Figure 11: Estimated marginal means for Experiment 3

These comparisons were treated as a family of 4 tests, and accordingly used a significance level of $p = .013$. When there was no inferential connection, "And" sentences received substantially and significantly higher agreement ratings than "If" sentences ($M_{Difference} = 2.58$, $SE = .12$, $z = 21.71$, $p < .001$). But when there was a connection, "And" sentences received only slightly and non-significantly higher ratings ($M_{Difference} = .25$, $SE = .17$, $z = 2.13$, $p = .03$). The parameter estimate for this difference and its standard error suggested that our data are compatible with small differences between sentence types.

Turning to *Research Question 2*, we see that "If" sentences received substantially and significantly higher agreement ratings with a connection than without ($M_{Difference} = 2.36$, $SE = .12$, $z = 20.16$, $p < .001$). Moreover, "If" sentences with an inferential connection received agreement ratings comfortably above the midpoint of the scale, as shown by the estimated marginal mean ($M = 6.30$, 95%

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CI [6.07, 6.54]). Turning to *Research Question 3*, we see that inferential connections did not benefit sentences equally, since "And" sentences received only very slightly, and non-significantly, higher agreement ratings with a connection than without ($M_{Difference} = .03$, $SE = .18$, $z = .28$, $p = .78$).

Turning to *Research Question 4* we see no clear evidence for an effect of the content expressed by the clauses. Type sentences received slightly and non-significantly higher agreement ratings ($M = 5.89$, 95% CI [5.68, 6.10]) than token sentences ($M = 5.76$, 95% CI [5.55, 5.97]). The Clause Content variable did not enter into significant interactions.

4.3. Discussion

Experiment 3 replicated the answers to three out of four research questions with a new dependent variable, ratings of agreement. TT conjunctions did not uniformly receive higher agreement ratings than corresponding conditionals (*Research Question 1*). Conjunctions only received reliably higher agreement ratings than corresponding conditionals when there was no inferential connection. When there was a connection, conjunctions and conditionals attracted similar agreement ratings. Inferential connections led to higher ratings with conditionals, which were again rated comfortably above the midpoint of the scale (*Research Question 2*). And as in Experiments 1 and 2, inferential connections did not benefit sentence types equally: inferential connections did not benefit conjunctions (*Research Question 3*). However, there was no clear effect of Clause Content (Type vs. Token; *Research Question 4*). There was no interaction between Clause Content and Sentence, which can be explained by Experiment 3 dropping the "Or" sentences that drove this interaction. But there was no interaction of Content and Connection, nor was there a similar trend in Experiment 3 (or, indeed, Experiment 1). That interaction, then, does not look reliable.

This experiment has added useful data over Experiments 1 and 2. Experiments 1 and 2 showed that a conditional with a true antecedent and true consequent does not have to be a strange thing to say. These experiments,

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then, contradicted a prediction derived from the Gricean account of conversational pragmatics. Conditionals with true clauses had similar assertability to corresponding conjunctions as long as their clauses had meaningful inferential connections. A sentence might be unassertable for different reasons, only one ⁸⁶⁵ of them being a violation of some pragmatic rules, such as the maxims of the Cooperative Principle. Another reason is the content of that sentence: a false sentence, or a sentence for which a speaker lacks appropriate justification, might be deemed a strange thing to say, too (Pagin 2016). By directly probing the participants' epistemic attitude towards conditionals and conjunctions used in ⁸⁷⁰ Experiment 2, Experiment 3 provides an additional piece of evidence against the first option and, indirectly, for the second option.

5. Experiment 4

Experiments 1, 2, and 3 show that TT conditionals are neither less assertable, less acceptable, nor do they make less sense than the conjunctions of their ⁸⁷⁵ antecedents and consequents when there is a connection between these clauses. However, an anonymous reviewer pointed out that the pattern of responses that we have found might have been due to a contribution of "then" which has been present in all conditionals in our experimental materials, in all three experiments.

⁸⁸⁰   Most theories of conditionals in philosophy and in the psychology of reasoning do not seem to make a distinction between "If p, q" and "If p, *then* q," although Grice suggested that the two types of conditional might have different meanings. More importantly, the semantics of "then" and its contribution to the meaning of the conditional has been discussed in linguistics. Iatridou ⁸⁸⁵ (1994) has famously proposed that "then" carries a presupposition that at least in some cases in which the antecedent is false, so is the consequent. Relatedly, von Fintel (1994) analysed "then" as carrying a conventional implicature which conveys that if the antecedent were not true, the consequent would not be true either.

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Both proposals are able to explain some linguists' intuitions that, while (8a) and (8b) appear equivalent, there is supposedly a clear distinction between (9a) and (9b):

(8) a. If Anna ate the biscuits, she was hungry.

    b. If Anna ate the biscuits, then she was hungry.

(9) a. If you are hungry, there are biscuits in the cupboard.

    b. #If you are hungry, then there are biscuits in the cupboard.

On these intuitions, adding "then" to the consequent of a biscuit conditional renders the sentence infelicitous (e.g. Bhatt and Pancheva 2006). Similarly, "then" seems to be unavailable in non-interference conditionals:

(10) a. Even if Anna was hungry, she didn't eat the biscuits.

    b. #Even if Anna was hungry, then she didn't eat the biscuits.

What (9b) and (10b) seem to have in common is their factual consequent, hence the presupposition that at least some not-p cases are not-q cases fails. More recently, Biezma (2014) proposed an analysis of "then" as a discourse marker which requires that the antecedent is a reason for, or a causal explanation of, the consequent. This requirement is not satisfied in sentences such as (9b) or (10b).

This analysis has not, to the best of our knowledge, been supported by any actual experimental or corpus-based evidence. In fact, an experiment by Skovgaard-Olsen (2019) showed that the effect of relevance on the probability judgments of conditionals does not depend on the presence of the particle "then" in the consequent, already undermining the above discussed analysis.[14] Nevertheless, let us consider the hypothesis that the presence of the particle

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[14]We are grateful to an anonymous Reviewer for this journal for bringing this to our attention.

"then" in our materials is the driving force behind the effect of connection we have found in our experiments, which would be an important limitation to our results.

If this were indeed the case, we should not observe for conditionals without "then" the same pattern of responses that we have established in experiments 1-3. We consider two possibilities, here, on which our results may fail to generalise. Firstly, the Gricean account may truly apply only to conditionals without "then": hence, they should be rated uniformly worse than corresponding conjunctions. Secondly, conditionals with "then" are peculiar in requiring a connection; conditionals without "then" may therefore be uniformly acceptable and not reliably different from conjunctions.

To address the reviewer's concerns, we have conducted a fourth experiment which followed the design of Experiment 3 except that it compared three types of sentences: conditionals with "then," corresponding conditionals without "then," and conjunctions of their antecedents and consequents. As in the preceding experiments, we have additionally manipulated the type of content expressed by the clauses of the test sentences, and the presence of an inferential connection between them. Our test hence followed a $3 \times 2 \times 2$ between-participants factorial design with sentence type (conditionals without "then" vs. conditionals with "then" vs. conjunctions, denoted by "If," "If_then," and "And," respectively), content type (generic, "Type," vs. specific, "Token") and the inferential connection (Connected vs. Unconnected). We have also used the same materials as in experiments 1–3. The following sentences are example test items belonging to Unconnected Type condition:

If   If roses are plants, they have thorns.

If_then   If roses are plants, then they have thorns.

And   Roses are plants, and they have thorns.

Unlike in the previous experiments, we have used anaphoric constructions in the consequents (or the second conjunct, in the case of conjunctions), instead of repeating the noun phrase from the antecedent (or the first conjunct; e.g.

"If roses are plants, roses need water"), so the items sounded more natural.

⁹⁴⁵ Repeating the subject noun phrase seemed to make some of our items sound less natural, particularly when the distance between the first occurrence of the phrase and its repetition is short, hence it particularly affected many of our conditionals without "then." To avoid the repetition acting as a confounding variable, we have rephrased all our type items using anaphoric constructions.

⁹⁵⁰ The token items were exactly as before. As in Experiment 3, we have asked participants for their agreement ratings. However, we have omitted the filler items. Their presence in Experiment 3 did not affect the pattern of responses that we established in Experiments 1 and 2, but it made the survey three times longer and potentially more tiresome for the participants.[15]

⁹⁵⁵ Note that this experiment allows us to replicate Experiment 3 while investigating slightly modified versions of the four key research questions, repeated here for convenience: (1) Are TT conditionals—including conditionals without "then"—given lower ratings than their corresponding conjunctions? (2) Does an inferential connection between antecedent and content benefit conditionals with

⁹⁶⁰ and without "then," and how acceptable are they? (3) Is there any clear difference across the three sentence types—but in particular, between the types of conditional—in how much inferential connections benefit improve ratings? And (4) Do ratings of conditionals of either sort depend on whether they concern types or tokens?

⁹⁶⁵ *5.1. Method*

Participants. 481 participants completed the online survey via the MTurk platform (https://www.mturk.com/). We removed one participant who answered "No" to a sincerity question, and a further 6 participants who indicated that they were neither native English speakers nor bilingual from birth. Of the re-

⁹⁷⁰ maining participants, 238 identified as women and 2 identified as non-binary. Excluding one participant who did not supply their age, the average age of the

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[15]This decision was additionally affected by budgetary limitations.

participants was 37.69. All participants received a small remuneration for their time and effort.

Materials and procedure. After giving informed consent, each participant was randomly assigned to a condition. After the introductory block explaining participants' rights and the data protection regulations, and a block explaining the task, Participants in each condition were presented with 16 blocks with test questions, one at a time. The order of presentation was randomised. Each block asked to what extent participants agree with a given sentence. The participants were asked to mark their responses on the 7-point Likert scale, from "strongly disagree" to "strongly agree."

5.2. Results

Table 9 summarizes the data, averaged across items. Notably, "And" sentences receive similar ratings in all conditions. When both "If" and "If_then" sentences also have an inferential connection, they receive similar ratings to "And" sentences. But when they lack a connection, they receive considerably lower ratings. This pattern hints at an interaction of sentence type and connection, and suggests that the effect on an inferential connection is not limited to "If_then" sentences. This interaction appears similar for both type and token sentences.

		Token		Type	
		Unconnected	Connected	Unconnected	Connected
And	mean	6.32	6.51	6.64	6.47
	sd	1.03	1.07	.79	.95
If	mean	4.77	6.29	4.18	6.20
	sd	1.94	1.18	2.12	1.19
If_then	mean	3.98	6.30	4.36	6.20
	sd	2.03	1.22	2.03	1.33

Table 9: Descriptive statistics for the data from Experiment 4, averaged across items.

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The analysis followed the same template as for Experiments 2 and 3, comprising a mixed-effects model on ratings of agreement. The model included main effects of Clause Content (Type / Token) × Connection (Unconnected / Connected) × Sentence (And / If / If_then), all two-way interactions, the three-way interaction. As in previous experiments, the maximal converging model included only random intercepts by item and participant, and not the full random-effects structure justified by the design. Table 10 reports the fixed effects.

Effect	df	χ^2	p
Clause Content	1	.08	.78
Connection	1	192.86	$< .001*$
Sentence	2	158.37	$< .001*$
Clause Content∗Connection	1	.46	.50
Clause Content∗Sentence	2	7.39	.03
Connection∗Sentence	2	107.90	$< .001*$
Clause Content∗Connection∗Sentence	2	6.72	.04

Table 10: Fixed effects for Experiment 4.

Figure 12 shows the estimated marginal means for each condition. Firstly we note that, there was a significant main effect of Connection, with connected sentences ($M = 6.33$, 95% CI [6.12, 6.54]) receiving significantly higher ratings than unconnected sentences ($M = 5.04$, 95% CI [4.83, 5.25]). Turning to *Research Question 1*, we see a significant effect of Sentence Type, with "And" sentences receiving the highest ratings ($M = 6.48$, 95% CI [6.26, 6.71]), then "If" sentences ($M = 5.36$, 95% CI [5.13, 5.59]), and finally "If_then" sentences ($M = 5.21$, 95% CI [4.98, 5.44]). However, these effects were qualified by significant interactions of Clause Content and Sentence, Connection and Sentence, and the three-way interaction.

To address *Research Questions 1 and 2*, we must address the three-way interaction and consider, in particular, how the interaction between Connection and Sentence changes depending on the level of Clause Content.
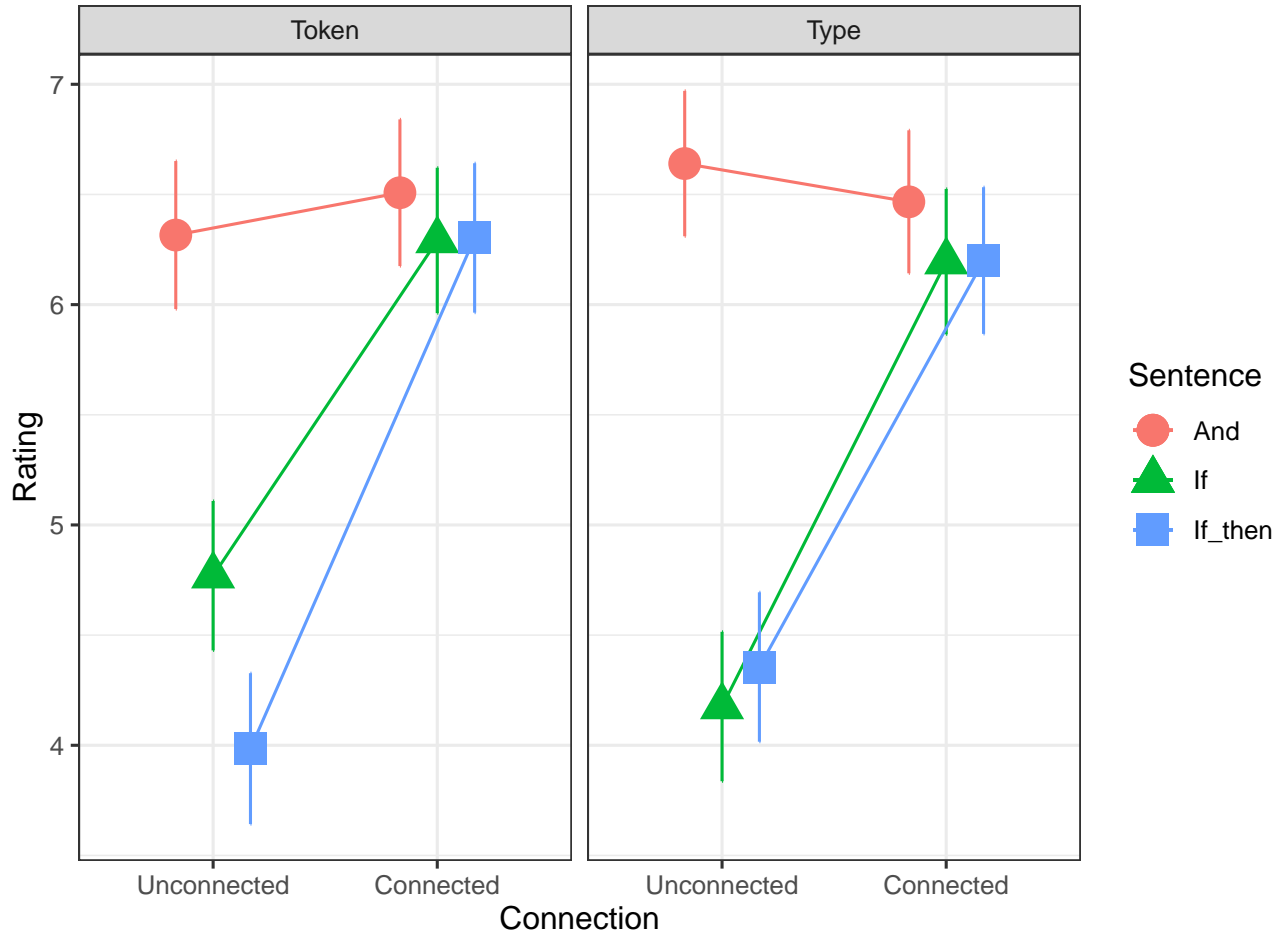
Figure 12: Estimated marginal means for Experiment 4.

We compared sentence types for each combination of content type and connection. The results are shown in Table 11 with a Holm adjustment for a family of 12 tests. As Figure 12 suggests, for both Type and Token sentences, when there was a connection, "And," "If," and "If_then" sentences did not differ significantly from each other. Again for both Type and Token sentences, when there was no connection, "And" sentences were rated significantly higher than both "If" and "If_then" sentences. But as Figure 12 also suggests, there was more differentiation between "If" and "If_then" sentences. For Token sentences with-

Content	Sentence	Contrast	$M_{Difference}$	SE	z	p
Token	Unconnected	And − If	1.55	0.21	7.48	$< .001*$
		And − If_Then	2.33	0.21	11.20	$< .001*$
		If − If_Then	0.78	0.21	3.75	$0.001*$
	Connected	And − If	0.22	0.20	1.08	1.00
		And − If_Then	0.21	.21	1.00	1.00
		If − If_Then	−0.01	0.20	−0.06	1.00
Type	Unconnected	And − If	2.46	0.20	12.06	$< .001*$
		And − If_Then	2.28	0.20	11.19	$< .001*$
		If − If_Then	−0.18	0.21	−0.86	1.00
	Connected	And − If	0.27	0.20	1.37	1.00
		And − If_Then	0.27	0.20	1.34	1.00
		If − If_Then	−0.005	0.20	−0.02	1.00

Table 11: Holm-corrected comparisons of sentence types.

out a connection, "If" sentences were rated significantly higher than "If_then"
₁₀₂₀ sentences. For Type sentences, there was a small but non-significant difference
in the opposite direction. We return to this point below.

Turning to *Research Question 2*, we ran comparisons on the estimated
marginal means, comparing connected and unconnected sentences for each com-
bination of sentence type and content. The results are shown in Table 12. Note
₁₀₂₅ that a Holm adjustment was applied for a family of 6 tests. A connection signif-
icantly improved ratings for both "If" and "If_then" sentences. "If" sentences
with a connection received ratings comfortably above the midpoint of the scale
for both Type sentences ($M = 6.20$, 95% CI $[5.87, 6.53]$) and Token sentences
($M = 6.29$, 95% CI $[5.96, 6.62]$). "If_then" sentences with a connection likewise
₁₀₃₀ received ratings comfortably above the midpoint of the scale for both Type sen-
tences ($M = 6.20$, 95% CI $[5.87, 6.53)$ and Token sentences ($M = 6.30$, 95% CI
$[5.96, 6.64]$).

Turning to *Research Question 3*, we see that a connection did not benefit

sentence types equally, since a connection did not significantly improve ratings
for "And" sentences. The standard error indicates that "And" sentences were
consistent with small effects of a connection, both positive and negative.

Turning to *Research Question 4*, we note evidence that there was a non-significant main effect of Clause Content, with token sentences ($M = 5.70$, 95% CI [5.48, 5.91]) and type sentences ($M = 5.68$, 95% CI [5.46, 5.88]) receiving very similar ratings. However, Clause Content is implicated in the two-way interaction of Clause Content and Sentence type and the three-way interaction. The role of Clause Content here appears to be driven by the effect identified above: that there is a significant difference between "If" and "If_then" sentences only for token sentences.

5.3. *Discussion*

Experiment 4 addressed the possibility, raised by our reviewers, that our findings have limited generality because of the presence of "then" in our conditionals. We considered the possibility that the Gricean account is limited to conditionals without "then" and the possibility that the effect of inferential connections is different for conditionals with and without "then." In fact, Experiment 4 replicated the key findings of Experiments 1-3. In particular, we found that TT conjunctions did not uniformly receive reliably higher agreement ratings than

Content	Sentence	$M_{Difference}$	SE	z	p
	And	0.20	0.20	0.94	0.69
Token	If	1.52	0.20	7.45	$< .001*$
	If_Then	2.32	0.21	11.06	$< .001*$
	And	-0.17	0.20	-0.88	0.69
Type	If	2.02	0.20	9.89	$< .001*$
	If_Then	1.85	0.21	8.98	$< .001*$

Table 12: Holm-corrected comparisons of connected and unconnected sentences. The mean difference is "Connected−Unconnected": hence a positive number means connected sentences were rated higher.

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corresponding conditionals, whether with or without "then,"(*Research Question 1*). Rather, when there was a connection, conditionals with and without "then" ¹⁰⁵⁵ received ratings that were not reliably different from conjunctions. Connections benefited both types of conditionals, which were rated comfortably above the midpoint of the scale when there was a connection between antecedent and consequent (*Research Question 2*). But as in the previous experiments, connections did not benefit conjunctions, and there was no clear difference in the extent to ¹⁰⁶⁰ which connections benefited the two types of conditional (*Research Question 3*). Lastly, as in Experiment 2, there was an interaction between clause content (Type vs. Token) and sentence type ("If" vs. "If_then" vs. "And"; *Research Question 4*)—though note that the sentence type variable has different levels from Experiment 2. In this case, the interaction seems to be driven by a rela- ¹⁰⁶⁵ tive difference in ratings for conditionals with "then" and those without "then" in the Token-Unconnected condition. Unconnected Token Conditionals without "then" received higher ratings that Unconnected Token Conditionals with "then", although much lower than corresponding conjunctions.

By and large, we have not found any clear, consistent effect of the particle ¹⁰⁷⁰ "then" on the acceptability of conditionals with true clauses. Our results then indicate that the reported effect of the inferential connection is unlikely to be driven by the contribution of the particle "then" instead of the conditional itself, as the reviewer suggested. In fact, already Geis and Lycan (1993) argued that adding "then" to the consequent of a conditional does not change its meaning. ¹⁰⁷⁵ The received view on the semantics of "then" has recently been additionally challenged by an observation that, contrary to what was put forward by Iatridou (1994), and followed up by many others, "then" turns out to be felicitous in some biscuit conditionals (Zakkou 2017). Declerck and Reed (2001) made a similar claim, based on an extensive corpus study of conditional constructions ¹⁰⁸⁰ in English. Furthermore, our finding is consistent with the data reported in Skovgaard-Olsen (2019) who showed that the same relevance effect on participant's probability assignments is observed whether the conditional's consequent was phrased with or without "then." Skovgaard-Olsen notes that the differ-

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ence between the two types of conditionals appeared to have been treated by participants as a "little more than a stylistic difference" (p. 8).

The difference between conditionals with and without "then" for Token sentences deserves closer attention. It bears further emphasis that the two types of conditional are importantly similar: when there is a connection, TT conditionals are given similar acceptability ratings to corresponding conjunctions, while their acceptability drops substantially when the connection is missing. This data pattern is crucial for our purposes. However, it is intriguing that the two types of Token conditional differ when there is no connection. One possible explanation for this difference is that "then" emphasises the presence of the connection which is, in the Unconnected condition, not there, rendering the conditional even more infelicitous than it is without it. If that is the case, however, it is surprising that "then" has no such effect on the acceptability of the Type Unconnected conditional. Given that this finding does not substantively affect our overall conclusions, we defer an exploration of this difference to future research.

6. General Discussion

In this paper, we addressed four research questions. First, we investigated whether TT conditionals are less assertable (and less acceptable) than conjunctions of their antecedents and consequents, as predicted by a Gricean account of the oddity of missing link conditionals (*Research Question 1*), and if the assertability ratings of conditionals are affected by the presence of a connection between their clauses (*Research Question 2*). Additionally, we tested whether such an effect, if found, is specific to conditionals or if it affects other types of sentences too (*Research Question 3*). Finally, we explored the possibility that the assertability of a TT conditional depends on the type of content expressed by its antecedent and consequent (*Research Question 4*).

Contrary to the predictions drawn from Gricean pragmatics, the fact that the antecedent and the consequent are both known to be true is not sufficient

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for a conditional to be judged as unassertable. While TT conditionals without a connection indeed received lower assertability ratings than corresponding conjunctions, this was not the case for TT conditionals with a meaningful, e.g., causal or inferential, link between their antecedents and consequents. Conditionals with a connection were judged to be as reasonable things to say, as natural to assert, and as acceptable, as corresponding conjunctions. Moreover, we have shown that knowing that p and q are both true is not sufficient for "If p, then q" to be acceptable, which we replicated for conditionals without "then." The participants' explicitly epistemic attitudes towards conditionals seem to be equally affected by the presence or absence of the connection between their clauses. Finally, we demonstrated that the presence of a connection, while necessary for a conditional to be assertable and acceptable, does not seem to affect participants' assertability ratings for conjunctions and disjunctions in a similar way. It is, then, a unique characteristic of conditionals.

The Clause Content manipulation, however, did not have such a clear effect across our experiments. The assertability and acceptability patterns were very similar for generic conditionals and conjunctions to their specific counterparts. Our data hinted at a role for this variable in Experiments 2 and 4. In Experiment 2, there was a significant interaction between Clause Content and Connection averaged over the Sentence variable. But this effect did not show up in Experiments 1, 3 or 4, so has questionable reliability. In contrast, there were significant interactions between clause content and sentence type in both Experiments 2 and 4, though the sentence type variable was implemented with different levels in the two experiments, reducing their comparability. In Experiment 2, the Clause Content manipulation produced a distinctive pattern for disjunctions: Type sentences increased the assertability of disjunctions but decreased the assertability of conjunctions and conditionals. This finding adds to our evidence that conditionals differ importantly from both conjunctions and disjunctions. In Experiment 4, the content manipulation was involved in a two-way interaction with sentence type and a three way interaction with sentence type and connection. Breaking these effects down, we identified that there was a

reliable difference between the two types of conditional but only for unconnected

¹¹⁴⁵ sentences that were about tokens. While this effect merits further attention, we set it aside for future work.

Our findings pose a challenge for all theories that treat the connection between antecedent and consequent as solely a pragmatic aspect of its meaning— something conversationally implicated— such as the material account, the Men-

¹¹⁵⁰ tal Models Theory, the possible worlds account, or the probabilistic Suppositional Theory[16] (in what follows, we will limit our discussion to those theories of conditionals that became important in the context of psychology of reasoning, to wit, Mental Models Theory and the Suppositional Theory). On the assumption that what a conditional conveys is weaker or less informative than what

¹¹⁵⁵ a conjunction conveys, a speaker who knowingly chooses to assert a TT conditional instead of the corresponding conjunction, violates the Maxim of Quantity. Yet, as our data clearly show, when a connection is present, conditionals are as assertable as the conjunctions of their antecedents and consequents.

An explanation of these findings could follow two different paths: One can

¹¹⁶⁰ reject the most fundamental principles of Gricean pragmatics by denying that informativeness guides people's assertability judgements. Another, less costly, option is to rethink the assumptions about the semantics of conditionals, and to accept the possibility that the connection between antecedents and consequents is an important part of their core meaning. On the latter approach, the con-

¹¹⁶⁵ ditional would not be entailed by the conjunction, and, hence, it would not be weaker in the relevant sense. Moreover, the connection would be taken as an additional piece of information conveyed by a conditional, but not by a conjunction. In other words, to keep the Gricean view on pragmatics intact, we need an account that allows conditionals to be viewed as (approximately) equally

¹¹⁷⁰ informative as conjunctions (on the standard, truth-functional interpretation of

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[16]Strictly speaking, the latter two accounts might be construed as attempts to capture the dependence of a conditional's consequent on its antecedent, but they fail to do that for some cases, such as precisely the case of TT conditionals.

a conjunction).

Neither Mental Models nor the Suppositional Theory can follow this path, however. On the Mental Models Theory (MMT), for instance, compound assertions refer to conjunctions of possibilities, where the possibilities are understood ₁₁₇₅ in an epistemic sense. These are possible states of affairs—situations—that are compatible with the assertion (Khemlani et al. 2018). Consequently, the *core meaning* of a natural language conditional, "If p then q," is a conjunction of: "it is possible that p and q," "it is possible that $\neg p$ and q," and "it is possible that $\neg p$ and $\neg q$." A basic conditional is true if all these three situations are pos-₁₁₈₀ sible, and p and $\neg q$ is impossible (Johnson-Laird et al. 2015, p. 206). Although a conditional on the MMT is not entailed by a conjunction of its clauses, the connection between the clauses is not a part of its core meaning either. While the proponents of the MMT do not deny that conditionals often seem to convey the presence of a relation between their clauses, they construe this phenomenon ₁₁₈₅ as an effect of the mechanism of a semantic and pragmatic modulation:

> . . . modulation can establish an indefinite number of different temporal, spatial, and coreferential relations between the antecedent and consequent of a conditional. (Johnson-Laird and Byrne 2002, p. 660)

In other words, the content of the clauses (semantic modulation) and contextual ₁₁₉₀ factors (pragmatic modulation) can influence the interpretation of a conditional. However, the only thing that these mechanisms do is constrain (or expand) the set of possibilities a speaker envisages when interpreting a sentence. In particular, they come into play when, e.g, some of the possibilities belonging to the explicit model cannot co-occur. For instance, the content of the clauses "If ₁₁₉₅ it rains, then it'll pour" prevents the construction of the model consisting of the possibility that it was not raining and the possibility that it was pouring since pouring entails raining (Johnson-Laird et al. 2015, p. 206).

To the best of our knowledge, in the MMT literature, there is no explicit discussion of conditionals whose clauses are known to be true, and how their ₁₂₀₀ models relate to corresponding conjunctions. Nevertheless, we conjecture that

MMT would predict that the construction of "it is possible that $\neg p$ and q," and "it is possible that $\neg p$ and $\neg q$" should be prevented in such cases, at least due to contextual factors (pragmatic modulation). Consequently, the models for TT conditionals and for conjunctions of their clauses should be the same, which ₁₂₀₅ would explain why, when TT conditionals are assertable at all, their assertability ratings would not differ from those of the conjunctions. However, it is unclear then how the semantic and pragmatic modulation could help to account for the observed differences between connected and unconnected TT conditionals, given that true states of affairs are necessarily possible, and, consequently, there ₁₂₁₀ does not seem to be any difference in what kind of possibilities a person can envisage when interpreting TT conditionals with or without a connection. In both conditions, "it is possible that p and q" seems to be the only available option.

Things do not look much better for the Suppositional Theory. The term ₁₂₁₅ Suppositional Theory is used to denote a family of related accounts of conditionals that share, and emphasise, the commitment to what has become known as *The Equation*, that is, the equality between the probability of a conditional and the corresponding conditional probability, $\Pr(\text{If } p \text{ then } q) = \Pr(q \,|\, p)$. The Equation has become central to the New Paradigm psychology of reasoning due ₁₂₂₀ to the significant empirical support it has received (e.g., Evans et al. 2003; Fugard et al. 2011; Politzer et al. 2010; Oaksford and Chater 2007). These studies show that, in reasoning experiments, participants' judgements of the probability of conditionals tend to equal their judgements of the corresponding conditional probability. However, as shown by Skovgaard-Olsen et al. (2016), this equality ₁₂₂₅ only holds as long as there is a connection, a reason relation—operationalised, in probabilistic terms, as positive relevance—between antecedents and consequents. Due to the triviality proofs by Lewis (1976) and others,[17] the commitment to the Equation comes at a price. Some authors gave up the view

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[17]See, e.g., (Bennett 2003, Ch. 5) for a discussion of the triviality results and their consequences.

that conditionals can express propositions, that is, that they belong to those

₁₂₃₀ linguistic expressions that can be true or false at all (e.g. Adams 1975; Edgington 1995; Bennett 2003). Many psychologists, however, advocate a view that combines the probabilistic approach with a three-valued truth table proposed by de Finetti (see, e.g., de Finetti 1970/1990).

On the latter approach, the conditional is true when its antecedent and ₁₂₃₅ consequent are both true, and it is false when its antecedent is true but the consequent is false. When the antecedent is false, the conditional has no truth value—it is considered void—analogously to a conditional bet, which would be called-off when the condition expressed by the antecedent is not satisfied (for instance, when the coin whose landing is the object of a bet is not tossed ₁₂₄₀ at all; see, e.g., Politzer et al. (2010) for a comparison of conditionals and conditional bets). A refined version of the de Finetti's proposal combines the three-valued logic with conditional probability which replaces the value "void" for those conditionals that have false or undetermined antecedents (see, e.g., Baratgin et al. 2013).

₁₂₄₅ Since conditionals used in our experiment all consist of antecedents and consequents that are all true, the probabilities do not play a role on this version of the Suppositional Theory, which then does not differ from the material account and, consequently, renders all those conditionals true. On the fully non-propositional approach, the conditional probability of the consequent of a ₁₂₅₀ TT conditional given its antecedent is 1, too, and hence such conditionals are highly acceptable. Reserving the probability values 1 and 0 to logical truths and logical falsehoods will not help, since the Conjunctive Sufficiency is probabilistically valid, and hence the conditional whose clauses have probability values close to 1 will be highly probable, and hence acceptable, too. To account for the ₁₂₅₅ results of our experiments, and for the intuition that the clauses of a conditional have to be connected, the Suppositional Theory needs to be supplemented by a pragmatic account. The most natural candidate for such an account is precisely the Gricean story that purported to explain the intuition that missing-link conditionals are faulty in terms of the availability of stronger, more informative

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₁₂₆₀ statements. However, our experiments showed that a speaker's being justified in asserting a conjunction of p and q, which, on the Suppositional Theory, is stronger, more informative than "if p then q," does not suffice to render the conditional unassertable. It is the presence or absence of a connection that makes a difference. The Gricean account fails to account for this result.

₁₂₆₅ One could argue that the connection between the antecedent and consequent of a conditional might still be conversationally implicated, as Grice (1989, p. 77) envisaged, even if we have failed so far to identify which Gricean maxims of good conversation, or which neo-Gricean principles (Horn 1984) or heuristics (Levinson 2000) missing-link conditionals actually violate. A seemingly
₁₂₇₀ promising suggestion was that the oddity of missing-link conditionals could be attributed to the violation of the Maxim of Relation which demands that whatever a speaker asserts be relevant in a given conversational context. However, as we have mentioned earlier, conditionals turned out to require a stronger type of a connection than what is sufficient to preserve the coherence of discourse
₁₂₇₅ (Krzyżanowska et al. 2017a). More importantly, the results of another recent empirical study, by Skovgaard-Olsen et al. (2019a), cast doubt on the very possibility of an explanation of the connection between antecedents and consequents in terms of conversational implicatures.

A key characteristic of conversational implicatures, as well as many other
₁₂₈₀ pragmatic phenomena, which distinguishes them from conventional aspects of meaning, is their defeasibility. Conversational implicatures then can be cancelled, that is, a speaker whose assertion that φ conversationally implicates that ψ is in a position to call off the implicature of ψ by clarifying that it was not the speaker's intended meaning, for instance, by adding "I didn't mean to
₁₂₈₅ say that ψ" (Grice 1989; Blome-Tillmann 2008).[18] For example, a person asserting that "Some of our guests brought wine," which tends to be interpreted as communicating that not all of the guests brought wine, might cancel the

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[18]Though see Haugh (2013) for a critical discussion of cancellability as a litmus test of implicature.

implicature of "not all" by adding "I didn't mean to imply that some of the guests didn't, I just don't know what, if anything, the others brought." By con-

¹²⁹⁰ trast, any attempt to cancel what an assertion *semantically entails* sounds like a speaker is contradicting themselves: one cannot assert "Tom and Jerry left the party" and then add "but I didn't mean to imply that Jerry left the party." Indeed, as shown by Skovgaard-Olsen et al. (2019a), a speaker who attempts to cancel the connection between the antecedent and consequent of a conditional

¹²⁹⁵ (e.g. "If Paul pushes down the brake pedal, then the car will slow down, but I am not suggesting that these two things are related") is perceived as contradicting themselves, exactly like a speaker attempting to cancel what their assertion entails. Relatedly, implicatures can be reinforced (Saddock 1978; Birner 2012): "Not all of them did" asserted right after "Some of our guests brought wine" is

¹³⁰⁰ not redundant—it makes explicit what has been merely suggested. By contrast, "Tom left the party" added after "Tom and Jerry left the party" is perceived as redundant, as it does not add any new information. A recent study by Rostworowski et al. (2021) shows that the connection, like semantic entailments and unlike conversational implicatures, is not reinforceable either.[19]

¹³⁰⁵ Conversational implicature is by no means the only candidate for a pragmatic category to which a connection between the antecedents and consequents could possibly belong. However, of the pragmatic categories that could be easily integrated with the psychology of reasoning theories of conditionals we have discussed above, it is a category whose status as pragmatic might be the least

¹³¹⁰ controversial, although it has been argued that generalised conversational implicatures do contribute to the truth-conditional content of sentences that carry them (see, e.g., Levinson 2000). How else could the connection between a conditional's antecedent and its consequent be accounted for, for it to be considered a pragmatic phenomenon? The short answer is: it depends. In particular, it

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[19]See Saddock (1978) for a discussion of possible candidates for practical tests that could allow us to detect the presence of a conversational implicature. Krzyżanowska (2019) argues that the connection conveyed by indicative conditional does not pass any of these tests.

₁₃₁₅ depends on where we draw the line between the semantic and pragmatic aspects of meaning, if such a line is indeed possible to draw.

While it is typical for researchers to try to decide between semantics and pragmatics (the aforementioned work by Skovgaard-Olsen et al. 2019a is a good example), one could object that the attempt risks a false dichotomy. We have ₁₃₂₀ noted in the introduction that the pragmatic meaning of an expression has been traditionally contrasted with its semantics, understood as the literal, conventional, and truth-conditional meaning of an expression, which is independent of context. Does the presence or absence, and strength, of an inferential connection affect the truth value of a given conditional? Evidence on this matter is ₁₃₂₅ mixed, however. On the one hand, Skovgaard-Olsen et al. (2017a) argued that inferential connections contributed to judgments of probability and acceptability but not to judgments of truth. On the other hand, Douven et al. (2018) found that not only the presence or absence, but also the strength of inferential connections affected the participants' truth value judgments, while Mirabile ₁₃₃₀ and Douven (2020) replicated that result for abductive inferential conditionals. Additionally, the latter showed that participant's endorsement of the conclusion of the Modus Ponens inferences was better predicted by their judgments of the strength of the explanatory connection between the antecedent and consequent of the major premise of the argument than the corresponding conditional proba- ₁₃₃₅ bility. The evidence collected by Krzyżanowska and Douven (2018), by contrast, is itself mixed. More data is clearly needed. It is also possible that people differ in how they interpret conditionals. A recent work by Skovgaard-Olsen et al. (2019b), who studied individual variation in the interpretation of conditionals, deserves attention here. It shows that even participants who tend to interpret ₁₃₄₀ conditionals according to the Suppositional Theory largely reject the inferences from conjunction to conditionals, as predicted by inferentialism. Moreover, the endorsement of these inferences can be predicted by participants' endorsement of an uncontroversially invalid inference of a conjunction from a single conjunct (see their Experiment 3). Nevertheless, even in an unlikely case that it is proven ₁₃₄₅ beyond doubt that the connection's contribution to the truth-conditional con-

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tent of a conditional is at best marginal, we are not justified in drawing the conclusion that the connection is a clearly pragmatic phenomenon.

Recent developments in linguistics and philosophy of language showed the traditionally construed semantics/pragmatics divide to be too simplistic (Korta

₁₃₅₀ and Perry 2015). On the one hand, it became clear that pragmatic inferences are often necessary to establish the semantic, truth-conditional content of expressions, for instance, to disambiguate, to resolve the referents of indexicals, to recover unarticulated constituents, and so on (see, e.g., Carston 2002; Levinson 2000; Recanati 2003; Jaszczolt 2005 for a dicussion of pragmatic enrichment

₁₃₅₅ and related phenomena). On the other hand, it became clear that what an expression literally, conventionally conveys—what we might still want to call its "core" meaning—does not always belong to the truth-conditional content of sentences the expression appears in (Birner 2012, see, e.g.,). In other words, what is semantic, conventional, and truth-conditional often diverge. By the

₁₃₆₀ same token, some phenomena do not sit neatly on only one side of the semantics/pragmatics divide; they sit on the fence. One fence-sitting phenomenon is the conventional implicature (e.g. Bach 1999; Potts 2015), also known as the "semantic implicature" (Davis 2014), which, as Skovgaard-Olsen et al. suggest, may house the inferential connection. The name of the phenomenon shows its

₁₃₆₅ fence sitting; it is both conventional and an implicature. To complicate the picture, Skovgaard-Olsen et al. (2019a) collected evidence showing that inferential connections do seem to belong to content which is *at issue*. The at-issue content is what speakers accept or deny, which is typically identified with the truth-conditional content. Conventional implicatures are typically considered

₁₃₇₀ to be *not-at-issue* content, that is, for instance, they are not what a speaker accepts or denies when accepting or denying the sentence that carries them (Bach 1999; Potts 2015; Tonhauser 2012).

Our data sit well with the view that the inferential connection belongs to the conventional meaning of the conditional. Whether it is construed as a part of the

₁₃₇₅ conditional's truth-conditional content or as a conventional implicature carried by "if," the inferential connection would be communicated out of any context

of utterance, as we have seen in Experiments 2, 3, and 4. It would also be non-cancellable and non-reinforceable. Evidence, in particular the above discussed findings by Skovgaard-Olsen et al. (2019a) and by Rostworowski et al. (2021), suggest it is neither. Lastly, our evidence suggests that the inferential connection is special to the conditional—it does not noticeably benefit conjunctions and disjunctions—it does not seem to depend on a specific conversational context; and it affects a more semantic dependent variable. Needless to say, we do not claim that our results conclusively rule out *any* conceivable strictly pragmatic account of the connection. Other purely pragmatic accounts of our data may eventually be formulated. However, the current data, particularly in conjunction with other findings discussed above, provide important constraints.

Note that conjunctions can also have a conditional, inferential interpretation, and thus might be said to express the presence of a connection too, as in: "You walk with me and I will tell you all about it" or "You push down the break pedal and the car will slow down." However, in such cases, even if these sentences indeed convey that there is a connection between the conjuncts, its status is clearly different. The data collected by Skovgaard-Olsen et al. (2019a) indicate that the connection is cancellable when it is conveyed by a conjunction: a speaker who states "Paul is wearing a shirt, and his car will suddenly break down, but I am not suggesting that these two things are related" is not judged by the participants to be contradicting themselves (unlike a speaker asserting "If Paul is wearing a shirt, then the car will slow down, but I am not suggesting that these two things are related"). This suggests that the inferential reading of a conjunction, unlike that of an indicative conditional, has a signature of a conversational implicature.

As we have explained above, more data are needed to decide whether inferential connections contribute towards judgments of truth. If they do contribute, then the inferential connections would belong to semantics as it has been traditionally construed: the conventional, truth-conditional content. If they do not contribute, then conventional implicatures seem a strong contender. While we cannot entirely rule out a possibility of yet another pragmatic account of

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the connection being advanced, we have provided reasons to believe that the inferential connections belong to what conditionals conventionally mean—what

₁₄₁₀ in psychology of reasoning is usually dubbed as their "core" meaning. In light of our experiments together with a growing number of other empirical results on the semantics and pragmatics of conditionals, the view that inferential connections can be explained away on merely pragmatic grounds becomes less and less plausible.

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