'Deduction' versus 'inference' and the denotation of conditional sentences

Carsten Breul

(2021)

1 Introduction

The present work argues that the denotation of a conditional sentence of the form *If p, (then) q* or *q, if p*, to be abbreviated as $p \rightarrow q$, is determined by the truth conditions that define material implication, i.e. $p \supset q$. It is thus a defence of a version of material implication analyses of natural language conditional sentences (*conditionals*, for short). Previous defences of proposals to the effect that the core meaning of a natural language conditional construction with p as its antecedent and q as its consequent is $p \supset q$ include, among others, Abbott (2004, 2010), Barker (1997), Grice (1989a), Jackson (1979, 1987), Rieger (2006, 2013, 2015), Smith & Smith (1988). It seems, though, that the majority of scholars having studied conditionals from the philosophical, psychological or linguistic perspectives in the past 30 years or so are critical of or downright reject material implication analyses.[1] The present work looks critically at some prominent arguments that have been put forward in order to demonstrate the implausibility or incorrectness of the claim that the meaning of $p \rightarrow q$ is $p \supset q$. This is done on the basis of the assumption that what is meant by *meaning* in this claim is the denotation of $p \rightarrow q$, not some other aspect of meaning or combination of aspects of meaning. Moreover, this is done on the conviction that it is important to distinguish between aspects of interpretation of conditionals that belong to the domain of deduction as opposed to the domain of inference, with the former domain belonging to, but not being the same as, semantics, and the latter domain being pragmatics. The purpose of the paper is to show that, from the perspective characterised by this assumption and this conviction, these arguments against a material implication analysis of conditionals are not convincing. Since these arguments constitute only a selection from those adduced against the material implication approach, the present work does not constitute a full defence, only a partial one supplementing previous defences by new lines of argumentation. One of these new lines of argumentation is the firm inclusion of subjunctive conditionals in the material implication approach.

A note on the notation and the terminology used in the present paper is in order: In $p \supset q$, p and q are to be understood as variables ranging over propositions; in $p \rightarrow q$, p and q are to be understood as variables ranging over clauses expressing propositions. Instantiations of $p \supset q$ and of $p \rightarrow q$, where the variables are assumed to have been provided a specific value, are written $P \supset Q$ and $P \rightarrow Q$ respectively; p in $p \supset q$ and $p \rightarrow q$ as well as P in

[1] According to von Fintel (2011: 1524) and Cantwell (2018: 139), the dominant approach to conditionals in linguistics is the restrictor approach initiated by Kratzer (1979, 1986, the latter republished as 1991 and 2012), drawing on Lewis (1975). For overviews of this approach from the linguistic and philosophical perspectives see, for example, Edgington (2014: section 4.3), Kaufmann & Kaufmann (2015: 246, 254–255), von Fintel (2011). Restrictor theorists reject the Gricean view (see Grice 1989a, 1989b) that the meaning of $p \rightarrow q$ is $p \supset q$ augmented by pragmatic effects – a view with "a long tradition" (Abbot 2004: 1), though. Thus, the present work swims against the major current – but with a venerable minor countercurrent – alongside the defenders of (versions of) the Gricean view mentioned in the main text above, to which may be added Kearns (2011: 29–32) at the level of textbooks of formal linguistic semantics.

P⊃Q and *P→Q* are called antecedent; *q* in *p⊃q* and *p→q* as well as *Q* in *P⊃Q* and *P→Q* are called consequent.

Versions of material implication analyses of conditionals are truth-functional accounts. Thus, the present paper does not go along with the scholars referred to in the following quotation from Sanford (2003: 196): "Some theorists hold that a truth-functional account of indicative conditionals is only partial: some indicative conditionals are true; some are false; and some, especially those with false if-clauses, are neither true nor false". I reject the assumption that conditionals with false *if*-clauses are neither true nor false. If this assumption were true, then there would be no way for a sentence like the following one to be true or false, given that either the proposition 'Joy is going to study art history' or its negation 'Joy is not going to study art history' is true, and consequently the other one false.

(1) If Joy is going to study art history, her mother will be annoyed, and if Joy is not going to study art history, her father will be annoyed.

For then either the first or the second conjoined conditional clause in (1) would have no truth value. Consequently, the whole conjunctive sentence would lack a truth value as well. I can see nothing that would support this conclusion.

The logical basics of material implication analyses of conditionals can be conveniently recalled while discussing an observation by Nickerson (2015: 17). He writes: "A major reason for the unwillingness of many to consider indicative conditionals to be material conditionals is objection to the idea that *A* [an antecedent] being false is adequate grounds for inferring that *C* [a consequent] is true". Consider the truth table that defines material implication:

Table 1

Truth table for material implication

	p	q	p⊃q
1	T	T	**T**
2	T	F	**F**
3	F	T	**T**
4	F	F	**T**

What does this mean in terms of deductive commitment for a person who posits *P⊃Q*? It means that they are deductively committed to maintaining the truth of *Q* given that *P* is true (line 1) and to maintaining the falsity of *P* given that *Q* is false (line 4). They are not deductively committed to anything else, specifically, neither to the truth nor the falsity of *Q* given that *P* is false. For *P*'s being false is compatible with both the truth and falsity of *Q* (lines 3 and 4). Consequently, there is no logically adequate ground for inferring that *Q* is true given that *P⊃Q* is true and that *P* is false. Hence, this idea, which according to Nickerson is a "major reason for the unwillingness of many to consider indicative conditionals to be material conditionals" (see above) is wrong and should thus not constitute a reason for objecting against a material implication analysis of conditionals.

What, in general terms, is the denotation of a finite natural language sentence, and thus of a conditional sentence $P \rightarrow Q$? Given that a finite sentence *S* expresses the proposition *'S'*, it has become the mainstream in formal semantics to consider the denotation of *S* to be the set of all possible worlds in (or: of) which *'S'* is true (see e.g. Chierchia & McConnell-Ginet 2000: 261; Lohnstein 2011: 340; Zimmermann & Sternefeld 2013: 143). I modify this idea by substituting the notion 'possible worlds' by the notion 'possible states of mental models of worlds':

(2) The denotation of a finite sentence *S* that expresses the proposition *'S'* is the set of possible states of mental models of worlds of which *'S'* is true.

The motivation for this substitution is due to the desire to make the ontology underlying possible world semantics cognitively plausible along the following lines.[2]

There is one actual world (or universe). Human beings cognitively create and constantly modify states of a mental model of this world that are vastly underspecified in comparison to the world itself. Some of the unspecified components of a mental model of the world can be hypothetically specified. Often, different such hypotheses can be entertained that are compatible with the specified components. This results in different possible states of the model. For example, I do not know whether Churchill swallowed any kind of liquid between 8 and 9 o'clock pm on Dec 20, 1952. But it is compatible with the specified components of my model of the world that he drank nothing, or that he drank whisky, red wine, milk or water, for instance. It is not compatible with the specified components of my world model that he drank Diet Coke, for in the model it is specified that Diet Coke did not yet exist in 1952. One can also mentally entertain possible states of alternative world models. These result from the substitution of at least one specified component of one's actual world model by its contradiction.[3] For example, if I substitute the component of my actual world model according to which it is specified that Diet Coke did not yet exist in 1952 by its contradiction – 'Diet Coke did exist in 1952' – I can mentally entertain possible states of an alternative world model in which Churchill did drink Diet Coke.

The defence of a material implication approach effected by the present paper takes place against the background of the following theoretical assumptions, which will themselves be highlighted in section 5:

• The denotation of an indicative conditional sentence is a subset of the set of possible states of a communicator's (or interpreter's) actual world model; in other words, the set of possible states of a communicator's (or interpreter's) actual world model is the logical space for an indicative conditional.[4]

• The denotation of a subjunctive conditional sentence is a subset of the set of possible states of a communicator's (or interpreter's) alternative world models; in other words,

[2] As far as I can see, the following sketch of my conception of possible states of mental models of worlds avoids the problems for possible world semantics pointed out by Rescher (2007: ch. 15).

[3] See also Byrne (2005: 3): "People create a counterfactual alternative to reality by mentally altering or 'undoing' some aspects of the facts in their mental representation of reality".

[4] The specific class of complexities entailed by the fact that the denotation of a conditional is ultimately relative to how a world is represented in an individual human language user's (a communicator's or interpreter's) mind, is not discussed in the present paper. In this respect I simplify by assuming idealised, prototypical users of conditional sentences whose world models overlap in the aspects relevant for the purposes of the paper with one another, with mine and with those of my readers.

the set of possible states of a communicator's (or interpreter's) alternative world models is the logical space for a subjunctive conditional.

Note that when in the following I refer to a communicator's world model without characterising it explicitly as an *alternative* world model, I always refer to their actual world model. Note also that the semantic constituency of the compounds *actual world model* and *alternative world model* is intended to be *[[actual world] model]* and *[[alternative world] model]*.

2 Deduction and inference

According to Harman (2002),

> it is crucial not to confuse issues of implication with issues of inference. Inference and implication are very different things and the relation between them is rather obscure. Implication is a fairly abstract matter, a relation among propositions. Inference and reasoning are psychological processes, processes of reasoned change in view (or of reasoned no change in view). (171)
>
> Deduction is not a kind of inference or reasoning, although one can reason about deductions. Deduction is implication. A deduction or proof or argument exhibits an implication by showing intermediate steps.
>
> Logic, conceived as the theory of deduction, is not by itself a theory of reasoning. In other words, it is not by itself a theory about what to believe or intend. It is not a theory concerning reasoned change in view or reasoned no change in view. (178)

In order to show that the view here expressed by Harman is not an obvious one, though, a quote from Woods et al. (2002: 4) is in order which nicely shows the tension in the history of philosophy created by scholars' thinking about the relation between the notions of logic, deduction, implication, inference and reasoning:

> For good or ill, in these past two and a half millennia it has been natural to assume that logic is the theory of reasoning. […] Notwithstanding some aggressive skepticism over the ages, logic's hegemony in these matters persisted until the latter part of the twentieth century. Even to this day, many logicians introduce their subject to first-year students as an account of deductive *reasoning*, and nearly everyone persists in the habit of calling the transformation rules of deductive logic "rules of inference." If ever a case could have been made for supposing that the rules of the logic of deduction are indeed rules of inference available to real-life reasoners in real-life situations, it would have been a conception of deduction that satisfies the more psychologically real constraints on syllogisms. Since 1879 which marks the publication of Frege's *Begriffsschrift*, the classical logic of deduction honours none of these constraints, making the claim that logic is a theory of reasoning a good deal less plausible.

The perspective from formal linguistic semantics and inferential linguistic pragmatics (i.e. linguistic pragmatics in the wake of Grice 1989b, such as Levinson 2000, Sperber & Wilson 1995) is helpful in this context. This is because formal semantics is, among other things, concerned with relations among propositions and thus, in Harman's (2002) view, with deduction while inferential pragmatics is concerned with, among other things, psychological processes involving belief and intention that are going on in the production and interpretation of utterances.

It has been observed by several scholars that the idea that conditionals have the semantics of material implication appears sometimes to have logically nonsensical implications. Indeed, as pointed out by Nickerson (2015: 348), "[i]t is easy to construct conditional arguments that have a logically valid form, but that yield a conclusion that most people are likely to reject". Accepting or rejecting a conclusion is the result of a psychological process of inferencing (reasoning). Consider, for example, the valid deductive argument form in (3) (*modus tollens*).

(3) $p \supset q$
$\sim q$
$\therefore \sim p$

Now assume that the proposition variables *p* and *q* are instantiated by the propositions 'Bo is a dog' and 'Bo is not a poodle' respectively. Expressing the propositions by English sentences, we would thus get the unacceptable natural language argument in (4) (the unacceptability is signaled by *).

(4) If Bo is a dog, then he is not a poodle.
Bo is a poodle.
*∴ Bo is not a dog.

It appears odd that an instantiation of a valid deductive argument form yields an unacceptable argument. From observations like this one, some scholars have inferred that the semantics of a conditional sentence cannot be that of material implication. The problem, though, is rather one having to do with the propositions that are taken as the value of the propositional variables. The point is that deduction is primarily concerned with argument *forms* and the question of their validity. Argument forms are expressed in terms of propositional variables rather than specific propositions. The problem displayed by (4) can be argued to arise because of there being a constraint requiring the consistency of the propositions that constitute the premise set of a deductive argument (see e.g. Besnard & Hunter 2001: 205) and because of inconsistency being potentially due to semantic relations exhibited by the propositions constituting the premise set. In the work of Woods (2002, 2004), the relevance of semantic relations for arguments crystallises in the "Logical Inertia Rule" and its strengthened version:

> Simple sentences of English to which the formalization rules [for valid arguments] apply may not either imply one another or be inconsistent with one another. In other words, the simple sentences that are inputs to the formalization mechanism of **PC** [i.e. the propositional calculus] must be *logically inert*. (Woods 2004: 51)
>
> Atomic inputs to *PC*'s formalization devices may not include those that bear meaning relations to one another. (Woods 2004: 59)

Atomic sentences are said to bear meaning relations to one another when "one entails another"; "one is inconsistent with another", or "they share semantically significant topical overlap" (Woods 2004: 59). The main point I want to draw from this is that semantic relations are relevant for whether a deductively valid argument form is reasonably instantiated by a natural language argument, i.e. acceptable at the level of inference. This consideration is applied to the example in (4) as follows: the truth of the second premise 'Bo is a poodle' (~Q) semantically entails the truth of 'Bo is a dog' (P), which, given the first premise, logically implies the truth of 'Bo is not a poodle' (Q), thus resulting in a contradiction, i.e. an inconsistent premise set.

The following cases of unacceptable natural language arguments that have been adduced in the literature to counter the view that the semantics of English conditionals is that of material implication (see e.g. Sanford 2003: 225) are also due to inconsistent premise sets. (5)a and (5)b are unacceptable natural language instantiations of the valid argument forms of (hypothetical) syllogism and contraposition respectively:

(5) a. If Smith dies before the election, Jones will win the election.
If Jones wins the election, Smith will retire after the election.
Therefore, if Smith dies before the election, Smith will retire after the elec tion.

b. If I had drawn a flush, I would not have drawn a straight flush.
Therefore, if I had drawn a straight flush, I would not have drawn a flush.

(5)a is unacceptable on the following grounds: due to the first premise, the truth of 'Smith dies before the election' logically implies the truth of 'Jones will win the election'; this, due to the second premise, logically implies 'Smith will retire after the election'; however, 'Smith dies before the election' and 'Smith will retire after the election' are semantically inconsistent, which makes the premise set inconsistent. (5)b is ruled out on the following grounds: the falsity (in an alternative world model, as I will say below) of the consequent in the premise, i.e. the truth of 'I drew a straight flush' (in that alternative world model), semantically entails the truth of the antecedent in the premise, i.e. the truth of 'I drew a flush' (in that alternative world), which in turn logically implies the truth of the consequent in the premise, i.e. the truth of 'I did not draw a straight flush' (in that alternative world model); this makes the premise (the only element of the premise set) inconsistent.

Consequently, a part of the problems of the unacceptability of natural language arguments involving conditional constructions that have been adduced in order to motivate the rejection of a material implication analysis of conditional constructions are actually due to semantic constraints on the kind of sentences that are allowed to be used as antecedent and consequent. Arguably, these constraints are independent of the question whether what is semantically essential to a conditional construction qua conditional construction is the material implication relation between antecedent and consequent. Note that taking this position also implies that the distinction between deduction and inference emphasised in the present paper is not equivalent to any one of the common boundaries drawn between semantics and pragmatics (for an overview and discussion see Ariel 2010). For here it is semantic relations – the meaning relations in Woods' (2004) strengthened "Logical Inertia Rule" (see above) – that decide about whether a deductively valid *argument form* yields an acceptable natural language *argument*, this evaluation being the result of a reasoning process, i.e. an inference. That is, semantics is orthogonal to the relation between deduction and inference.

3 A critical review of arguments against material implication analyses

3.1 An argument about logical form

Higginbotham (1986) and others in his wake claim that the material implication analysis of conditionals provides a wrong result for sentences like (6), where *he* is a bound-variable pronoun bound by *no student*.

(6) No student will succeed if he goofs off.

The reasoning underlying the claim is that, given a material implication approach, the logical form of (6) is assumed to be (7)a, which does not express what (6) actually means. This can be clearly seen if we consider (7)b, which is logically equivalent to (7)a and obviously means "every student goofs off and doesn't succeed" (von Fintel 2011: 1520).

(7) a. ~∃x(student'(x)&(goof'(x)⊃succeed'(x)))
b. ∀x(student'(x)⊃(goof'(x)&~succeed'(x)))

Indeed, the logical forms provided in (7) are not appropriate representations of the semantics of (6).

Higginbotham's (1986) observation rests on the assumption that the denotation of *no student* in (6) is *λP[~∃x(student'(x)&P(x)]*, i.e. a negated existential denotation. However, it has been argued by several scholars that a *no*-phrase in subject position cannot generally, if ever, be said to have a negated existential denotation. Rather, the appearance of *no* and its counterpart in other languages than English is licensed by overt or covert sentential negation, and the phrase has the denotation of an indefinite or universally quantified noun phrase (see Giannakidou & Zeijlstra 2017: 2113–2127 and the literature mentioned there). Since this is not the place to decide between the indefiniteness or universal quantification approaches, I will, just for the sake of concreteness and without further elaboration, make a proposal as to how the problem raised by Higginbotham (1986) disappears on a universal quantification approach.

The correct logical form of (6) is (8), where the material implication expressed by *goof'(x)⊃~succeed'(x)* corresponds to the clause connection effected by *if* in (6).

(8) ∀x(student'(x)⊃(goof'(x)⊃~succeed'(x)))

Note that (8) is also the semantic representation of one reading (the '∀~ reading' where ∀ has scope over ~) of the clumsy and ambiguous sentence in (9).[5]

(9) Every student will not succeed if he goofs off.

My morphosyntactic implementation of the idea that the appearance of *no* in sentences like (6) is dependent on licensing by sentential negation goes as follows: the abstract lexical item spelled-out as *every* in (9) is spelled-out as *no* in the structure correspond-

[5] The ambiguity of sentences like *Every student will not succeed* is very well known (see, among many others, Horn 1989: 491). The additional *if*-clause in (9) does not change anything about the ambiguity.

ing to the $\forall\sim$ reading of (9) when the negation is not spelled-out at all (i.e. remains phonologically silent). That is, (6) (*No student will succeed if he goofs off*) is a phonological alternative of (9) when (9) expresses the $\forall\sim$ reading;[6] analogously for the corresponding pair of sentences where the *if*-clause is missing (i.e. *No student will succeed* and *Every student will not succeed*). The more general claim is that *no* always spells out $\lambda P[\lambda Q[\forall x(P(x)\supset Q(x))]]$ when this is the denotation of the determiner of a subject noun phrase and when the phrase instantiating $Q(x)$ is headed by negation.

Thus, providing a compositional semantic derivation for the $\forall\sim$ reading of (9) amounts to providing one for (6) as well. This is going to be done in what follows, by ignoring the contribution of *will*, which is irrelevant for the present purposes. In (10), I provide denotations for lexical items and phrases occurring in (9), where the phrase *he goofs off* is an open proposition of semantic type *t* (see e.g. Bott & Sternefeld 2017: 230); *p* and *q* are variables for (open and closed) propositions; $P(x)$ and $Q(x)$ are open propositions.

(10) $\|\text{every}\| = \lambda P[\lambda Q[\forall x(P(x)\supset Q(x))]]$
$\|\text{student}\| = \lambda x[\text{student}'(x)]$
$\|\text{not}\| = \lambda p[\sim p]$
$\|\text{succeed}\| = \lambda x[\text{succeed}'(x)]$
$\|\text{if}\| = \lambda p[\lambda q[p\supset q]]$
$\|\text{he goofs off}\| = \text{goof}'(x)$

The derivation proceeds as in (11) below, where simplifying use is made of the "derived VP rule", type shifting the open proposition $\text{goof}'(x)\supset\sim\text{succeed}'(x)$ into the type of a predicate by prefixing λx to it (see Jacobson 1999: 125, Jacobson 2008: 45; Bott & Sternefeld 2017: 230–231). Following Haegeman (2003: 323–327), I assume that the semantic composition of sentences like (9) proceeds according to the syntactic structure *[Every student [will not succeed [if he goofs off]]]*.

(11) $\|\text{if he goofs off}\|$
$= \lambda p[\lambda q[p\supset q]](\text{goof}'(x))$
$= \lambda q[\text{goof}'(x)\supset q]$
$\|\text{x (will) not succeed}\|$
$= \lambda p[\sim p](\lambda x[\text{succeed}'(x)](x))$
$= \sim\lambda x[\text{succeed}'(x)](x)$
$= \sim\text{succeed}'(x)$
$\|x_1 \text{ (will) not succeed if he}_1 \text{ goofs off}\|$
$= \lambda q[\text{goof}'(x)\supset q](\sim\text{succeed}'(x))$
$= \text{goof}'(x)\supset\sim\text{succeed}'(x)$
$= \lambda x[\text{goof}'(x)\supset\sim\text{succeed}'(x)]$ (by the "derived VP rule"; see above)
$\|\text{every student}\|$
$= \lambda P[\lambda Q[\forall x(P(x)\supset Q(x))]](\lambda x[\text{student}'(x)])$

[6] This presupposes an architecture of grammar with late insertion, where "the phonology which represents the morphological features manipulated by the syntax is provided at PF rather than being present throughout the derivation" (Siddiqi 2009: 7–8). Although the assumption of late insertion is characteristic of the framework of distributed morphology, it does not entail the adoption of this framework (see Williams 2007: 358).

$= \lambda Q[\forall x(\lambda x[student'(x)](x) \supset Q(x))]$
$= \lambda Q[\forall x(student'(x) \supset Q(x))]$
$\|$every $student_1$ (will) not succeed if he_1 goofs off$\|$
$= \lambda Q[\forall x(student'(x) \supset Q(x))](\lambda x[goof'(x) \supset {\sim}succeed'(x)])$
$= \forall x(student'(x) \supset (\lambda x[goof'(x) \supset {\sim}succeed'(x)](x)))$
$= \forall x(student'(x) \supset (goof'(x) \supset {\sim}succeed'(x))) = (8)$[7]

Note that the denotations assumed in (10) obviously also provide the correct denotation for the sentence in (12)a (with *he* being a bound-variable pronoun bound by *every student*), namely (12)b.

(12) a. Every student will succeed if he works hard.
b. $\forall x(student'(x) \supset (work\text{-}hard'(x) \supset succeed'(x)))$

The only difference between (12)b and (8), apart from the change of the second predicate, consists in the presence of negation in front of *succeed'(x)* in the latter, which corresponds to the presence of *not*, phonologically realised in (9) and phonologically null in (6). Moreover, we also get correct results for run-of-the-mill conditionals where the subject is not quantified, but denotes an entity:

(13) $\|Tom_1$ will not succeed if he_1 goofs off$\|$
$= \lambda x[goof'(x) \supset {\sim}succeed'(x)](Tom')$
$= goof'(Tom') \supset {\sim}succeed'(Tom')$

Thus, the problem of compositionality for material implication analyses of conditionals raised by Higginbotham (1986) and the authors in his wake rests on debatable assumptions about the syntactic-semantic role of *no*.

3.2 Arguments going beyond denotation

One of the basic points that are often adduced against material implication analyses of conditionals is the following one, here formulated by Nickerson (2015: 244–245), namely

> the embarrassing problem that, if given the truth value [*sic*] of the material conditional, any conditional with a false antecedent must be considered true; one may find it hard to agree that no matter how "If the moon is made of green cheese" is finished, one must grant that the assertion is true.

Let us consider the sentence in (14).

(14) If the moon is made of green cheese, then the storming of the Bastille took place in 1789.

What is the denotation of the antecedent (15)a and of the consequent (15)b in this sentence?

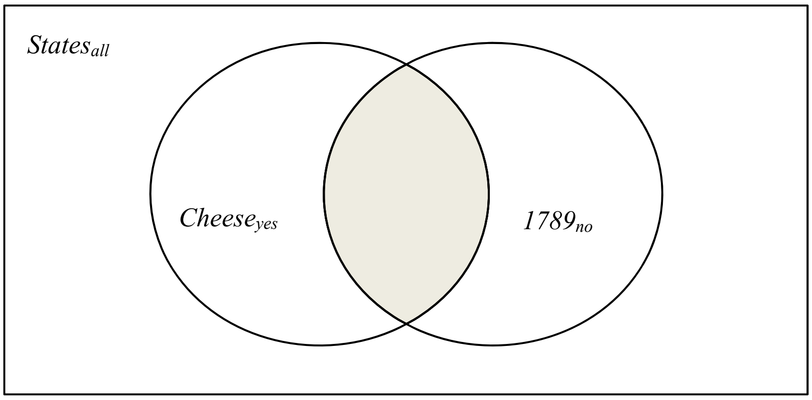
---

[7] In the case where *he* is a free variable, we derive $goof(x) \supset \forall x(student'(x) \supset {\sim}succeed'(x))$; analogously for (12) and (13) below.

(15) a. The moon is made of green cheese.
b. The storming of the Bastille took place in 1789.

The denotation of (15)a is the set of possible states of a communicator's world model in which the moon is made of green cheese. Let us call this set $Cheese_{yes}$. It is a subset of the set of all possible states of the world model, $States_{all}$, and its complement set $Cheese_{no}$ equals the set $States_{all} \backslash Cheese_{yes}$. The denotation of (15)b is the set of possible states of the world model in which the storming of the Bastille took place in 1789. Let us call this set 1789_{yes}, whose complement set is 1789_{no} (= $States_{all} \backslash 1789_{yes}$). A material implication is false only if the antecedent is true and the consequent is false. That is, (14) is false for the possible states of the world model that are in the intersection of $Cheese_{yes}$ and 1789_{no}, i.e. $Cheese_{yes} \cap 1789_{no}$. (14) is true for all other states, i.e. for the states in $States_{all} \backslash (Cheese_{yes} \cap 1789_{no})$, which is its denotation. In terms of the Venn diagram in Figure 1, the denotation of (14) is the set of all possible states minus those that are contained in the set represented by the area in grey.

Figure 1



Venn diagram for the denotation of (14)

Now, what does an assertion of (14) amount to? It amounts to the claim that the state of the world model that is isomorphic to the world, i.e. the state of the world model that actually represents the world, is an element of the denotation of (14), i.e. of $States_{all} \backslash (Cheese_{yes} \cap 1789_{no})$; or, equivalently, that the state of the world model that is isomorphic to the world is *not* an element of $Cheese_{yes} \cap 1789_{no}$. This is, for all we believe, true – and is nothing hard to agree to; if this state of the world model were an element of $Cheese_{yes} \cap 1789_{no}$, it would have to be an element of $Cheese_{yes}$ and of 1789_{no}, which it certainly is not. From now on, I will use the expression *the world is an element of some set* as a shorthand version of *the state of the world model that is isomorphic to the world is an element of some set*.

It is easily seen that a substitution of the consequent of (14) by *the storming of the Bastille took place in 1889* would change the denotation of the conditional sentence to $States_{all} \backslash (Cheese_{yes} \cap 1889_{no})$. The assertion that the world is an element of this set, or, equivalently, that it is *not* an element of $Cheese_{yes} \cap 1889_{no}$, is again true and easy to agree to; if it were an element of $Cheese_{yes} \cap 1889_{no}$, it would again have to be an element of $Cheese_{yes}$, which it certainly is not. And the substitution of any other consequent, itself true or false, if asserted, would have the same result. Arguably, then, whatever it is that is hard to agree to, according to Nickerson, about the case presented by him that involves sentences like (14) is *not* due to an analysis of the denotation of a conditional sentence $P \rightarrow Q$ as one where P and Q are connected as antecedent and consequent in material implication.

I may also note that, as is well known, conditionals like (16)a, i.e. those with a false antecedent and a false consequent are actually used by communicators. Some examples of such conditionals with conventionally used consequents are provided in (16)b.

(16) a. If the moon is made of green cheese, then the storming of the Bastille took place in 1889.
b. If this is a good argument, {I am the queen of Sheeba / pigs can fly / I am a Dutchman}.

As is equally well known, the point of asserting such conditionals is this: given that the denotation of conditionals is defined by material implication, the communicator's and addressee's mutual knowledge that the consequent is false enables the addressee to deduce that the antecedent is false as well, from which the addressee may infer that this is what the communicator intends to convey.

The reason why assertions of sentences like (14) and (16)a are hard to agree to is that they are uninformative for an addressee who is convinced that the moon is not made of cheese. We have just seen that asserting (14) is asserting that the world is a member of the set $States_{all} \backslash (Cheese_{yes} \cap 1789_{no})$; asserting (16)a is asserting that the world is a member of the set $States_{all} \backslash (Cheese_{yes} \cap 1889_{no})$. The point now is that for an addressee who is convinced that the moon is not made of green cheese, the set $Cheese_{yes}$ is identical to the empty set. For such an addressee, the set of possible states of the world model in which the moon is made of green cheese is empty. This gives rise to the following equations:

(17) a. $\mathrm{States_{all}} \backslash (\mathrm{Cheese_{yes}} \cap 1789_{no}) = \mathrm{States_{all}} \backslash (\varnothing \cap 1789_{no}) = \mathrm{States_{all}} \backslash \varnothing = \mathrm{States_{all}}$
b. $\mathrm{States_{all}} \backslash (\mathrm{Cheese_{yes}} \cap 1889_{no}) = \mathrm{States_{all}} \backslash (\varnothing \cap 1889_{no}) = \mathrm{States_{all}} \backslash \varnothing = \mathrm{States_{all}}$

Note that for those who are convinced that the storming of the Bastille took place in 1789, the set 1789_{no} is identical to the empty set as well; and the set 1889_{no} would be identical to $States_{all}$ for such an addressee. Substituting $\varnothing$ for 1789_{no} in (17)a and substituting $States_{all}$ for 1889_{no} in (17)b, however, would not change anything about the result that the expression is equal to $States_{all}$ in both cases. Hence, irrespective of what they think about when the storming of the Bastille took place, to an addressee who is convinced that the moon is not made of green cheese, an assertion of (14) or (16)a amounts to the assertion that the world is a member of the set $States_{all}$. This is completely uninformative. For that the state of a person's world model that is supposed to be isomorphic to the world is a possible state of that person's world model is true by definition and thus necessarily true.

The reference to uninformativeness here is, of course, a reference to the violation of a principle of informativeness which, in some guise or another, is part of any theory of inferential pragmatics. Note that the oddness of an utterance of sentences like those in (14) or (16)a follows straightforwardly from such a principle – given one is convinced of the falsity of the antecedents and given the material implication semantics – without the need to invoke complex pragmatic machinery.[8] Uninformativeness will also be identified as the source of the unacceptability of natural language instantiations of deductively valid argument forms involving material implication further below.

The point underlying Nickerson's (2015) observation discussed above is also made by von Fintel (2011: 1519), in a probabilistic guise, though. Von Fintel writes:

> One of the "paradoxes of material implication" (not paradoxes in the sense of a formal system that is internally incoherent, but shortcomings in the match between the formal analysis and the natural language data it might be thought to cover) is that disbelief in the antecedent *p* should result in a proportionate willingness to believe *if p, q*, no matter what the consequent *q* might be, because as soon as the antecedent is false, material implication makes the conditional true no matter what the consequent is. Clearly, this does not correspond to the actual behavior of language users. Just because I find it unlikely in the extreme that the sun will explode in a minute from now, I do not find it likely at all that if the sun explodes in a minute from now, a Vogon Constructor spaceship will come and rescue all of Earth's inhabitants.

Von Fintel's example concerns the propositions in (18)a and b and the denotations of the sentences used to express these propositions.

(18) a. 'The sun will explode in a minute from now'
b. 'If the sun explodes in a minute from now, a VC spaceship will come and rescue all of Earth's inhabitants'

Let us again call the set of all possible states of von Fintel's world model $States_{all}$. Let us call the set of possible states of his world model of which the proposition in (18)a is true $Explode_{yes}$;[9] this proposition is the antecedent of the proposition in (18)b. Let us call the set of possible states of his world model of which the consequent of (18)b is true $Rescue_{yes}$; the complement set of $Rescue_{yes}$ be $Rescue_{no}$. Then the set of possible states of von Fintel's world model in which (18)b is true is $States_{all}\backslash(Explode_{yes}\cap Rescue_{no})$. Now, in probabilistic approaches to conditional reasoning "[p]robabilities are interpreted as degrees of belief" (Nickerson 2015: 205) and, the other way around as well – degrees of belief are interpreted as probabilities – as becomes clear from Nickerson's (2015: ch. 9, 10) discussion of the relevant research. For von Fintel (2011), the probability *Pr* of the world being in $Explode_{yes}$, is extremely low ("I find it unlikely in the extreme that the sun will explode in a minute from now"). Let us call this probability $Pr(Explode_{yes})$. For the sake of concreteness, let us assume $Pr(Explode_{yes}) = 10^{-10}$. The probability of the world being in $(Explode_{yes}\cap Rescue_{no})$ is at most the probability of $Explode_{yes}$, i.e. at most 10^{-10}. Since the probability of the world being in $States_{all}$, i.e. $Pr(States_{all})$, is 1 by

[8] It is clear that the uninformativeness of a sentence does not necessarily lead to the judgement that asserting it is odd. The utterance of tautologies such as *Boys will be boys*, for instance, is often not found to be odd. Note, however, that according to Wierzbicka (1987: 95), tautologies are "partly conventional and language specific" and literal translations of sentences like *Boys will be boys* into other languages than English are judged to be unacceptable by speakers of those languages (see Wierzbicka 1987: 96). Hence, I assume that uninformativeness *is* a pragmatic anomaly unless the uninformative utterance is invested with a conventional implicature or with a non-conventional implicature that hinges on the uninformativeness.

[9] Here and below I do not always make it explicit that a set that carries the index $_{yes}$ is also always the denotation of the clause or sentence that expresses the respective proposition.

definition, the probability of the world being in $States_{all}\backslash(Explode_{yes}\cap Rescue_{no})$ is at least 1 - 10^{-10} = 0.999999999, an extremely high probability. Thus, while my assessment of the probability of the antecedent *p* is the same as that of von Fintel, I find it *extremely likely* that the model of the world that is isomorphic to the world is in the denotation of the sentence *If the sun explodes in a minute from now, a VC spaceship will come and rescue all of Earth's inhabitants*, i.e. in the set $States_{all}\backslash(Explode_{yes}\cap Rescue_{no})$. Thus, if one talks about denotations, "disbelief in the antecedent *p*" *does* "result in a proportionate willingness to believe *if p, q*, no matter what the consequent *q* might be", contrary to what von Fintel aims to demonstrate.

This reasoning leads to a very different result than the one championed by Edgington (2007). One of her main arguments against truth functional accounts of conditionals is the following, where *W* abbreviates the proposition 'the Queen is worrying about my [i.e. Edgington's] whereabouts':

> Suppose, having read in the newspaper of her day's engagements, I'm about 90% certain that the Queen isn't at home yet ($\neg Q$); then I must be at least 90% certain that at least one of the propositions $\{\neg Q, W\}$ is true, i.e. at least 90% certain that $\neg Q \vee W$, i.e. at least 90% certain that if she is at home, she is worrying about my whereabouts (on the truth-functional reading of that thought). […]
>
> Contrary to this account, any sane ordinary subject not on intimate terms with royalty, who thinks the Queen isn't at home yet, rejects the conditional 'But if she is, she'll be worried about where I am'. We do not use conditionals as this account would have it. But that empirical observation is not the main point, which is this: we would be intellectually disabled without the ability to discriminate between believable and unbelievable conditionals whose antecedents we think are unlikely to be true. The truth-functional account deprives us of this ability: to judge *A* unlikely is to commit oneself to the probable truth of $A \supset B$. (135)

In other words, while the probability of $P\supset Q$ is the sum of the probability of *P* and *Q* being both true plus the probability of *P* being false, our assessment of 'the probability of $P\rightarrow Q$' (i.e. the probability of a conditional sentence being true) and thus of 'the degree of belief that $P\rightarrow Q$' does not appear to be affected in such a way that this probability and degree of belief increase with an increase of our assessment of 'the probability of not-*P*', i.e. of 'the degree of belief that not-*P*'. I will come back to and reject this argument in Section 4 below.

Evans & Over (2004: 19–20) discuss the conditional sentence in (19).

(19) If it rains, then the plants will die.

They mention the valid argument form in (20)a and claim that the corresponding argument in (20)b is absurd.

(20) a. $\sim p$
$\therefore\ p\supset q$
b. It will not rain.
Therefore, if it rains, then the plants will die.

This constitutes one of their reasons for rejecting the material implication analysis of conditional constructions. They argue:

> Suppose that there has been a drought and the plants are starting to die as a result. In this case, it seems absurd that [(19)] should be true […] merely because it will not, in fact, rain. Equally, we will not assert [(19)] merely because we believe strongly that the drought will continue. Yet if [(19)] is a truth functional conditional, [(19)] would be true, and so we would apparently be justified in asserting [(19)] on the mere basis that the drought will continue. (Evans & Over 2004: 20)

Let us look at their example in terms of the denotations and the deduction involved and the inference that is based on the deduction.

Let us consider what the propositions expressed by (21)a on the one hand and (21)b on the other hand denote.

(21) a. It will not rain.
     b. If it rains, then the plants will die.

(21)a denotes the set of possible states of the communicator's world model in which it will not rain. Let us call this set $Rain_{\text{no}}$. Analogically, the antecedent of (21)b denotes $Rain_{\text{yes}}$ and the consequent of (21)b denotes Die_{yes}. Let us assume the complement set of Die_{yes} to be Die_{no}. (21)b as a whole denotes $States_{\text{all}} \backslash (Rain_{\text{yes}} \cap Die_{\text{no}})$. The deduction in (22) – understood as "a relation among propositions", as Harman (2002) says (see Section 2 above) – states validly that $Rain_{\text{no}}$ is a subset of $States_{\text{all}} \backslash (Rain_{\text{yes}} \cap Die_{\text{no}})$, i.e. any element of $Rain_{\text{no}}$ is also an element of $States_{\text{all}} \backslash (Rain_{\text{yes}} \cap Die_{\text{no}})$, i.e. if a possible state of the world model is an element of $Rain_{\text{no}}$, then it is also an element of $States_{\text{all}} \backslash (Rain_{\text{yes}} \cap Die_{\text{no}})$.

(22) 'It will not rain'
     ∴ 'If it rains, then the plants will die'

So far, there is nothing absurd about this deduction. There continues to arise nothing absurd about an inference that makes use of the deduction in (22), if we think about it in the following way: Conceive of the assertion of 'It will not rain' as the claim that the world is an element of $Rain_{\text{no}}$. Accepting this assertion as true commits us to accepting that the world is an element of $States_{\text{all}} \backslash (Rain_{\text{yes}} \cap Die_{\text{no}})$ and thus to also accepting as true an assertion of 'If it rains, then the plants will die'. Again, there is nothing absurd about this inference.

The absurdity noted by Evans & Over (2004) is due to the fact that the inference is uninformative. Someone who maintains that the world is an element of $Rain_{\text{no}}$, more precisely, that the state of their world model that is isomorphic to the world is an element of the set of possible states of the world model in which it will not rain, is committed to maintaining that $Rain_{\text{yes}}$ is identical to the empty set: there is no possible state of the world model in which it rains for a person who maintains that the set of possible states of the world model contains only states in which it does not rain. The inference thus boils down to the conclusion that the world is an element of $States_{\text{all}} \backslash (\varnothing \cap Die_{no}) = States_{all}$. This conclusion is completely uninformative. It expresses something that is known by the reasoning person right from the start by definition: the state of the world model that is isomorphic to the world is a possible state of the world model. Inferences serve the purpose of gaining insight about what proper subset(s) of $States_{all}$ the world is an element of. This has not been achieved by the inference just traced. Consequently, it is the pragmatic requirement that assertions be informative that makes "asserting [(19)]

on the mere basis that the drought will continue" in Evans & Over's (2004) example pragmatically absurd.

4 True conditionals with false antecedents and false consequents

If my interlocutor, a 5-year old child, say, asserted (23), I would react by saying *No. That's not true.*

(23) If 2 + 2 = 5, then 2 + 3 = 4.

I would do so despite the fact that I am of the opinion that the proposition expressed by (23) is true. For both *2 + 2 = 5* and *2 + 3 = 4* are false in any of the possible states of my world model so that their denotations, let us call them the sets $2{+}2{=}5_{yes}$ and $2{+}3{=}4_{yes}$, are both identical to the empty set ∅, and hence, $2{+}3{=}4_{no}$, the complement set of $2{+}3{=}4_{yes}$, is identical to $States_{all}$, giving us (24) as the denotation of (23) under the assumption that the denotation of $p \rightarrow q$ is that of $p \supset q$.

(24) $\mathrm{States_{all}} \backslash (2{+}2{=}5_{\mathrm{yes}} \cap 2{+}3{=}4_{\mathrm{no}}) = \mathrm{States_{all}} \backslash (\emptyset \cap \mathrm{States_{all}}) = \mathrm{States_{all}} \backslash \emptyset = \mathrm{States_{all}}$

That is, the proposition expressed by (23) is true in all possible states of my world model. By contrast, if the same interlocutor asserted (25), I would react by saying *That's true*, probably adding *Only, 2 plus 2 does not equal 5.*

(25) If 2 + 2 = 5, then 2 + 3 = 6.

In both (23) and (25), which are of the same type in all respects, both the antecedent and the consequent are false.

What is the reason for the difference in my reaction to (23) and (25) despite their similarities? The reason is that the subject of the two sentences *That's not true* and *That's true* does not refer to the respective proposition expressed but to some implicature arising from asserting (23) and (25), or, in terms of speech act theory, to some felicity condition associated with the speech act performed by asserting them.[10] Let us call this speech act arguing. My point is that assertions of $P \rightarrow Q$ are typically performances of the speech act of arguing – more specifically arguing from the proposition expressed by *P* to the proposition expressed by *Q* – and that one of the felicity conditions for this speech act type consists in there being grounds for such an argument. Such grounds may be of various kinds, some of which discussed under the notion 'dependence' by Sanford (2003: ch. 14). The existence of grounds for the argument is implicated by the performance of this type of speech act. It appears that especially in those cases where the truth or falsity of *P* and/or *Q* is not known by the communicator, or where the truth or falsity of *P* and/or *Q* is not established in the discourse, the point of asserting $P \rightarrow Q$ is precisely that of conveying the implicature, i.e. that there are grounds for the argument. And such grounds may be identifiable even if the addressee knows *P* and/or *Q* to be false. This is

[10] See Zucchi (1995: 50): "Conventional implicatures carried by a particular lexical item or syntactic construction are often treated as *felicity conditions* for the use of that item or construction, i.e., as requirements imposed by that item or construction on contexts appropriate for its use". See Barker (1995: 202): "A conditional can be negated without uttering a compound sentence. In reply to U's utterance of 'if P, Q', I might assert 'That's not so'. Does H dispute the truth of an asserted proposition or the correctness of an utterance? Intuitions do not favour either option".

what happens in the situation where I am the addressee of (23) and (25). I do see grounds for the argument from *P* to *Q* in (25) – having to do with the fact that 3 is the successor of 2 and 6 is the successor of 5 – while I do not see such grounds in (23). Thus, the referent of the subject of the sentences *That's (not) true* uttered by me in response to (23) and (25) appears to be the implicature that there are grounds for the argument from *P* to *Q*.

The preceding explanation of my reaction to assertions of (23) and (25) is based on the premise that these assertions of $P \rightarrow Q$ manifest the speech act of arguing from *P* to *Q*. Arguing from *P* to *Q* is claiming that the truth of *Q* can be inferred from the truth of *P*. That is, where arguing from *P* to *Q* as a speech act and thus inference is concerned, we hypothetically assume *P* to be true. On this basis, we have an explanation for the observation discussed in Section 3.2 that our assessment of 'the probability of $P \rightarrow Q$' and of 'the degree of belief that $P \rightarrow Q$' does not commonly appear to conform to the probability of $P \supset Q$. While the probability of $P \supset Q$ is computed by adding the probability of *P* being false to the probability of *P* and *Q* being both true, the assessment of the probability of, or of the degree of belief in, an argument from *P* to *Q* is based on the hypothetical assumption that *P* is true. And we consider this probability and this degree of belief to be low to the extent that we do not see what grounds there may be for the argument from *P* to *Q*. For example, we would have to believe in the possible existence of a VC spaceship, we would have to believe in its possibly having been designed in such a way that it can take on board all of Earth's inhabitants and we would have to believe that, possibly, the extraterrestrial species that has designed it actually intends to employ it for that purpose in order to accept that there may be grounds for an argument from (26)a to (26)b.

(26) a. 'The sun will explode in a minute from now'
b. 'A VC spaceship will come and rescue all of Earth's inhabitants'

And I must at least assume that the Queen is aware of my existence in order to grant that there may be grounds for the argument from (27)a to (27)b.

(27) a. 'The Queen is at home'
b. 'The Queen is worrying about my whereabouts'

My point is that, when asked to assess 'the truth of $P \rightarrow Q$', 'the probability of $P \rightarrow Q$', or 'the degree of our belief that $P \rightarrow Q$', we are prone to interpret this as follows, respectively: is it true that, or how probable is it that, or what is the degree of your belief that there are grounds for an argument from *P* to *Q*. That is, we are prone to interpret the question after 'the truth, probability, degree of our belief that $P \rightarrow Q$' rather as a question aiming at the speech act of arguing from *P* to *Q* than at what $P \rightarrow Q$ denotes. Yet, this does not prevent that we can be induced to accept that the probability of what $P \rightarrow Q$ denotes is the probability of $P \supset Q$, as I showed in Section 3.2 above with respect to von Fintel's (2011) spaceship example. The theory that $P \rightarrow Q$ denotes $P \supset Q$ does not entail "intellectually disabled" hypothetical human interlocutors, "without the ability to discriminate between believable and unbelievable conditionals whose antecedents we think are unlikely to be true", as Edgington (2007: 135) claims. The unlikeliness of *P*'s truth simply has no role to play in our assessment of the believability of an argument from *P* to a consequent *Q* performed by an assertion of $P \rightarrow Q$, whereas it does play a role in the assessment of the probability of what $P \rightarrow Q$ denotes, namely $P \supset Q$.

5 Indicative vs. subjunctive conditionals: a novel outlook from a material implication perspective

Conditionals are commonly categorised as belonging either to the kind that is often called 'indicative' or, as far as English is concerned, 'open' (see Mittwoch et al. 2002: 739–748, or to the kind that is often called 'subjunctive', or, as far as English is concerned, 'remote' (see Mittwoch et al. 2002: 748–755).[11] This last section before the conclusion presents some ideas from the perspective of a material implication approach about how we may think of the denotation of subjunctive conditionals on the basis of the distinction between a communicator's actual world model and their alternative world models. In the last part of this section, these ideas are employed in a critical discussion of a recent study of counterfactual conditionals (Ciardelli et al. 2018).

The logical space for indicative conditionals is the set of all possible states of the actual world model of a communicator, so far called $States_{all}$. The logical space for subjunctive conditionals is the set of all possible states of all alternative world models of a communicator. I call this set $States_{alt}$ and, from now on, use the name $States_{act}$, rather than $States_{all}$, for the set of all possible states of a communicator's actual world model. The assertion of an indicative conditional sentence $P \rightarrow Q$ conventionally implicates that the denotation of $P \rightarrow Q$ is a subset of $States_{act}$ and that P expresses a hypothetical specification of a component of the communicator's actual world model that is unspecified. A hypothetical specification of an unspecified world model component does not contradict the unspecified component; it is compatible with it. The assertion of a subjunctive conditional sentence $P \rightarrow Q$ conventionally implicates that the denotation of $P \rightarrow Q$ is a subset of $States_{alt}$. Let P_{yes} be the set denoted by P and Q_{no} be the complement set of the set denoted by Q of an indicative or subjunctive conditional $P \rightarrow Q$. The denotations of the respective indicative and subjunctive conditionals, then, are as given in (28).

(28) a. Denotation of an indicative conditional $P \rightarrow Q$:
$\text{States}_{\text{act}} \setminus (\text{P}_{\text{yes}} \cap \text{Q}_{\text{no}})$
b. Denotation of a subjunctive conditional $P \rightarrow Q$:
$\text{States}_{\text{alt}} \setminus (\text{P}_{\text{yes}} \cap \text{Q}_{\text{no}})$

The pragmatic complexity of a subjunctive conditional $P \rightarrow Q$ is due to two aspects that differentiate it from an indicative conditional: the first is that the logical space for the subjunctive conditional is not only the set of all possible states of one – the actual – world model, but that of many – namely all alternative – world models; the second is that the set of alternative world model components that are specified contradictorily to actual world model components may or may not contain the component associated with P or Q. That is, if we call a component c^* that is specified contradictorily to its specification in the actual world model – i.e. one that is false in the communicator's actual world model – a counterfactual component and if we call a proposition that denotes the

[11] In English, the grammatical evidence that enables the identification of an indicative or of a subjunctive conditional arises from certain patterns of matching between the grammatical form (tense, aspect, modality) of the verb group (verb and auxiliaries) in the antecedent and in the consequent on the one hand and the time reference of the antecedent and of the consequent on the other hand (see e.g. Mittwoch et al. 2002: 743–745, 751–755). There are cases, though, where a conditional sentence is ambiguous between an indicative and a subjunctive reading (see e.g. Mittwoch et al. 2002: 754–755).

set of states of all alternative world models that contain *c** a counterfactual proposition, then *P* may or may not be counterfactual and *Q* may or may not be counterfactual either.

The following example proves this, that is, it proves that the assertion of a subjunctive conditional sentence neither entails nor conventionally implicates the falsity of the antecedent or the consequent in the communicator's actual world model, i.e. their counterfactuality. The example concerns the discussion of a game of chess where black's last move was Ke6 (i.e. the black king was moved to square e6) upon which white played Ke4 and won.

(29) A: Let's see what would have happened in case black had played Kc7 instead of Ke6.
B: a. If white had played Kc5, white would have lost.
b. If white had played Ke4, white would have lost.
c. If white had played Kc5, white would have won.
d. If white had played Ke4, white would have won.

None of B's potential utterances of a subjunctive conditional in (29) is unacceptable or odd. In (29)Ba, both *P* and *Q* are false in B's actual world model, in (29)Bb, *P* is true and *Q* is false in B's actual world model, in (29)Bc, *P* is false and *Q* is true in B's actual world model, and in (29)Bd, both *P* and *Q* are true in B's actual world model. Thus, the assertion of a subjunctive conditional $P \rightarrow Q$ cannot be said to entail or conventionally implicate the counterfactuality of *P* or *Q*.[12] Note also that, analogously to an indicative conditional, *P* here expresses a hypothetical specification of a component of an alternative world model that is unspecified, namely the component concerned with white's move in response to black's counterfactual move Kc7.

Yet, as is well known, in many communicative situations the utterance of a subjunctive conditional sentence is, and is to be, interpreted as conveying that either the antecedent or both the antecedent and the consequent are false in the communicator's actual world model, i.e. counterfactual. Hence, there usually is an implicature to this effect, although no conventional one. The utterance of a subjunctive conditional sentence such as *If white had played Ke4, white would have won* will commonly be taken to convey the counterfactuality of its antecedent and its consequent given that the context does not specify that antecedent and consequent are factual (i.e. true in the communicator's actual world model) – that is, in cases different in this respect from (29) above. The important point for the purposes of the present paper is this: saying that the logical space for subjunctive conditionals is the communicator's set of all possible states of all alternative world models requires that all these states comprise at least one component that is specified contradictorily to the specification of at least one component of the communicator's set of possible states of their actual world model (counterfactual component); it is not necessarily the component associated with the antecedent or the consequent of the subjunctive conditional, though, that is counterfactual. However, it appears that, if the context does not make manifest to the interpreter what the counterfactual components are,

[12] Anderson's (1951: 37) famous arsenic example also shows this: "In the investigation of Jones' death, a doctor might say 'If Jones had taken arsenic, he would have shown just exactly those symptoms which he does in fact show'".

the interpreter will commonly assume that they are (at least) the components associated with the antecedent and the consequent.[13]

The point of asserting an indicative conditional is to be informative about possible states of the communicator's actual world model given that one of its unspecified components gets specified in the way expressed by the antecedent. Let us consider (30), with respect to which von Fintel (2011: 1518) writes that "most people would accept [it] as true (since they know that Kennedy was assassinated)".[14]

(30) If Oswald didn't kill Kennedy, someone else did.

The actual world model of the people von Fintel has in mind consists of possible states in all of which Kennedy was assassinated; in some of these Oswald is the assassin while in others he is not. In other words, the model component concerned with whether or not Kennedy was assassinated is specified while the component concerning the identity of the assassin is unspecified. Note that uttering (30) neither entails nor implicates anything about a communicator's alternative world models. In particular, nothing is asserted, entailed or implicated about whether Oswald killed Kennedy, someone else did or nobody did in the communicator's alternative world models. (31), which is the minimally different subjunctive version of (30), is commented on by von Fintel (2011: 1518) by writing that "only the most conspiracy-minded would accept [it]".

(31) If Oswald hadn't killed Kennedy, someone else would have.

What is the explanation for the difference between (30) and (31)? It is this.

The denotation of (30) is (32)a and that of (31) is (32)b.

(32) a. $\text{States}_{act}\backslash(\text{Oswald-not-kill-Kennedy}_{yes}\cap\text{someone-else-kill-Kennedy}_{no})$
b $\text{States}_{alt}\backslash(\text{Oswald-not-kill-Kennedy}_{yes}\cap\text{someone-else-kill-Kennedy}_{no})$

The set *Oswald-not-kill-Kennedy*$_{yes}$ contains all those possible states of the actual and alternative world models, respectively, in which Kennedy was not killed by anyone as well as those in which he was killed by someone else than Oswald. The set *someone-else-kill-Kennedy*$_{no}$ contains all those possible states of the actual and alternative world models respectively in which Kennedy was killed by Oswald as well as those in which he was not killed by anyone. Their intersection thus contains all those states in which Kennedy was not killed by anyone. Note that this intersection is subtracted from *States*$_{act}$ and *States*$_{alt}$, respectively, in the denotations (32)a-b. Hence, asserting the indicative version (30) amounts to the claim that the actual world is isomorphic to a possible state of the actual world model in which Kennedy was assassinated by someone, which is accepted by most people, as pointed out by von Fintel (2011) (see above). Asserting the subjunctive version (31) amounts to the claim that any possible state of any alternative world is one in which – just like with (30) – Kennedy was assassinated by someone. This is something that is not accepted by most people since most people entertain models of alternative worlds in which Kennedy was not assassinated at all.

[13] The context for all of B's potential utterances in (29) above makes it manifest that at least the component associated with 'Black played Kc7' is counterfactual, i.e. it is a component of the states that belong to the set of all possible states of all alternative world models.
[14] See Starr (2019: note 2) for the history of this example.

The claim defended in this section is that there is no difference between the denotation of an indicative conditional sentence and its minimally different subjunctive counterpart, if 'denotation' is considered in terms of sets of possible states of the communicator's actual and alternative world models, respectively. This approach is now employed to comment on results of an experiment recently reported by Ciardelli et al. (2018). These authors use their results to argue that an account of the meaning of subjunctive conditionals requires a non-classical semantics where $\sim P \vee \sim Q$ and $\sim (P \& Q)$ are not equivalent. They provide an account based on inquisitive semantics (see Ciardelli et al. 2019).

In the experiment, native speakers of English were asked to evaluate the subjunctive conditionals in (34)a–e below as true, false or indeterminate in the context of the text in (33) and the wiring diagram mentioned there (Ciardelli et al. 2018: 587).

(33) Imagine a long hallway with a light in the middle and with two switches, one at each end. One switch is called switch *A* and the other one is called switch *B*. As this wiring diagram shows, the light is on whenever both switches are in the same position (both up or both down); otherwise, the light is off. Right now, switch *A* and switch *B* are both up, and the light is on. But things could be different …

(34) a. If switch *A* was down, the light would be off.
b. If switch *B* was down, the light would be off.
c. If switch *A* or switch *B* was down, the light would be off.
d. If switch *A* and switch *B* were not both up, the light would be off.
e. If switch *A* and switch *B* were not both up, the light would be on.

Each participant in the experiment was presented one of the target sentences in (34)a–e preceded or followed by the filler sentence in (35).

(35) If switch *A* and switch *B* were both down, the light would be off.

Only the judgements for the target sentences of those participants were taken into further consideration who gave the response 'false' for the filler sentence.[15] The results (rounded) were as shown in Table 2 (see Ciardelli et al. 2018: 588).

Table 2

Results from an experiment by Ciardelli et al. (2018)

	T	F	I	n
(34)a	66%	2%	32%	256
(34)b	65%	3%	32%	235
(34)c	69%	4%	27%	362
(34)d	22%	37%	41%	372
(34)e	22%	32%	47%	200

T = true; F = false; I = indeterminate; n = number of evaluations

[15] Ciardelli et al. (2018: 584) claim that "[o]ur fillers were all uncontroversial in terms of naturalness and truth value, and thus the response to them was an indication of whether participants paid enough attention to stimuli". Actually, it follows from my ensuing discussion of the authors' results that the evaluation of the filler is as little uncontroversial as that of the target sentences.

Within the framework of the present paper, especially of what precedes in the present section, the results can be explained as follows. The final assertion "But things could be different" in the context for the task as well as the fact that target and filler sentences are subjunctive conditionals invite the interpreter to consider alternative world models of theirs that differ from the model that is defined by what precedes this assertion. Let us call the latter model *m* and let us call *L* the set of alternative world models that deviate from *m*. The antecedent of the respective conditional sentence informs the interpreter of one respect in which the models in *L* are to be conceived as different from *m*. Whereas both switches A and B are up in *m*, this model component, which is presupposed to exist in the models in *L*, is implicated by the assertion of the respective conditional sentence to be specified differently in these models. (If *m* were an actual world model, we would say that the corresponding switch-A-B components of the models in *L* were specified counterfactually.) It is important to see now that, in principle, the models in *L* may, though need not, deviate with respect to other model components from *m* in addition to the switch-A-B components. Some of these other components will be considered irrelevant for the light being on or off (such as, potentially, components concerned with whether or what Churchill drank in the evening of Dec 20, 1952), others will be considered relevant (such as, for example, the components concerned with the wiring of the switches). I refer to the model components that are considered relevant for whether the light is on or off as r-components.

One basis on which to judge (34)a true is its evaluation at a model of *L* where there is no difference to *m* as far as r-components are concerned except for the setting of switch A. A first reason for a participant to judge (34)a false is its evaluation at a model of *L* where there is at least one r-component in addition to the setting of switch A that is specified differently than in *m*; more specifically, there is at least one r-component that is specified in such a way that the down-setting of switch A contributes to the light being on (or does not prevent the light from being on) – for example, switch B may be down as well, or the wiring may be different, so that switch A's being down and switch B's being up lead to the light being on. A second reason for judging (34)a false is an interpretation of it as meaning 'if switch A was down, the light would be necessarily off (i.e. off at all models of *L*)', i.e. the universal interpretation. From the discussion of the first reason it follows that this is false. Those subjects who judge (34)a as indeterminate convey that the sentence is true at some models of *L* and false at others. One factor that contributes to the fact that many more participants judged (34)a to be true than false and indeterminate is that the context leaves unspecified what model(s) of *L* the sentence has to be evaluated at – 1) any or every model of *L*; 2) a model where there is no difference to *m* as far as r-components are concerned except for the setting of switch A; 3) any other model of *L* where there is at least one more difference to *m* as far as r-components are concerned in addition to the setting of switch A. The interpreter is forced to make assumptions in this respect. It is my claim now that assuming option 2) from the three options just listed is the pragmatically most salient choice. The interpreter is entitled to infer that if the communicator had intended the interpreter to interpret the assertion at a model of *L* that differs from *m* in more respects than only the setting of switch A, they should have mentioned it.[16] However, not mentioning it may also mean that we are allowed to assume it, hence that we may evaluate the sentence at any model of *L*. But if

[16] See the effects of the first maxim of quantity in connection with the co-operative principle in Grice (1989b), or see any post-Gricean pragmatic theory that derives these effects.

we are allowed to evaluate the sentence at any model of *L*, we are also allowed to evaluate it at any specific model of *L* at which the down-setting of switch A is compatible with the light being on. The rising complexity of these reasonings corresponds to the decreasing number of corresponding evaluations in line with some version of the pragmatic principle that the more effort it needs to infer an interpretation of an utterance the less probable it is that this interpretation was intended by the communicator (see Grice 1989b; Sperber & Wilson 1995). What has just been said with respect to (34)a holds analogously for (34)b.

In principle, sentence (34)c opens up the same array of possibilities for interpretation and thus options for evaluations as (34)a–b. But the characterisation of the model(s) of *L* that is/are most likely to be chosen as the one(s) at which the sentence is evaluated, according to the pragmatic principle just mentioned, is more complex than in the cases of (34)a–b. Now such a model is one where there is no difference to *m* as far as r-components are concerned except for the setting of either switch A alone or of switch B alone or of both switches together. The sentence is true at those models where switch A alone or switch B alone is set differently than in *m*, but it is false at those models where both switches are set differently than in *m*. This might lead us to expect fewer 'true' judgements for (34)c than for (34)a–b. On the other hand, there very likely were interpreters who interpreted (34)c as involving exclusive *or*. This interpretation disqualifies those models of *L* as the most likely chosen ones for the evaluation of the sentence in which both switches A and B are down. This has the consequence that only models at which the sentence is true are considered. My point is this: the explicit mention of switch A and switch B in connection with *or* in (34)c induced more participants to disregard the models in which both switches are down than in the interpretation of (34)a–b where switch B or switch A respectively is not explicitly mentioned.[17]

Sentences (34)d–e are multiply ambiguous, as Ciardelli et al.'s (2018: 593) discussion shows. For example, their joint antecedent (*switch A and switch B were not both up*) may be interpreted to mean 'switch A and switch B are in any one of the three possible positions apart from both up' or, with an accent on *both*, 'one of switch A or switch B is up, but not both'. This in combination with the various possibilities for choosing alternative world models at which to evaluate the sentences in analogy to the possibilities discussed above in connection with (34)a renders the distribution of the evaluations plausible. 'Indeterminate' is the most frequently chosen option, since one does not know which one of the readings of the sentence one ought to choose and one does not know what model to evaluate it at. 'False' is a good choice as well, since there are indeed many ways for the sentences to be false depending on the reading chosen and on the model used to evaluate them at. Moreover, if the sentences are interpreted universally ('if switch A and switch B were not both up, the light would necessarily be {off, on}'), they are false. But there are also ways for the sentences to be true, again depending on the reading chosen and on the model used to evaluate them at. In view of these considerations the substantially fewer 'true' judgements for (34)d in comparison to (34)c –

[17] Ciardelli et al. (2018: 592) dismiss the possibility of an exclusive interpretation of *or* as the *primary* factor for the difference in the number of 'true' judgements for (34)c as opposed to (34)d. But even if we were to grant this, it does not follow that there is not a more or less substantial share of participants who interpreted *or* exclusively in (34)c, thus contributing to the number of 'true' judgements based on a model that differs from *m* only in the setting of switch A alone or B alone respectively.

which are, on the appropriate reading of the antecedent of (34)d, truth-conditionally equivalent according to classical propositional logic – do not constitute evidence for Ciardelli et al.'s (2018: 615) claim that "our experimental results show that de Morgan's law $\neg(\phi \wedge \psi) \equiv \neg\phi \vee \neg\psi$ does not hold in natural language: a compositional account of our results requires a theory of propositional connectives that assigns different semantic values to $\neg(A \wedge B)$ and $\neg A \vee \neg B$".

In sum, this discussion of Ciardelli et al.'s (2018) empirical results suggests that they can be accounted for by means of the alternative world model approach to subjunctive conditionals taken in the present section. As this approach is based on classical propositional logic and on the assumption that the denotation of $P \rightarrow Q$ is equivalent to $P \supset Q$, the discussion also suggests that a semantics based on classical propositional logic in combination with pragmatic considerations is sufficient for the explanation of the meaning of conditionals. An augmentation of the logical apparatus as in inquisitive semantics, the apparatus employed by Ciardelli et al. (2018), does not appear to be necessary.

6 Conclusion

The immensely rich philosophical, psychological and linguistic literature on the meaning of conditionals is replete with attacks on the material implication approach. To address many of the attackers' arguments in a single paper is impossible. The purpose of the present paper has been to undermine some of these, thus to supplement previous defences and to open up a perspective for a material implication analysis of subjunctive conditionals. The paper suggests that the resources of classical propositional logic in combination with basic and simple pragmatic principles may not be exhausted when it comes to a unified account of the meaning of indicative and subjunctive conditionals. The requirement to keep the technical machinery of our theoretical frameworks as simple as possible warrants the present endeavour.

References

Abbott, Barbara. 2004. Some remarks on indicative conditionals. In Robert B. Young (ed.), *Proceedings of SALT 14*, 1–19. Washington, DC: Linguistic Society of America.

Abbott, Barbara. 2010. Conditionals in English and FOPL. In Dingfang Shu & Ken Turner (eds.), *Contrasting meaning in languages of the East and West*, 579–606. Oxford: Peter Lang.

Anderson, Alan Ross. 1951. A note on subjunctive and counterfactual conditionals. *Analysis* 12(2). 35–38.

Ariel, Mira. 2010. *Defining pragmatics*. Cambridge: Cambridge University Press.

Barker, Stephen J. 1995. Towards a pragmatic theory of 'if'. *Philosophical Studies* 79(2). 185-211.

Barker, Stephen. 1997. Material implication and general indicative conditionals. *The Philosophical Quarterly* 47. 195–211. https://doi.org/10.1111/1467-9213.00055 (accessed 25 June 2019).

Besnard, Philippe & Anthony Hunter. 2001. A logic-based theory of deductive arguments. *Artificial Intelligence* 128. 203–235. https://doi.org/10.1016/S0004-3702(01)00071-6 (accessed 25 June 2019).

Bott, Oliver & Wolfgang Sternefeld. 2017. An event semantics with continuations for incremental interpretation. *Journal of Semantics* 34(2). 201–236. https://doi.org/10.1093/jos/ffw013 (accessed 25 June 2019).

Byrne, Ruth M. 2005. *The rational imagination: How people create alternatives to reality*. Cambridge, MA: MIT Press.

Cantwell, John. 2018. Conditionals. In Sven Ove Hansson, Vincent F. Hendricks & Esther Michelsen Kjeldahl (eds.), *Introduction to formal philosophy*, 131–146. Cham: Springer.

Chierchia, Gennaro & Sally McConnell-Ginet. 2000 [1990]. *Meaning and grammar: An introduction to semantics*, 2nd edn. Cambridge, MA: MIT Press.

Ciardelli, Ivano, Jeroen Groenendijk & Floris Roelofsen. 2019. *Inquisitive semantics*. Oxford: Oxford University Press.

Ciardelli, Ivano, Linmin Zhang & Lucas Champollion. 2018. Two switches in the theory of counterfactuals: A study of truth conditionality and minimal change. *Linguistics and Philosophy* 41(6). 577–621. https://doi.org/10.1007/s10988-018-9232-4 (accessed 25 June 2019).

Edgington, Dorothy. 2007 [1995]. On conditionals. In Dov M. Gabbay & Franz Guenthner (eds.), *Handbook of philosophical logic*, vol. 14, 2nd edn., 127–221. Dordrecht: Springer.

Edgington, Dorothy. 2014 [2001]. Indicative conditionals. In Edward N. Zalta (ed.), *The Stanford encyclopedia of philosophy* (Winter 2014 Edition). https://plato.stanford.edu/archives/win2014/entries/conditionals/.

Evans, Jonathan S. B. T. & David E. Over. 2004. *If*. Oxford: Oxford University Press.

Fintel, Kai von. 2011. Conditionals. In Klaus von Heusinger, Claudia Maienborn & Paul Portner (eds.), *Semantics: An international handbook of natural language meaning*, vol. 2, 1515–1538. Berlin: De Gruyter Mouton.

Giannakidou, Anastasia & Hedde Zeijlstra. 2017. The landscape of negative dependencies. In Martin Everaert & Henk C. van Riemsdijk (eds.), *The Wiley Blackwell companion to syntax*, vol. 3, 2nd edn., 2099–2136. Hoboken, NJ: Wiley Blackwell. https://doi.org/10.1002/9781118358733.wbsyncom102 (accessed 25 June 2019).

Grice, Paul. 1989a [1967]. Indicative conditionals. In Paul Grice, *Studies in the way of words*, 58–85. Cambridge, MA: Harvard University Press.

Grice, Paul. 1989b [1967]. Logic and conversation. In Paul Grice, *Studies in the way of words*, 22–40. Cambridge, MA: Harvard University Press.

Haegeman, Liliane. 2003. Conditional clauses: External and internal syntax. *Mind and Language* 18(4). 317–339.

Harman, Gilbert. 2002. Internal critique: A logic is not a theory of reasoning and a theory of reasoning is not a logic. In Dov M. Gabbay, Ralph H. Johnson, Hans Jürgen Ohlbach & John Woods (eds.), *Handbook of the logic of argument and inference: The turn towards the practical*, 171–186. Amsterdam: Elsevier.

Higginbotham, James. 1986. Linguistic theory and Davidson's program in semantics. In Ernest LePore (ed.), *Truth and interpretation: Perspectives on the philosophy of Donald Davidson*, 29–48. Oxford: Blackwell.

Horn, Laurence R. 1989. *A natural history of negation.* Chicago: The University of Chicago Press.

Jackson, Frank. 1979. On assertion and indicative conditionals. *The Philosophical Review* 88(4). 565–589.

Jackson, Frank. 1987. *Conditionals*. Oxford: Blackwell.

Jacobson, Pauline. 1999. Towards a variable-free semantics. *Linguistics and Philosophy* 22(2). 117–184. https://doi.org/10.1023/A:1005464228727 (accessed 25 June 2019).

Jacobson, Pauline. 2008. Direct compositionality and variable-free semantics: The case of antecedent contained deletion. In Kyle Johnson (ed.), *Topics in ellipsis*, 30–68. Cambridge: Cambridge University Press.

Kaufmann, Magdalena & Kaufmann, Stefan. 2015. Conditionals and modality. In Shalom Lappin & Chris Fox (eds.), *The handbook of contemporary semantic theory*, 2nd edn., 237–270. Hoboken (NJ): Wiley-Blackwell.

Kearns, Kate. 2011 [2000]. *Semantics*, 2nd edn. Houndmills: Palgrave Macmillan.

Kratzer, Angelika. 1979. Conditional necessity and possibility. In Rainer Bäuerle, Urs Egli & Arnim von Stechow (eds.), *Semantics from different points of view*, 117-147, Berlin: Springer.

Kratzer, Angelika. 1986. Conditionals. In Anne M. Farley, Peter Farley & Karl-Erik McCullough (eds.), *Papers from the parasession on pragmatics and grammatical theory at the twenty-second regional meeting [of the] Chicago Linguistic Society*, 1–15. Chicago (IL): Chicago Linguistic Society.

Kratzer, Angelika. 1991. Conditionals. In Arnim von Stechow & Dieter Wunderlich (eds.), *Semantik: Ein internationales Handbuch der zeitgenössischen Forschung*. / *Semantics: An international handbook of contemporary research*, 651–656. Berlin: De Gruyter.

Kratzer, Angelika. 2012. Conditionals. In Angelika Kratzer, *Modals and conditionals*, 86–108. Oxford: Oxford University Press.

Levinson, Stephen C. 2000. *Presumptive meanings: The theory of generalized conversational implicature.* Cambridge, MA: MIT Press.

Lewis, David. 1975. Adverbs of quantification. In Edward L. Keenan, (ed.), *Formal semantics of natural language*, 3–15. Cambridge: Cambridge University Press.

Lohnstein, Horst. 2011 [1996]. *Formale Semantik und natürliche Sprache*, 2nd edn. Berlin: De Gruyter.

Mittwoch, Anita, Rodney Huddleston & Peter Collins. 2002. The clause: Adjuncts. In Rodney Huddleston & Geoffrey K. Pullum, *The Cambridge grammar of the English language*, ch. 8. Cambridge: Cambridge University Press.

Nickerson, Raymond S. 2015. *Conditional reasoning: The unruly syntactics, semantics, thematics, and pragmatics of 'if'*. Oxford: Oxford University Press.

Rescher, Nicholas. 2007. *Conditionals*. Cambridge, MA: MIT Press.

Rieger, Adam. 2006. A simple theory of conditionals. *Analysis* 66(3). 233–240. https://doi.org/10.1111/j.1467-8284.2006.00620.x (accessed 25 June 2019).

Rieger, Adam. 2013. Conditionals are material: The positive arguments. *Synthese* 190(15). 3161–3174. http://dx.doi.org/10.1007/s11229-012-0134-7 (accessed 25 June 2019).

Rieger, Adam. 2015. Defending a simple theory of conditionals. *American Philosophical Quarterly* 52(3). 253–260. http://apq.press.illinois.edu/52/3/rieger.html (accessed 25 June 2019).

Sanford, David H. 2003 [1989]. *If* P*, then* Q*: Conditionals and the foundations of reasoning*, 2nd edn. London: Routledge.
Siddiqi, Daniel. 2009. *Syntax within the word: Economy, allomorphy, and argument selection in Distributed Morphology.* Amsterdam: Benjamins.
Smith, Neil & Amahl Smith. 1988. A relevance-theoretic account of conditionals. In Larry M. Hyman & Charles N. Li (eds.), *Language, speech and mind: Studies in honour of Victoria A. Fromkin*, 322–352. London: Routledge.
Sperber, Dan & Deirdre Wilson. 1995 [1986]. *Relevance: Communication and cognition*, 2nd edn. Oxford: Blackwell.
Starr, William. 2019. Counterfactuals. In Edward N. Zalta (ed.), *The Stanford encyclopedia of philosophy* (Fall 2019 Edition). <https://plato.stanford.edu/archives/fall2019/entries/counterfactuals/>.
Wierzbicka, Anna. 1987. Boys will be boys: 'Radical semantics' vs. 'radical pragmatics'. *Language* 63(1), 95–114.
Williams, Edwin. 2007. Dumping lexicalism. In Gillian Ramchand & Charles Reiss (eds.), *The Oxford handbook of linguistic interfaces*, 353–381. Oxford: Oxford University Press.
Woods, John. 2002. Standard logics as theories of argument and inference: Deduction. In Dov M. Gabbay, Ralph H. Johnson, Hans Jürgen Ohlbach & John Woods (eds.), *Handbook of the logic of argument and inference: The turn towards the practical*, 40–103. Amsterdam: Elsevier.
Woods, John. 2004. *The death of argument: Fallacies in agent based reasoning.* Dordrecht: Springer Science+Business Media.
Woods, John, Ralph H. Johnson, Dov M. Gabbay & Hans Jürgen Ohlbach. 2002. Logic and the practical turn. In Dov M. Gabbay, Ralph H. Johnson, Hans Jürgen Ohlbach & John Woods (eds.), *Handbook of the logic of argument and inference: The turn towards the practical*, 1–39. Amsterdam: Elsevier.
Zimmermann, Thomas Ede & Wolfgang Sternefeld. 2013. *Introduction to semantics: An essential guide to the composition of meaning*. Berlin: De Gruyter Mouton.
Zucchi, Alessandro. 1995. The ingredients of definiteness and the definiteness effect. *Natural Language Semantics* 3(1). 33–78.

Prof. Dr. Carsten Breul
Fakultät für Geistes- und Kulturwissenschaften
Institut für Linguistik
Bergische Universität Wuppertal
Gaußstr. 20
42119 Wuppertal

E-Mail: breul@uni-wuppertal.de