Between If and Then

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BETWEEN "IF" AND "THEN"

KAROLINA KRZYŻANOWSKA

Towards an Empirically Informed Philosophy of
Conditionals

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INTRODUCTION

Language is a powerful toolkit, full of sophisticated utensils allowing us to communicate almost anything we want, ranging from the most trivial of trivia to the greatest ideas a human mind can possibly construe. Regardless of whether we want to ask a housemate to buy some milk or to explain advances in string theory to a group of specialists, language will usually provide the right tools for our purposes. Some of these tools are exceedingly simple while others are highly complex devices, yet we are using them all routinely and effectively, though typically without much understanding of their internal structure.

Among those most complex and obscure linguistic devices, we find a class of sentences called *conditionals*, which are expressions (usually) of the form "If φ, (then) ψ," where φ and ψ can be, in principle, any sentences. Conditionals have been an object of interest of philosophers, linguists, and psychologists for a few decades now, and this interest has kept growing over recent years. For someone outside this narrow field, this may strike as odd. Ultimately, all those books and papers concern just one type of sentence, and quite a common one, too. We encounter them almost everywhere, ranging from newspaper articles, *e.g.*:

(1) If the funds are not released within two weeks, the government risks being unable to pay wages and pensions. (*The Economist.*)

through works of fiction:

(2) If there are as many minds as there are men, then there are as many kinds of love as there are hearts. (Leo Tolstoy, *Anna Karenina.*)

philosophical treatises:

(3) If a question can be put at all, then it can also be answered. (Ludwig Wittgenstein, *Tractatus Logico-Philosophicus.*)

to everyday conversations:

(4) If Dorothy hears the news, she will be surprised.

(5) If your bike is not where you left it, someone must have stolen it.

(6) If Clara had not made a complaint, someone else would have.

Despite their prevalence, conditional sentences seem to belong to the most troublesome linguistic expressions. It is bewilderingly hard to come up with a non-trivial claim concerning conditionals that would not be subject to a contentious debate. Consequently, even the most fundamental questions regarding the semantics and pragmatics of conditionals are still awaiting a conclusive answer. There is no consensus among philosophers on what conditional sentences mean, what their truth conditions are, and whether or not they have truth conditions at all. Their assertability or acceptability conditions are not much less perplexing, not to mention the interpretation of conditionals whose antecedents or consequents are conditionals themselves. Regarding the problem of belief revision upon learning conditional information, philosophers have barely scratched the surface.

Despite the fact that a tremendous amount of work devoted solely to conditional sentences has been published in the course of the last three or four decades, the available theories still fail to meet all of the theoretical objectives that have been formulated in the literature. We appear to have reached a point at which every theory faces a counterexample, every argument has its counterargument, and every solution seems to give rise to an avalanche of new problems. One could even wonder if there is a point to further inquiry at all. But, of course, it is not customary for a philosopher to admit defeat. The inquiry must go on. However, it does not always have to continue along the same road, especially if the familiar road appears to be a blind alley.

1.1 JUST ANOTHER LINGUISTIC EXPRESSION?

There are many reasons to believe that conditionals are special. To start with, it is not common for philosophers of language to question the very possibility for a whole class of sentences to have a truth value. Yet when it comes to conditionals, even this is controversial. Many researchers are convinced that conditionals do not have truth conditions, and, as a consequence, do not express propositions at all. But if that were true, which I am going to argue that it is not, how are we to account for the fact that people

seem to *mean something* when they assert sentences of the form "If φ, then ψ," and frequently they mean it to be true? We seem to learn something from assertions of this form after all. In other words, they do seem to convey some sort of information. What is that information if not a proposition expressed by the asserted sentence?

Few philosophers nowadays hold that the meaning of a linguistic expression should be equated with its use. According to the received view, meaning belongs to the domain of semantics, while use is the concern of pragmatics. However, given that drawing a line demarcating semantic phenomena from the pragmatic ones is not trivial, it is unwarranted to assume that we could investigate the former without ever considering the latter. Ultimately, sequences of sounds or strings of letters do not mean anything on their own. They only become meaningful when they are so intended by some language user. For example, the string "przepraszam" could be a random combination of letters of the Latin alphabet, but if uttered by a Polish speaker, it will have a meaning. Depending on the context, it can be used to say "I am sorry" or "Excuse me." Anything we say has a meaning only because we intend it to have one. Even more complex strings, like

(7) Witold Gomborowicz is a Polish writer.

are just strings of letters unless they are used by a speaker to convey some information. This one has a straightforward interpretation: it means that an individual called "Witold Gombrowicz" has a property of being a Polish writer (or, alternatively, that this individual belongs to the set of Polish writers), precisely because an English speaker would use this particular sentence to convey the information about Gombrowicz's profession and descent.

Interpreting a sentence can be thought of as a process of "decoding" its meaning, that is, of identifying the proposition that the sentence is meant to express in a given context. This process is abductive in nature: we attribute a particular meaning to an utterance on explanatory grounds. We interpret an utterance of p as expressing a proposition φ, because the speaker's intention to communicate φ is the best explanation of his utterance of p in the particular conversational situation. Thanks to this mechanism, we can usually understand expressions that are immensely underspecified, like sentences with indexicals or scope ambiguities, ellipses or anaphoras:

(8) a. She found it there.

b. Everyone has got one.

c. Ben does too.

d. Done.

We are able to interpret expressions that are not even proper sentences, and, moreover, we often do that automatically and effortlessly. Arguably, our capacity to communicate with others depends on our mindreading skills (Sperber and Wilson 1995).[1] We tend to interpret people's actions, including their linguistic behaviour, as meaningful. If, for example, I see my neighbour, Jim, rushing down the stairs and then suddenly turning around and hurrying back home, I may come to think that he must have forgotten something important. This seems to be the best explanation of Jim's unusual behaviour—unusual, because it is not typical of people who apparently are in a hurry to suddenly turn and run back to where they came from. My interpretation of Jim's behaviour hinges upon an assumption that whatever people do, they do it for a reason or because of a reason. (Note that *reason* is here understood very loosely, so what we may sometimes call a purposeless behaviour can also have some sort of a reason: doing things for fun, for instance, just to amuse oneself, or even to procrastinate from doing something else, is in such a loose sense of the word reasonable enough.) Likewise, when we interpret people's utterances, we assume them to be meaningful, purposeful, and relevant.

This assumption is obviously crucial for the interpretation of highly context-dependent or underspecified expressions like those in (8), but it also plays a role in understanding more straightforward expressions. Sometimes, the proposition expressed by a sentence, like perhaps (7), is so easy to grasp that *prima facie* the sentence hardly needs any explication, and hence inquiring into the speaker's intentions appears redundant. In many conversational situations though, the truth conditions of a sentence are not so overt. For this reason asking why a speaker used a particular construction, or what kind of information they intended to convey, may prove to be a very helpful step in the process of identifying its meaning. This is why investigating the cognitive processes leading to a construction of a particular linguistic item is so important—a correct interpretation of what has been said

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1 See also, e.g., Apperly (2011, pp. 26-30) on the relationship between language and the theory of mind.

often depends on understanding why it has been put in this particular way.

It is a common assumption in philosophy of language that the meaning of a declarative sentence is given by its truth conditions (see, e.g., Davidson 1967). Accordingly, to interpret a sentence is, roughly, to determine the conditions under which that sentence expresses a true proposition. But does this directive apply to all types of sentences? Specifically, can we analyse the meaning of a conditional in terms of its truth conditions?[2]

None of the hitherto proposed theories seems to have succeeded in accounting for all of our intuitions and the over-the-years collected data on how people use and interpret conditional sentences. Truth-conditional accounts are no exception. However, their failure should not be taken as a rationale behind a belief that conditional sentences have no truth conditions at all. It is not uncommon to have a strong intuition that whenever someone asserts sentences like "If I don't take the first train in the morning, I will be late for my flight" or "Sarah will be disappointed if you don't show up at her birthday party" they are saying something which can be either true or false. This intuition has been the driving force that led to a quest for a descriptively correct theory of conditionals, a quest of which this thesis is a documentation.

1.2   WHAT IS THOUGHT AND HOW IT IS EXPRESSED

To answer the question about the conditions that have to be fulfilled for a conditional to be true, we might first ask ourselves other questions: What do we learn from conditional statements? What kind of information does a speaker *intend* to convey when asserting a conditional? Why did they choose a conditional form to express their thought? And what kind of thoughts are manifested in this particular way?

There is an evident connection between production and interpretation of conditional sentences on the one hand, and hypothetical thinking on the other hand. The gist of this connection has been encapsulated in Frank Ramsey's legendary footnote from "General propositions and causality" (Ramsey 1990, p. 155):

> If two people are arguing 'If p will q?' and are both in doubt as to p, they are adding p hypothetically to their

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2 This thesis is concerned exclusively with conditional sentences that are declarative; interrogative, imperative and exclamatory sentences, which, in principle, can also have a form of a conditional, are beyond the scope of our investigations.

> stock of knowledge and arguing on that basis about q:
> so that in a sense 'If p, q' and 'If p, ¬q' are contradict-
> ories. We can say they are fixing their degrees of belief
> in q given p.

The above described procedure, known as the *Ramsey Test*, hints at a cognitive process that may lay underneath the interpretation of conditional sentences, namely, the process of hypothetical thinking. The idea that evaluating a conditional boils down to evaluating the consequent under the supposition of the antecedent seems to appeal to intuitions of many philosophers on the one hand, and to fit the data resulting from psychological experiments, on the other hand. However, the Ramsey Test in its original phrasing, although clearly intuitive and supported by the evidence from psychology, is, as pointed out by Jonathan Evans and David Over (2004, p. 153), a very specific procedure, meant only as a method of fixing one's degree of belief in a conditional. The notion of hypothetical thinking, by contrast, denotes a more general cognitive process (cf. Evans 2007). Evaluating conditional sentences is just one application of this general cognitive process, but the association between the two might be exactly what made the idea of the Ramsey Test so intuitively appealing. One way to construe *if* itself is as "a linguistic device the purpose of which is to trigger a process of hypothetical or suppositional thinking and reasoning" (Evans and Over 2004, p. 153). Furthermore, hypothetical thinking prompts using words like *if* or *suppose*, so the dependence between the linguistic forms in question and the particular mode of thinking goes in both directions. Conditional sentences can thus be seen as outcomes of the process of hypothetical thinking, that is, hypothetical thoughts encoded as single linguistic expressions.

The process of hypothetical thinking can be roughly characterised as consisting of two steps. The first step amounts to entertaining a hypothesis, or in other words, to making a supposition. Reasoning under this supposition, that is evaluating possible consequences of the hypothesis, is the second step of this process. A conditional's if-clause corresponds to such a hypothesis or a supposition. What is asserted under this supposition—the content of the conditional's main clause—is an outcome of the process of hypothetical thinking. It is, roughly speaking, a statement about an imaginary version of the world such that the supposition holds in that world. But this is not just any statement. Although the Ramsey Test can be easily applied to a conditional consisting of any

two sentences, it is not the case that in the process of hypothetical thinking language speakers can arrive at *any* statement that holds under the supposition. We are not likely to assert sentences like the following:

(9) If there is life on some extrasolar planets, then Greece will not leave the European Union.

as we would find it bizarre to say:

(10) Let's suppose that there is life on some extrasolar planets. In that case Greece would not leave the European Union.

The above statements sound strange even if the sentence "Greece will not leave the European Union" holds under the supposition of life on some extrasolar planets, or even if this sentence can be found in the speaker's (and hearer's) stock of beliefs after it has been revised by "There is life on some extrasolar planets." Interestingly,

(11) If there is life on some extrasolar planets, then somewhere in the Universe there exists an advanced alien civilisation.

seems less bizarre a statement, even though it is unlikely that many people would tend to agree with it. (11) does not sound as absurd as (9), because it is possible to imagine a speaker whose assumption that there is life on some extrasolar planets would lead him to an idea of an advanced alien civilisation existing somewhere in the Universe. But what does it mean that an assumption *leads* a speaker to a certain conclusion?

Answering this very question is, in my opinion, what understanding the meaning of conditional sentences amounts to. The connection between the supposition expressed by a conditional's antecedent, and the content of its consequent is what seems to define meaningful conditionals, that is, those conditionals that can be true and assertable. An analysis of this connection is therefore the main focus of my thesis.

1.3 TOWARDS AN EMPIRICALLY INFORMED PHILOSOPHY

The theory of conditionals to be presented in this thesis is not meant to be a normative theory, nor a theory of how ideally rational agents use their neat, formal-like languages. My objective is to characterise the way actual human beings, with all their biases and proneness to fallacies on the one hand, and their immensely

accurate capability to decipher hazy contextual cues on the other hand, use and interpret conditional sentences. Such a task, obviously, cannot be successfully performed in abstraction from the results of empirical investigations related to conditionals and hypothetical thinking.

Combining methods of hitherto distinct fields, like theoretical philosophy, logic, experimental linguistics and psychology of reasoning does not only facilitate modelling real-world phenomena, but over and above it allows us to tackle old issues in an utterly different way, prompting new developments. Moreover, empirically obtained data force us to verify our intuitions and re-evaluate the objectives imposed on theories that pretend to descriptive adequacy.

1.3.1 *Outline of the thesis*

In chapter 2, I present the two main families of propositional theories of indicative conditionals, the truth functional account and the possible worlds semantics, and discuss their strengths and shortcomings. Subsequently, in chapter 3, I introduce a new semantic theory of conditionals that emphasises the connection between antecedents and consequents, while doing justice to the intuitions captured by the Ramsey Test. I argue that, on the one hand, the new semantics escapes certain theoretical problems that undermine traditional accounts of conditionals, and on the other hand, that it matches the currently available data from psychology of reasoning and psycholinguistics. Furthermore, in chapter 4, I report the results of a new empirical study involving conditional sentences and various evidential markers in English and in Dutch. The results do not only support the proposal, but also show that the theory advocated here has a significant explanatory power. Chapter 5 shows that the proposal helps to explain an old philosophical problem posted by Allan Gibbard in his seminal 1981 paper. The aim is not just to present a new theoretical analysis of the stand-off, but also to support it empirically by reporting the results of an experiment. Furthermore, I show that the new semantics of conditionals sheds some new light on the role indicative condiitonals can play in decision theory. In the conclusion, I outline possible extensions of the theory and highlight some avenues for further research.

2

WHAT DOES A CONDITIONAL MEAN?

It is customary to characterise conditionals as compound linguistic expressions consisting of two sentences conjoined by a connective "if." Roughly speaking, the *if*-clause, also referred to as the *antecedent* or *protasis*, expresses a condition under which the main clause of the conditional sentence, that is its *consequent* or *apodosis*, is meant to hold. A paradigmatic conditional is hence a sentence of the form: "If φ, (then) ψ," or, alternatively, "ψ if φ," like, for instance, the following sentences:

(12) a. A book is not eligible for the Man Booker Prize if it has not been originally written in English.

b. If Francisco Goya did not paint the black paintings himself, his son Javier must have painted them.

c. If Alice Munro had not been awarded the Nobel Prize in Literature in 2013, someone else would have received it.

d. If Maria Skłodowska-Curie had not married a Frenchmen, people would not tend to think that she was French.

Of the above sentences, (12a) and (12b) are traditionally referred to as *indicative conditionals* (or *indicatives*, for short), whereas (12c) and (12d) are called *subjunctive conditionals* (or *subjunctives*). To illustrate the semantic difference between indicatives and subjunctives, various authors typically invoke the following two sentences due to Adams (1970):

(13) a. If Oswald did not kill Kennedy, someone else did.

b. If Oswald had not killed Kennedy, someone else would have.

Here, (13a) is an indicative and (13b) is a subjunctive. Subjunctive conditionals are frequently counterfactual and vice versa, yet the two terms are not interchangeable. The term "subjunctive conditional"
should be understood as indicating a grammatical category, while "counterfactual" is a semantic notion. A conditional is counterfactual when it presupposes the falsehood of its antecedent, and not all subjunctives do that. To give an example, the sentence:

(14) If he were to marry her, he would have to move to Finnland.

is a subjunctive conditional, yet it can be asserted by a speaker for whom the antecedent is an open possibility. At the same time, one might assert an indicative:

(15) If Denmark is ruled by a king, it is a kingdom.

even if they know that the Kingdom of Denmark is not ruled by a king, but by a queen, if in the given context it does not matter who the actual ruler is. Such a conditional could be asserted, for instance, as an instance of an inference from "a country is ruled by a king" to "a country is a kingdom." Given that this work is mostly concerned with indicative conditionals, the unqualified term "conditionals" or "conditional sentences" will henceforth refer to indicatives.

The last few decades witnessed a growing interest among researchers of various backgrounds in the issues related to conditionals. Consequently, countless theories trying to account for the meaning of conditional sentences have been developed. It would be pointless, if not utterly impossible, to even try to discuss them all in any detail, especially given that many outstanding works reviewing the available literature have been published in recent years. To name just a few, Bennett (2003) and Edgington (2014) offer comprehensive guides through the philosophical issues related to conditionals. Sanford (1989), by contrast, takes a historical perspective in his presentation. Discussions of various approaches towards conditional logic can be found in Nute and Cross (2002) or Arló-Costa (2007), while Evans and Over (2004) provide a thorough analysis of psychological results concerning the interpretation of conditional sentences. Of more recent works, Douven (in press) explores the epistemological issues raised by conditional sentences, demonstrating additionally the benefits of applying both formal and empirical methods to philosophical analysis.

Instead, to prepare the grounds for the presentation of my own results, I will focus on some of the most distinctive and problematic features of two classes of approaches towards conditional sentences that do not contest their propositionality. First, I will review strengths and flaws of a truth-functional account of conditionals, that is, the material account, according to which "If φ, (then) ψ" is equivalent to an inclusive disjunction of $\neg\varphi$ and ψ. Second, I will discuss truth-conditional theories of conditionals inspired by the Ramsey Test, focusing on the possible world semantics developed by Stalnaker (1968). But before I move on to

analysing the above mentioned accounts, let me touch upon the issue of what a conditional sentence actually is.

2.1 INTERLUDE: CONDITIONALS AND "IFS"

Even though a prototypical conditional sentence can be characterised by the presence of a connective "if," it would be wrong, however tempting, to conclude that studying conditionals is nothing more than studying the function or the meaning of the word "if" alone. Associating one with the other seems natural especially from the perspective of native English speakers,[1] but one should not forget that English is not necessarily the most representative language in the world. Any claims about language that are intended as universal, or at least as more general than statements about particular features of a specific language, cannot be based solely on linguistic data drawn from a single source.

   Even if we look into very limited cross-linguistic data from, for instance, languages relatively closely related to English like other European languages, we can easily find evidence in favour of a separate treatment of conditional sentences and sentences with *if*-clauses. First and foremost, there are languages in which English *if* can be translated in more than one way, depending on the linguistic or extralinguistic context. In Polish, for instance, a subordinate clause of an indicative conditional can be introduced by means of *jeśli* or *jeżeli*. The sentence:

(16) Jeśli Beata wie,   to   musi się martwić.
     If   Beata knows then must worry.
     If Beata knows, she must be worried.

is roughly equivalent to:

(17) Jeżeli Beata wie, to musi się martwić.

There is no evident semantic difference between the two Polish indicative *ifs*.[2] The word *jeżeli* is perhaps more formal, but one could argue that the choice between *jeśli* and *jeżeli* amounts to something more than a matter of style. *Jeżeli* as longer and thus

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1 In fact, some seminal works devoted broadly to conditionals and conditional reasoning are simply titled "If" or "Ifs" (Evans and Over 2004; Harper et al. 1981, respectively).

2 To be precise, there is no semantic difference that I, as a native Polish speaker, am able to observe. I am also not aware of any corpus-driven or experimental research on differences between Polish *jeśli* and *jeżeli*.

less economical seems to be most felicitous when a speaker wants to stress that what is being said is hypothetical, or to draw an interlocutor's attention to the content of the antecedent. For this reason, (17) may in some contexts sound somewhat emotionally loaded while (16) would remain entirely neutral.

By contrast, a subjunctive conditional in Polish involves yet another connective that is translated as *if* into English, namely *gdyby*:

(18) Gdyby Beata wiedziała,   to   by się martwiła.
     If   Beata had known then would have worried.
     If Beata had known, she would have worried.

Furthermore, *if* is not the only English connective linking the main and the subordinate clauses of a conditional. On the basis of an extensive study of linguistic corpora, Declerck and Reed (2001) note that conditional clauses can be also introduced by means of expressions like *unless*, *provided that*, *in case*, *supposing*, *assuming* and many others, including connectives typically associated with temporal clauses like *when* or *as soon as*. Though it usually implies factuality, *when* can have a clearly conditional connotation, e.g.:

(19) I will stop nagging you when you start doing what you've promised. (Declerck and Reed 2001, p. 32)

Moreover, Declerck and Reed (2001, p. 33) claim that in cases like the following:

(20) a. Children are orphans when their parents are dead.

      b. Children are orphans if their parents are dead.

when- and *if*-clauses can be used interchangeably.[3]

Polish is additionally equipped with connectives such as *skoro* and *jak* that seem to have both temporal and conditional connotations. Asserting a conditional with a *jak*-clause seems to indicate that the speaker's degree of belief that the antecedent holds is rather high, although not as high as when *kiedy* or *gdy* (which can be directly translated into English as *when*) are used. By contrast, *skoro*, when it is used in a conditional (that is, not purely temporal) clause, seems roughly equivalent to English *given that* or *provided that*.

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3 See also Elder (2012) for a corpus-driven exploration of different ways a conditional can be expressed in Eglish.

Another piece of evidence in favour of a separate analysis of a conditional on the one hand, and of the connective, on the other hand, is the fact that it is not necessary for a conditional to involve any connective at all:

(21) No broccoli, no dessert.

The above example clearly expresses a conditional dependency. However, one could argue that (21) is not really a sentence, but, for instance, an abbreviation that can be developed into a full sentence along the following lines:

(22) If you do not eat your broccoli, you will not get the dessert.

Nevertheless, the constructions with so-called *zero-conjunction* and inversion can constitute full-fledged conditional sentences (for a more detailed analysis of these, see Declerck and Reed 2001):

(23) a. Had she told him earlier, he would not have been so furious.

  b. Should someone ring, tell them I'll be at the office till six. (Declerck and Reed 2001, p. 27)

  c. Were he to try that again, I'd go to the police. (*ibid.*)

A similar phenomenon can be also observed in Polish:

(24) a. Odwiedzisz mnie, to   sam   zobaczysz.
    You will visit me   then yourself you will see.
    If you visit me, then you will see for yourself.

  b. Porozmawiałbyś z nim, to   by zrozumiał.
    You would talk   to him then he would understand.
    Had you talked to him, he would have understood.

Yet another reason to disentangle the analysis of conditionals from the analysis of *if* is the presence of this connective in sentences whose conditionality is questionable. One could argue, for instance, that the following sentences:

(25) a. If this is true, I'm a Dutchman.

  b. If that's Jack who wrote this essay, I am a monkey's uncle.

are just a fanciful way to say, respectively:

(26) a. This cannot possibly be true.

     b. Jack could not have possibly written this essay.

In principle, however, (25a) and (25b) can be seen as proper conditionals that simply convey somewhat unusual thoughts, namely, that supposing their antecedents leads to ridiculous conclusions.

Sentences belonging to the class of so called *speech-act conditionals* constitute perhaps a more compelling example of linguistic constructions with "if" whose conditionality can be contested, for instance:

(27) a. If you are hungry, there are biscuits on the table.

     b. If you really must know, Bill did not come.

In (27a), clearly, the content of the consequent is asserted unconditionally: the biscuits are on the table regardless whether the interlocutor is hungry or not. The only purpose the *if*-clause of this sentence seems to serve is of a pragmatic kind. It directs a hearer's attention to the asserted information or indicates when that information is relevant for the hearer. In (27b), similarly, the antecedent is not a condition under which the consequent is supposed to hold, but rather a remark suggesting that what follows is said somewhat reluctantly. In more general terms, what is conditionally modified by the content of an *if*-clause in the case of speech-act conditionals is the *act* of asserting the main clause, not its content (Dancygier and Sweetser 2005, p. 113).

Although the interpretation of the above reported phenomena is likely to remain a matter of some controversy—a controversy which is not my ambition here to resolve—I believe that they constitute a good enough reason not to think of *if* as being all there is to the analysis of conditional sentences. That being said, the example sentences I will use to illustrate the theory proposed in this dissertation will mostly be sentences with *if*-clauses, as those are the most typical cases of conditionals. It is nonetheless important to bear in mind that what signifies a conditional sentence is not its particular surface structure, or more specifically, a particular connective.

2.2   THE IDEAL: A TRUTH-FUNCTIONAL ACCOUNT

Conditionals are complex linguistic expressions. They are sentences compounded of two simpler sentences, which can be com-

plex themselves, usually (but not necessarily, cf. section 2.1) con-
joined by means of a connective "if." A noble tradition cultivated
in semantics and philosophy of language teaches us to analyse
meanings of complex expressions as functions of the meanings
of their constituents and the way they are syntactically combined
(see, e.g., Partee 1984; Janssen 1997). This idea, known as the Prin-
ciple of Compositionality, derives from writings of Gottlob Frege[4]
who realised that the immense productivity of language can only
be accounted for by the existence of some mechanism allowing us
to decode the correspondence between the syntactic structure and
the structure of the thought it expresses. As he writes in "Com-
pound Thoughts":

> It is astonishing what language can do. With a few
> syllables it can express an incalculable number of
> thoughts, so that even a thought grasped by a ter-
> restrial being for the very first time can be put into a
> form of words which will be understood by someone
> to whom the thought is entirely new. This would be
> impossible, were we not able to distinguish parts in
> the thoughts corresponding to the parts of a sentence,
> so that the structure of the sentence serves as the im-
> age of the structure of the thoughts. (Frege 1963)

In Fregean philosophy, both the meaning (*Sinn*) and the reference
(*Bedeutung*) of a complex expression are compositional. As the
reference of a sentence is its truth value, where φ and ψ are sen-
tences and $\star$ is some binary sentential operator conjoining them,
the truth value of "$\varphi \star \psi$" depends on the truth values of φ and ψ
as well as on the structure of the whole expression determined by
the operator $\star$. Ideally, this dependency is functional, that is, the
truth value of a complex sentence is a function of the truth values
of its parts. Hence, a theory of conditionals in which intuitions
articulated in the above quote are realised in the simplest and
perhaps the most elegant way is the so called material account,
sometimes referred to as a horseshoe analysis of a conditional
due to the convention of using the sign "$\supset$" as a material condi-
tional connective.[5]

   The material conditional, "$\varphi \supset \psi$", inherited its name after
the notion of material implication introduced by Bertrand Russell

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4 Though traditionally attributed to Frege and indubitably in the spirit of his late
   works, there is no clear evidence that the Principle of Compositionality has been
   endorsed by Frege *as* a principle. See Janssen (1997) for a discussion of this issue.
5 This is the convention I am going to follow from now on.

and Alfred North Whitehead in *Principia Mathematica* (1962, p. 7; see also Sanford 1989, pp. 50-52). However, the first philosopher to whom the truth-functional analysis of a conditional can be attributed is a stoic philosopher, Philo of Megara (Sanford 1989, pp. 15-23), whence the term "Philonian conditional" is also to be encountered in the literature. On this account, the semantics of a natural language conditional is identical to that of an implication as defined in classical logic. Of the four possible ways we can assign the truth values, $\{0, 1\}$, to the two constituents, φ and ψ, only one results in the implication being false, namely, when the antecedent is true but the consequent is false. In other words, a material conditional is true if and only if either its antecedent is false, or its consequent is true:

$$\varphi \supset \psi \equiv \neg\varphi \vee \psi \tag{1}$$

Analogously to other classical logic formulas, the meaning of a conditional is exhausted by the following truth table:

φ	ψ	$\varphi \supset \psi$
1	1	1
1	0	0
0	1	1
0	0	1

One can clearly see that this is a truth-functional interpretation: the truth value of a conditional is determined by the truth values of its antecedent and consequent alone, exactly as it is in the case of logical conjunctions and disjunctions.

Truth-conditionality is not only a theoretical virtue by itself. What is more, one of the strongest arguments in favour of the material account is an immediate consequence of its truth-functionality, namely, it allows us to infer a conditional, "If $\neg\varphi$, ψ," from the disjunction, $\varphi \vee \psi$. The *or-to-if inference* is not merely logically valid, but it also seems intuitively appealing and relatively prevalent in our ordinary everyday reasoning. For instance, if I do not remember whether I left my copy of Lewis's *Counterfactuals* at home or in the office, but I am quite sure that the book must be in one of these places, I instantly believe that if the book is not at home, it is in the office:

(28) a. Either the book is at home or it is in the office.

   b. *Therefore*, if the book is not at home, it is in the office.

The above inference appears so natural that validating it would seem a highly desirable feature of a theory of natural language conditionals (however, we will discuss this allegedly uncontroversial issue in section 3.4). The material account renders the above inference valid (Stalnaker 1975). More importantly still, as demonstrated by Edgington (1995, 2014), it is also the only account that does that. For let us assume that $\varphi \lor \psi$ is known, or in other words that we know that φ and ψ cannot be both false. To see that this is sufficient for us to infer a material conditional $\neg\varphi \supset \psi$, but not a non-truth functional conditional, denoted here by $\neg\varphi \to \psi$, let us consider the following table:

φ	ψ	$\varphi \lor \psi$	$\neg\varphi \supset \psi$	$\neg\varphi \to \psi$
1	1	1	1	0 or 1
1	0	1	1	0 or 1
0	1	1	1	0 or 1
0	0	0	0	0

It is worth noting that a non-truth-functional interpretation of a conditional is usually represented as departing from the material interpretation only in the cases where the antecedent is false, which in the above case would be the first and the second row of the table. This is because Stalnaker's truth-conditional semantics is the best known alternative to the truth-functional account, and on this interpretation, as we will see later in this chapter, a conditional is true whenever its antecedent and the consequent are true. This is not only an unnecessary feature of a truth-conditional semantics, but also, as I will argue, one of the weaknesses of Stalnaker's account. Nevertheless, for the present argument to go through, that is, for $\to$ to be a non-truth-functional operator, it is sufficient that there is just one way to assign truth-values to the constituents, φ and ψ, such that $\to$ does not return a unique value.

Knowing that at least one of φ and ψ is true allows us to eliminate the bottom row which represents $\neg\varphi \land \neg\psi$, which is incompatible with our knowledge. One can clearly see that $\neg\varphi \supset \psi$ is true whenever the disjunction is true, thus $\varphi \lor \psi$ entails the material conditional. By contrast, eliminating the bottom row of the table does not lead us to any certainty that $\neg\varphi \to \psi$ is true. For all we know, the non-truth-functional conditional can still be false. $\varphi \to \psi$ is therefore not entailed by the disjunction of φ and ψ.

As conditionals play a vital role in reasoning, be it in science, mathematical proofs, or in our everyday decision making and planning, being able to demarcate correct and incorrect inferences or good and bad arguments is of utmost importance for our existence. One of the advantages of the material account is that it allows us to apply classical logic to evaluate arguments articulated in natural language. More precisely, it allows us to recognise logically valid and logically invalid arguments just on the basis of their form. If there is such a truth value assignment that results in true premises but a false conclusion, the argument form is logically invalid. Otherwise, the argument is logically valid.

Apart from the *or-to-if inference* discussed above, the most important argument forms involving conditional sentences are four *elimination inferences*: Modus Ponens (MP), Modus Tollens (MT), Affirmation of the Consequent (AC) and Denial of the Antecedent (DA). In each of them, a conditional, $\varphi \supset \psi$, acts as a major premise, and one of its constituents, a categorical φ or ψ, as a minor premise. The conclusion is again a categorical, φ or ψ, hence a conditional is in this type of argument being eliminated.

Of the four aforementioned argument forms, the first two are logically valid, and the last two logically invalid. Moreover, the valid forms seem intuitively appealing, in a sense that, at least *prima facie*, they seem to hold for the ordinary language conditional, too. Modus Ponens:

$$\frac{\varphi \supset \psi \, , \ \varphi}{\psi}$$

is an inference pattern that is often invoked in our everyday thought processes or discussions, for instance:

(29) a. If Paulina has been to Ljubljana, then she has been to Slovenia.
      Paulina has been to Ljubljana.
      Therefore, Paulina has been to Slovenia.

      b. If the Netherlands is ruled by a king, then it is a monarchy.
      The Netherlands is ruled by a king.
      Therefore, The Netherlands is a monarchy.

      c. If Alex is a vegetarian, then he doesn't eat meat.
      Alex is a vegetarian.
      Therefore, Alex doesn't eat meat.

Moreover, it seems to play a critical role in our everyday deliberations, which makes it an important component of planning and decision making:

(30) a. If you want to become a professional cellist, you must practice regularly.
You want to become a professional cellist.
Therefore, you must practice regularly.

b. If I don't want to overpay, I should book my flight in advance.
I don't want to overpay.
Therefore, I should book my flight in advance.

c. If you are interested in conditionals, you should read Jonathan Bennett's book.
You are interested in conditionals.
Therefore, you should read Jonathan Bennett's book.

Data from countless reasoning experiments also show that MP is relatively easy and usually endorsed by the participants. In fact, it is more frequently endorsed than any other inference form, including Modus Tollens (see Evans and Over 2004, pp. 46-52, and references there). It might be partly due to the fact that it is compatible with both a conjunctive and a biconditional interpretation of the conditional attributed to some participants, in particular, to children, adolescents, and cognitively less able adults (Barrouillet et al. 2000).

By contrast, Affirmation of the Consequent (AC):

$$\frac{\varphi \supset \psi \, , \, \psi}{\varphi}$$

is not a valid argument, yet its endorsement rates in different experiments range from 23 to 75% (Evans and Over 2004, p. 51).

(31) a. If Paulina has been to Ljubljana, then she has been to Slovenia.
Paulina has been to Slovenia.
Therefore, Paulina has been to Ljubljana.

b. If Ukraine is ruled by a king, then it is a monarchy.
Ukraine is a monarchy.
Therefore, Ukraine is ruled by a king.

c. If Alex is a vegetarian, he doesn't eat meat.
Alex doesn't eat meat.
Therefore, Alex is a vegetarian.

One can easily see that the above inferences are flawed. Paulina might have been to, for instance, the Slovenian town of Bled and never visited the country's capital, and a monarchy can also be ruled by a queen. Interestingly, the conclusion of (31c), though the argument is still invalid, seems fairly appealing. The antecedent of the conditional given as the major premise may be perceived as sufficient for the truth of the consequent, which facilitates biconditional interpretation (Thompson 1994; Evans and Over 2004, p. 96). It might be the case that people tend to assert a conditional when a biconditional is equally acceptable: "Alex is a vegetarian if and only if he doesn't eat meat." English does not seem to be equipped with a single word connective that could be used to express a biconditional.[6] The phrase "if and only if" seems to belong to a mathematical jargon rather than to an ordinary language. The phrases such as "precisely if" or "just in case" do not seem to be used frequently either. English speakers may prefer to assert just one of the two conditionals entailed by a biconditional they actually believe, especially if only one of them is relevant in the context of a conversation. In consequence, however, this might lead to what seems to be an erroneous practice of reading biconditional statements into conditional assertions, and, accordingly, to false conclusions.

Similarly, the third elimination inference, Denial of the Antecedent (DA):

$$\frac{\varphi \supset \psi \,,\, \neg\varphi}{\neg\psi}$$

is invalid, but sometimes convincing, and hence endorsed (Evans and Over 2004, p. 46, report 19-73% endorsement rates for DA inferences across various studies).

(32) a. If Paulina has been to Ljubljana, then she has been to Slovenia.
Paulina hasn't been to Ljubljana.
Therefore, Paulina has't been to Slovenia.

b. If the Netherlands is ruled by a king, then it is a monarchy.
The Netherlands is not ruled by a king.
Therefore, The Netherlands is not a monarchy.

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6 This is also true for, e.g., Polish, Dutch, or German, and, presumably, many other languages.

c. If Alex is a vegetarian, then he doesn't eat meat.
Alex is not a vegetarian.
Therefore, Alex eats meat.

One can easily imagine someone accepting, for instance, (32b) as a correct inference just because they did not realise the possibility of a queen-ruled monarchy. (32c) can again be interpreted so that the conclusion, "Alex eats meat" is true. The endorsement of DA inferences is also linked to a biconditional interpretation of "if..., then..." statements typical for adolescents, though also shown by some adults (Barrouillet et al. 2000). Evans and Over (2004) point out, however, that the biconditional pattern of responses does not necessarily indicate a truth-functional interpretation of conditional sentences:

> It can simply indicate a superficial reading that p and q go together. If you have one, you have the other; if you do not have one, you don not have the other (p. 52).

This might also be the reason why Modus Tollens:

$$\frac{\varphi \supset \psi \, , \; \neg\psi}{\neg\varphi}$$

is not as frequently endorsed by the participants of the reasoning experiments as MP. Even though it is a valid inference rule, the endorsement rates across various studies have been reported to range from 14 to 81% (Evans and Over 2004, p. 46). At least at first glance, MT seems as intuitively appealing as MP:

(33) a. If Paulina has been to Ljubljana, she has been to Slovenia.
Paulina hasn't been to Slovenia.
Therefore, Paulina hasn't been to Ljubljana.

b. If Ukraine is ruled by a king, it is a monarchy.
Ukraine is not a monarchy.
Therefore, Ukraine is not ruled by a king.

c. If Alex is a vegetarian, he doesn't eat meat.
Alex eats meat.
Therefore, Alex is not a vegetarian.

Yet it seems to be more difficult and more cognitively demanding than MP (see, for instance, Li et al. 2014). This might be due to the fact that, to perform a MT inference, participants do not only

need to process a conditional, but, additionally, a negation. This could also explain that AC is more frequently endorsed than DA.

Nevertheless, there are contexts in which MT does not seem to be applicable. To begin with, MT applied to conditional sentences whose consequents involve a deontically interpreted modal auxiliary verb like *should* or *must*, of which we can see examples in (30), results in arguments that are, to say the least, rather awkward:

(34) a. If you want to become a professional cellist, you must practice regularly.
It is not the case that you must practice regularly.
? *Therefore*, you do not want to become a professional cellist.

b. If I don't want to overpay, I should book my flight in advance.
It is not the case that I should book my flight in advance.
? *Therefore*, I want to overpay.

c. If you are interested in conditionals, you should read Jonathan Bennett's book.
It is not the case that you should read Jonathan Bennett's book.
? *Therefore*, you are not interested in conditionals.

One way to escape the problems with MT applied to deontic conditionals is by arguing, for instance, that their logical form, as opposed to the surface structure, is somehow different from simple $\varphi \supset \psi$. However, the material interpretation of a conditional does not allow us to make a distinction between sentences with and without modal auxiliaries. MT is a valid argument scheme and it should be applicable to any sentences that fall under the scheme without exceptions. Sentences in (34) definitely fall under that scheme.

In order to avoid the above discussed problems with deontic conditionals, advocates of the material interpretation can opt for excluding statements involving modal verbs from the analysis. They could claim that what they propose is a semantics for a fragment of natural language that consists of simple, atomic sentences and sentences that can be build thereof by means of logical connectives: $\neg$, $\vee$, $\wedge$, and $\supset$. However, this solution does not only appear to be rather *ad hoc*, but it also fails to settle all the issues related to MT and the material interpretation of the conditional. Consider the following instances of MT inferences (cf. Adams 1988):

(35) a. If Dora dyed her hair, she didn't dye it blue.
         Dora dyed her hair blue.
         Therefore, Dora didn't dye her hair.

      b. If Eric bought a computer, he didn't buy a Mac.
         Eric bought a Mac.
         Therefore, Eric didn't buy a computer.

      c. If Patrick is running, he is not running fast.
         Patrick is running fast.
         Therefore, Patrick is not running.

We can easily imagine contexts in which the conditionals in (35) are fully assertable. Yet it would be unreasonable to allow the MT inference in these and similar cases. MT is classically valid and thus it must always be applicable to instances of material conditional. After all, $\varphi \supset \psi$ is, by the law of contraposition, logically equivalent to $\neg\psi \supset \neg\varphi$. MP and $\neg\psi$ suffice then to conclude $\neg\varphi$. The following pairs of natural language conditionals and their contrapositives clearly show that those conditionals cannot be interpreted as material:

(36) a. If Dora dyed her hair, she didn't dye her hair blue.
         ? If Dora dyed her hair blue, she didn't dye her hair.

      b. If Eric bought a computer, he didn't buy a Mac.
         ? If Eric bought a Mac, he didn't buy a computer.

      c. If Patrick is running, he is not running fast.
         ? If Patrick is running fast, he is not running.

Speaking colloquially, the contrapositives do not make sense at all. A material interpretation of a conditional allows contraposition because it ignores any possible relations or dependencies between a conditional antecedent and its consequent. In the above examples, the antecedents of the contrapositives entail the negations of their consequents. That Dora dyed her hair blue entails that she dyed her hair. As Mac is a brand of computers, buying a Mac entails buying a computer. And, obviously, Patrick's running fast presupposes his running in the first place. The very possibility, not to even mention their prevalence, of this kind of analytic dependencies between constituents of a conditional undermines MT as a generally valid inference form for ordinary language conditionals. This is the first of the long list of difficulties into which the advocates of the material interpretation of a conditional are bound to run.

One could object that the above conditionals belong to a class of so called *non-interference conditionals*, that is sentences whose subordinate clauses can be introduced by means of "even if:"

(37) a. Even if Dora dyed her hair, she didn't dye her hair blue.

  b. Even if Eric bought a computer, he didn't buy a Mac.

  c. Even if Patrick is running, he is not running fast.

As such, they may need to be treated separately, analogously to the class of speech-act conditionals briefly discussed in the previous section. It is not clear, however, that the material account allows for differentiating between types of conditional sentences. Moreover, once again, this does not resolve the problem since there are cases of conditionals that do not fall into any special class (at least not in a sense that would be appropriate from the perspective of the advocates of the material account), yet their contrapositives are infelicitous, for instance:

(38) a. If Martha has not received any formal education, she is very talented.

  b. If Martha is not very talented, she has received a formal education.

MT inference does not seem to be applicable here either. Suppose that I believe that "If Martha has not received any formal education, she is very talented" is true. Upon learning from her teacher that Martha is not very talented, I might be more inclined to withdraw my believe in a conditional, or at least to lower my confidence that there is a meaningful connection between that conditional's antecedent and its consequent, than to conclude that the girl has not received any formal education.

Perhaps even more striking are those cases in which Modus Ponens seems to fail. One of the most famous counterarguments against MP comes from McGee (1985). Before the 1980 elections, one had good reasons to believe that:

(39) If a Republican wins the election, then if it's not Reagan who wins it will be Anderson.

given that there were two Republican candidates, Ronald Reagan and John Anderson. The opinion polls showed that Reagan was significantly ahead of the second in the race, the Democrat Jimmy Carter, with Anderson being a distant third, justifying a belief that:

(40) A Republican will win the election.

However, as McGee observed, it would not be rational to believe the following conditional:

(41) If it's not Reagan who wins, it will be Anderson.

even though one can arrive at it by virtue of MP. This example shows, then, that MP is not strictly valid. Moreover, experimental data on reasoning with right-nested conditionals suggest that MP inferences can be strong or weak depending on context (Huitink 2012; we will return to this issue at the end of chapter 3).

One could try to defend the validity of Modus Ponens by not allowing nesting of conditionals. After all, as has been already mentioned, MP seems to be one of the easiest inference patterns, and people strongly tend to endorse it. However, in an influential reasoning experiment, Ruth Byrne (1989, 1991) showed that a logically valid inference can be *suppressed* when an additional piece of information is added to the context. She reports that even though 96% of participants endorse the following valid inference:

(42) If she meets her friend, then she will go to a play.
      She meets her friend.
      Therefore, she will go to a play.

only 38% do so when a second conditional premise is added:

(43) If she meets her friend then she will go to a play.
      If she has enough money then she will go to a play.
      She meets her friend.
      Therefore, she will go to a play.

In classical logic and, consequently, on the material account of a conditional, the above argument is still valid, and hence people who do not endorse its conclusion commit a fallacy. The rules of classical logic notwithstanding, it often seems completely rational for people to withdraw earlier endorsed conclusions upon learning a new piece of information. Even though the following inferences:

(44) a. If Bob exercises twice a week, he will maintain his weight.
         Bob exercises twice a week.
         Therefore, Bob will maintain his weight.

      b. If the switch is on, the lamp is on.
         The switch is on.
         Therefore, the lamp is on.

   c. If Molly got an A for the logic course, her parents are proud of her.
     Molly got an A for the logic course.
     Therefore, Molly's parents are proud of her.

are all instances of MP, and thus both valid and intuitively appealing, it suffices to add an additional premise to make their conclusions difficult to maintain:

(45) a. If Bob exercises twice a week, he will maintain his weight.
     Bob exercises twice a week.
     Bob eats only fast foods and drinks only sweetened sodas.
     ? *Therefore*, Bob will maintain his weight.

    b. If the switch is on, the lamp is on.
     The switch is on.
     There is no light bulb in the lamp.
     ? *Therefore*, the lamp is on.

    c. If Molly got an A for the logic course, her parents are proud of her.
     Molly got an A for the logic course.
     Molly failed all of her other exams.
     ? *Therefore*, Molly's parents are proud of her.

Insisting that, for instance, Molly's parents are still proud of her despite the fact that she failed everything but logic seems irrational, and so is holding on to the conclusion that the lamp without a light bulb is on just because the switch is on, or that Bob will maintain his weight regardless his unhealthy diet. Arguments in (44) and (45) are perhaps even more striking than those used by Byrne in her experiments, because the additional premise is here in a rather overt conflict with the conditional, and yet the argument is still logically valid, whereas in (43) the additional conditional premise only triggers an inference that makes the primary premise insufficient for the conclusion.

   The failure of MP as illustrated by the above examples indicates that, unlike classical logic inferences, our everyday conditional reasoning is inherently defeasible. In addition, various studies on the role of background knowledge in conditional reasoning seem to indicate that it is highly context-sensitive (see, for instance, Thompson 1994; Liu 2003 or Klauer et al. 2010 on the effect of the perceived necessity and sufficiency of a conditional's antecedent for its consequent on the evaluation of MP, DA, AC

and MT; or Thompson and Evans 2012 on so-called *belief bias*).
Treating natural language conditionals as material implications is
hence highly problematic. To make this point even stronger, let
us consider a number of phenomena known as the *paradoxes of
material implication*.

In classical logic and, consequently, under the material account
of a conditional, strengthening of the antecedent is a valid argu-
ment form:

$$\frac{\varphi \supset \psi}{(\varphi \wedge \chi) \supset \psi}$$

This rule leads to the first of the paradoxes of material implication,
closely related to suppression of MP inferences demonstrated in
(43) and (45). Consider the following pair of conditionals:

(46) a. If Molly got an A for the logic course, her parents are
proud of her.

b. If Molly got an A for the logic course and failed all the
other exams, her parents are proud of her.

Anyone who believes the first conditional is automatically com-
mitted to accepting[7] the second even though the piece of inform-
ation added to the antecedent of that conditional makes its con-
sequent less likely to be true, and hence the whole sentence is
hardly acceptable. Importantly, this is not an isolated case as the
following pairs of conditionals clearly demonstrate:

(47) a. If Bob exercises twice a week, he will maintain his weight.

b. If Bob exercises twice a week and eats only fast food, he
will maintain his weight.

(48) a. If you offer John a cup of tea, he will be pleased.

b. If you offer John a cup of tea and add a tablespoon of
salt to it, he will be pleased.

(49) a. If the weather tomorrow is nice, I will go for a bike ride.

b. If the weather tomorrow is nice and I break my leg today,
I will go for a bike ride.

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7 I do not assume any theory of acceptability. The term is used in its intuitive,
ordinary sense.

In each of the above pairs, the material account rules that we cannot believe the first conditional without believing the second, even though they sound absurd.

The paradoxes of material implication are even more taxing if they do not involve any changes in the contexts or in the belief states of a speaker. As a matter of fact, the material account allows us to generate countless instances of true yet absurd conditionals precisely due to the way their truth conditions are specified. The first class of problems stems from the fact that a true consequent is a sufficient condition for a materially interpreted conditional to be true, that is:

$$\frac{\psi}{\varphi \supset \psi}$$

is a valid argument. Therefore, if I believe the following sentences to be true:

(50)   a. Nanga Parbat has never been climbed in winter.

     b. I have a younger sister.

     c. Lithuania is not a monarchy.

the material account commits me to accept the following conditionals, too:

(51)   a. If summits of all 14 eight-thousanders have been reached in winter, then Nanga Parbat has never been climbed in winter.

     b. If my only sister is 5 years older than me, then I have a younger sister.

     c. If Lithuania is reigned by a king, then it is not a monarchy.

The second class of paradoxical conditionals owes its problematic character to the fact that a false antecedent is, again, sufficient for the truth of a material conditional. Given that

$$\frac{\neg\varphi}{\varphi \supset \psi}$$

is a valid argument form, the following conditionals:

(52)   a. If aubergine is a species of small birds, then most Belgians speak Basque.

    b. If Orhan Pamuk did not win the Nobel Prize in literature, then he is not a writer.

    c. If raccoons are not American mammals noted for their intelligence, then they are not animals.

if interpreted materially, must be evaluated as true when the negations of their antecedents are evaluated as true:

(53) a. Aubergine is not a species of small birds.

    b. Orhan Pamuk won the Nobel Prize in literature.

    c. Raccoons are American mammals noted for their intelligence.

The sentences in (51) and (52) seem so awkward, that one could think that no theorist could seriously defend the material account of a conditional. However, some philosophers, and most prominently Grice (1989), argued that there is nothing wrong with the above sentences in terms of their truth values. They all can be true yet simply unassertable. According to Grice, asserting a conditional when one knows the truth value of any of its constituents is a violation of one of the principles of good conversation, namely:

THE PRINCIPLE OF QUANTITY: Make your contribution as informative as is required (for the current purposes of the exchange).

This Gricean principle teaches us that a speaker who knows φ to be true but asserts a disjunction $\varphi \vee \psi$ is highly uncooperative, for he does assert something weaker than what he has evidence for. Consequently, since the material conditional, $\varphi \supset \psi$, is defined as equivalent to the disjunction of $\neg\varphi$ and ψ, asserting (52a) by a speaker who knows that aubergine is not a bird is as infelicitous as asserting:

(54) Either aubergine is not a species of small birds or most Belgians speak Basque.

in the same context. The same holds for asserting "Either Orhan Pamuk won the Noble Prize in Literature or he is not a writer" or "Either raccoons are American mammals noted for their intelligence or they are not animals" when one knows that, respectively, (53b) or (53c) are true. There is nothing wrong though with judging these disjunctions true, and, as Grice argues, neither there

is anything wrong with judging the corresponding conditionals true for they are unassertable for purely pragmatic reasons.

A Gricean defence of material conditional account has been motivated by semantic Occamism which teaches us not to multiply senses beyond necessity. Grice worried that interpreting "or," "and," and "if..., then...," as meaning something more than the logical connectives $\vee$, $\wedge$, and $\supset$, makes the connectives ambiguous, because there will always be a context in which some of the senses will be missing (see Bennett 2003, pp. 25-28, for a discussion of semantic Occamism). He prefers to explain the differences in how people use certain words as pragmatic phenomena. However, this strategy leads to a result that seems to betray Occam's spirit itself, namely, to an unlimited multiplication of truths. That one should apply Occam's razor to multiple meanings of a connective rather than to the profusion of nonsensical yet true propositions like (51) and (52) appears to be an arbitrary decision.

Let us assume, nevertheless, that allowing such a plethora of silly sentences to be true is not something to be worried about. As Edgington (1995, p. 243) provocatively proposes:

> If a theory which serves us well most of the time has the consequence that all such uninteresting conditionals are true, perhaps we can and should live with that consequence. It is too much—or maybe too little— to expect our theories to match ordinary usage perfectly. Perhaps, in the interests of simplicity and clarity, we should replace "if" with "$\supset$."

But is it indeed the case that the material interpretation of "If φ, then ψ" aided by Gricean principles of good conversation suffices to explain all the data?

In fact, Edgington's own response to the above suggestion is negative. As she observes, when we have to deal with beliefs that are not certain—which is arguably what natural language speakers usually do—the unacceptability of the inference from $\neg\varphi$ to $\varphi \supset \psi$ is even more striking. Edgington notes that when one has good reasons to believe $\neg\varphi$ yet they have no absolute certainty that it is true, they are justified in believing $\varphi \supset \psi$. For instance, to paraphrase Edgington's own example, I am pretty confident that the king of the Netherlands is not on a visit to Poland right now. I am following the news and I am convinced that if such a visit were taking place, Polish newspapers would write about it. However, there is still a small chance that the Dutch king is actually in Poland but I have simply missed the news, or, perhaps

an even smaller chance, that he is now visiting the country incognito. Yet my high certainty that the king of the Netherlands is not in Poland at the moment leads me to accepting the following conditional:

(55) If the king of the Netherlands is in Poland right now, he is thinking about me.

assuming that the conditional is to be interpreted materially. This obviously is an absurd thing to believe or to assert. Nonetheless, uncertainty about ¬φ means that φ is not entirely excluded, and hence one cannot simply apply Gricean's principles of good conversation to dismiss this and similar conditionals as true but unassertable.

The above conditionals with uncertain antecedents are not the only problems of the material interpretation that cannot be accounted for pragmatically. As Frank Jackson (1979) points out (I follow Bennett 2003, p. 32, here), logically equivalent sentences can differ in assertability, but Gricean pragmatics cannot explain such differences. For instance, the material account rules that as $¬φ \land (φ ⊃ ψ)$ and $¬φ \land (φ ⊃ χ)$ are logically equivalent, because they are both equivalent to $¬φ$. Hence, there should be no difference in assertability of the following sentences:

(56) a. The sun will come up tomorrow, but if it doesn't it won't matter.

   b. The sun will come up tomorrow, but if it doesn't it will be the end of the world.

Grice's "assert the stronger instead of weaker" is of no help here as the above sentences are equally strong. Yet it does not only seem rational to assert just one of them and reject the other, but it could be easily considered irrational to even *accept* both of them. Intuitively, they appear contradictory.

Analogously, Gricean pragmatics does not help to explain the discrepancies between the contrapositives. As has been already mentioned, the contrapositives of the conditionals listed in (36) or (38). To repeat an earlier example, out of the following pair of conditionals:

(38) a. If Martha has not received any formal education, she is very talented.

   b. If Martha is not very talented, she has received a formal education.

I may be inclined to assert the first but not the second, and there does not seem to be anything irrational about my preferences. Again, none of Grice's principles of good conversation can explain why one of the two equivalent sentences is more assertable than the other. Yet again, material implication proves not to be the right interpretation of a natural language conditional.

Furthermore, interpreting conditionals materially and discarding all their odd instances on pragmatic grounds can have severe consequences for our epistemic hygienics. As has been discussed earlier, sentences like (52b) "If Orhan Pamuk did not win the Nobel Prize in literature, he is not a writer" are not assertable for someone who knows that the antecedent is false. Unassertability does not prevent us though from believing that if Orhan Pamuk did not win the Nobel Prize in literature, he is not a writer. After all, it is true that either Orhan Pamuk won the Nobel Prize in literature or he is not a writer, because he has actually been awarded the Nobel Prize in Literature. If such a belief is stored in the form of the above conditional, however, it may lead to certain false convictions.[8]

Imagine, for instance, that Bob, who believes (52b), encounters the name of Harry Mulisch, one of the most important Dutch writers of the last century. Mulisch, however, has never been honoured by the Swedish Academy, and therefore Bob may come to believe that he cannot be a writer at all. After all, (52b) that he already believes suggests that being awarded the Nobel Prize is some sort of a condition that has to be fulfilled for someone to be called a writer. It relates to the fact that (52b) could be paraphrased by Bob as "If someone did not win the Nobel Prize in Literature it means that he is not a writer" or "only people who win the Nobel Prize in Literature are writers." Regardless whether these sentences can indeed be taken as correct paraphrases of (52b), they seem to be likely interpretations of the original sentence.

The reason for the misleading effect of a belief stored in a form that would make it unassertable, and in particular, as in this case, of a conditional whose truth is granted by the falsehood of its antecedent (or, analogously, by the truth of its consequent), is that such a conditional sentence conveys the existence of a connection between its antecedent and the consequent. A connection or some sort of a dependency between the clauses seems to be what we learn when we learn a conditional. If the material ac-

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8 Cf. Douven (2010) on the pragmatics of belief.

count deserves the title of the least intuitive theory of conditionals,[9] it is precisely because it utterly ignores any semantic relations between the contents of their constituents. In its pursuit of truth-functionality, the material conditional account looses what is the most distinctive about conditional constructions, namely, their *conditionality*.

2.3 IN SEARCH OF CONDITIONALITY

The counterintuitive consequences of the material account suggest that the natural language conditional requires stronger than truth-functional truth conditions. The data on how people actually use and interpret conditional sentences suggest that an empirically adequate theory should be guided by an idea that the antecedent of a conditional is *some* sort of a condition that the consequent in *some* way depends on.

Some of the most prominent propositional theories of conditionals that take the conditionality of conditionals into consideration have been inspired by a celebrated idea of Frank Ramsey (1990, p. 155), mentioned in section 1.2. Ramsey outlined a procedure for fixing one's degree of belief in a conditional, known henceforth as the Ramsey Test, which can be construed as a specification of the acceptability conditions for conditional sentences. He argues that deciding whether to accept "If φ, then ψ" or "If φ, then $\neg\psi$" amounts to deciding whether ψ holds under the supposition that φ. The test seems to hint at a plausible cognitive mechanism underlying the interpretation of conditional sentences, sometimes referred to as the *simulation heuristics* (Kahneman and Tversky 1982) or, more broadly, the process of hypothetical thinking (Evans and Over 2004, p. 153).[10]

Being merely a footnote, however, a side comment that the author did not elaborate on, Ramsey's illustrious passage allows some freedom of interpretation. Not surprisingly then, it inspired a family of theories focusing on conditional probabilities and acceptability conditions for conditionals, sometimes denying that conditionals can be truth-apt at all (Adams 1965; Edgington 1995). But it also did not stop Robert Stalnaker from incorporating the

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9 Cf. Jackson's [1979] argument from classroom experience (Bennett 2003, p. 33).

10 It should be pointed out that applications of this mechanism go beyond the interpretation and production of conditional sentences. It has been proposed, for instance, that a process similar to the Ramsey Test is involved in something *prima facie* very different from evaluating conditionals, namely, in reasoning about other people's beliefs (Peterson and Riggs 1999; Krzyżanowska 2013).

Ramsey test into his propositional account of conditional sentences.

Stalnaker (1968) developed Ramsey's idea into a full-fledged truth-conditional semantics for both indicative and subjunctive conditionals. It is worth noting that some philosophers, and most notably Lewis (1973), are of the opinion that Stalnaker's theory provides roughly the right framework for analysing subjunctive or counterfactual conditionals, and not indicatives. Lewis himself advertised the material interpretation of indicative conditionals which, as I have argued in the previous section, is not a descriptively correct account of natural language conditionals. Moreover, there seems to be a consensus in linguistics that semantics of indicatives is intensional (see, e.g., Kratzer 1986, 1991; Veltman 1985; von Fintel 2011). In fact, a view that became a dominant paradigm in linguistic literature, that is, so-called *restrictor analysis* developed by (Kratzer 1986) can be seen as a version of Stalnaker–Lewis approach.[11] Given that this thesis is predominantly concerned with indicative conditionals, I will focus on evaluating Stalnaker's theory as an attempt to provide a semantics for conditionals in this class.

Stalnaker's account is build upon the possible worlds semantics proposed by Kripke (1963). Note that even though the notion of a possible world seems metaphysically laden, Stalnaker emphasises that it is just a formal tool, a utility helpful in unravelling the structure of thought.[12]

> Possible worlds are primitive notions of the theory, not because of their ontological status, but because it is useful to theorize at a certain level of abstraction, a level that brings out what is common in a certain range of otherwise diverse activities. The concept of possible worlds that I am defending is not a metaphysical conception, although one application of the notion is to provide a framework for metaphysical theorizing. The concept is a formal or functional notion, like the notion of an individual presupposed by the semantics for extensional quantification theory. . . .

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11 As noted by von Fintel (2011), the restrictor approach is not really an alternative to the Stalnaker–Lewis semantics, "but a radical rethinking of the compositional structure of conditional sentences."

12 The notion of a possible world has also been recognised as a handy tool in psychology, where it helps to explicate people's hypothetical and counterfactual reasoning, that is their ability to think about or to mentally represent alternatives to reality (Rafetseder et al. 2010; Leahy et al. 2014).

... The theory leaves the nature of possible worlds as
open as extensional semantics leaves the nature of in-
dividuals. A possible world is what truth is relative
to, what people distinguish between in their rational
activities. To believe in possible worlds is to believe
only that those activities have a certain structure, the
structure which possible worlds theory helps to bring
out (Stalnaker 1984, p. 57).

Possible worlds should be then understood as ways the world
might be or might have been, or in other words, as alternative
scenarios according to which things might happen or might have
happened. In this sense, if we are about to toss a coin and wonder
how it will land, we are considering two possible worlds, or, to be
more specific, sets of worlds: one in which the coin lands heads,
and another one in which it lands tails. If the coin has already
been tossed and it landed heads, we may still entertain a thought
that it might have landed tails. The notion of a possible world is,
at least in this framework, just a useful theoretical device allow-
ing us to model phenomena that involve thinking about various
possibilities.[13] For this reason, a possible worlds semantics seems
perfectly well suited for analysing the meaning of conditional sen-
tences.

Intuitively, the if-clause of a conditional invites us to imagine
that the world is somewhat different, that is, it is different in a
way specified by the content of the if-clause. The main clause can
be then construed as an assertion that should be evaluated in
relation to that mental image. For instance, when I am asserting
or thinking that:

(57) If Tolstoy did not write *Anna Karenina*, someone else must
     have.

I first imagine that, contrary to my belief otherwise, *Anna Karenina*
was not authored by Tolstoy, and, consequently, in order to make
sense of this imagined state of the world, I decide that the book
must have been written by some other author. For this reason, I
believe that (57) is true. By contrast, I would not assert that:

(58) If Tolstoy did not write *Anna Karenina*, the book does not
     exist.

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13 Some philosophers, and most notably Lewis (1973), disagree that the notion of a
   possible world can be treated instrumentally, as a metaphysically innocent tool.

even though it is easy to conceive of a possible world in which there is no such a book. The clear intuitions I have regarding (57) and (58) suggest that we intuitively impose certain constraints on what we can take as an alternative to the reality when asserting or interpreting conditional sentences.

To account for the difference between sentences like (57) and (58), a possible world semantics for conditional sentences must make it possible to determine which scenarios are, roughly speaking, "more possible" than others. In the Stalnaker's framework, this is achieved by means of a *selection function* s (or *s*-function for short) that picks *the closest possible world* in which the antecedent of a given conditional is true. More precisely, s is defined as the mapping:

$$s\colon W \times 2^W \to W \tag{2}$$

where W is the set of all possible worlds. The first argument of the selection function, $w_0 \in W$ is the candidate for the actual world, or, more generally, a world in which a conditional $\varphi > \psi$ is to be evaluated,[14] and the second second argument is the proposition expressed by the φ, that is, a set $\{w \in W\colon v(\varphi,w) = 1\}$ where $v\colon W \to [0,1]$ is a valuation function assigning binary truth values to propositions. The output of s is a possible world $w_1 \in W$ such that, of the worlds in which φ is true, w_1 is the most similar to w_0. To evaluate a conditional "$\varphi > \psi$", one has to evaluate its consequent, ψ, in $s(\varphi, w)$, that is, the closest φ-world. A conditional is true if and only if its consequent is true in the closest possible world in which the antecedent is true. More formally:

$$v(\varphi > \psi, w) = 1 \ \text{ if and only if } \ v(\psi, s(w, \varphi)) = 1 \tag{3}$$

Assuming that a person's beliefs, as propositions, can be represented as sets of possible worlds, the notion of the closest possible world neatly corresponds to Ramsey's idea of minimally changed stock of beliefs. What an agent believes determines which possible worlds they consider as the candidates for the actual world. Upon hypothetically accepting a new proposition, an agent considers an alternative to the actual world, or rather, to what they believe is the actual world. The selected world w' differs from the (candidate for the) actual one only with respect to the truth value

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14 We are following here a convention of using the symbol ">" as a truth-conditional connective for Stalnaker's nearness conditionals.

of φ and, if necessary, the values of other propositions that need to be changed in order to avoid inconsistency.

Closeness is a vague notion and it is somewhat controversial whether it can serve the purpose it has been designed for. Nevertheless, studies on counterfactual reasoning, and in particular, on so called counterfactual emotions of regret and relief suggest that people tend to have rather clear intuitions about the relative closeness of different possibilities (see, for instance, Kahneman and Miller 1986; Byrne 2002; Roese 2004; Teigen 2005). The examples of (57) and(58) well illustrate that our intuitions about plausibility of different scenarios can be fairly strong. I can easily imagine that Tolstoy did not write *Anna Karenina*. However, I am convinced that there is such a novel: I do not only remember reading it but I also own a copy. If I hypothetically accept "Tolstoy did not write *Anna Karenina*," that is, if I imagine a possible world in which Tolstoy did not write this book, I do not have to hypothetically withdraw my belief that it has been actually written. Quite the contrary: it would be a waste of mental energy to make so far-reaching changes in the set of my beliefs since the thought of *Anna Karenina* not being one of the Tolstoy's masterpieces can be easily reconciled with the belief that the book nonetheless exists. The possible world in which someone else than Tolstoy wrote *Anna Karenina* seems more similar to what I believe to be the actual world than the world in which the book has not been written at all. This is why I am inclined to judge (57) as true and (58) as false.

The difference between the two sentences can be easily illustrated by means of the following model:
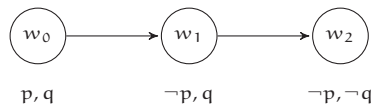
Let p stand for "Tolstoy wrote *Anna Karenina*" and q for "The book titled *Anna Karenina* exists." In the actual world, w_0 both p and q are true. Given that p entails q, there is no possible world in which $\neg p \wedge \neg q$ is true.[15] The worlds w_1 and w_2 are $\neg p$-worlds.

15 To be precise, in Stalnaker's semantics, there is a notion of an absurd world, defined as a world that is not accessible from any possible world, and where, roughly speaking, everything holds. Stalnaker introduced this semantic device to account for the meaning of conditionals with impossible antecedents, e.g., "If circles were square, it would never snow in Groningen." In his theory, all conditionals with impossible antecedents are trivially true, because everything is true

Since the only difference between w_0 and w_1 is the truth value of q while w_0 and w_2 diverge with respect to both p and q, w_1 is evidently more similar to w_0 than w_2 is.

Note that although my belief in Tolstoy's authorship is very strong, I can still consider it as a possibility that *Anna Karenina* was attributed to him by mistake. Therefore, the conditional I utter does not need to be a subjunctive. Interestingly, Stalnaker's semantics was supposed to account for both indicative and subjunctive conditionals, that is, on his account they have the same truth conditions. However, indicatives are pragmatically constrained: the closest possible worlds in which the antecedent is true, w_1 in the above example, cannot have been ruled out by anything accepted in the context in which the conditional is being evaluated. Whenever the antecedent is known to be false, the conditional is a counterfactual and the subjunctive mode is required. But given that we are rarely absolutely certain about the truth or falsehood of contingent propositions, it seems possible to use the subjunctive form when the antecedent is just very unlikely, though not entirely ruled out. For this reason, I might find the indicative (57) true while rejecting the subjunctive:

(59) If Tolstoy had not written *Anna Karenina*, someone else would have done that.

At the same time, I might be perfectly inclined to evaluate:

(60) If Tolstoy had not written *Anna Karenina*, the book would not have existed.

as true. If we pair the indicatives (57) and (58) with their subjunctive counterparts, (59) and (60), it appears that to tell the indicatives and subjunctives apart we may need something more than a pragmatic constraint since it is possible for one person in one context to believe (57) and (60), or, though the result does not sound particularly smoothly, to even conjoin them in one sentence:

(61) If Tolstoy had not written *Anna Karenina*, the book would not have existed, but if he did not write *Anna Karenina*, someone else must have done that.

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in the world in which these antecedents hold. As pointed out by Lewis (1973), however, "the absurd world is a technical convenience not to be taken seriously," and Stalnaker's semantics can do without it (p. 78). See Nute and Cross (2002) for an alternative take on impossible antecedents within Stalnaker's framwork.

The above examples suggest that when deciding on which world is the most similar to the actual one, we take different aspects of that world into account, depending on whether we assert an indicative or a subjunctive conditional. Hence, if both indicatives and subjunctives are to be modelled within the same possible worlds framework of Stalnaker, we will have to explain why the selection function picks different possible worlds depending on the mood of the conditional sentence.

The issue of distinguishing between indicative and subjunctive conditionals aside, the concept of the closest possible world seems perfectly suited for explicating our intuitions about sentences like (57) and (58). However, even it raises problems of its own. Needless to say, similarity is an extremely vague notion, and even if in some cases we can simply count the propositions whose truth values are different, this will not always suffice. For instance, we may want to evaluate $\neg p > q$ in the world w_0 of the following model:
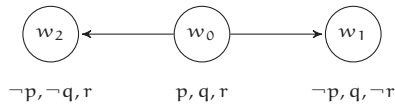
Since p holds in our base world w_0, we need to select the closest possible world in which $\neg p$ is true to see whether q holds in that world. But which of the $\neg p$-worlds are we supposed to select: w_1 or w_2? The world w_1 differs from w_0 with respect to the truth values of two propositions, p and q, but so does w_2. It differs from w_0 with respect to the truth values of p and r. There does not seem to be any reasonable way to decide which of the two $\neg p$-worlds is the closest: w_1 is as similar to w_0 as w_2 is.

To illustrate that this is not just an artificial example that has nothing to do with natural language, consider the following scenario. Bonnie and Clyde went for a hike. While Bonnie was admiring the landscape, Clyde walked ahead and she lost sight of him. Bonnie followed Clyde and arrived at a crossroads. It is likely that Clyde just walked straight ahead, however, he could have also taken a turn. Bonnie considers two conditionals:

(62) a. If Clyde did not go straight ahead, he turned right.

  b. If Clyde did not go straight ahead, he turned left.

As Bonnie has no evidence in favour of any of the two conditionals, it is unclear how she should evaluate them. Looking for the

closest possible world in which Clyde did not go straight ahead is a lost call here for it is impossible to decide, given all the data at hand, whether the "turned right"- or the "turned left"-world is the closest. This on its own, however, is not necessarily a problem for Stalnaker's logic, even though it validates the principle of *Conditional Excluded Middle* (CEM):

$$(\varphi > \psi) \vee (\varphi > \neg\psi) \tag{4}$$

As he argues in (Stalnaker 1981), the truth values of conditionals in pairs like (62) or like the following famous example of subjunctives from Quine (1959, p. 15):

(63) a. If Verdi and Bizet had been compatriots, Bizet would have been Italian.

     b. If Verdi and Bizet had been compatriots, Verdi would have been French.

can be undetermined. Stalnaker acknowledges vagueness as an immanent element of natural language and deals with it by adopting van Fraassen's idea of supervaluations (van Fraassen 1966). Nevertheless, the above example illustrates that the similarity between worlds is not such an easy notion to operate with as one would *prima facie* expect.

In fact, the idea of the closest possible world has been challenged in the literature by many authors (see Bennett 2003, ch. 11 and 12, for a review), usually in the context of counterfactual conditionals like:

(64) If the president had pressed that button, a nuclear war would have started.

whose consequent is supposed to be true in possible worlds that are dissimilar from the actual world in the extreme (Fine 1975). This problem, however, can be resolved by specifying what kinds of dissimilarity can and cannot be allowed. For instance, we should not allow "miracles," that is, the laws of nature should not be violated (Lewis 1979). But our intuitions about the similarity of worlds can also be at odds with our evaluations of certain indicative conditionals, especially when they involve vague predicates like "tall" or "bald." Consider the following context: Bruce has a head full of hair. However, while some of his male family members do not experience any hair loss whatsoever, others go completely bald later in their life. Assuming that baldness is, at

least to an extent, a genetic condition, we may come to believe
that:

(65) If Bruce goes bald, he will be completely bald.

"Bald" is a paradigmatic example of a vague predicate, hence not
only a person with no hair at all can be referred to as bald, but
also someone with, for instance, 100 or 500 hairs. Hairs on Bruce's
head in the actual world count in thousands, but how many hairs
does Bruce have in the closest possible world in which he is bald?
If the similarity between the worlds is a decisive factor, any world
in which Bruce is partially bald is closer to the actual world than
a world in which he is completely bald. Yet, given the above de-
scribed context, (65) seems perfectly justified.

   But assume, for the discussion's sake, that we can define the
relation of similarity between worlds in a satisfactory way. Does
then Stalnaker's semantics provide us with the right framework
for analysing indicative conditionals? Is it suitable for capturing
our intuitions about conditionality? Indubitably, Stalnaker's the-
ory does a much better job than the material account in explaining
the meaning of "if" and the relationship between a conditional's
antecedent and its consequent. However, as I am going to show,
it is not good enough. For this reason, it is worthwhile to have a
closer look at the differences and, perhaps most importantly, the
similarities between the two accounts.

   The possible worlds semantics for conditionals is clearly not a
truth functional account, since knowing the truth value of φ and
ψ is not sufficient for determining the truth value of $\varphi > \psi$:

φ	ψ	$\varphi > \psi$
1	1	1
1	0	0
0	1	0 or 1
0	0	0 or 1

As the above table illustrates, conditionals with false antecedents
do not have to be all true, because their evaluation does not hinge
upon what is true or false in the actual world, at least not in a
direct way. *Prima facie*, this seems to have allowed Stalnaker to
escape those paradoxes of material implication that result from
the falsehood of the antecedent, like, e.g., the sentences discussed
above:

(52) a. If aubergine is a species of small birds, then most Belgians speak Basque.

b. If Orhan Pamuk did not win the Nobel Prize in literature, then he is not a writer.

c. If raccoons are not American mammals noted for their intelligence, then they are not animals.

Supposing that aubergines are birds should not lead us to consider a possible world in which Belgians speak Basque as such a world would be much more remote than a world in which Belgians speak Flemish or French, as they actually do. Similarly, given that Orhan Pamuk is actually a writer, in the closest possible world in which he did not win the Nobel Prize in literature, he still is a writer—otherwise that possible world would not be similar enough to the actual one, that is, not similar enough to be considered the closest. Finally, hypothetically changing a very specific characteristics of American mammals known as raccoons can be limited to supposing that, for instance, they are not as cognitively skilled as they are reported to be in the actual world. Hypothesising that they might be something else than animals would lead us far beyond the closest possible world. For these reasons, Stalnaker's semantics renders all the sentences in (52) false.

By the same token, the truth of a consequent is not sufficient for the truth of a conditional. Even though it is true that the summit of Nanga Parbat has never been climbed in winter, that I have a younger sister, and that Lithuania is not a monarchy, the following sentences are false on Stalnaker's account:

(51) a. If summits of all 14 eight-thousanders have been reached in winter, then Nanga Parbat has never been climbed in winter.

b. If my only sister is 5 years older than me, then I have a younger sister.

c. If Lithuania is reigned by a king, then it is not a monarchy.

It seems natural to imagine that, as Nanga Parbat is one of the 14 mountains higher than 8000 meters above see level, in the closest possible world in which all of these 14 mountains have been climbed in winter, Nanga Parbat's summit has been climbed,

too. Likewise, in a possible world in which my only sister is 5 years older than me, "I have a younger sister" must be false or else it would be an inconsistent world. And given that, by definition, a country that has a monarch acting as a head of state is a monarchy, in the closest possible world in which Lithuania has a king, it should also be a monarchy.

Furthermore, in Stalnaker's logic:

$$\frac{\varphi > \psi}{\neg\psi > \neg\varphi}$$

is not a valid principle, hence it does not render the pairs of sentences in (36) equivalent. For instance, even if we accept that if Dora dyed her hair, she didn't dye it blue, we are not only free to reject the contraposition: "If Dora dyed her hair blue, she didn't dye her hair," but we are even obliged to do so, for in the closest possible world in which Dora dyed her hair blue, regardless of how far from reality such a world is, she dyed her hair in the first place. In the closest possible world in which Eric bought a Mac, Mac should still be a computer and thus "If Eric bought a Mac, he didn't buy a computer" cannot be true even if "If Eric bought a computer, he didn't buy a Mac" is. Similarly, running fast presupposes running, therefore "If Patrick is running, he is not running fast" does not entail that if Patrick is actually running fast, he is not running.

Strengthening of the antecedent is not a valid argument form in Stalnaker's logic either. Therefore, someone who accepts that if Bob exercises twice a week, he will maintain his weight, is not immediately committed to accepting that if Bob exercises twice a week and eats only fast food, he will maintain his weight. It is likely that the closest possible world in which both "Bob exercises twice a week" (p) and "Bob eats only fast food" (q) is further away from the actual world (w_0) than the world in which only the first conjunct is true, so it does not necessarily make "Bob will maintain his weight" (r) true:
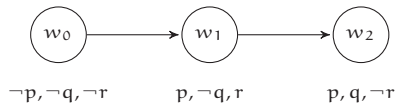
This seems promising. The truth conditions proposed by Stalnaker make it seem as if there was a need for some sort of a dependency between a conditional's antecedent and its consequent.

In his 1968 paper, Stalnaker notes that the connection between φ and ψ is indeed sometimes relevant for the evaluation of "If φ, then ψ":

> If you believe that a causal or logical connection exists, then you will add the consequent to your stock of beliefs along wiht the antecedent, since the rational man accepts the consequences of his beliefs (p. 101).

However, Stalnaker's semantics does not always help to avoid the troubles that made us discard the material account as inadequate. Even though a false antecedent is not sufficient to make a conditional true, conditionals with false antecedents and true consequents will often turn out true despite the lack of connection between the clauses as is the case with the following sentences:

(66) a. If aubergine is a species of small birds, then raccoons are American mammals noted for their intelligence.

   b. If it is never raining in Groningen, then Kazimierz Ajdukiewicz was a prominent Polish philosopher.

   c. If Tolstoy did not write *Anna Karenina*, then Ljubljana is the capital of Slovenia.

The consequents of the three above sentences are all true in the actual world. Even if we hypothetically assume that aubergine is a species of small birds, we do not need to change our beliefs about raccoons. In fact, given that we should keep the change as minimal as possible, we must not change any beliefs that are not inconsistent with the assumed proposition. Therefore, in the closest possible world in which aubergine is a species of birds, raccoons are still American mammals noted for their intelligence. Analogously, the closest possible world in which it is never raining in Groningen should not differ from the actual one with respect to the status of Kazimierz Ajdukiewicz as a prominent Polish philosopher. Likewise, in the closest possible world in which Tolstoy did not write *Anna Karenina*, Ljubljana should still be a capital of Slovenia. All three sentences in (66) are rendered true by Stalnaker's semantics:

> if you already believe the consequent (and if you also believe it to be causally independent of the antecedent), then it will remain a part of your stock of beliefs when you add the antecedent, since the rational man does not change his beliefs without reason (*ibid.*).

Strangely enough, this is not only the case *despite* there being no connection between these conditionals' antecedents and their consequents. As a matter of fact, this is only possible *because* the connection is missing, and hence hypothetically assuming the antecedent has no bearing whatsoever on the truth value of the consequent:

This phenomenon is related to another problem with Stalnaker's possible worlds semantics for conditionals. Whenever an antecedent, φ, is true in w, the following holds:

$$s(w, \varphi) = w \qquad (5)$$

In other words, if a conditional's antecedent is true in the actual world, then the closest possible world needed for the evaluation of that conditional is the actual world itself. As a result, the truth conditions defined by Stalnaker coincide with the material account whenever the antecedent is true, which means that Stalnaker's semantics validates the following principle:

$$(\varphi \wedge \psi) \vdash (\varphi > \psi) \qquad (6)$$

Any two sentences that are true in the actual world conjoined by means of a connective "if" will make a true conditional. Therefore,

(67) a. If aubergine is a vegetable, then raccoons are American mammals noted for their intelligence.

b. If it sometimes rains in Groningen, then Kazimierz Ajdukiewicz was a prominent Polish philosopher.

c. If Shakespeare did not write *Anna Karenina*, then Ljubljana is the capital of Slovenia.

are all rendered true on Stalnaker's account. Even though this theory appears to be all about a dependence between conditionals' antecedents and their consequents, it still fails to pin down what this dependence exactly is. And given that it allows some of the undesirable consequences of the material account to sneak in, it also fails to adequately capture the meaning of a natural language conditional.

2.4   WHAT IS WRONG WITH THE RAMSEY TEST?

It seems that Stalnaker's account fails exactly because of what the Ramsey Test does not take into account. The possible world semantics as well as the nonpropositional theories of conditionals

that have been build upon Ramsey's idea (e.g. Adams 1965, 1975; Gibbard 1981; Edgington 1995) fail to acknowledge that there is more to the dependency between an acceptable conditional's antecedent and its consequent than the truth or a high degree of belief in the consequent under the supposition of the antecedent. The Ramsey Test is perhaps best construed as an operational definition of conditional probability and as such it does not exhaust the meaning of conditional sentences, though it somewhat suggests a broader mechanism of hypothetical thinking involved in their production.

As a procedure of fixing one's degrees of belief in a conditional, the Ramsey Test seems to be, intuitively, plausible. Therefore, it seems to present a good basis for the acceptability or assertability conditions for conditional sentences, and as such it has been utilised by many authors, with, perhaps, the most influential of them being Ernest Adams (1965, 1966, 1975)[16] according to whom the acceptability or assertability of a conditional "goes by" its conditional probability. Regardless of how we specify what exactly "goes by" means, one is clear: "If φ, ψ" is highly assertable or acceptable if and only if $Pr(\psi | \varphi)$ is high. That there is a strong correlation between a conditional's degree of acceptability or assertability and the probability of the conditional's consequent on a supposition of its antecedent, usually referred to as *The Adams Thesis*, is, interestingly, one of the very few claims about conditionals that is not only relatively uncontroversial, but also frequently taken for granted, even though it has been experimentally shown that, as a general claim about how actual speakers use conditional sentences, it does not hold (Douven and Verbrugge 2010). Moreover, it is not unproblematic if taken solely as a normative principle. As observed by Douven (2008), the high conditional probability does not suffice for the high degree of assertability or acceptability of a conditional either. If it were sufficient, the following two conditionals would be equally assertable or acceptable:

(68) a. If there is a heads in the first ten tosses,
           there will be at least one heads in the first 1,000,000 tosses of this fair coin.

      b. If Chelsea wins the Champions League,
           there will be at least one heads in the first 1,000,000 tosses of this fair coin.

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16 See also Lewis (1973); Jackson (1979, 1987)

The probability of the shared consequent of the two above sentences, that is, the probability that there will be at least one heads in the first $1,000,000$ tosses of a fair coin (ψ) is extremely high. More precisely, $\Pr(\psi) = 1 - \frac{1}{2}^{1,000,000} \approx 1$. On the assumption that there is a heads in the first ten tosses of that fair coin (α), ψ is absolutely certain, that is, $\Pr(\psi \mid \alpha) = 1$. Being a tautology, (68a) is perhaps not very likely to be asserted in a conversation, nevertheless, it is perfectly acceptable and assertable. (68b), by contrast, seems to have a rather low degree of assertability, yet it passes the Ramsey Test with flying colours: after hypothetically adding "Chelsea wins the Champions League" (β) to our stock of beliefs, we find out that our degree of belief in (ψ) is very high, thus the conditional (68b) should be highly acceptable and assertable. As long as $\Pr(\beta)$ is non-zero, and $\Pr(\psi) \approx 1$, $\Pr(\psi \mid \beta) \approx 1$, thus, assuming the Adams Thesis, the degree of assertability or acceptability of a conditional with β as an antecedent and ψ as a consequent is extremely high. However, this leads to counterintuitive consequences, parallel to the paradoxes of the material implication. As the example of (68b) clearly shows, the Ramsey Test and the Adams Thesis allow for conditional sentences whose antecedents have nothing to do with their consequents to be rendered highly acceptable or highly assertable, which should not be the case.

The assertability or acceptability conditions defined on a basis of the Ramsey Test fall into a similar problem as Stalnaker's semantics: they do not account for the connection between a conditional's antecedent and its consequent in an appropriate way, forcing us to yield acceptable and assertable bizarre conditionals that, intuitively, are not acceptable nor assertable at all. But if the effect of assuming the antecedent on the probability of the consequent is not sufficient for the acceptability or assertability of conditional sentences, what is still missing? Within Bayesian framework, the hitherto missing connection between the antecedent and the consequent of a conditional can be captured by means of an *evidential support* relation (Douven 2008). Some logicians, on the other hand, talked about a relation of relevance, which according to some authors amounts to sharing variables, while others insisted that an antecedent of a conditional should be a part of a proof of that conditional's consequent (Mares 2014).[17] However, before we can choose between any of the available proposals, we should ask ourselves a question: what do we assert

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17 The relevance logics will be briefly discussed in section 3.2 of the next chapter

when we assert a conditional sentence? In other words, what is it that we are trying to communicate whenever we decide to use a sentence of the form "If φ, ψ" instead of some simpler, more straightforward construction. In the following chapters, I will attempt to answer these questions and, accordingly, to propose a new semantics of conditionals that will do justice to both our intuitions and the linguistic data on these sentences are used and interpreted by natural language speakers.

TOWARDS A NEW SEMANTICS

This chapter is based on joint works with Sylvia Wenmackers and Igor Douven (Krzyżanowska et al. 2013, 2014).

3.1 MOTIVATIONS

Among the numerous theories of conditionals that have been proposed so far, none seems able to account for all the empirical data concerning how people use and interpret such sentences. As has been demonstrated in chapter (2), a theory of conditionals appears materially inadequate if it validates, in whichever precise sense, sentences like these:

(69)   a. If badgers are cute, then 2012 was a leap year.

      b. If weasels are people's best friends, then dogs have four legs.

      c. If Groningen is bigger than Kielce, Kazimierz Ajdukiewicz was a prominent Polish philosopher.

It is easy to understand why we are reluctant to accept conditionals like (69a), (69b) and (69c); the antecedents of those conditionals have nothing to do with their consequents. And it seems that using a conditional construction is meant to convey, possibly among other things, the existence of some sort of link between the content of the if-clause and the content of the main clause.

As has been already hinted at in the previous chapter, the most prominent theories of conditionals turn out to be untenable as descriptive accounts of the meaning of conditionals in natural language, because they fail to acknowledge the existence and the importance of a connection between the clauses of a conditional. Even these theories that capture some form of a dependence between a conditional's consequent and its antecedent, like the possible worlds semantics of Stalnaker (1968) or the suppositional theory advocated by, among others, Adams (1965, 1975); Edgington (1995) or Evans and Over (2004) fail to recognise its nature. In this chapter, I will attempt to characterise the link whose existence a conditional sentence seems to convey. Specifically, I

am going to propose a new semantics based on this characteristics and argue that it escapes certain undesirable consequences that hitherto proposed theories face. In chapter (5), I will discuss a famous argument by Allan Gibbard (1981), also known as the Gibbardian stand-off (Bennett 2003, p. 83– 86), which led some to accept the idea that the meaning of a conditional is extremely subjective and others to entirely reject the possibility that conditionals express propositions. In the next chapter, I will also provide empirical evidence in support of this proposal.

3.2 BETWEEN A CONDITIONAL'S ANTECEDENT AND ITS CONSEQUENT

Although the most successful accounts of natural language conditionals tend to neglect the connection between the clauses of a conditional sentence, the idea that such a connection can be pertinent to the truth of a conditional is not entirely new to philosophy. Moreover, the nature of that connection could be characterised in a variety of ways. As observed by Douven (in press, p. 25 of the manuscript):

> Candidate-answers abound: it could be logical, causal, explanatory, metaphysical, epistemic; or the "connector" could be a second-order functional property in that there is some first-order property or other that links antecedent and consequent, much in the way in which some have argued that truth is a second-order functional property, instantiated by correspondence to the facts in some domains of discourse, by assertability or verifiability in other domains, and by yet some other first-order property in again other domains.

According to a suggestion that has been repeatedly made in the history of philosophy, the link between a conditional's antecedent and its consequent is inferential in nature. That this idea has been dismissed as often as it has been floated may be due to the fact that it was always understood, implicitly or explicitly, that the inferential connection had to be of the same type—namely, deductive —for all conditionals.

Recently in experimental linguistics, a typology of conditionals has been proposed that takes seriously the aforementioned suggestion and argues that it is correct for at least a large class of conditionals, aptly termed "inferential conditionals" in the lin-

guistics literature, while also pointing out that the type of inferential connection may be different for different types of conditionals. In chapter (2), I have briefly introduced the most general distinction to be made when it comes to classifying conditionals, namely, the distinction between indicative and subjunctive conditionals, of which the paradigmatic cases are, to repeat the example, respectively:

(13) a. If Oswald did not kill Kennedy, someone else did.

 b. If Oswald had not killed Kennedy, someone else would have.

For many theorists, this is only the beginning of a typology, though there is little unanimity as to what the typology should further look like. In linguistics, even if not so much in the philosophical or psychological literature on conditionals, it has become common practice to classify conditionals as *inferential* and *content* conditionals (see, among others, Dancygier 1998, 2003; Dancygier and Sweetser 2005; Declerck and Reed 2001; Haegeman 2003; Verbrugge 2007b). Inferential conditionals can be regarded as expressing a reasoning process, having the conditional's antecedent as a premise and its consequent as the conclusion, such as:

(70) a. If she has not had much sleep recently, she will perform poorly on her exams.

 b. If he owns a Bentley, he must be rich.

 c. If all dogs have a good sense of smell, then your dog has a good sense of smell.

By contrast, the class of content conditionals is not particularly well defined. Its members are sometimes loosely said to describe relations between states of affairs or events as they happen in reality. This description is, however, too broad to allow for a demarcation of content conditionals from other types of conditional sentences.[1] Even though sentences such as:

(71) a. If Alice never answers Bob's e-mails, he will get very disappointed with her.

 b. If you take ice out of the deep freeze, it melts.

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1 Douven and Verbrugge (2010, p. 303) also remain neutral on the question of whether what linguists identify as content conditionals constitute a genuinely different class of conditionals.

    c. If I manage to hand in the entire text by the end of this month, I will throw a party.

have been described as typical examples of content conditionals (Verbrugge 2007b, p. 4), it would seem that those may well be characterized in terms of inferential relations between their antecedents and consequents, and hence labelled as "inferential." As will become clear later on (see section 3.3.2), the antecedent of a conditional does not need to be the only premise involved in the reasoning process expressed by that conditional. Due to their vague characteristics, content conditionals will not concern us here. Instead, we will limit our attention to inferential conditionals.

Even if not all conditionals encountered in natural language can be said to express a reasoning process, inferential conditionals certainly constitute a common type. Not surprisingly then, the idea that a conditional can be considered as somehow embodying a kind of "condensed argument" (Woods 2003, p. 15) is not altogether new to philosophy; it can be traced back at least to Chrysippus, a stoic logician from the third century BC. Chrysippus is believed to have held the view that a conditional is true if it corresponds to a valid argument[2] (Sanford 1989, p. 24). This idea seems to have been also endorsed by Ramsey (1990, p. 156) who, in the same text that gave rise to the famous Ramsey test, states that:

> 'If φ, then ψ ' can in no sense be true unless the material implication p ⊃ q is true; but it generally means that p ⊃ q is not only true but deducible or discoverable in some particular way not explicitly stated. This is always evident when 'If φ then ψ ' or 'Because φ, ψ ' (*because* is merely a variant on *if*, when φ is known to be true) is thought worth stating even when it is already known that φ is false or that ψ is true. In general we can say with Mill that 'If φ then ψ ' means that ψ is inferrible from φ, that is, of course, from φ together with certain facts and laws not stated but in some way indicated by the context.

Some authors, and most notably Mackie (1973, p. 69), claim that conditionals are not just linguistic devices that express arguments, but that they *are* arguments themselves, just in a truncated form.

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2 Note that this view can be also construed as paralleling the strict conditional account of Lewis (1918); see Sanford (1989, p. 69).

Also psychologists working in the mental models tradition seem to be endorsing a similar position. Braine (1978, p. 8), for instance, argued that:

> The logical function of *if-then* is to state inference rules. *If ... then ...* is taken to be a grammatical frame such that, when the blanks are filled in with propositions (say, α and β), the result is the following inference rule:
>
> $$\frac{\alpha}{\beta}$$
>
> That is, if α has been established, then β can be immediately concluded. Thus, the logical function of *if-then* is taken to be the same as that of the inference line, that is, *if-then* and the inference line are different notations for indicating the same relation between two propositions. In effect, when one constructs an *if-then* sentence (say, if α then β), one is instructing one's hearers to add the inference rule, α/β, to their systems of prepositional logic. Thus, *if ... then ...* is simply a convenient device that permits inference rules to be supplied ad hoc for the duration of their relevance (usually transient) to any matter at hand.

More recently, Johnson-Laird and Byrne (2002) claimed that for a conditional to be true, "the consequent *has* to occur given the antecedent" (p. 649, italics mine), which can be interpreted along the same lines.

An attempt to capture the connection between a conditional's antecedent and its consequent in terms of the relation of *relevance* as specified within the framework of relevance logics (Anderson and Belnap 1975) also seems to be an idea of the same kin. In fact, the development of this branch of logics has been motivated by the unintuitive consequences of the classical notion of entailment, and the paradoxes of material implication in particular, dubbed by the relevance logicians "irrelevance fallacies." As the name suggests, these logics (also referred to as "relevant" or "relevantistic," cf. Burgess (2009) or Mares (2014)) are meant to ensure that premises of an argument are *relevant* for its conclusion and, by the same token, an antecedent of an implication is *relevant* for its consequent. The relation of relevance is understood in purely logical terms: an antecedent φ is relevant for the consequent ψ if φ is involved in a proof of ψ (Anderson and Belnap 1975, p.

18). Hence, sentences like "If the moon is made of licorice, then it never rains in Warsaw" are false under the relevant interpretation: "The moon is made of licorice" cannot be a part of a proof of "It never rains in Warsaw." The antecedent's being blatantly nonsensical does not need to bother us either, since relevant logics do not validate *ex falso quodlibet*, that is, $\varphi \wedge \neg \varphi$ does not entail any arbitrary ψ.

Obviously, if the notion of a consequent's following from an antecedent is to be understood strictly in terms of classical deductive inference, it is not hard to come up with counterexamples to the aforementioned idea. After all, indicative conditionals are most frequently a vessel for the kind of reasoning which is usually loaded with uncertainty. We assert sentences like "If you get vaccinated, you will not get sick," or "If Mike passed the exam, he must have cheated," on a regular basis, even though it would not be possible to prove their consequents from their antecedents. Thus, the relation of relevance needed to account for the meaning of natural language conditionals cannot be specified in terms of proofs.[3] As has been demonstrated by Goodman (1955) by means of his famous "grue" / "bleen" puzzle, induction cannot be accounted for in purely syntactic terms, which would be needed to render the relevant implication any useful for the analysis of natural language conditionals. Goodman made his point by defining a new predicate, "grue," that applies to all green objects examined before time t, and to all blue objects examined after t (p. 74). A green emerald provides inductive support to the hypothesis that all emeralds are green, but not to the hypothesis that all emeralds are grue. This discrepancy, however, cannot be explained in terms of differences between the logical forms of the two hypotheses, given that "All emeralds are green" and "All emeralds are grue" have exactly the *same* logical form. Instead, it stems from a difference in the *meanings* of the predicates "green" and "grue"—and this difference is beyond the scope of purely logical analysis.

It should be clear by now that theories of inferential conditionals must not neglect the fact that deduction is not the only type of inference people rely on in their reasoning. For this reason, finer-grained distinctions within the class of inferential conditionals are called for. Linguists have proposed various typologies of inferential conditionals (see, e.g., Declerck and Reed 2001), but most of these stem from grammatical distinctions and as such are not

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3 See Oaksford and Chater (2007, p. 102) for a similar evaluation of the usefulness of relevance logic for the analysis of ordinary language conditionals and everyday reasoning.

suitable for our purposes. In the following section, I will present a differently based typology recently introduced by Douven and Verbrugge (2010), who acknowledge the variety of inferential relations that may exist between a conditional's antecedent and its consequent.

3.3   THE NEW TYPOLOGY OF CONDITIONALS

The first distinction Douven and Verbrugge make is between *certain* and *uncertain* inferences, where *certain* inferences guarantee the truth of the conclusion given the truth of the premises while *uncertain* inferences only tend to make the truth of the conclusion likely given the truth of the premises.

In Douven and Verbrugge's typology, the certain inferences coincide with the deductively valid ones. The uncertain inferences are, following standard philosophical practice, further divided into *abductive* and *inductive* ones. The deductive consequence relation is familiar from standard logic courses, and the non-deductive consequence relations have also received a fair amount of attention in the literature; see, for instance, Cialdea Mayer and Pirri (1993, 1995), Kyburg and Teng (2001), and Gabbay and Woods (2005). Still, there is much less agreement on how abductive and inductive inference are best explicated than agreement on how deductive inference is to be explicated.

For present purposes, it will suffice to say that abductive inferences are based on explanatory considerations and inductive inferences rely on information about frequencies (which may be more or less precisely specified). More exactly, in an abductive inference, we infer a conclusion from a set of premises because the conclusion provides the best explanation for those premises, that is, ψ is an abductive consequence of φ (given the background premises) if and only if ψ best explains φ (in light of the background premises). For example, we may infer that Sally failed her exam from the premises that Sally had an exam this morning and that she was just seen crying and apparently deeply unhappy. That she failed the exam is the best explanation for her apparent unhappiness. In an inductive inference, a conclusion follows from the premises with high statistical probability. In other words, ψ is an inductive consequence of φ (given the background premises) if and only if ψ follows with high statistical probability from φ (in light of the background premises). For instance, we infer that Yngwe speaks English fluently from the premise that he is Nor-

wegian because we know that by far the most Norwegians speak very good English. It is largely uncontested that people engage in abductive and inductive inferences on a routine basis, even though it still is a matter of some controversy how to best characterize the notions of abductive and inductive validity and which psychological processes are involved in the said kind of inferences. Douven and Verbrugge do not commit to any specific proposals in this regard, and we will not do so here either.

Douven and Verbrugge's typology of inferential conditionals mirrors the aforesaid typology of inference. That is to say, they distinguish between certain (or deductive) and uncertain inferential conditionals, and then divide the latter class further into abductive and inductive inferential conditionals.[4] More specifically, they propose the following:

DEFINITION 1:   *A sentence "If φ, then ψ" is*

- *a deductive inferential (DI, for short) conditional if and only if ψ is a deductive consequence of φ;*
- *an inductive inferential (II) conditional if and only if ψ is an inductive consequence of φ;*
- *an abductive inferential (AI) conditional if and only if ψ is an abductive consequence of φ.*

Douven and Verbrugge also point out that, often, the inferential relation between antecedent and consequent partly relies on the antecedent φ together with background premises that are assumed to hold in the context in which the conditional is asserted or evaluated. They call such conditionals *contextual* DI, AI, or II conditionals, depending on the type of inference involved.

DEFINITION 2:   *Where $\mathbf{K} = \{p_1, \ldots, p_n\}$ is the set of salient background premises, "If φ, then ψ" is*

- *a contextual DI conditional if and only if ψ is a deductive consequence of $\{\varphi\} \cup \mathbf{K}$;*
- *a contextual II conditional if and only if ψ is an inductive consequence of $\{\varphi\} \cup \mathbf{K}$;*
- *a contextual AI conditional if and only if ψ is an abductive consequence of $\{\varphi\} \cup \mathbf{K}$.*

For example, considered on its own, ψ may fail to explain φ, but in light of all that one knows, ψ may be the best explanation

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4 Note that this typology is not necessarily exhaustive. Following Douven and Verbrugge, we remain non-committal as to whether conditionals expressing, for instance, causal or analogical inferences should be analysed as separate types or as subclasses of, say, inductive inferential conditionals.

of φ. If so, then "If φ, ψ " qualifies as a contextual AI conditional, where the relevant context is provided by one's current belief state. Moreover, as Douven and Verbrugge (2010, p. 304) note, in contextual AI conditionals, the consequent need not always be the best explanation of the antecedent. It may also be that the consequent is, *in light of the antecedent*, the best explanation of one of the background assumptions.

What Douven and Verbrugge do not note in their 2010 paper (and what is also not important for their purposes) is that there can be an inferential connection between antecedent and consequent which involves inferences of more than one of the aforementioned types. For example, in some conditionals the consequent may follow from the antecedent via an abductive step *and* a deductive step. In cases of this kind, we may say that the consequent is a mixed consequence of the antecedent. It is important to note that as soon as either abductive or inductive steps are involved, the conditional is to be grouped with the uncertain inferential conditionals.

3.3.1 *Douven and Verbrugge's experiment*

Douven and Verbrugge do not claim that their typology of inferential conditionals is *correct* and the ones that so far have been propounded by other theorists are *incorrect*. What they do claim is that their typology is exceedingly simple and that it is non-ad hoc in that it relies on a time-tested distinction between types of inference. More importantly still, they show in their 2010 paper that the typology has considerable explanatory force by recruiting it in service of testing (what is generaly called) Adams' Thesis, briefly discussed in section 2.4.

According to this thesis, first proposed by Adams (1965) and championed by many since, the acceptability of a conditional is measured by the probability of its consequent conditional on its antecedent. In their experiment, Douven and Verbrugge divided the participants into two groups, asking one group to judge the acceptability of ten DI, ten AI, and ten II conditionals (see Figure 1 for an example) and the other group to judge the corresponding conditional probabilities (Figure 2).[6]

For all sentences taken together, Douven and Verbrugge were able to disprove Adams' Thesis both in its strict form and in some

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6 See Appendix A of Douven and Verbrugge (2010) for the full materials used in this experiment.

CONTEXT: You strongly doubt that Hank will have passed the first- year examination. You suspect that his parents will buy him a car only if he passed that examination. You suddenly see Hank driving a new car.

CONDITIONAL: If the car Hank is driving is his, then he passed the first-year examination.

Indicate how acceptable you find this conditional in the given context:

Highly   Highly
unacceptable   1   2   3   4   5   6   7   acceptable[5]

Figure 1: An example of a question asking for the acceptability of an AI conditional from the experiment of Douven and Verbrugge (2010).

of its looser forms. That is to say, where Ac stands for the degree of acceptability of a sentence and Pr for the probability operator, they demonstrated that neither is it generally true that

$$Ac(\text{If } \varphi, \psi) = Pr(\psi \mid \varphi) \tag{7}$$

nor that

$$Ac(\text{If } \varphi, \psi) \approx Pr(\psi \mid \varphi) \tag{8}$$

nor that

$$Ac(\text{If } \varphi, \psi) \text{ is high (middling / low)}$$
$$\text{iff } Pr(\psi \mid \varphi) \text{ is high (middling / low)} \tag{9}$$

Splitting out the results for the three types of conditionals showed that Adams' Thesis in its strict form holds only for DI conditionals. For AI conditionals the most that can be said is that acceptability and conditional probability are highly correlated. For II conditionals not even that much was found to be true.

The typology of inferential conditionals proposed by Douven and Verbrugge explains the systematic differences in the acceptability judgements of different types of conditionals. We take these

CONTEXT: You strongly doubt that Hank will have passed the first- year examination. You suspect that his parents will buy him a car only if he passed that examination. You suddenly see Hank driving a new car. Suppose the car Hank is driving is his.

SENTENCE: Hank passed the first-year examination.

Indicate how probable you find this sentence in the given context:

| Highly | | | | | | | Highly |
| improbable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | probable |

Figure 2: An example of a question asking for the conditional probability from the experiment of Douven and Verbrugge (2010).

results to be evidence for the significance and cognitive plausibility of the typology.[7] The deeper explanation of these results might be in terms of acceptability conditions, which might be different for the different types of conditionals, or in terms of truth conditions, which might also be different for the different types. The idea that the different types of inferential conditionals have different truth conditions will be explored in the following section. In chapter 4, I aim to provide further support for this typology by relating it to the use of certain linguistic expressions that in the literature have been identified as evidential markers or that can reasonably be assumed to act as such markers. Chapter 5 will demonstrate how the new semantics built upon this typology helps to evade an old philosophical puzzle.

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[7] Note that by taking its explanatory force as evidence for the typology we are relying on abduction. While neither for the purposes of Douven and Verbrugge's (2010) paper nor for the current use we are making of their proposal is it necessary to make any assumptions about the confirmation- theoretic status of abduction, for independent reasons we do believe that abduction is in much better normative standing than is generally believed. See Douven (2013) and Douven and Wenmackers (in press).

3.3.2 *A note on content conditionals*

At the beginning of the section 3.3, we noted that the distinction between inferential and content conditionals is not particularly clear-cut. Upon a closer look at the sentences used in the investigations of differences in production and comprehension of content and inferential conditionals (see, e.g., Verbrugge 2007a,b; Verbrugge et al. 2007), we can observe that content conditionals constitute a very heterogeneous class. For instance, Verbrugge (2007b, p. 106) contrasts the following, allegedly, content conditionals:

(72) a. If she runs down the stairs from the sixth floor, she'll be exhausted.

b. If he is in hospital, they will help him recover.

with inferential sentences:

(73) a. If she runs down the stairs from the sixth floor, she is in a hurry.

b. If he is in hospital, he has had an accident.

However, in the light of the above proposed definitions 1 and 2, conditionals in (72) are of inductive inferential type. For instance, that someone will receive help leading to recovery can be inferred inductively from the assumption that the person is in hospital in conjunction with background knowledge on what he suffers from, how effective hospitals are in treating the issue in question, etc. The conditionals in (73) are, on our proposal, also of a specific type, namely, abducitve inferential.

This is not to say that all sentences labelled "content conditionals" in psycholinguistic literature can be reduced to inferential conditionals. Verbrugge et al. (2007, Appendix 2, pp. 130-131) presents a broader selection of conditionals from this class, grouped into promises, tips and causal sentences (incidently, all the instances of conditionals labelled as inferential are, in fact, abductive inferential). It seems that all the content conditionals grouped as causal sentences, e.g., "If the landlord turns up the thermostat, it will become warm in my room," can be easily interpreted as inductive inferential conditionals, and the same can be said about two out of four content conditionals falling under the category of tips, e.g., "If you pay attention, you will learn a lot." However, the following examples from Verbrugge et al. (2007, *ibid.*) cannot be so easily analysed in terms of inferential connections between their antecedents and the consequents:

(74) a. If you write my essay, I will help you with your maths exercises.

      b. If you get married in Church, we will pay for the wedding party.

      c. If you want concrete information, take a look at the website.

      d. If you want to impress him, wear your new perfume.

Sentences (74a) and (74b) fall under the category of promises while (74c) and (74d) are tips. But they are not only conditionals that serve the purpose of being a promise or a tip, they are conditional promises and conditional tips, respectively. Together with conditional threats, commands, questions, and the like, these can be classified as *speech-act conditionals*, which are:

> cases where the *if*-clause appears to conditionally modify not the contents of the main clause, but the speech act which the main clause carries out (Dancygier and Sweetser 2005, p. 113).

As has been indicated earlier, performatives are beyond the scope of this thesis, and thus is the issue of telling speech-act and content conditionals apart. Whether, however, a subclass of content conditionals needs to be discerned from the class of declarative indicative conditionals and contrasted with inferential ones is an empirical question which, for the time being, will remain open.

3.4   TRUTH CONDITIONS

The semantics that we want to propose takes its cue from the aforementioned idea according to which a conditional is true if and only if its consequent follows from its antecedent. This idea was meant to do justice to the broadly felt intuition that there must be some kind of internal connection between a conditional's antecedent and its consequent if that conditional is to count as true. Our proposal aims to avoid the above discussed problems by doing justice to the fact that a consequent's following from an antecedent may be understood in terms of a number of different inferential connections, including but not limited to deductive inference.

In doing so, we are following the lead of Douven and Verbrugge (2010) in distinguishing between deductive inferential (DI), in-

ductive inferential (II), and abductive inferential (AI) conditionals.

While, to our minds, the typology of consequence relations introduced in section 3.3 is directly relevant to the semantics for conditionals, it may be difficult to capture this relevance by the standard model-theoretic means, if only because there is currently no satisfactory model-theoretic characterization of best explanation. But there is an alternative tradition in semantics, one that uses proof theory instead of model theory for the purposes of explicating meaning. This tradition is best known for its claim that the meanings of the logical constants are given by the standard introduction and elimination rules for these constants.

Our suggestion is *not* that the standard introduction and elimination rules for the conditional operator from propositional logic give us the semantics for the conditional; that would amount to endorsing the material conditional account, which we have already dismissed. Rather, the idea is to state truth conditions for conditionals directly in terms of the various mentioned consequence relations. Doing so helps to amend in two ways the traditional idea that was our starting point, to wit, by relaxing the requirement that a conditional's consequent follows *deductively* from its antecedent for the conditional to be true, and by acknowledging the role the background plays in determining whether or not a conditional's consequent follows from its antecedent. To be precise, the proposed semantics is that:

DEFINITION 3:   *A speaker S's utterance of "If φ, ψ" is true if and only if*

(i) *ψ is a consequence of φ in conjunction with S's background knowledge,*

(ii) *ψ is not a consequence of S's background knowledge alone but not of φ on its own, and*

(iii) *φ is deductively consistent with S's background knowledge or ψ is a consequence of φ alone,*

where the consequence relation can be deductive, abductive, inductive, or mixed.

Note that we are requiring background *knowledge* and not merely background *beliefs*: it would be counter-intuitive to designate the utterance of a conditional as true if its consequent followed (in any of the mentioned senses) from its antecedent in conjunction with false beliefs that the speaker may have.

Clauses (ii) and (iii) are meant to ensure that the antecedent is not redundant in the derivation of the consequent, respectively, that the consequent does not follow trivially from the antecedent plus background knowledge. Without them, one could still have true conditionals without any intuitive inferential connection between antecedent and consequent. As for clause (ii), note that the proposal would be too restrictive if we demanded simply that the consequent not follow from the background knowledge alone. While we do want to keep from qualifying as true

(75) If Milan Kundera is a candidate for the 2016 Nobel Prize in Literature, then the earth weighs more than 2 kilograms.

we do *not* want to keep from qualifying as true

(76) If the earth weighs more than 3 kilograms, then it weighs more than 2 kilograms.

The consequent of these conditionals follows (in almost any context) from background knowledge alone. However, in (76) it also follows from the antecedent, which is enough to ensure the the intuitively required inferential link, whereas in (75) antecedent and consequent have nothing to do with each other, which at least on our hypothesis accounts for the felt falsity of this sentence. The proposal would also be too restrictive if clause (iii) simply required that the antecedent be deductively consistent with the background knowledge. The conditional

(77) If the UK is ruled by a king, then it is a monarchy.

seems true, even if its antecedent is inconsistent with background knowledge. By contrast,

(78) If the UK is ruled by a king, then Milan Kundera will be a candidate for the 2016 Nobel Prize in Literature.

seems false, notwithstanding the fact that its consequent follows deductively, by virtue of *ex falso quodlibet*, from its antecedent together with the background knowledge that the UK is (currently) ruled by a queen; whether Milan Kundera will be nominated for the 2016 Nobel Prize in Literature, has, as far as we can see, *nothing* to do with whether the UK is ruled by a king.

3.5   LIMITATIONS AND MERITS

As the proposal stands, conditionals with a necessarily true consequent as well as those with a necessarily false antecedent still

qualify as true. Thus, clauses (ii) and (iii) do not quite ensure what they are intended to ensure. But perhaps that is as it should be. We do not have strong intuitions about whether, say,

(79) a. If $2 + 2 = 5$, Milan Kundera will be a candidate for the 2016 Nobel Prize in Literature.

   b. If raccoons are American mammals noted for their intelligence, 41 is a prime number.

   c. If π is a rational number, $23 + 7 = 30$.

are true or false. Those who do have a strong intuition that these sentences are false could still consider dealing with this type of conditional by appealing to Gricean pragmatics.[8] More generally, we would not be hugely surprised if clauses (ii) and (iii) needed further fine-tuning.

   The first clause of Definition 3 may be considered the gist of the current proposal. This clause raises some tangled issues by itself, in particular in relation to II conditionals, that is, conditionals whose consequent is an inductive consequence of their antecedent. To mention a pressing one, few might want to say that a speaker informed about the circumstances of a fair and large lottery could truly assert the II conditional:

(80) If you buy a ticket, you will lose.

however many tickets there are in the lottery and however low the chances are of winning the lottery (Lowe 1996). Of course, this may just mean that some clause is to be added to our proposal. Alternatively, one might try to argue that the intuition that (80) cannot be truly asserted is to be explained in terms of this conditional's not being assertable in the first place, which in turn may have an explanation along Gricean lines (Douven 2012b). We flag this potential difficulty here only to set it aside for future research.

   The above mentioned issues notwithstanding, we would like to point out some attractive features of Definition 3. First, note that it has no difficulty blocking the paradoxes of material implication like, for instance:

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8 Some might think that Gricean pragmatics on its own is capable of accounting for the intuition that there should be a link between a conditional's antecedent and consequent if that conditional is to count as true. However, see Douven (2008) for an argument to the effect that no currently known pragmatic principle can do the required job.

(51) a. If summits of all 14 eight-thousanders have been reached in winter, then Nanga Parbat has never been climbed in winter.

b. If my only sister is 5 years older than me, then I have a younger sister.

c. If Lithuania is reigned by a king, then it is not a monarchy.

discussed in section 2.2. Because ψ may be true without there being any inferential connection between it and φ, "If φ, ψ" need not be true just because ψ is true. Nor does the truth of the conditional follow from the mere falsity of φ, as that does not either ensure the existence of an inferential connection between φ and ψ. Hence, the following conditionals:

(52) a. If aubergine is a species of small birds, then most Belgians speak Basque.

b. If Orhan Pamuk did not win the Nobel Prize in literature, then he is not a writer.

c. If raccoons are not American mammals noted for their intelligence, then they are not animals.

discussed earlier as instances of conditionals that, if interpreted materially, are true due to their false antecedents, are rendered false on our account. And so are instances where strengthening the antecedent yields counterintuitive consequences. Of the following sentences,

(46) a. If Molly got an A for the logic course, her parents are proud of her.

b. If Molly got an A for the logic course and failed all the other courses, her parents are proud of her.

the first can be true, since one can inductively infer that Molly's parents are proud of here from the premise that she got an A for the logic course, given some background information about Molly's parents being concerned about their daughter's grades. Yet such a conclusion does not follow any more, not even inductively, when the set of premises is expanded by the information that Molly failed all the other courses. Induction and abduction are non-monotonic types of inference, thus the proposed

semantics does not validate the rule of strengthening of the antecedent: the truth of a conditional "If φ, ψ" does not suffice for the truth of a conditional whose antecedent is a conjunction of φ and an arbitrary χ.

Furthermore, although the semantics does not validate the *Or-to-if* principle since, as has been shown by, e.g., Stalnaker (1975) or Edgington (1995, p. 242-243)[9] it is possible only for the truth-functional account, this does not have to be seen as a shortcoming. In fact, the semantics does get the Or-to-if inferences right precisely in the kind of cases in which it is intuitively right. According to this principle, "If φ, ψ" can be inferred from "Not-φ or ψ." Now, if ψ follows from the background knowledge alone in a context, then so does "Not-φ or ψ."[10] However, given clause (ii) of Definition 3, it still does not follow that "If φ, ψ" is true in that context; it is *not*, unless ψ also follows from φ alone. Similarly if not-φ follows from the background knowledge. Then even though "Not-φ or ψ" follows from that background knowledge as well, it does, given clause (iii), *not* follow that "If φ, ψ" is true in the given context; it is *not*, unless ψ follows from φ alone. Note, however, that in these two kinds of situations it is not intuitively all right to infer "If φ, ψ " from "Not-φ or ψ": if we know that the butler did it, we do not want to infer that if the butler did not do it, then the maid did; nor do we want to infer this if we know that the maid did it. Moreover, this observation seems to fit the empirical data on how people infer conditionals from disjunctions. As shown by Over et al. (2010), people tend not to accept a conditional as a conclusion of an argument when a disjunction given as a premise is justified constructively, that is, one if its disjuncts is known, which may be taken to suggest that a theory of conditionals aiming at descriptive accuracy does not need to validate the Or-to-if inference as a general principle. On the other hand, sometimes it *is* perfectly all right to apply the Or-to-if principle, namely, in the kind of case in which neither not-φ nor ψ follows from the background knowledge though their disjunction does. And given Definition 3, "If φ, ψ" *is* true in that case, for given "Not-φ or ψ ," there is an inferential connection— to wit, via Disjunctive Syllogism—from not-φ to ψ.[11]

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9 See section 2.2 for a reconstruction of the argument.
10 We are assuming knowledge to be closed under classical entailment.
11 See also Gilio and Over (2012), who analyse the Or-to-if inference from the probabilistic perspective. They demonstrate that $Pr(\text{If not-}φ \text{ then } ψ)$, which is usually judged to be the conditional probability $Pr(ψ \mid φ)$, is "close to" $Pr(φ \text{ or } ψ)$ when

Finally, the new semantics validates the so-called Import–Export principle, according to which "If φ and ψ, χ" and "If φ, then if ψ, χ" are equivalent. This principle is of utmost importance for the advocates of non-propositional theories of conditionals (see, e.g., Gibbard 1981; Edgington 1995), since they cannot allow for conditionals embedded by means of Boolean operators. The empirical fact that English speakers do utter iterated conditionals like:

(81) a. If there are days when the sun does not set at all, then if you are on the Northern Hemisphere, you are north from the Arctic Circle.

   b. If it starts raining, then if you don't take your umbrella, you will get wet.

   c. If Julian stands up to his boss, then if he gets fired, he will regret that.

seems hard to deny. Assuming the Import–Export principle, the above sentences can be paraphrased as the following simple conditionals:

(82) a. If there are days when the sun does not set at all and you are on the Northern Hemisphere, you are north from the Arctic Circle.

   b. If it starts raining and you don't take your umbrella, you will get wet.

   c. If Julian stands up to his boss and gets fired, he will regret that.

Import–Export seems not only intuitively appealing, but it is also supported by empirical evidence van Wijnberger-Huitink et al. (in press).[12]

To see why the Import–Export is valid on our account, let "If φ and ψ, χ" be given. Then χ can be inferred (in the broad, generalized sense) from the conjunction of φ and ψ; let Δ be the name of

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"φ or ψ" is justified non-constructively. However, it is not the case when the disjunction is justified constructively.

12 See, however, Douven and Verbrugge (2013) whose results somewhat undermine the descriptive accuracy of the Import–Export principle. They found a significant difference between the probability ratings of a conditional, "If q, then r," given a certain proposition p and the probability ratings of the consequent of that conditional, r, given the conjunction of p with q. According to van Wijnberger-Huitink et al., this discrepancy could be explained by the fact that Douven and Verbrugge used thematic materials, so the participant's responses were more likely to be influenced by pragmatic considerations.

one way to derive χ from the conjunction of φ and ψ . Then from φ we can infer that χ can be inferred from ψ . After all, given φ as a premise, we can assume ψ and form the conjunction of φ and ψ . Then we can use Δ to derive χ from that conjunction. Discharging ψ yields that "If ψ , χ" can be inferred from φ.[13] And this means that "If φ, then if ψ , χ" is true. Conversely, let "If φ, then if ψ , χ" be given. Then from φ we can infer that χ can be inferred from ψ . Supposing the conjunction of φ and ψ , we first infer from φ that χ can be inferred from ψ and then use that and ψ to infer χ. Thus we infer χ from the conjunction of φ and ψ , which is enough for the truth of "If φ and ψ , χ."

One may wonder, however, what remains on the present proposal of the intuition that Modus Ponens is a valid rule of inference for conditionals (and not just for the material conditional). By relaxing the requirement of previous semantics that the inferential connection between antecedent and consequent be deductive, our semantics makes room for the possibility that a true conditional has a true antecedent and a false consequent. After all, what distinguishes deduction from induction and abduction is that deduction guarantees the truth of any conclusion reached on the basis of true premises. But this means that Modus Ponens may lead from true premises to a false conclusion, and hence that the rule is not valid in the classical sense of guaranteeing preservation of truth.

In response, first note that the validity of Modus Ponens has been challenged on independent grounds by McGee (1985) and Lycan (2001, Ch. 5).[14] More importantly, even if abduction and induction are not *guaranteed* to preserve truth, we rely on them in daily practice because we take them to be reliable guides to the truth; that is, we trust them to preserve truth with high probability. If we are right to trust these modes of inference, then, supposing our semantics, in the vast majority of cases in which we apply Modus Ponens to a conditional with a true antecedent, its consequent will be true as well. That may be all there is to the intuition that Modus Ponens is a classically valid rule of inference— and it may be all that matters for practical purposes. Epistemologists have observed that people's knowledge attributions often

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13 This assumes the validity of Conditional Proof for the conditional, that is, that we may conclude "If φ, ψ " if we can infer (still in the relevant broad sense) ψ from φ. But Conditional Proof is trivially valid on the present account, which explicitly makes it sufficient for the truth of a conditional that its consequent can be inferred from its antecedent.

14 See also section 2.2 of the previous chapter.

appear to be context-dependent (see Decock et al., in press, and references given there). In particular, whether something is considered to be knowledge seems to hinge on what is at stake. By the same token, whether a conclusion of a Modus Ponens inference will be perceived as correct may be subject to contextual variation. And as it is the case with what we habitually call "knowledge," it is most of the time good enough.

Yet, in some contexts, it may be vital to act on what is absolutely certain rather than just very likely. Does it then mean that, if Modus Ponens is only a realiable heuristics and not a truth-preserving rule of inference, we should entirely refrain from relying on it in this kind of contexts? But is Modus Ponens only a reliable heuristics throughout?

As our theory recognises different types of consequence relation that can connect a conditional's antecedent and consequent, it can also distinguish between the classes of conditionals for which Modus Ponens is valid and those for which it is not. Specifically, there is no reason to deny the validity of Modus Ponens when its scope is limited to the class of DI conditionals, that is, conditionals whose consequents follow deductively from their antecedent. More precisely, if a DI conditional "If φ, ψ" is true given some background premises $\{\varphi_0, \ldots, \varphi_n\}$, then one can infer ψ from φ, assuming that the background premises, $\{\varphi_0, \ldots, \varphi_n\}$, still hold.[15]

This observation would not be of any use, however, if we had no way to tell different types of conditionals apart. In the following chapter, we will discuss an empirical study on linguistic markers that allow to distinguish between DI, AI and II conditionals.

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[15] In other words, applying Modus Ponens to a contextual DI conditional requires the minor premise to be the antecedent φ in conjunction with the background premises $\{\varphi_0, \ldots, \varphi_n\}$.

INFERENTIAL CONDITIONALS AND EVIDENTIALITY

In the previous chapter, we introduced a new semantics based on an old idea. According to this semantics, what a conditional sentence coveys is the existence of an inferential connection between its antecedent and its consequent (3.4). This semantics takes into account a well- established philosophical tradition of distinguishing between deductive, inductive and abductive inferences whose relevance for conditionals has been first observed by Douven and Verbrugge (2010). In the following, we aim to provide further support for the typology of conditionals introduced in section 3.3 of the previous chapter and for the semantics based on it. We do this by relating the typology to the use of certain linguistic expressions that in the literature have been identified as evidential markers or that can reasonably be assumed to act as such markers. Specifically, we want to show that the typology is able to explain certain patterns in how people evaluate conditionals depending on whether or not these conditionals contain a particular evidential marker. Inserting this or that evidential marker should make the conditional sound more or less natural, depending on the type of inference the conditional expresses. In Sections 4.2 and 4.3, we report experimental results that relate the typology of conditionals at issue to various English and Dutch evidential markers. First, we briefly present the broader context of evidentiality and motivate the choice of markers we use in our experiments.

Parts of this chapter, including the reported experiment, have been published as a joint paper with Sylvia Wenmackers and Igor Douven (Krzyżanowska et al. 2013).

4.1 EVIDENTIAL MARKERS

Not all that we believe or assert rests on an equally solid footing. Some things we believe because we saw them with our own eyes. Other things we believe because we heard them from others, or we read them in the newspaper or on the Internet. And again other things we believe on the basis of inferences we made. The source of a belief typically will, and arguably also should, have an

effect on the firmness with which we hold the belief. Things we believe because we saw them happening may be particularly firmly held. Second-hand beliefs may also be firmly held, but doubts about the reliability of the source from which we obtained the information giving rise to the belief may have a tempering effect on the firmness with which we hold the belief. Ditto for beliefs based on inference if the inference was non-deductive.

It can be useful for a hearer to know what the source is of the belief a speaker expresses. Even if we take a speaker to be completely sincere, we tend to accept with greater confidence the proposition asserted by the speaker if the source of the speaker's belief in the proposition was their eyesight than if they inferred it from things they read on the Internet (e.g., because we have more confidence in the reliability of the speaker's eyes than in their inferential capacities or in the quality of the information available on the Internet). It is thus no surprise that we often communicate information about the evidential grounds for the contents of our assertions.

In fact, there exist languages, equipped with so called "grammatical evidentiality," in which doing so is mandatory (Aikhenvald 2004, p. 6). In these languages, evidentials are typically expressed by means of morphosyntactic items such as affixes, particles, clitics or special forms of verbs. By contrast, speakers of languages that do not encode evidentiality grammatically, having only lexical means at their disposal, may omit the evidential signal entirely. Note that, according to Aikhenvald (2004), evidentiality is a grammatical category, and hence lexical items used to mark the source of information, which are available in all languages, are not evidentials in this strict, narrow sense. She argues that what can be found in English and many other European languages are mere *evidential strategies*. However, not all linguists agree on such a restrictive view.[1] Here, the terms "evidentiality" and "evidential markers" are used in a broader sense that extends to lexical items used in evidential strategies.

The evidentiality systems of different languages vary with respect to the number and types of information sources they discriminate. The distinction which is most commonly marked is that between direct (perceptual) access to the evidence and indirect access, where the latter can often be further divided into inferential and reportative access. Some evidentiality systems are

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[1] For a discussion of Aikhenvald's position see, e.g., Diewald and Smirnova (2010, p. 3-6).

more elaborate still and allow to distinguish between different modalities of perception, or between different types of witness reports, or different types of inference (Willett 1988; Aikhenvald 2004).

We are mostly interested in the strategies used by speakers allowing to determine the type of inference that underlies their assertion (if the assertion is based on an act of inference). It is customary in the literature on evidentials to group inferences into those that are based on observations (also referred to as inferences "from results") and those that are based on reasoning ("inferences from reasoning;" see, e.g., Willett 1988; Faller 2002; Matthewson et al. 2007). The first class is typically said to include inferences from premises that the speaker has direct evidence for, whereas inferences based on reasoning are supposed to draw on general knowledge, common sense, previous experience or conjectures. Linguists working on evidentiality have, to our knowledge, made no attempt to relate this distinction to the types of inference commonly distinguished in philosophy and logic with a notable exception of Kwon (2012), who identified the Korean evidential *-napo-* as signalling the presence of an inductive inference. Principally, the definitions found in the literature on evidentiality are too vague to permit any definite conclusions on this point. Nevertheless, examples used to illustrate this linguistic typology at least somewhat suggest that the former is more closely related to abductive reasoning while the latter is more closely related to inductive reasoning. For instance, an inferential evidential in Bulgarian, discussed by Smirnova (2012), clearly indicates an abductive inference, as illustrated by the following example:

> *Context:* You and your sister were out of touch for a couple of years. Today you visit her for the first time. As she shows you around her apartment, you see that there is a piano in her daughter Maria's room. You infer that Maria plays the piano. Later, you tell your husband:

> (83) *"Maria plays the piano, [I inferred]."*

By contrast, if the speaker concludes that Maria plays the piano on the basis of what she knows about Maria's mother's plans for her daughter (conjoined perhaps with a high degree of certainty that the mother achieved what she wanted), which would be an example of inductive inference, (83) with the evidential form of the verb "to play" is not felicitous (p. 13).

On the other hand, the evidential system of St'át'imcets[2] is equipped with two inferential markers (Matthewson et al. 2007), which both seem to be appropriate when the reasoning is abductive, yet one of them can only be used when the premise from which the conclusion is drawn, is provided by a direct perception. Matthewson illustrated the difference by the following example (p. 206):

> *Context:* You are a teacher and you come into your classroom and find a caricature of you drawn on the blackboard. You know that Sylvia likes to draw caricatures.
>
> (84) a. *"It was [must have been] Sylvia who did it."*
>
>   b. # *"[Apparently], it was Sylvia who did it."*

In the above context, (84b), which involves an evidential marker signalling reasoning from what has been directly perceived, is not felicitous since the speaker lacks perceptual evidence for their conclusion. However, if the speaker saw Sylvia hiding behind the door, they could express their conclusion by means of any of the two inferential evidentials. Here the distinction between inferences "from results" and inferences "from reasoning" clearly applies to how the premises are justified, rather than the type of reasoning itself.

Given that we aim to do experimental work on inferential conditionals, and given that we can only recruit for our experiments native speakers of either English or Dutch, we are interested in strategies that speakers of these two languages, both of which are devoid of any grammatical evidentiality, can use to signal the evidential grounds for their assertions. It is always possible to convey information about one's evidential grounds in direct ways, as when we say that we *saw* that John crossed the street; or that it *seems* to us that Harriet is worried; or by the use of such words as "presumably," "apparently," "allegedly," or "they say," and so on. However, we are hardly ever explicit about the exact kind of inference that led us to the conclusion we are communicating. For instance, we do not normally say that we inductively inferred that the weather tomorrow will be nice or that we deduced that the beer is in the fridge. But in a more indirect way, we may sometimes indicate the type of inference underlying whatever it is that we are claiming to be the case.

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2 A language of indigenous inhabitants of British Columbia, Canada, also known as Lillooet.

In the linguistics literature (Aksu-Koç 1988; Matthewson et al. 2007; Haßler 2010), evidentiality has frequently been associated with modality. Even though modality and evidentiality are argued to be distinct categories (de Haan 1999; Aikhenvald 2004), they do seem to overlap. In particular, the category of epistemic modality and the category of inferential evidentiality seem to be closely related (van der Auwera and Plungian 1998; Faller 2002). In fact, Verbrugge (2007b, Ch. 6) established a close connection between Dutch modal expressions "zal wel" (which translates as "may well") and "waarschijnlijk," and inferential conditionals. Specifically, in an elicitation task in which participants were requested to complete conditionals whose antecedents were given, they tended to come up with a significantly higher number of inferential conditionals (as opposed to content conditionals) when they were in addition requested to use "zal wel" in the consequents than when they were not (see, however, the note on content conditionals in 3.3.2).

The idea that epistemic modals may function as evidential markers indicating the presence of an inference has also been put forward in the debate concerning the meaning of English epistemic "must." A number of authors, e.g., Karttunen (1972, p. 12), Groenendijk and Stokhof (1975, p. 69), Veltman (1985, p. 161 ff), and Kratzer (1991, p. 645), have argued that insertion of this modal auxiliary verb makes an assertion weaker, and that "It must be that p" does not entail p. They noted that, for instance, when an English speaker notices a fresh cup of coffee and a pile of new papers on a desk of a colleague who is not present at the moment and has been on vacation for the last couple of days, they may infer that their colleague is back at work and express the resulting belief by saying:

(85) She must be back.

Were they to see their colleague sitting at her desk, their assertion of (85) would seem odd or even inappropriate. On the other hand, there are contexts in which the content of an assertion is entailed by premises assumed in the context yet "must" does fit in. To give an example, if one knows that Mary has put a bottle of wine either in the fridge or in the cupboard, and one has checked that it is not in the cupboard, it would be perfectly all right to say:

(86) The bottle of wine must be in the fridge.

As noticed by von Fintel and Gillies (2007, 2010), what the uses of "must" in (85) and (86) have in common is that both signal the presence of an inference.[3]

While we are not aware of any relevant discussion in the literature of "should," this auxiliary, too, often seems to play the role of an inferential marker. For instance, when we are wondering about the translation of a phrase in Latin and we know that Susan studied classical languages for a number of years, we might say:

(87) Susan should be able to translate this phrase.

"Should" here seems to signal an uncertain inference: An assertion of (87) would seem odd if we knew that (say) the phrase is from a text which Susan recently published in English translation.

In the following, we assume that "must" and "should" can both serve as inferential markers. We will then be interested in the question of whether the use of "must" and "should" gives us any indication as to what *kind* of inference (if any at all) led the speaker to feel warranted in making the assertion she did on the basis of the evidence she had.

Our hypothesis is that "must" marks either abductive or deductive inference, while "should" is rather a marker of inductive inference. Consider, for instance, that the inference underlying the assertion of (85) in our earlier example is most plausibly thought of as being abductive, that is, as an inference to the best explanation: that the colleague is back is the best explanation for the evidence that the speaker has, to wit, that there is a fresh cup of coffee and a pile of new papers laying on her desk. In the example of Susan, it rather seems to be some form of inductive reasoning that warrants the assertion of (87): the people we met in our lives who had studied classical languages for a number of years were typically able to translate Latin phrases; given that Susan studied classical languages for a number of years, we expect her to be able to translate the designated phrase. That "must" may equally serve as a marker of a deductive inferential connection between evidence and assertion is suggested by (86).

We include in our study the epistemic adverb "probably," which we hypothesize to mark uncertain inference generically. While strictly speaking something that is certain could be said to be

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3 Dietz (2008, p. 246) also notes that in "It must be raining," the auxiliary indicates that the speaker only has (what he calls) "inferential evidence," and no direct observational evidence, that it is raining. See in the same vein Anderson (1986); Papafragou (1998); van der Auwera and Plungian (1998); Nuyts and Vonk (1999); Salmon (2011), and Mortelmans (2012).

probable, neo-Gricean pragmatists have argued that saying of something one is certain of that it is *probably* the case generates the misleading (scalar) implicature that one is *not* certain of it (see, e.g., Levinson 1983, p. 134). So, one would expect "probably" to go well with uncertain inferences, but not with certain ones.

We in fact want to broaden the scope of our investigations at least slightly by comparing "must" and "should" in their putative roles as inferential markers to what comes accross as being the closest counterparts of these markers in Dutch, the native language of two of the researchers involved in the study, to wit, "moet" and "zou moeten."[4] In the Dutch study, we also look at "waarschijnlijk," which is the Dutch translation of "probably." The first study to be reported below concerns the English markers, the second one their Dutch counterparts.

It is to be noted that, ideally, these markers together yield something like an acid test for classifying conditionals. It cannot be generally read off from an inferential conditional to which type it belongs: a conditional that qualifies as a contextual DI conditional relative to one set of background premises may qualify as an AI or II conditional relative to another such set and similarly with the broader distinction between certain and uncertain inferential conditionals. The markers mentioned above may provide means of identifying the type to which an inferential conditional belongs, in that a speaker's use of a given marker in a conditional or her willingness to assent to a re-assertion of the conditional but now with a particular marker inserted, may show what kind of inference the speaker takes the conditional to embody.

4.1.1 *Note on the methodology*

Before we turn to the experiments, we want to clarify an aspect of our approach that might otherwise raise methodological worries. On the one hand, we are interested in a typology of conditionals that groups conditionals according to the type of inference that they embody. We aim to show that this typology helps explain how the assertability of conditionals can be influenced by inserting in them particular lexical expressions. On the other hand, we are interested in whether precisely those lexical expressions have the linguistic properties that they have been said to have by us and

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4 In Dutch, "should" is expressed by means of the verbal complex consisting of a counterfactual auxiliary "zou" and the infinitive "moeten" ("must"). See Huitink (2008) for a discussion of modal concord in Dutch.

other authors, mainly based on intuitive judgements of a handful of examples (such as (85)–(87) above). The worry might now be that this involves us in circular reasoning, given that, as it would seem, we are assuming the truth of the one hypothesis in testing the second, and assuming the truth of the second in testing the first.

As has been argued by Glymour (1980) and as has been accepted by many philosophers since, there is nothing per se objectionable to using one hypothesis as an auxiliary in testing a second while also using the second as an auxiliary in testing the first. In fact, in his book Glymour gives many examples from the history of science that are generally considered to constitute good science in which this kind of mutual scaffolding occurs. As Glymour convincingly argues, what matters in this kind of situation is that the mutual scaffolding construction does not by itself *guarantee* success for the hypotheses involved and leaves open the possibility of failure; the test should be (what Glymour calls) *non-trivial*. Using a quantitative version of Glymour's theory of confirmation (as developed in Douven and Meijs 2006), we can even strengthen the non-triviality requirement by demanding that the scaffolding construction does not by itself make it more likely that we will get positive results for the hypotheses at issue.

The non-triviality requirement is clearly met in the present case, even in the more demanding probabilistic sense. Assuming that our and others' intuitions about which lexical markers go with which types of inferences are correct will do nothing to ensure, or even to make more likely, that there will be any pattern to be discovered in the data of our experiments that aligns in any significant way with how we are proposing to carve up the class of inferential conditionals. Conversely, assuming the typology marks theoretically importantly different classes of inferential conditionals does not make it any likelier that the lexical markers we consider will have any effect on the assertability of our stimuli, and, if they do have an effect, that effect might be completely out of line with our predictions (e.g., "should" might turn out to go better with abductive conditionals, "must" better with inductive conditionals, and "probably" better with deductive conditionals).

4.2 EXPERIMENT 1. ENGLISH MARKERS: "SHOULD," "MUST," AND "PROBABLY"

Both of our experiments concern the typology of inferential conditionals discussed above. We look at a number of conditionals of the various types and consider whether they are perceived as more naturally assertable depending on whether or not "must," "should," or "probably" are inserted.

Before describing the experiment, we should be clear about the operational criteria that we will assume in determining whether an expression can count as an inferential marker. That an expression is a marker of a particular type of inference does not necessarily have to mean that inserting it in the consequent of a given conditional embodying that type of inference raises the conditional's degree of assertability. Even if the insertion leaves the degree of assertability more or less as it is, it serves as a marker for the type of inference if it does have an outspoken effect on the assertability of conditionals embodying other types of inference. For instance, an expression might have no effect on the degree of assertability of, say, II conditionals, and it would still qualify as an inferential marker of inductive inference if at the same time it lowers *substantively* the degree of assertability of the other types of inferential conditionals.

4.2.1 *Method*

Participants

Participants were recruited via the CrowdFlower interface,[5] which directed them to the Qualtrics platform[6] on which the experiment was run. The participants received a small amount of money for their participation. All participants were from Australia, Canada, the United Kingdom, and the United States. Of the 138 participants who started the survey, 136 completed it. We removed responses from participants who indicated a mother tongue other than English as well as from participants who failed at least one of two comprehension questions. The data are based on the remaining 68 participants. The average age of these participants was 35 ($\pm$11); the gender balance was 59 % females, 41 % males. Of these participants, 84 % had a college education or higher, 15 % only had a high school education, and the remaining 1 % had a lower

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5 http://www.crowdflower.com.
6 http://www.qualtrics.com.

level of education. The average time spent on the survey was 14 minutes ($\pm$18). On a scale from 1 (very easy) to 7 (very difficult), the survey was judged as 2.88 ($\pm$1.21) by the participants.

Design

The type of conditional (DI / AI / II) as well as the markers were manipulated within subjects.

Materials and Procedure

All materials were in English, the participants' mother tongue. Fifteen items were presented on screen. The participants were presented five items involving a DI conditional, five items involving an II conditional, and five items involving an AI conditional. Each item consisted of a context and four versions of the same conditional, where the first version had no marker and the second, third, and fourth versions contained "should," "must," and "probably," respectively. The participants were asked to rate on a seven-point scale the assertability of each version of the conditional in light of the given context. The order of the items was randomized per individual.

An example of an item involving an AI conditional is given in Figure 3. See the Appendix A for the rest of the materials.

4.2.2 Results and Discussion

We conducted for each of the three types of conditionals a separate one-way repeated measures ANOVA with type of marker (no marker / should / must / probably) as independent variable and degree of assertability as dependent variable.

For the three types of conditionals, DI, AI, and II, Mauchly's test indicated a violation of the assumption of sphericity ($\chi^2(5) = 95.17$, $p < .0001$; $\chi^2(5) = 97.08$, $p < .0001$; $\chi^2(5) = 80.01$, $p < .0001$; respectively). Because of this, the Huynh–Feldt correction was used to determine degrees of freedom ($\epsilon = .852$ for the DI conditionals; $\epsilon = .839$ for the AI conditionals; and $\epsilon = .865$ for the II conditionals). The outcomes showed that assertability rates for all types of conditionals are significantly affected by type of marker: $F(2.56, 866.70) = 15.491$, $p < .0001$, for the DI conditionals; $F(2.51, 853.34) = 164.221$, $p < .0001$, for the AI conditionals; and $F(2.60, 880.03) = 221.169$, $p < .0001$, for the II conditionals.

CONTEXT: Nelly lives on the sixth floor of an apartment building. The elevator has been broken since earlier this morning. A good friend of Nelly's who lives on the third floor of the same building hears someone rushing down the stairs. She knows that Nelly tends to avoid exercise as much as possible. How assertable are the following conditionals given this context?

CONDITIONAL: If that's Nelly rushing down the stairs, then she is in a hurry.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If that's Nelly rushing down the stairs, then she should be in a hurry.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If that's Nelly rushing down the stairs, then she must be in a hurry.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If that's Nelly rushing down the stairs, then she probably is in a hurry.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

Figure 3: An example of an AI item used in the Experiment 1.

The mean assertability ratings for the three types of conditionals with and without the various markers are given in Table 1. Inspecting the means for the DI conditionals shows that inserting any of the markers negatively impacts assertability. Post hoc tests using Bonferroni's adjustment revealed that the means for "should," "must," and "probably" are all significantly lower than the mean for no marker ($p < .0001$ for "should" and "must"; $p = .016$ for "probably"). Also, the mean for "should" is signific-

antly lower than the means for "must" (p = .017) and "probably" (p = .001). As for the AI conditionals, the mean for "probably" is highest, that for "must" is second highest, followed by the mean for no marker. The lowest mean is for "should." Post hoc tests using Bonferroni's adjustment showed that the mean for "should" is indeed significantly lower than the others (all ps < .0001). The difference between the means for "must" and no marker is not significant. The mean for "probably" is significantly higher than the other means (all ps < .0001). Finally, for the II conditionals, the mean for "probably" is again highest but is now followed by that for "should." The mean for "must" is lowest. Post hoc tests using Bonferroni's adjustment showed that the mean for "probably" is significantly higher than the other means, while the mean for "must" is significantly lower than the other means (all ps < .0001). The mean for "should" is significantly higher than those for no marker and for "must" (both ps < .0001).

Table 1: Mean assertability (averaged over the five items per type of inference) and standard deviations (SD) for the three types of inferential conditionals.

	DI		AI		II	
	Mean	SD	Mean	SD	Mean	SD
no marker	6.52	0.87	5.01	1.32	4.71	1.59
should	6.11	1.13	4.13	1.56	5.38	1.32
must	6.29	1.07	5.14	1.51	4.06	1.65
probably	6.32	1.01	6.01	1.02	6.15	0.96

In order to make the impact that the insertion of the markers has on the different types of conditionals easier to see, Figure 4 plots the differences in the mean *relative* assertability of the conditionals. By the relative assertability of a conditional, we mean the degree of assertability of a conditional with a marker minus the degree of assertability of the conditional without marker. The graph clearly shows that inserting "should" has a positive impact on the assertability of II conditionals but a negative impact on the assertability of both DI and AI conditionals. By contrast, the insertion of "must" has a somewhat positive impact on the assertability of AI conditionals and a somewhat, respectively strong, negative impact on the assertability of DI and II conditionals. "Probably"
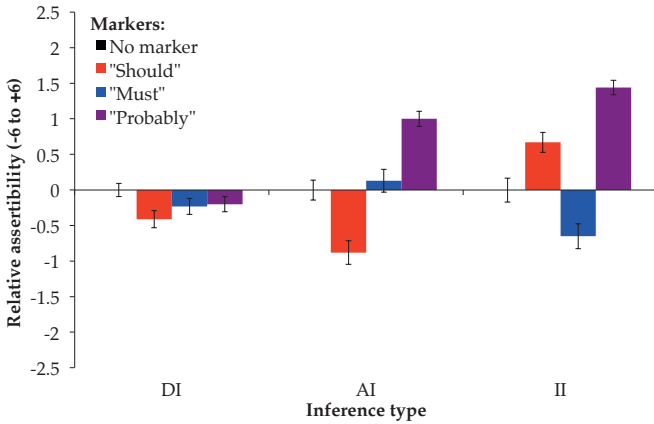
Figure 4: Effect of the various English markers on relative assertability for the different types of conditionals. Error bars represent 95 % confidence intervals.

does very well with AI and II conditionals but less so with DI conditionals.

Given how we previously operationalised the notion of an inferential marker, the above findings support the hypothesis that "should" serves as an inductive inferential marker, that "must" serves as an abductive inferential marker, and that "probably" is a marker of uncertain inference. On the other hand, we found no evidence for the claim that "must" serves as a deductive inferential marker, which was suggested by considering (86).

4.3 EXPERIMENT 2. DUTCH MARKERS: "ZOU MOETEN," "MOET," AND "WAARSCHIJNLIJK."

We wanted to investigate whether repeating the first experiment in Dutch will yield similar results. We hypothesized that the Dutch expressions "zou moeten" and "moet" come closest to being equivalents, *qua* inferential markers, of "should" and "must," respectively. And given that "waarschijnlijk" is a straightforward translation of "probably," it may be expected to have a similar role as a marker of uncertainty.

4.3.1 *Method*

Participants

We recruited Dutch and Flemish participants via CrowdFlower (N = 25) and via social media (N = 19), which directed them to the Qualtrics platform on which the survey was run. The former participants were paid a small amount of money in return for their cooperation. We excluded from the analysis participants who did not complete the survey as well as participants who answered incorrectly at least one of the two comprehension questions. This left us with 15 participants. The average age of these participants was 35 ($\pm$11), with 67 % of them being females. Of these participants, 60 % had a college education or higher, 27 % had only high school, and the remaining 13 % had a lower level of education. The average time spent on the survey was 19 ($\pm$13) minutes. On a scale from 1 (very easy) to 7 (very difficult), the survey was judged as 2.81 ($\pm$1.21) by the participants.

Design

The type of conditional (DI / AI / II) as well as the markers were manipulated within subjects.

Materials and Procedure

We used the same materials as in Experiment 1 translated into Dutch, the participants' mother tongue (see the Appendix B). Here too, the first version of each conditional that was presented had no marker and the second, third, and fourth versions contained "zou moeten," "moet," and "waarschijnlijk," respectively. Participants were again asked to rate the assertability of each version of the conditional in light of the given context. The order of the items was randomized per individual.

4.3.2 *Results and Discussion*

The analysis was identical to the analysis of Experiment 1. We again conducted for each of the three types of conditionals a separate one-way repeated measures ANOVA with type of marker (no marker / zou moeten / moet / waarschijnlijk) as independent variable and degree of assertability as dependent variable.

For the DI and AI conditionals, Mauchly's test indicated a violation of the assumption of sphericity ($\chi^2(5) = 38.76$, p $<$ .0001,

and $\chi^2(5) = 14.01$, p $=$ .016, respectively). The Huynh–Feldt correction was used to determine degrees of freedom ($\epsilon = .782$ for the DI conditionals and $\epsilon = .913$ for the AI conditionals). The outcomes showed that assertability rates for both types of conditionals are significantly affected by type of marker: $F(2.35, 173.69) = 11.179$, p $<$ .0001, for the DI conditionals, and $F(2.74, 202.69) = 59.380$, p $<$ .0001 for the AI conditionals. For the II conditionals, the outcomes also showed that assertability rates are significantly affected by type of marker, $F(3, 222) = 47.536$, p $<$ .0001. (Mauchly's test did not reach statistical significance in this case, so no sphericity corrections were applied.)

Table 2 gives the mean assertability ratings for the three types of conditionals with and without the various markers. Also for

Table 2: Mean assertability (averaged over the five items per type of inference) and standard deviations (SD) for the three types of inferential conditionals.

	DI		AI		II	
	Mean	SD	Mean	SD	Mean	SD
no marker	6.05	1.22	4.71	1.63	4.04	1.68
zou moeten	5.19	1.63	3.65	1.52	4.53	1.66
moet	5.40	1.34	5.07	1.40	3.69	1.72
waarschijnlijk	4.80	1.73	6.16	0.92	6.08	1.10

the Dutch DI conditionals, inserting any of the markers has a negative impact on assertability. Post hoc tests using Bonferroni's adjustment showed that the means for "zou moeten," "moet," and "waarschijnlijk" are significantly lower than the mean for no marker (p $=$ .002 for "zou moeten"; p $=$ .001 for "moet"; p $<$ .0001 for "waarschijnlijk"). The differences between the means for the other markers did not reach significance. Comparable to what we found for the English AI conditionals, for the Dutch AI conditionals the mean for "waarschijnlijk" is highest, followed by that for "moet," which is followed by the mean for no marker. The lowest mean is for "zou moeten." Here, too, post hoc tests using Bonferroni's adjustment showed that the mean for "zou moeten" is significantly lower than the other means (all ps $<$ .0001); the mean for "waarschijnlijk" is significantly higher than the other means (all ps $<$ .0001); and the mean for "moet" is higher than that for

no marker, but not significantly so. And for the II conditionals, the mean of "waarschijnlijk" is again highest, followed by that for "zou moeten." The mean for "moet" is lowest. Post hoc test using Bonferroni's adjustment revealed that the mean for "waarschijnlijk" is significantly higher than the other means, while the mean for "moet" is significantly lower than the means for "zou moeten" and "waarschijnlijk" (both ps < .0001) but not significantly lower than the mean for no marker. By contrast to the result for "should" in the context of II conditionals, the mean for "zou moeten" is not significantly higher than the mean for no marker.

Again, it is easiest to show the impact of the various markers on the assertability of the different types of conditionals by plotting the differences in the mean relative assertability of the conditionals (see Figure 5). The patterns are qualitatively almost identical
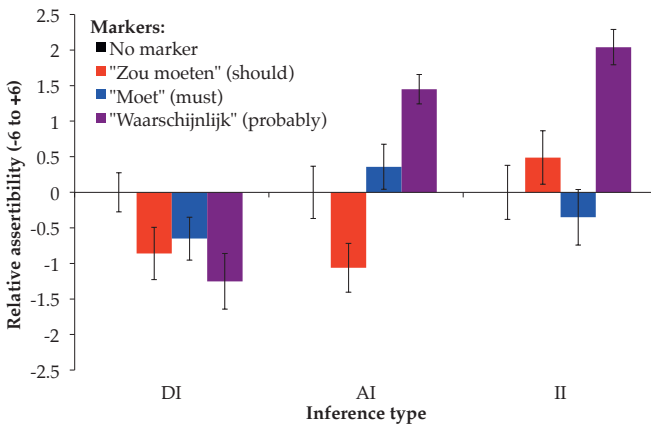
Figure 5: Effect of the various Dutch markers on relative assertability for the different types of conditionals. Error bars represent 95% confidence intervals.

to the ones shown in Figure 4 (there is a small difference between the pattern for "must" and that for "moet"). Similarly to "should," "zou moeten" has a positive impact on the assertability of II conditionals but a negative impact on the assertability of DI and AI conditionals. And similarly to "must," "moet" has a somewhat positive impact on the assertability of AI conditionals and a neg-

ative impact on the assertability of DI and II conditionals. Finally, "waarschijnlijk" does, like its English translation, very well with AI and II conditionals but less so—even much less so—with DI conditionals.

These results support the hypothesis that "zou moeten" serves as an inductive inferential marker, "moet" serves as an abductive inferential marker, and "waarschijnlijk" serves as a generic marker of uncertain inference. Here too, there is no evidence that "moet" also serves as a deductive inferential marker.

4.4 GENERAL DISCUSSION

In Douven and Verbrugge (2010), it was shown that the typology of inferential conditionals proposed in that paper helps to explain certain systematic differences in how people's acceptability judgements of conditionals relate to their corresponding conditional degrees of belief. That was the first piece of evidence in favour of our hypothesis that the typology cuts at the joints. We have added to this another piece of evidence by showing that the typology helps to explain systematic differences in how people's assertability judgements vary depending on whether a marker and, if so, which marker, is inserted in a conditional.

As was predicted, both English "probably" and its Dutch equivalent, "waarschijnlijk," have a tendency to increase the assertability of uncertain (that is, II and AI) conditionals when added to the consequent of such a conditional and an opposite tendency to decrease the assertability of DI conditionals. It is worth noting that, as Figures 4 and 5 show, the effect of "probably" on the assertability ratings of II conditionals in both English and in Dutch is stronger than its effect on the assertability ratings of AI conditionals. We speculate that this is because the defeasibility of inductive inferences tends to be more conspicuous to people than that of abductive inferences. Stating that something happens *most* of the time, or that it has a 95 % chance of happening, conveys the information that it does not happen all the time or that it is not certain to happen. Hence, the very premises of an inductive argument direct a hearer's attention to the possibility of an exception, whereas the conclusion of an abductive argument, which is supposed to be the *best* explanation of (one of) its premises, might be easily thought to be the *only* explanation given that alternative explanations are often hard to conceive.

Our studies further support the hypothesis that the English modal verb "should" functions as an evidential marker of inductive inference. This may not seem a surprising result considering that, for instance, the Cambridge Dictionary Online lists one of the uses of "should" as "[showing] when something is likely or expected,"[7] and people's expectations regarding future events often result from inductive reasoning. Given that inductive inference is overtly defeasible, it might be perceived as providing relatively weak grounds for an assertion. But a comparison with "probably" suggests that "should" does more than just weaken an assertion given that, unlike "probably," it does not go well with abductive conditionals. Similar remarks apply to the Dutch expression "zou moeten."

We saw that both "must" and "moet" have a positive effect on the assertability of AI conditionals, though for neither marker does this effect reach statistical significance. However, the combined fact that "must" and "moet" have a negative effect on the assertability of II conditionals, a weaker negative effect on the assertability of DI conditionals, and yet no negative effect (and in fact an, albeit insignificant, positive effect) on the assertability of AI conditionals constitutes a pattern which warrants the conclusion that "must" and "moet" are evidential markers indicating abductive inference. Given that this is the typology of conditionals discussed in chapter 3 which allows us to explain the systematic differences observed in our experiments, we take these results to be a piece of evidence in favour of our proposal. In the next chapter, we will show that the semantics built upon the said typology helps to evade certain challenges that many theories of indicative conditionals have to face. Additionally, we will see that our proposal's ability to distinghish between the types of inferential conditionals allows us to reevaluate the role indicative conditionals play in the process of decision making.

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7 http://dictionary.cambridge.org/dictionary/british/should_2.

RETHINKING GIBBARD'S RIVERBOAT ARGUMENT

This chapter is based on a joint paper with Sylvia Wenmackers and Igor Douven published in *Studia Logica* (Krzyżanowska et al. 2014) and on a paper included in the book "Philosophical and Formal Approaches to Linguistic Analysis," edited by Piotr Stalmaszczyk (Krzyżanowska 2012).

5.1 CONDITIONAL NON-CONTRADICTION

According to the principle of Conditional Non-Contradiction (CNC), conditionals with the same antecedent and contradictory consequents cannot both be true, unless the antecedent is inconsistent.[1] We follow the mainstream in regarding this principle as an adequacy constraint on any truth-conditional semantics for conditionals. After all, it may be reasonable to believe that

  (88) If Matt is on holidays, he is in Venice.

or that

  (89) If Matt is on holidays, he is not in Venice.

but, it would seem, we could at no one time reasonably believe both. That immediately rules out the material conditional account, which assigns to a conditional the truth conditions of its material counterpart (see section 2.2 for a discussion of this theory). Given this semantics, "If φ, ψ" and "If φ, not ψ" are both true whenever φ is false. But surely CNC leaves many other truth-conditional semantics in the running? An old but still influential argument by Gibbard (1981) purports to show that the answer is negative. In Gibbard's view, any truth-conditional semantics that validates CNC is bound to get things wrong—from which he concludes that conditionals do not have truth conditions.

Central to Gibbard's argument is this story:

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1 Some authors use the label CNC to refer to what we call CNC minus the proviso that the antecedent be consistent. The principle as stated here is then referred to as "Restricted Conditional Non-Contradiction." See for instance Unterhuber (2013, Ch. 3), which also contains a thorough discussion of the status of both principles in the context of various semantics for conditionals.

> Sly Pete and Mr. Stone are playing poker on a Mississippi riverboat. It is now up to Pete to call or fold. My henchman Zack sees Stone's hand, which is quite good, and signals its content to Pete. My henchman Jack sees both hands, and sees that Pete's hand is rather low, so that Stone's is the winning hand. At this point, the room is cleared. A few minutes later, Zack slips me a note which says "If Pete called, he won," and Jack slips me a note which says "If Pete called, he lost." I know that these notes both come from my trusted henchmen, but do not know which of them sent which note. I conclude that Pete folded. (Gibbard 1981, p. 231)

Gibbard argues that if

(90) If Pete called, he won.

and

(91) If Pete called, he lost.

have a truth value at all, they must both be true. This is because Zack and Jack both appear warranted in their assertions, and their warrants do not rest on any false beliefs about relevant matters of fact. But CNC rules that (90) and (91) cannot both be true. Truth-conditional semantics for conditionals that validate CNC—as we granted they must—cannot get this right.

Or rather, Gibbard does see an escape route for the advocates of such semantics, namely, to claim that conditionals have their meanings relative to speakers' epistemic states, so that (90) does not express the same proposition when it is uttered by Zack as when it is uttered by Jack. Supposing this to be true, we would equivocate by taking CNC to apply to (90) and (91). Stalnaker (1984, p. 109), the principal addressee of Gibbard's critique, seconds this solution to the riverboat puzzle and compares the case of the above conditionals with an unproblematic instance of context-dependence:

> There is a straightforward sense in which the sentences "I was born in Istanbul" and "I was not born in Istanbul" are contradictories: when both are interpreted relative to the same context they must have opposite truth-values. But different speakers create different contexts, and so two tokens of the respective sentences

> may both be true if spoken by different speakers. Since I accept what you say, I am prepared to assert the *proposition* you expressed, but I will have to use a different sentences to do so.

Jack and Zack are in different epistemic situations, hence the context in which Jack asserts (91) is different that the context in which Zack asserts (90), so these speakers do not contradict each other at all. In Stalnaker's semantics, the selection functions are pragmatically determined. If we have a closer look at the henchmen's epistemic situations, we can clearly see that they will consider completely different possible worlds as the closest antecedent-worlds.

There are, at least *prima facie*, four relevant possibilities to be considered:

w_{cw}:	Pete calls	Pete has a winning hand
w_{cl}:	Pete calls	Pete has a losing hand
w_{fw}:	Pete does not call	Pete has a winning hand
w_{fl}:	Pete does not call	Pete has a losing hand

Zack knows that Pete knows his opponent's cards. He also strongly believes in Pete's rationality and familiarity with the rules of the game. Therefore, he does not consider the world w_{cl} possible at all, and only w_{cw}, w_{fw} and w_{fl} are compatible with what he knows. In Zack's view, Pete will call only in those possible worlds in which he has a winning hand. In Stalnaker's terms, from Zack's perspective in the closest (and, in fact, the only available) "Pete calls"-world, "Pete wins" is true, and therefore the conditional "If Pete called, he won" is true.

w_{cw}:	Pete calls	Pete has a winning hand
w_{fw}:	Pete does not call	Pete has a winning hand
w_{fl}:	Pete does not call	Pete has a losing hand

At the same time Jack, knowing the exact distribution of cards, eliminates all those worlds in which Pete has a winning hand. Hence the only worlds he considers possible are w_{cl} and w_{fl}:

w_{cl}:	Pete calls	Pete has a losing hand
w_{fl}:	Pete does not call	Pete has a losing hand

As a result the closest "Pete calls"-world selected by Jack is w_{cl} in which Pete has a losing hand. Clearly, the sets of possible worlds that constitute epistemic states of the speakers are different and

their respective selection functions take different values. "If Pete called, he won" can indeed express two different propositions depending on the context, that is, on whether it is uttered by Zack or by Jack. But—Gibbard thinks—this is a kind of context-sensitivity that is hard to uphold. After all, we do seem able to make sense of (90) and (91) even if we are ignorant of the epistemic states that the authors of these notes were in at the time of their writing.

5.2 PRAGMATIC AMBIGUITY

We already granted CNC. We also agree with Gibbard's claim that if one of (90) and (91) is true, then so is the other.[2] If we still do not accept the conclusion that conditionals must lack truth conditions, then this is because we disagree with Gibbard's appraisal of the escape route he mentions. Why should it be more objectionable to claim that a conditional can express different propositions in the mouths of different speakers than to claim that, for instance,

(92) I am the owner of this house.

or

(93) Everyone has got a drink.

express different propositions in the mouths of different speakers? (92) may be true when said by Sally and false when said by Paul, yet the two speakers clearly do not contradict each other. The truth value of (93) depends on the intended scope of the the quantifier and, again, the reference of the indexical "here." It can be true when uttered by Clara at her house warming party and false when uttered by Robert at a rock concert. According to Gibbard, however, the cases are not parallel because we can rely on fairly straightforward rules for detecting the relevant contextual information necessary to interpret sentences like (92) or (93): " 'I' refers to the speaker, 'this' to whatever the speaker points at, 'here' refers to the place of utterance." Similarly, the scope ambiguous quantifier "everyone" can be easily interpreted as ranging over a group of people salient in the context of utterance.

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2 Our agreement is based on pre-theoretical intuition rather than on Gibbard's argument for this claim. True, neither Jack's nor Zack's assertion rests on a mistaken belief, but Jack, in contrast to Zack, still lacks knowledge of a seemingly highly relevant matter of fact, to wit, what cards Pete is holding. While Zack may not have any *mistaken* beliefs about these cards, his ignorance might still lead him to assert something false—even warrantedly so, given the quality of the evidence that *is* in his possession. See, in the same vein, Lycan (2001, p. 169).

Gibbard (1981, p. 232) argues that the difference in contexts in which (90) and (91) occur has "a strange feature," because:

> Ordinarily when context resolves a pragmatic ambiguity, the features of the context that resolve it are common knowledge between speaker and audience. If the chairman of a meeting announces "Everyone has voted 'yes' on that motion," what the audience knows about the context allows it to judge the scope of 'everyone'.

In the sly Pete story, by contrast:

> whatever contextual differences between the utterances there may be, they are unknown to the audience. I, the audience, know exactly the same thing about the two contexts: that the sentence is the content of a note handed me by one of my henchmen. Whatever differences in the context make them invoke different s-functions is completely hidden from me, the intended audience.

Gibbard concludes that there do not seem to exist similarly straightforward rules for interpreting context-sensitive conditionals. Stalnaker, who not only acknowledges but also endorses the context-sensitivity of conditional sentences, admits that asserting a conditional, especially in contexts resembling the one described by Gibbard, seems to be a violation of a conversational maxim that teaches us to assume that our interlocutors have all the information necessary to interpret our messages.

> In general, in any context in which *If A then B* and *In A then not-B* are (epistemically) possible answers, the questioner will have the contextual information necessary to interpret the answer only when he knows what it is. This seems to violate the following conversational maxim: speakers ought, in general, to assume that their addressees have whatever information is necessary to determine what they are saying. It seems that the assumption that open conditionals express propositions leads to the conclusion that in a very general kind of context, the assertion of indicative conditionals will always conflict with a very plausible principle of conversation. (Stalnaker 1984, pp. 110-111)

Stalnaker's advice is to relax the maxim so it allows for exceptions. But this is not really a solution to the problem that Gibbard is bothered with, namely, that if conditionals do express propositions, these propositions are extremely subjective, that is, they depend on the epistemic states of the speakers who utter them, and we rarely have direct access to what other speakers know or believe. And this is exactly the kind of context-sensitivity Gibbard finds unacceptable.

We dispute Gibbard's assessment of the situation and believe that, pace Gibbard, interpreting context-sensitive conditionals is not so different from interpreting sentences containing indexicals . This is not to deny that we can make sense of (90) and (91) even if we have no idea which note is from Zack and which from Jack, nor know much about Zack's and Jack's belief states. But in the same way we can make sense of (92) or of (93) if these are written on notes of unknown origin, and we do not know the referents of "I" or "this house," in the first case, or the scope of the quantifier "everyone," in the second case. What is true is that in such cases we cannot *fully* interpret (92) nor (93), but we still get *something* from them. We get from (92) that whoever wrote the message claims to be the owner of whichever house "this house" is meant to refer to. In some contexts, we might even be able to say with some confidence who the author is and to which house he or she is referring. A message containing a scope-ambiguous quantifier "everyone" would be particularly hard to interpret. If I do not know anything about the context in which (93) was uttered, I will have no clue what is the scope of the quantifier occurring there. However, from (93), we can get that each member of a group of people present in the place where the message was written has got a drink. In our view, much the same is true for (90) and (91). Having been given the notes with (90) and (91) on them, but not knowing who gave us which note and what the persons' epistemic states were, we can still get *something* out of those messages. To be sure, one gets *more* out of the messages if one does know who handed one which note, and what the relevant beliefs of the authors were at the time of writing. But that is as with the notes with (92) or (93) on them: one gets more out of those if one does know the intended referents of "I," "this house," and "everyone" than if one does not.

In the following section, we will argue that the truth-conditional semantics for conditionals introduced in chapter 3 renders both (90) and (91) true, given the specifics of the above story. Moreover, the position allows us to keep CNC on board while avoiding the

untoward consequences that Gibbard envisions for any semantics that factors a speaker's epistemic state into the truth conditions of conditionals. Additionally, in section 5.5 we report some experimental evidence favouring our diagnosis of the Gibbard story.

5.3 A NEW SOLUTION

In chapter 3, we proposed a new semantic theory of conditionals based upon an idea that many, if not all, conditional sentences convey the existence of an inferential connection between the content of their antecedent and the content of their consequents. Importantly, we acknowledged the variety of possible consequence relations linking antecedents and consequents, following the typology of inferential conditionals introduced by Douven and Verbrugge (2010). We defined the truth conditions in the following way:

DEFINITION 3:   *A speaker S's utterance of "If φ, ψ" is true if and only if:*

(i) ψ is a consequence of φ in conjunction with S's background knowledge,

(ii) ψ is not a consequence of S's background knowledge alone but not of φ on its own, and

(iii) φ is deductively consistent with S's background knowledge or ψ is a consequence of φ alone,

where the consequence relation can be deductive, abductive, inductive, or mixed.

To see what follows from Definition 3 for the Gibbard story, first consider a variant of that story. Sly Pete and Mr. Stone are playing poker again, with Zack and Jack again doing their business. Once more, it is up to Pete to call or fold, who also in this story has been signalled the content of Mr. Stone's hand by Zack. In contrast to the original story, however, Pete now has the upper hand. Zack does not know this, but Jack, who has again seen both players' hands, does. After the room has been cleared, both Zack and Jack sincerely assert:

(90) If Pete called, he won.

Although by doing so, they both assert something true, what makes Zack's assertion true is not the same as what makes Jack's

assertion true. Relative to Zack's background knowledge, the best explanation for Pete's calling— supposing he called—is that he held cards that were better than Mr. Stone's, which Pete knew thanks to Zack's fraudulent act. From this in conjunction with the antecedent of (90), it follows deductively that Pete won, so that, from Zack's perspective, the consequent of (90) is a mixed consequence of the antecedent of this conditional. That is what makes Zack's assertion of (90) true. On the other hand, relative to Jack's background knowledge, that Pete won follows logically from his calling together with the information about both players' hands and the rules of poker. *That* is what makes Jack's assertion of (90) true.

The proposed diagnosis of what is going on in Gibbard's original story will now be unsurprising. From Jack's perspective, "Pete lost" obviously follows deductively from "Pete called," which is what makes his assertion of (91) true. This does not mean that Zack's utterance of (90) must be false. To the contrary, as in the above story, from Zack's perspective Pete's calling is best explained by his having a winning hand, from which, in conjunction with the antecedent, it follows deductively that Pete won —and this is what makes Zack's assertion of (90) true. That is to say, according to Definition 3, both Jack and Zack assert something true.

A number of authors (e.g., Bennett 2003, p. 85 or Edgington 1995, p. 294-295) have presented "symmetric" versions of Gibbard's story which involve pairs of conditionals that are both of the same inferential type, for instance:

> Suppose there are two vaccines against a certain disease, A and B. Neither is completely effective against the disease. Everyone who has A and gets the disease, gets a side effect S. Everyone who has B and gets the disease, doesn't get S. Having both vaccines is, however, completely effective against the disease (though not many people have both). These scientific facts are known. X knows that Jones has had A, and says "If Jones gets the disease, he'll get S." Y knows that Jones has had B, and says "If he gets the disease, he won't get S." (Edgington 1995, p. 294-295)

But given that in those versions the personae asserting the conditionals still have different background knowledge, there is no problem acknowledging that the conditionals are both true. More precisely, there is nothing wrong with "If φ then ψ" being true

because ψ follows from φ in conjunction with a set of background premises $\{\alpha_1, \ldots, \alpha_n\}$, while, at the same time, "If φ then not ψ" is true because "not ψ" follows from φ in conjunction with a different set of background premises, $\{\beta_1, \ldots, \beta_n\}$.

On the other hand, it might be said that accounts like the one presented in this thesis, that relativise the truth of a conditional to the speaker's background knowledge, fail to address the intuition that Zack and Jack disagree with each other. In our view, however, their disagreement is only apparent. If Jack and Zack were to talk to each other, they would quickly realize that they have different information, which might lead them to share what they know. Probably, that would make Zack change his mind. But this would not really amount to retracting his earlier assertion. Rather, we would expect Zack to say something like the following once Jack had revealed his information: "What I meant to say is that if Pete called, that would have indicated that he had the upper hand. But now that Jack told me that in fact Mr. Stone had the upper hand, I'm sure Pete did not call." After they have exchanged their information, Pete's calling becomes inconsistent with Zack's and Jack's shared background knowledge. As observed by, for instance, Edgington (1995, p. 295):

> The Gibbard phenomenon arises if and only if there are currently ascertainable facts that rule out [the antecedent].

If it turns out that, in the original version of the story, Pete actually called, it would mean that Zack was actually mistaken about something, for instance, he wrongly believed that Pete played to win or that he correctly interpreted Zack's signals. If that were the case, the consequent of Zack's conditional would not be a consequence—be it deductive, inductive, abductive or mixed—of Zack's background *knowledge*, and, consequently, (90) would be false. What Zack could truthfully assert in such a situation, however, given his background knowledge, could be, for instance, another abductive inferential conditional, "If Pete called, he does not want to win" or "If Pete called, he is irrational."

In summarizing Gibbard's argument in Section 5.1, we said that, by taking the escape route suggested by Gibbard, his story would no longer present a violation of CNC. We took that escape route, but it could be objected that, strictly speaking, we still have a violation of CNC. For, as it stands, CNC assumes that one can determine merely on the basis of form whether a conditional in the mouth of one speaker is inconsistent with a conditional in

the mouth of another speaker. And the above proposal has not done anything to alter the form of either (90) or (91). As will be clear, we take this to overlook the crucial role that the background knowledge of a speaker plays in determining the interpretation of a conditional. To make this role explicit, it suffices to reformulate CNC as the principle that utterances of instances of "If φ, ψ" and "If φ, not ψ" cannot both be true in conjunction with the same body of knowledge. Put this way, the conditionals in Gibbard's story no longer constitute a violation of CNC.

To come to what is arguably the main challenge of Gibbard's argument, we note that while our view makes the interpretation of conditionals relative to speakers' background knowledge, it does not lead to a relativism that must leave one completely clueless as to the interpretation of any given conditional. Not knowing who wrote which note, we still understand that Pete's losing is a consequence of his calling relative to one of the henchmen's background knowledge, and Pete's winning is a consequence of his calling relative to the other henchman's background knowledge. More precisely, what the message with (90) on it conveys is that, from the perspective of its author, "Pete won" follows—by virtue of deduction, induction, abduction or a combination of these—from "Pete called." Likewise, what we learn from the message with (91) on it is that its author has grounds to infer—again, in one way or the other—"Pete lost" from the assumption that Pete called. Naturally, we understand more if we know who wrote which note, and if we know something about his background knowledge. For instance, knowing that (90) comes from Zack, and that Zack signalled Mr. Stone's hand to Pete but did not see Pete's hand, it should not take too much effort to figure out that Pete's winning is not just *a* consequence of his calling, but more specifically a *mixed* consequence, involving an abductive inferential step. Still, Gibbard or anyone else defending his line would be hard pressed to argue how any of this is essentially different from reading a note with, for instance, (92) on it in a context in which one is ignorant of who wrote the note as compared to reading that note in a context in which one does know who wrote it. They would be equally hard pressed to argue that, on our account, one gets less from reading (90) or (91) than one does from a pre- theoretic viewpoint.

The main general point to be emphasized in this connection is that interpretation is not a matter of all or nothing. It is not as though we always either do or do not get what a speaker says; there are many shades of partial understanding in-between these

extremes. By reading his henchmen's notes, the first-person narrator in Gibbard's story gets a lot, just not everything.

5.4 DELIBERATIONALLY USELESS CONDITIONALS

Gibbard's poker game scenario does not only pose a challenge to propositional theories of conditionals that validate the Principle of Conditional Non-Contradiction (CNC), but it can also serve as a case against indicative conditionals-based decision making. Incidentally, contexts of deliberation provide some extra motivation for endorsing CNC: a piece of advice of the form "If you take a cab, you will not be late for the concert" would be useless if "If you take a cab, you will be late for the concert" can be truthfully asserted in the same context, given the same background knowledge. The semantics proposed in this thesis presents a solution to the problem raised by Gibbard (see section 5.3), and, additionally, sheds new light on the phenomenon of so-called deliberationally useless conditionals.

It is a common assumption that conditionals of deliberation, that is conditionals that a rational agent considers in the process of decision making, are future directed counterfactuals of the form "If I were to do φ, then ψ would happen" (see *e.g.* Gibbard and Harper 1978 and Joyce 1999). For instance, someone who recently got into financial troubles may think:

(94) a. If I were not to ask my sister for a loan, I would have to go to a bank.

b. If I were to borrow money from a bank, I would have to pay the interest rate.

Clearly, realising the dependencies between the states of affairs expressed by the above conditionals' antecedents and their consequents can help the agent to make a right decision. But could he not phrase them in a more straightforward way as "If I do φ, then ψ will happen"? At least *prima facie*, the following future directed indicatives:

(95) a. If I don't ask my sister for a loan, I will have to go to a bank.

b. If I borrow money from a bank, I will have to pay the interest rate.

can act as conditionals of deliberation, too. Sentences in both (94) and 95) seem to be equally closely related to yet another type of conditionals that can guide agents in their decision making:

(96) a. If I don't want to pay the interest rate, I shouldn't borrow money from a bank.

b. If I don't want to go to a bank, I should ask my sister for a loan.

Sentences of the form "If I want ψ, I should do φ" can be classified as "goal-directed" conditionals of deliberation.

Despite the close relationship between grammatically subjunctive conditionals in (94) and their indicative counterparts in (95), it seems that there are reasons not to follow indicative conditionals in contexts of decision making. Most notably, some indicatives can constitute bad or even conflicting advice, and hence they can mislead a deliberating agent. Yet DeRose (2010) maintains that conditionals of deliberation are in fact indicatives, albeit some of them are unassertable in contexts of deliberation. However, although I agree with DeRose's main claim, I am going to show that he failed to recognise the reason why certain indicative conditionals should not be used in contexts of decision making. Furthermore, I will argue that the inferential semantics of conditionals proposed in chapter 3 offers an alternative explanation of the phenomenon of bad or conflicting advice.

5.4.1 *The problem of bad advice*

DeRose (2010) observed that Gibbard's poker game scenario discussed in the previous sections is a good example of a context in which indicative conditionals may pose a problem to a deliberating agent.[3] To recapitulate the scenario, Pete is playing poker against Mr. Stone. Zack signals the content of Stone's hand to Pete, while Jack peeks at both player's hands and sees that Stone has the winning hand. The only aspect of Gibbard's original story that needs to be changed for it to become a context of deliberation are the tenses of the sentences asserted by Zack and Jack. These conditionals, originally in the past tense, have to be rephrased as future directed conditionals. Accordingly, before Pete makes his decision, Zack sends Gibbard a message saying:

(97) If Pete calls, he will win.

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3 DeRose used a simplified version of the original Gibbard story; see appendix C.

As has been argued earlier in this chapter, this is a warranted assertion, given that Zack knows that Pete is cheating, and hence will not call unless he has the winning hand. Yet (97) would constitute a very bad guideline for Pete in the process of deciding whether to play or to quit. Similarly, even though driving a Maserati is very good evidence for being rich, and it is perfectly reasonable to believe that if Charlie drives a Maserati, he is rich,

(98) If Charlie drives a Maserati, he will be able to afford a stay in a 5 star hotel.

taken by Charlie as a piece of advice may lead to disastrous consequences. Since if Charlie, who does not own a Maserati, nor can afford a 5 star hotel, overhears (98) and interprets it as an instruction on how to get rich, it could lead him to take an enormous loan for a luxurious car. That would not only be an irrational decision to make, but also extremely counter-productive, given Charlie's goal of becoming rich. Analogously, Pete interpreting (97) as a guideline can end up calling despite his unfavourable position in the game.

By contrast, Jack's assertion:

(99) If Pete plays, he will lose.

is based on his knowledge of exactly what cards both players have. On that account, it would not only be a piece of advice conflicting with the one from Zack, but, at the same time, it would be an extremely valuable one. This observation alone is not helpful though, unless we know how to accurately tell those conditionals that will not mislead us from those that will or at least may mislead us. Without such a criterion, one seems to be better off avoiding following pieces advice phrased as indicative conditionals.

Fortunately, in the cases like (97) and (98), as DeRose points out, a deliberating agent would not consider the indicative conditional as an instruction if he knew what are the speakers' grounds for asserting it. Likewise, should the speakers of (97) and (98) realise that they are involved in the contexts of Pete's and Charlie's decision making, respectively, they would never assert (97) and (98) (or at least not without any explanations). And the reason for this, as DeRose argues, is that conditionals like (97) and (98) are simply *deliberationally useless* and hence unassertable in the context of deliberation, whereas (99) is an example of a *deliberationally useful* conditional.

As noted, acknowledging the distinction between deliberation-ally useless and deliberationally useful conditionals would not be of much help, if we had no systematic way to recognise a condi-tional's membership in one of the classes. DeRose's own proposal is that future directed conditionals "are deliberationally useless when they are based on *backtracking grounds*" (pp. 28). Indeed, in the poker game scenario, Zack supposes that Pete calls, and then he reasons back in time to realise that Pete knows the opponent's card and hence will play only when his cards are stronger. But is it really the backtracking that we should avoid when involved in the process of decision making?

Although DeRose's analysis of Zack's grounds for asserting (97) is basically correct, he still fails to recognise the reason why (97) or (98) are deliberationally useless. Although they both hinge upon backtracking reasoning, it is not backtracking itself that renders those conditionals unassertable in contexts of deliberation. In fact, I am going to argue that a whole class of deliberationally useful in-dicative conditionals notably depends on reasoning back in time.

5.4.2   *Backtracking in the context of deliberation*

As mentioned above, goal-directed conditionals of the form "If I want ψ, I should do φ" can be thought of as just another way of expressing dependencies between certain actions and states of affairs that are crucial for rational decision making. Moreover, sen-tences like those in (96) or:

(100) a. If Bob wants to have a well-paid job, he should study law.

 b. If you don't want to be late for the meeting, you should leave in 10 minutes.

sound in contexts of deliberation perfectly natural. Assuming that their assertions are well justified, they usually constitute rather good pieces of advice. And yet they involve some form of back-tracking. Though they are not backtracking conditionals *per se*, and the reasoning pattern here is slightly different than in the cases discussed by DeRose, their dependence on reasoning back in time is significant. The antecedents of the above conditionals are propositional attitude reports, and as such they do not seem to be preceded by whatever is expressed by the consequents. But to figure out what should be done in order to fulfill the wishes

or plans reported by the antecedents, one has to start with the objects of those propositional attitudes.

For instance, the speaker of (100a) considers the possibility that Bob finds a well-paid job and reasons back in time to find out what may *make this happen*, that is, which study programme would most likely lead to a carreer providing a good pay. He arrives at the conclusion that lawyers usually earn good money, and hence that Bob should study law. In other words, one can follow the procedure below:

1. Assume the antecedent of the conditional, φ (*e.g.* "Bob wants to have a well-paid job");
2. "Extract" the embedded sentence $\varphi*$ (*e.g.* "Bob has a well-paid job") from the attitude report "an agent a wants $\varphi*$" ("Bob wants that Bob has a well-paid job");
3. Assume $\varphi*$;
4. Reason back in time to see what could lead $\varphi*$ to be the case. Given the relevant background knowledge, choose what is the best way to achieve $\varphi*$, and call it $\psi*$ (*e.g.* "Bob studies law").[4]
5. Rephrase $\psi*$ as an instruction Q for a by adding a modal verb "should" to $\psi*$, as in "an agent a should $\psi*$" (*e.g.* "Bob should study law").
6. Assert "If φ, then ψ" (100a).

Although the backtracking reasoning involved in goal-directed conditionals is different than what DeRose is concerned with, it is still a backtracking reasoning. The example serves as an illustration that it is not reasoning back in time itself that renders conditionals like (97) deliberationally useless. Equating backtracking conditionals with deliberational uselessness would exclude from the context of decision making a vast class of conditionals that seem to be rather useful. Furthermore, saying that deliberationally useless conditionals depend on backtracking reasoning, even if true, does not explain why they are useless. Why is it the case then that some indicative conditionals that depend on backtracking are unassertable in the context of decision making? The semantics proposed in this thesis provides a straightforward answer.

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4 Note that studying law should be the best way to a well-paid job for Bob, given his personal qualities or the situation he finds himself in. It does not need ot be the best choice for an arbitrary person with the same goal. Moreover, if there is more than one way to achieve the goal, and they are all equally good in given circumstances, the speaker is not warranted in asserting the conditional.

5.4.3   *The source of unassertability*

In section 5.3 we have argued that what distinguishes Zack's de-
liberationally useless conditionals from the one asserted by Jack is
the type of inference those conditionals reflect. In the case of (99),
on the one hand, assumption of the antecedent "Pete calls" to-
gether with background information on the distribution of cards
and on the rules of the game leads to the conclusion expressed by
the consequent: "Pete will lose." It does so, because Pete's losing
follows deductively from the supposition that he called together
with the background knowledge. Zack's assertion, on the other
hand, is based on backtracking reasoning (as DeRose quite cor-
rectly observed), that is reasoning on what precedes the state of
affairs expressed by the antecedent. This backtracking reasoning
is, as a matter of fact, an instance of abduction. Supposing that
Pete calls leads Zack to *the best explanation* of Pete's decision to
call. In other words, what Zack reasons about is what could make
Pete decide to call. The consequent of the conditional asserted by
Zack is an abductive consequence of its antecedent in conjunction
with Zack's background knowledge.

How does it relate to the issue of deliberational uselessness?
Simple as that, abductive reasoning, or reasoning to the best ex-
planation, does not provide us with any information that we could
use to make a rational decision. If I am trying to decide whether
I should do A, what I am interested in are the consequences of
the action A, not its causes or explanations. Someone explaining
to me what my decision to do A would be an indication or a symp-
tom of would not help me to make up my mind. To illustrate this
point, let us consider another example. Suppose that I received an
invitation to a party from people that I do not like. To the best of
my knowlede, there will be no one at that party that I would really
like to hang out with. On the other hand, I have no other plans
for the evening, and I am longing for some company. Should I go
to that party? I may consider a conditional: "If I go to that party,
I am desperately lonely." Obviously, I do not want to be desper-
ately lonely, but does it mean that I should reject the invitation?
No, because my loneliness would not be the result of my parti-
cipation in the party, but rather a mere explanation of my own,
somewhat surprising decision. This abductive inferential condi-
tional does not inform me whatsoever about the benefits of either
accepting or rejecting the invitation, it only provides me with an
explanation of a hypothetical action that I still have no reason not

to undertake.[5] By contrast, an inductive inferential conditional, for instance "If I go to that party, I will meet some new people" could be exactly what I need in order to make a rational decion regarding this one particular evening of my life.

Taking into account the typology of infernetial conditionals in the analysis of Gibbard's poker game scenario not only allows to identify those conditionals that are deliberationally useless, but also provides a reason and an explanation for their infamous role in the process of decision making.

5.5   EXPERIMENT: GIBBARD STORIES

Our diagnosis of what is going on in Gibbard's argument is so far mainly supported by our own pre-theoretic responses to (90) and (91) in the context provided by Gibbard's story. While in our opinion intuition-based approaches still have their value in philosophy, we have considerable sympathy for the recent trend to try and provide more robust, less subjective support for one's philosophical claims and analyses. This section presents an experiment that is meant to offer precisely that kind of additional support for our analysis of Gibbard's argument.

The experiment makes use of previous experimental work on so-called evidential inferential markers in relation to conditionals discussed in chapter 4. In that work, we found that "probably," when occurring in the consequent of a conditional, is a good marker of conditionals that are uncertain in Douven and Verbrugge's 2010 sense. Specifically, inserting "probably" in the consequent of a conditional has a tendency to *raise* that conditional's perceived assertability if the conditional is either an II or an AI conditional as well as a tendency to *lower* the conditional's perceived assertability if the conditional is a DI conditional.

This finding suggests a straightforward empirical test of our diagnosis of Gibbard's riverboat argument. After all, according to that diagnosis, "If Pete called, he lost" is a certain conditional relative to the background information available to Jack, and so, in view of the above finding, the insertion of "probably" in the consequent should make the conditional less fitting into a context in which that information is assumed. Conversely, according to the same diagnosis, "If Pete called, he won" is an uncertain con-

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5 Of course, I do not claim that abductive conditionals cannot play any role whatsoever in the process in decision making. They can, but not *as* conditionals of deliberation.

ditional relative to the background information available to Zack, and so the insertion of "probably" in the consequent should make the conditional more fitting into a context in which *that* information is assumed.

5.5.1 *Method*

Participants

Two hundred and seventy-eight persons participated in the experiment. They were recruited via the CrowdFlower interface (http://www.crowdflower.com), which directed them to the Qualtrics platform (http://www.qualtrics.com) on which the experiment was run. The participants were paid a small amount of money in return for their cooperation. All participants were from Australia, Canada, New Zealand, the United Kingdom, and the United States. We excluded from the analysis 81 participants who failed two comprehension questions, 11 further participants who had indicated that they were non-native speakers of English, and 3 still further participants who had spent more than 30 minutes on the survey. This left us with 183 participants. The mean age of these participants was 35 ($\pm$13); 115 participants (63 %) were women; 79 % indicated college or higher as their education level, 20 % indicated high school, and 1 % indicated a lower education level.

Design

Every participant was given five different stories and was asked which of two conditionals fitted better in the context of the story. There were two versions of each story, a "certain" and an "uncertain" one. Each participant received only one version of a story. All the materials were presented on screen, with each story together with the associated question appearing on a different screen. The order of the story–question pairs was randomized and for each separate story it was randomly determined whether the agent received the certain or the uncertain version of that story.

Materials and Procedure

All materials were in English, the participants' native language. One group of participants (N = 83) was offered the part of Gibbard's story containing the information available to Jack, who sees both players' hands (which creates a "certain" context), and another group (N = 100) was offered the part of Gibbard's story

containing the information available to Zack, who can only see Mr. Stone's hand and signals its contents to Pete (which creates an "uncertain" context). Participants in the first group were then asked which of "If Pete called, he lost" and "If Pete called, he probably lost" they thought fitted best in the context. Participants in the second group were asked which of "If Pete called, he won" and "If Pete called, he probably won" they thought fitted best into the context. Both groups were given the options to answer that the first conditional fits best, that the second fits best, that both fit equally well, and that neither fits well. Figure 6 shows a story and a question presented on the screen to the first group of participants. The corresponding story plus question presented to the second group is shown in Figure 7.

> Pete and Mr. Stone were playing poker yesterday. At some point, it was up to Pete to call (i.e., to continue playing, with the risk of losing if his cards are worse than Mr. Stone's) or to fold (i.e., to quit playing). Jack, who was in the same room, saw that, at that point, Mr. Stone's cards were better than Pete's.
>
> Consider these sentences:
>
>   1. If Pete called, he lost.
>   2. If Pete called, he probably lost.
>
> Of these sentences
>
>   ○ the first fits best into the context.
>   ○ the second fits best into the context.
>   ○ both fit equally well.
>   ○ neither fits well.

Figure 6: Gibbard's story, certain version, as presented to the participants.

Because our own first impression of Gibbard's riverboat story was that it was somewhat difficult to comprehend, at least for people who are unfamiliar with the game of poker, we also included in our experiment DeRose's 2010 version of Gibbard's story, which is about a simpler game than poker but otherwise

Pete and Mr. Stone were playing poker yesterday. At some point, it was up to Pete to call (i.e., to continue playing, with the risk of losing if his cards are worse than Mr. Stone's) or to fold (i.e., to quit playing). Pete is a good poker player who does not like to lose. Moreover, he was cheating: his friend, Jack, was looking at Mr. Stone's hand and, using special signs, informed Pete about what cards Mr. Stone had.

Consider these sentences:

1. If Pete called, he won.
2. If Pete called, he probably won.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

Figure 7: Gibbard's story, uncertain version, as presented to the participants.

identical to Gibbard's story.[6] As we did in the case of Gibbard's story, we split the information presented in DeRose's story into a part containing the information available to one player's helper —we called the player "Jim" in the survey question—who sees only what is in the hand of Jim's opponent—called "Steve" in the survey question—and signals its content to Jim, and a part containing the information available to Steve's helper who sees both players' hands. Again we asked one group (N = 87) to assess the fittingness in the former context of "If Jim plays, he will win" with and without "probably" in its consequent, and another group (N = 96) to do the same for "If Jim plays, he will lose" in the latter context. (See the appendix C for the two versions of DeRose's story that we used.)

As an additional test of the correctness of our analysis of Gibbard's story and our hypothesis concerning what it shows about

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6 Actually, there is a difference in the tense of the conditionals used in the two stories (see examples (97) and (99) discussed in the previous section). As far as we can see, this difference is immaterial. But of course this claim might be refuted by future empirical research.

conditionals, we invented a number of stories that, supposing our analysis to be correct, closely parallel Gibbard's story in all relevant respects and that should therefore yield similar results with regard to the effect of inserting "probably" in the consequent of the conditionals that we supposed to parallel the conditionals in Gibbard's story. Specifically, we came up with three stories, one about a certain Mr. Smith, one about a poisoned apple, and one about a linguistics exam, the information in each of which could be filtered in two different ways, resulting in a story that, according to our judgement, should make a conditional pertaining to the story appear uncertain, and a story that, also according to our judgement, should make the same conditional appear certain. (See again the appendix for a description of these stories.) For the certain version of the Mr. Smith story, N = 86, for the uncertain version, N = 97; for the certain version of the story about the apple, N = 87, for the uncertain version, N = 96; and for the certain version of the linguistics exam story, N = 95, for the uncertain version, N = 88.

5.5.2 Results

A chi-square test was performed to test the hypothesis that one of the conditionals in the Gibbard story is a certain inferential conditional and the other an uncertain inferential conditional, given that "probably" is a good linguistic marker for distinguishing between the two types of conditionals. A moderately strong association was found between type of context (certain / uncertain) and assessment of effect of insertion of "probably," $\chi^2(3, N = 183) = 24.9$, $p < .0001$; Cramér's V = .369, $p < .0001$. Inspection of the cell frequencies showed that 55 (66 %) out of the 83 participants who had received the certain version of the story judged the corresponding conditional without "probably" to fit best into the context, whereas only 22 (27 %) of the same 83 participants judged the conditional with "probably" to fit better; 5 of the remaining 6 participants thought both conditionals fitted equally well; 1 participant thought neither fitted well. By contrast, 51 (51 %) out of 100 participants who received the uncertain version of the story judged the conditional with "probably" to fit best into the context, and only 30 (30 %) of the same group of participants judged the conditional without "probably" to fit best into the context; 12 participants thought that both conditionals fitted well; 7 thought neither fitted well.

We asked participants about their familiarity with the game of poker, and an analysis of the data of participants who indicated that they knew the game of poker well (38 of the 183 participants) revealed a stronger association than the one we found for the group as a whole. In particular, Cramér's V = .449 for this group. However, the effect size is only marginally significant (p = .053).

We obtained similar results for DeRose's story, although here a chi-square test revealed a *strong* association between type of context (certain / uncertain) and effect of "probably," $\chi^2(3, N = 183) = 64.4$, p < .0001; Cramér's V = .59, p < .0001. More specifically, in the certain context, 84 (88 %) out of 96 participants judged the conditional without "probably" to fit best; only 8 participants (8 %) judged the conditional with "probably" to fit best; 3 thought both fitted well; 1 thought neither fitted well. On the other hand, in the uncertain context, 26 (30 %) out of 87 participants judged the conditional without "probably" to fit best; 41 participants (47 %) judged the conditional with "probably" to fit best; 7 thought both fitted well; 13 thought neither fitted well.

As for the story about Mr. Smith, a chi-square test again found a strong association between type of context (certain / uncertain) and effect of "probably," $\chi^2(3, N = 183) = 60.2$, p < .0001; Cramér's V = .57, p < .0001. Cell frequencies for the certain version were: 64 (74 %) out of 86 participants thought that the conditional without marker fitted best; 8 (9 %) thought the conditional with marker fitted best, 7 thought both fitted well; 7 thought neither fitted well. Cell frequencies for the uncertain version were: 20 (21 %) out of 97 thought the conditional without marker fitted best; 56 (58 %) thought the conditional with marker fitted best; 9 thought both fitted equally well; 12 thought neither fitted well.

As for the story about the apple, a chi-square test found a very strong association between type of context (certain / uncertain) and effect of "probably," $\chi^2(3, N = 183) = 107.9$, p < .0001; Cramér's V = .77, p < .0001. Cell frequencies for the certain version were: 65 (75 %) out of 87 participants thought that the conditional without marker fitted best; 11 (13 %) thought conditional with marker fitted best; 9 thought both fitted well; 2 thought neither fitted well. Cell frequencies for the uncertain version were: 5 (5 %) out of 96 participants thought the conditional without marker fitted best; 75 (78 %) thought the conditional with marker fitted best; 4 thought both fitted well; 12 thought neither fitted well.

As for the linguistics test story, a chi-square test found a strong association between type of context (certain / uncertain) and ef-

fect of "probably," $\chi^2(3, N = 183) = 54$, p < .0001; Cramér's V = .543, p < .0001. Cell frequencies for the certain version were: 50 (52 %) out of 95 participants thought the conditional without marker fitted best; 30 (32 %) thought conditional with marker fitted best; 9 thought both fitted equally well; and 6 thought neither fitted well. Cell frequencies for the uncertain version were: 6 (7 %) of 88 thought the conditional without marker fitted best; 54 (61 %) thought the conditional with marker fitted best; 4 thought both fitted equally well; and 24 thought neither fitted well.

5.5.3 *Discussion*

Except possibly for the apple story, the scenarios presented to the participants may have triggered some associations that we were not quite able to control. For instance, in the linguistics test story, 32 % of the participants decided that the conditional with "probably" fits best in the certain context while only 53 % of them thought the conditional without the marker fits best. Even though the effect of "probably" here is statistically significant, it is still curious that so many people chose the conditional with "probably." The certainty of this scenario is based on rules that are of human origin. Participants may have their own experiences with universities, assignments and tests, and some of them might have experienced that rules of the sort at issue in the story are sometimes violated. It is well known that participants do not always fully believe what is given in vignettes and may, in view of their background beliefs, remain somewhat uncertain about what they are asked to suppose as being true (see Evans and Over (2004, Ch. 6) and Over et al. (2013)). Hence, they may not be willing to conclude p on a basis of (roughly) "there is a rule that p," and they may still prefer "probably p" in this kind of context.

The difference in the strength of association between Gibbard's story and DeRose's version of that story may be entirely due to the fact that the former involves the game of poker, the rules of which tend to strike outsiders as being relatively complex. Even if no real knowledge of those rules is presupposed by the story, that itself is not immediately evident unless one is at least somewhat familiar with the game. By contrast, DeRose's version poses no particular comprehension problems. For this reason, we take the responses to DeRose's version to be more relevant to our hypothesis, and those responses revealed a strong association between type of context and effect of inserting "probably" in the relevant

conditional. Specifically, inserting "probably" had a tendency to make the conditional appear better fitting in the uncertain context, but less fitting in the certain context. In view of the results of discussed in chapter 4, this finding is exactly what one would expect if the uncertain context invites an interpretation of the conditional as being uncertain and the certain context invites an interpretation of the conditional as being certain.

That, guided by our view on Gibbard's story, we were able to design a number of scenarios that were meant to parallel Gibbard's and DeRose's and that turned out to elicit the same patterns in the responses, is further evidence for the correctness of our diagnosis.

5.6   CONCLUSION

Gibbard's argument challenges truth-conditional accounts of conditionals. On the one hand, CNC appears an utterly plausible principle. On the other hand, the riverboat story features two conditionals, one of the form "If φ, ψ," the other of the form "If φ, not ψ," which in the context of the story strike one as being both true. According to Gibbard, it follows from his story that conditionals do not express propositions, and thus are not true or false; at least this follows, Gibbard thinks, unless one is willing to buy into a semantics that makes the communicative role of conditionals hard to understand. We have argued for a different conclusion by stating a semantics that relativises the interpretation of conditionals to speakers' background knowledge but not in a way that must leave us clueless about the meaning of a conditional whenever we are ignorant of the speaker's background knowledge. As a consequence of our proposal, conditionals cannot be judged to be inconsistent with each other purely on the basis of their form. But this admission requires no more than a minor amendment in the formulation of CNC. Furthermore, the proposed analysis sheds new light on the role indicative conditionals can play in the context of decision making. Finally, it was seen that, in light of recent experimental results on linguistic markers, our analysis of Gibbard's story has clear empirical content, part of which was investigated and borne out in the experiment that we conducted.

CONCLUSION

6

This dissertation concerns the meaning of conditional sentences in natural language. Our philosophical investigations have been aided by linguistic considerations and empirical results from the psychology of reasoning. We have argued that only by combining the insights from different disciplines, one can arrive at an account that fulfils all the theoretical desiderata and, at the same time, fits the over-the-years collected data on how people use and interpret conditional sentences. Now it is time to see where this approach has lead us to. Section 6.1 will recapitulate the outcome of our attempt to develop such an account.

The word "attempt" in the above sentence has been chosen deliberately, as the proposal presented in this dissertation is by no means the end of the story. On the contrary, even though a dissertation marks a conclusion of one's doctoral project, it is really only a prologue. Not surprisingly, in the course of the investigation, many new questions have arisen. Perhaps even more questions than we were concerned with at the beginning of the project. In section 6.2, we will outline the perspectives for future research.

6.1 SUMMARY

In chapter 1, we described our goal of developing an empirically informed theory of conditionals. We have noted that understanding what are the conditions for conditional sentences to be true amounts to answering the question of what we learn when we are given a piece of information phrased as an indicative conditional. Our starting point was an observation that the Ramsey Test, which is considered by many scholars to be an accurate description of a mechanism underlying the interpretation of conditional sentences, provides only a partial answer to the question of their meaning.

Chapter 2 discussed the two most prominent approaches towards the semantics of conditional sentences: the material conditional account and Stalnaker's possible worlds semantics, whose counter-intuitive consequences eventually motivated our own in-

vestigations. In particular, we have seen that conditionals with true antecedents and true consequents, for instance:

(67) a. If aubergine is a vegetable, then raccoons are American mammals noted for their intelligence.

  b. If it sometimes rains in Groningen, then Kazimierz Ajdukiewicz was a prominent Polish philosopher.

  c. If Shakespeare did not write *Anna Karenina*, then Ljubljana is the capital of Slovenia.

are rendered true on both the material interpretation and on Stalnaker's account, regardless of whether these sentences make any sense at all. We have argued that this kind of problem stems from the fact that none of these theories managed to account for what, in our opinion, seems to be the main message conveyed by conditional sentences, namely, that there is a particular connection between antecedents and consequents.

In chapter 3, we have presented a semantics based on an observation that the link between a conditional's antecedent and its consequent is inferential in nature. Moreover, the consequence relation connecting the clauses of a conditional sentence does not always have to be of the same type. Many, if not all, indicative conditionals can be grouped into deductive, inductive or abducitve inferential (DI, II and AI, respectively) conditionals (cf. definitions 1 and 2). On the basis of this observation, we have proposed the following truth conditions:

DEFINITION 3:   *A speaker S's utterance of "If φ, ψ" is true if and only if:*

  (i) *ψ is a consequence of φ in conjunction with S's background knowledge,*

  (ii) *ψ is not a consequence of S's background knowledge alone but not of φ on its own, and*

  (iii) *φ is deductively consistent with S's background knowledge or ψ is a consequence of φ alone,*

where the consequence relation can be deductive, abductive, inductive, or mixed.

Consequently, we have shown that the proposed semantics evades the paradoxes of material implication, and, that it validates a highly regarded principle of Import-Export. We have also argued

that, even though the Or-to-if and Modus Ponens inferences are not valid on our account, the semantics renders the conclusions of these two argument forms true precisely in the cases in which, intuitively, they need to be true.

Chapter 4 reports the results of two experiments that provided empirical support for the typology of conditionals introduced in chapter 3 and thereupon based semantics. We have investigated the relationship between Dutch and English evidential markers and the inferential conditionals of different types. In particular, we have examined how the assertability of a conditional changes when markers "should," "must" or "probably" in the English version of the experiment, and, in the Dutch version of the experiment, "zou moeten," "moet" and "waarschijnlijk" are inserted into the consequent of that conditional. The results of the two experiments support the hypothesis that English modal verb "should" and its Dutch equivalent, "zou moeten," function as evidential markers of inductive inference. Moreover, our studies suggest that the English modal verb "must" and its Dutch counterpart, "moet," serve as abducitve inferential markers. Unsurprisingly, English "probably" as well as its Dutch translation, "waarschijnlijk," can be thought of as markers signalling the uncertainty of what is asserted. We take these results to be a piece of evidence for the descriptive accuracy of our proposal.

In chapter 5, we put the theory proposed in chapter 3 to a philosophical test. We analysed an argument by Gibbard (1981) who purported to show that indicative conditionals cannot express propositions. The argument militates against those propositional theories of conditionals that validate the Principle of Conditional Non-Contradiction, which is often regarded as an adequacy constraint on any theory that attributes truth-conditions to conditional sentences. According to this principle, "If φ, ψ" and "If φ, not ψ" cannot both be true (unless φ is impossible). Gibbard described a scenario in which a pair of conditionals appears to violate the principle. However, we have argued that Gibbard's conclusion is too rash since, in the light of our proposal, the violation of Conditional Non-Contradiction is only apparent. We have emphasised the role the speaker's background knowledge plays in determining the meaning of a conditional sentence. Yet we have argued that our semantics prevents us from falling into the problem of extreme subjectivity of meaning of conditional sentences, as it allows to explain how a person can interpret a conditional message without having access to the utterer's epistemic states. Furthermore, we reported the results of an experiment provid-

ing further support for our diagnosis. Finally, Gibbard's story has served as an illustration of a problem that indicative conditionals can pose to a deliberating agent (DeRose 2010). We have shown that our analysis of Gibbard's scenario can serve also as a solution to the problem of deliberationally useless conditionals. In particular, acknowledging the fact that indicative conditionals can express various types of inferential relations helps to recognise the subclass of indicative conditionals which should be forgone in the process of decision making, namely, the conditionals of abductive inferential type.

Before we proceed with discussing the perspectives for further investigations, we should tackle one of the issues that opponents of our account may wish to raise. We have noted in the introductory chapter that the Ramsey Test provides a descriptively adequate account of how people decide whether or not to accept a conditional sentence. One could ask what is left from the Ramsey Test in our proposal. The semantics introduced in chapter 3 is build upon an idea that a conditional sentence conveys the existence of a link between its antecedent and the consequence, while the Ramsey Test does not call for any connection between the clauses of conditional sentences. However, we are of the opinion that the Ramsey Test is compatible with our proposal. By specifying the truth conditions of conditional sentences in correspondence to various consequence relations that can link their antecedents and consequents we did not *violate* the Ramsey Test. After all, on the account proposed in this dissertation, a consequent of a true conditional should also be considered true (or highly likely) on the supposition that its antecedent is true. In other words, true conditionals pass the Ramsey Test. Nonetheless, the converse does not hold—not all conditionals that pass the Ramsey Test will be true on our proposal: that ψ is true (or highly likely) on the supposition that φ is not sufficient for the truth of "If φ, ψ." There is no reason, though, to believe that this alone conflicts with the spirit of the Ramsey Test.

6.2 PERSPECTIVES FOR FUTURE RESEARCH

The proposal developed in this dissertation leaves many interesting questions unanswered. There are plenty of lines along which the follow-up investigations can be carried out. Some of these lines lie within the scope of philosophy of language or epistemo-

logy, while others belong to the domain of linguistics, the psychology of reasoning and cognitive science.

A philosopher of language or a semanticist might wish to see our proposal to be developed into a full-fledged formal semantics. In linguistics, a standard way to proceed would be to adapt the model-theoretic framework of possible worlds semantics. It is not yet clear, however, how to accommodate the variety of consequence relations by model-theoretic means. For instance, for the sake of modelling counterfactual conditionals in terms of causal dependencies, Schulz (2011) and Kaufmann (2013) have proposed semantic theories in the tradition of Kratzer (1979, 1986) enriched by the idea of causal networks developed by Pearl (2000). Perhaps the semantics for indicative conditionals could be extended in an analogous way. Or perhaps we should consider entirely different approach to semantic theory. For instance, a proof-theoretic semantics, belonging to the philosophical framework of inferentialism (Brandom 2000), might turn out to provide just the right tools for modelling inferential conditionals (see Schroeder-Heister 2014 for an overview). The Ramsey Test, on the other hand, which specifies a procedure for fixing one's degree of belief in a conditional, might be taken to suggest the need for a procedural perspective on meaning (e.g. Tichý 1969, see also Szymanik 2009).

There are more issues of interest to philosophers of language and linguists which were not tackled in this dissertation. For instance, we have not explored the relationship between conditionals and epistemic modals in any great detail, even though our results offer some insight into the meaning of epistemic "should" and "must". More precisely, we have not discussed the semantic differences between conditionals with a marker inserted in their consequents and the same conditionals without any marker. Is an II conditionals with "should" inserted into its consequent still an II conditional? If the uncertainty of the conclusion is made explicit, the inference could be construed as certain. For example, I might assert "It is the case that φ" as an inductive generalisation. This means that I am quite confident but not entirely certain that my assertion is true. On the basis of the same background knowledge, I might assert "It should be the case that φ." In this case, even though I came to the belief that φ by means of induction, I can be entirely certain about my assertion. This seems to be the case because I have encoded the information about my uncertainty and about the evidential grounds for my assertion in the linguistic expression I chose to use. Does it mean, then, that a conditional with an evidential marker signalling the presence of

an uncertain inference is itself a DI conditional? Perhaps. And perhaps the consequent of an AI or an II conditional is always within the scope of an epistemic modal in its evidential role, only this modal, at least in the languages unequipped with proper evidential systems, is not always explicit? A related question concerns the interpretation of a conditional without an explicit marker: Is there a default interpretation? Or a hierarchy of meanings analogous to what has been found in the context of quantified reciprocal sentences (Szymanik 2010). These and many other interesting nuances clearly require further investigations.

Furthermore, it still remains to be seen whether our proposal applies to the class of left-nested conditionals, which seem to notoriously escape generalisations (see, e.g., Dietz and Douven 2010). Prima facie, there is nothing bizarre in thinking about conditionals in terms of inferential relations connecting their antecedents and consequents even if their antecedents are themselves conditionals. After all, it is rather common for arguments to have conditional premises. However, it is not clear whether any inferential conditional can be taken as an antecedent, or how the embedding of different inferential conditionals may affect the interpretation of the sentence as a whole. This relates to the issue of learning conditional information (Douven 2012a). Does our theory shed any light on the still insufficiently explored issue of how people adjust (and how rational agents should adjust) their beliefs upon learning a conditional? And can our proposal explain the data on how people reason with conditional sentences? For instance, could the evaluation of various valid and invalid conditional argument forms depend on the inference relation expressed by a conditional? These questions need to be tackled both theoretically and empirically before we can fully evaluate the significance of our proposal.

Another matter without which our proposal may strike one as being incomplete concerns the probabilities of conditionals. Can we explain the data on how people assign probability values to conditional sentences? We have argued that the theory presented in this thesis is not at odds with the Ramsey Test, and hence, in principle, we could simply follow the test in determining our degrees of belief. Yet one could ponder over a question whether our truth-conditional theory could be reconciled with the famous triviality results of Lewis (1976) and others. According to a widely accepted interpretation of Lewis' proofs, the thesis that the probability of an indicative conditional equals the probability of its consequent conditional on its antecedent, frequently referred to

as "the Equation," can only hold if conditionals do not express propositions. Given the intuitive appeal of the Equation, the triviality results seem to pose a threat to any account on which conditionals can be true or false, including the one presented in this dissertation. Nevertheless, recent developments suggest that rejecting all propositional theories of conditionals might have been too rash a conclusion. For instance, Égre and Cozic (2011) propose a version of the Equation derived from the Lewis-Kratzer analysis of if-clauses as domain restrictors and argue that the triviality result may be seen as a result of inexpressibility. Moreover, Douven and Verbrugge (2013) report empirical results which challenge the assumptions of all triviality proofs. This means that we do not need to immediately proceed with rejecting our proposal on the basis of the alleged untenability of one of its most fundamental premises.

We have noted in the introduction that philosophers concerned with conditionals have come to the point where "every theory faces a counterexample, every argument has its counterargument, and every solution seems to give rise to an avalanche of new problems." It is beyond question that some of the answers our proposal has provided might appear unsatisfactory, and some of its features may turn out to spark even more problems than we were trying to solve. However, we do hope to have taken a step forward towards a better understanding of what conditional sentences are.

APPENDIX

This appendix presents the contexts and conditionals that were used in the Experiment 1 discussed in chapter 4, section 4.2.

INSTRUCTIONS

This survey is meant to determine how assertable given conditional sentences (sentences of the form "If..., then...") are in a given context. In other words, you are asked each time how natural, or reasonable, you think it would be to assert the various conditional sentences in the given context.

In particular, we are interested in whether slight differences in wording can have an effect on the assertability of conditional sentences. In one context, one phrasing may sound more natural than others, while in a different context, the same phrasing may sound unnatural or at least less natural than some others.

Please read the contexts and conditional sentences carefully.

DI ITEMS

CONTEXT: All students in class 6C have at least a B for their math test paper.

CONDITIONAL: If Ben is in class 6C, then he has at least a B for his math test paper.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Ben is in class 6C, then he should habe at least a B for his math test paper.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Ben is in class 6C, then he must have at least a B for his math test paper.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Ben is in class 6C, then he probably has at least a B for his math test paper.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONTEXT: Last year, all people older than 65 have been vaccinated for the flu.

CONDITIONAL: If Mrs Harris is 70 years old, then she has been vaccinated for the flu.

| | Highly | | | | | | | Highly |
| Highly unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Mrs Harris is 70 years old, then she should have been vaccinated for the flu.

| Highly unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Highly assertable |

CONDITIONAL: If Mrs Harris is 70 years old, then she must have been vaccinated for the flu.

| Highly unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Highly assertable |

CONDITIONAL: If Mrs Harris is 70 years old, then she probably has been vaccinated for the flu.

| Highly unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Highly assertable |

CONTEXT: All Indian elephants have small ears.

CONDITIONAL: If Babou is an Indian elephant, then it has small ears.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Babou is an Indian elephant, then it should have small ears.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Babou is an Indian elephant, then it must have small ears.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Babou is an Indian elephant, then it probably has small ears.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: All white cats possess a gene that predisposes them to develop blindness late in their lives.

CONDITIONAL: If Paul's kitten is white, then it possesses a gene that predisposes it to develop blindness late in its life.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Paul's kitten is white, then it should possess a gene that predisposes it to develop blindness late in its life.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Paul's kitten is white, then it must possess a gene that predisposes it to develop blindness late in its life.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Paul's kitten is white, then it probably possesses a gene that predisposes it to develop blindness late in its life.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: Two friends are wondering whether Cynthia passed the exam. They know that it was an absolute requirement for the exam to hand in a thesis before the end of the semester.

CONDITIONAL: If Cynthia did not hand in her thesis before the end of the semester, then she failed.

> Highly
> unassertable   1   2   3   4   5   6   7   Highly
> assertable

CONDITIONAL: If Cynthia did not hand in her thesis before the end of the semester, then she should have failed.

> Highly
> unassertable   1   2   3   4   5   6   7   Highly
> assertable

CONDITIONAL: If Cynthia did not hand in her thesis before the end of the semester, then she must have failed.

> Highly
> unassertable   1   2   3   4   5   6   7   Highly
> assertable

CONDITIONAL: If Cynthia did not hand in her thesis before the end of the semester, then she probably failed.

> Highly
> unassertable   1   2   3   4   5   6   7   Highly
> assertable

AI ITEMS

CONTEXT: Nelly lives on the sixth floor of an apartment building. The elevator has been broken since earlier this morning. A good friend of Nelly's who lives on the third floor of the same building hears someone rushing down the stairs. She knows that Nelly tends to avoid exercise as much as possible. How assertable are the following conditionals given this context?

CONDITIONAL: If that's Nelly rushing down the stairs, then she is in a hurry.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If that's Nelly rushing down the stairs, then she should be in a hurry.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If that's Nelly rushing down the stairs, then she must be in a hurry.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If that's Nelly rushing down the stairs, then she probably is in a hurry.

| | Highly | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONTEXT: You know that Tom and Hank recently had a flaming row which, you think, ended their friendship for good. Now a friend tells you that she thinks she just saw Tom and Hank jogging together.

CONDITIONAL: If Tom and Hank are jogging together again, then they are friends again.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Tom and Hank are jogging together again, then they should be friends again.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Tom and Hank are jogging together again, then they must be friends again.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Tom and Hank are jogging together again, then they probably are friends again.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: Someone tells you that a nearby village, located in a valley below a dammed reservoir, has been flooded. You doubt that this is true. On the other hand, the dam has been in a rather bad state for some time.

CONDITIONAL: If the village has been flooded, then the dam has broken.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If the village has been flooded, then the dam should have broken.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If the village has been flooded, then the dam must have broken.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If the village has been flooded, then the dam has probably broken.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: Judy is waiting for the train. She is looking for her iPod to listen to some music while she waits. It is not in her coat. Yet she is sure that she took it this morning. Perhaps it is in her bag. Then she sees that the bag has been cut open. At that moment there is an announcement that pickpockets are active in the train station.

CONDITIONAL: If Judy's iPod is not in her bag, then someone has stolen it.

| Highly | | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Judy's iPod is not in her bag, then someone should have stolen it.

| Highly | | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Judy's iPod is not in her bag, then someone must have stolen it.

| Highly | | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONDITIONAL: If Judy's iPod is not in her bag, then someone has proably stolen it.

| Highly | | | | | | | | Highly |
| unassertable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | assertable |

CONTEXT: Pete had to play the finals of a tennis tournament earlier today. Two friends of his, who do not yet know the result of the match, are walking to Pete's house. Pete is not really a party-person, but from a distance, it seems to them that there is a party going on in Pete's garden.

CONDITIONAL: If Pete is partying, then he has won the match.

Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If Pete is partying, then he should have won the match.

Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If Pete is partying, then he must have won the match.

Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If Pete is partying, then he has probably won the match.

Highly
unassertable   1   2   3   4   5   6   7   assertable

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CONTEXT: 99 % miners develop silicosis, a disease caused by inhaling fine dust for a prolonged period of one's life.

CONDITIONAL: If Rudolph has worked in the mines for all his life, then he has developed silicosis.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Rudolph has worked in the mines for all his life, then he should have developed silicosis.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Rudolph has worked in the mines for all his life, then he must have developed silicosis.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Rudolph has worked in the mines for all his life, then he has probably developed silicosis.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: According to the local bus company, none of their buses has been more than 5 min late in the past 10 years. You are presently waiting for a bus of this company.

CONDITIONAL: If our bus is not exactly on time, then it will be at most a few minutes late.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If our bus is not exactly on time, then it should be at most a few minutes late.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If our bus is not exactly on time, then it must be at most a few minutes late.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONDITIONAL: If our bus is not exactly on time, then it will probably be at most a few minutes late.

Highly   Highly
unassertable   1   2   3   4   5   6   7   assertable

CONTEXT: A pharmaceutical company unexpectedly got into financial trouble. They had to cut many jobs and decided to fire most employees above 50. Mark is an employee of this company.

CONDITIONAL: If Mark is above 50, then he is among the employees who will be fired.

Highly unassertable	1	2	3	4	5	6	7	Highly assertable

CONDITIONAL: If Mark is above 50, then he is among the employees who should be fired.

Highly unassertable	1	2	3	4	5	6	7	Highly assertable

CONDITIONAL: If Mark is above 50, then he is among the employees who must be fired.

Highly unassertable	1	2	3	4	5	6	7	Highly assertable

CONDITIONAL: If Mark is above 50, then he is among the employees who will probably be fired.

Highly unassertable	1	2	3	4	5	6	7	Highly assertable

CONTEXT: Bernard is a bit of an irregular student: sometimes he works hard, but he can also be lazy. So far he had excellent grades for most courses for which he had worked hard.

CONDITIONAL: If Bernard works hard for the linguistics course, then he will get an excellent grade for it.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Bernard works hard for the linguistics course, then he should get an excellent grade for it.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Bernard works hard for the linguistics course, then he must get an excellent grade for it.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Bernard works hard for the linguistics course, then he will probably get an excellent grade for it.

	Highly								Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONTEXT: The hepatitis A virus may be transmitted by contact with an infected person, so people working in health care are at a higher risk of getting ill from the virus. The vaccine against hepatitis A is 95 % effective. Adam has recently started volunteering at a hospital.

CONDITIONAL: If Adam has been vaccinated against hepatitis A, then he will not get ill from the virus.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Adam has been vaccinated against hepatitis A, then he should not get ill from the virus.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Adam has been vaccinated against hepatitis A, then he must not get ill from the virus.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

CONDITIONAL: If Adam has been vaccinated against hepatitis A, then he will probably not get ill from the virus.

	Highly							Highly
	unassertable	1	2	3	4	5	6	7	assertable

B

This appendix presents the contexts and conditionals that were used in the Experiment 2 discussed in chapter 4, section 4.3.

INSTRUCTIONS:

Deze survey beoogt te bepalen hoe goed bepaalde conditionele zinnen (zinnen van de vorm "Als..., dan...") in bepaalde contexten passen. U wordt telkens gevraagd aan te geven hoe natuurlijk of redelijk het zou zijn een bepaalde conditionele zin in een gegeven context te beweren.

We zijn in het bijzonder geïnteresseerd in de vraag of kleine verschillen in formulering een verschil maken voor hoe natuurlijk een conditionele zin klinkt in een bepaalde context.

De survey bevat 17 vragen. Lees de contexten en zinnen zorgvuldig. Aan het einde stellen we nog enkele vragen naar uw achtergrond.

CONTEXT: Alle leerlingen in klas 6C hebben minstens een 6 voor hun wiskunde proefwerk.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als Ben in klas 6C zit, dan heeft hij minstens een 6 voor zijn wiskunde proefwerk.

	Zeer								Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk	

CONDITIONAL: Als Ben in klas 6C zit, dan zou hij minstens een 6 voor zijn wiskunde proefwerk moeten hebben.

	Zeer								Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk	

CONDITIONAL: Als Ben in klas 6C zit, dan moet hij minstens een 6 voor zijn wiskunde proefwerk hebben.

	Zeer								Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk	

CONDITIONAL: Als Ben in klas 6C zit, dan heeft hij waarschijnlijk minstens een 6 voor zijn wiskunde proefwerk.

	Zeer								Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk	

CONTEXT: In de afgelopen maanden zijn alle mensen ouder dan 65 ingeënt tegen de griep.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als mevrouw Harms 68 is, dan is ze ingeënt tegen de griep.

	Zeer								Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als mevrouw Harms 68 is, dan zou ze tegen de griep ingeënt moeten zijn.

	Zeer								Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als mevrouw Harms 68 is, dan moet ze ingeënt tegen de griep zijn.

	Zeer								Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als mevrouw Harms 68 is, dan is ze waarschijnlijk ingeënt tegen de griep.

	Zeer								Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Context: Alle Indiase olifanten hebben kleine oren.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Babou een Indiase olifant is, dan heeft hij kleine oren.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk
Zeer

Conditional: Als Babou een Indiase olifant is, dan zou hij kleine oren moeten hebben.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk
Zeer

Conditional: Als Babou een Indiase olifant is, dan moet hij kleine oren hebben.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk
Zeer

Conditional: Als Babou een Indiase olifant is, dan heeft hij waarschijnlijk kleine oren.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk
Zeer

CONTEXT: Alle witte katten hebben een gen dat predisponeert voor blindheid op latere leeftijd.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als de kat van Paul wit is, dan heeft hij een gen dat predisponeert voor blindheid op latere leeftijd.

	Zeer							Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als de kat van Paul wit is, dan zou hij een gen moeten hebben dat predisponeert voor blindheid op latere leeftijd.

	Zeer							Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als de kat van Paul wit is, dan moet hij een gen hebben dat predisponeert voor blindheid op latere leeftijd.

	Zeer							Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als de kat van Paul wit is, dan heeft hij waarschijnlijk een gen dat predisponeert voor blindheid op latere leeftijd.

	Zeer							Zeer	
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONTEXT: Twee vrienden vragen zich af of Cynthia haar examen gehaald heeft. Ze weten dat het een absolute eis was voor het examen om een scriptie voor het einde van het semester in te leveren.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als Cynthia haar scriptie niet heeft ingeleverd voor het einde van het semester, dan is ze gezakt.

	Zeer							Zeer
onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als Cynthia haar scriptie niet heeft ingeleverd voor het einde van het semester, dan zou ze gezakt moeten zijn.

	Zeer							Zeer
onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als Cynthia haar scriptie niet heeft ingeleverd voor het einde van het semester, dan moet ze gezakt zijn.

	Zeer							Zeer
onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONDITIONAL: Als Cynthia haar scriptie niet heeft ingeleverd voor het einde van het semester, dan is ze waarschijnlijk gezakt.

	Zeer							Zeer
onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

AI ITEMS

Context: Je weet dat Tim en Henk onlangs slaande ruzie hebben gehad, zo erg dat—vermoed je—hun vriendschap voorgoed voorbij is. Nu vertelt iemand je dat ze gelooft dat ze net Tim en Henk samen heeft zien joggen.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Tim en Henk weer samen joggen, dan zijn ze weer vrienden.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   Zeer
natuurlijk

Conditional: Als Tim en Henk samen joggen, dan zouden ze weer vrienden moeten zijn.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   Zeer
natuurlijk

Conditional: Als Tim en Henk samen joggen, dan moeten ze weer vrienden zijn.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   Zeer
natuurlijk

Conditional: Als Tim en Henk samen joggen, dan zijn ze waarschijnlijk weer vrienden.

Zeer
onnatuurlijk   1   2   3   4   5   6   7   Zeer
natuurlijk

CONTEXT: Iemand vertelt dat een dorp in de buurt dat bij een waterdam ligt overstroomd is. Je betwijfelt of dit waar is. Anderzijds, de dam verkeert al een tijdje in slechte staat.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als het dorp overstroomd is, dan is de dam doorgebroken.

> Zeer onnatuurlijk   1   2   3   4   5   6   7   Zeer natuurlijk

CONDITIONAL: Als het dorp overstroomd is, dan zou de dam doorgebroken moeten zijn.

> Zeer onnatuurlijk   1   2   3   4   5   6   7   Zeer natuurlijk

CONDITIONAL: Als het dorp overstroomd is, dan moet de dam zijn doorgebroken.

> Zeer onnatuurlijk   1   2   3   4   5   6   7   Zeer natuurlijk

CONDITIONAL: Als het dorp overstroomd is, dan is de dam waarschijnlijk doorgebroken.

> Zeer onnatuurlijk   1   2   3   4   5   6   7   Zeer natuurlijk

Context: Judy staat op de trein te wachten. Ze zoekt haar iPod om ondertussen een beetje naar muziek te luisteren. Hij zit niet in haar jas. Ze weet toch zeker dat ze hem vanochtend heeft meegenomen. Misschien zit hij in haar tas. Dan ziet ze dat haar tas open gesneden is. Op dat moment wordt omgeroepen dat er zakkenrollers actief zijn in het station.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Judy's iPod niet in haar tas zit, dan is hij gestolen.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Judy's iPod niet in haar tas zit, dan zou hij gestolen moeten zijn.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Judy's iPod niet in haar tas zit, dan moet hij gestolen zijn.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Judy's iPod niet in haar tas zit, dan is hij waarschijnlijk gestolen.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Context: Peter moest eerder vandaag de finale van een tennistoernooi spelen. Twee vrienden van hem, die de uitslag van de wedstrijd nog niet weten, zijn op weg naar Peters huis. Peter is niet iemand die normaal feestjes organiseert, maar van een afstand lijkt het hun dat er een feestje is in de tuin van Peter.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Peter aan het feesten is, dan heeft hij de finale gewonnen.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Peter aan het feesten is, dan zou hij de finale gewonnen moeten hebben.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Peter aan het feesten is, dan moet hij de finale gewonnen hebben.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Peter aan het feesten is, dan heeft hij waarschijnlijk de finale gewonnen.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Context: 99% van de mijnwerkers krijgen silicose (stoflongen), een ziekte die veroorzaakt wordt door het inademen van fijn stof gedurende een lange periode.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Ruud zijn hele leven in de mijn heeft gewerkt, dan heeft hij silicose.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Ruud zijn hele leven in de mijn heeft gewerkt, dan zou hij silicose moeten hebben.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Ruud zijn hele leven in de mijn heeft gewerkt, dan moet hij silicose hebben.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

Conditional: Als Ruud zijn hele leven in de mijn heeft gewerkt, dan heeft hij waarschijnlijk silicose.

| | Zeer | | | | | | | Zeer |
| onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | natuurlijk |

CONTEXT: Volgens het plaatselijke busbedrijf is geen van hun bussen de afgelopen 10 jaar meer dan 5 minuten te laat geweest. Je staat op dit moment op de bus te wachten.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als onze bus niet precies op tijd is, dan is hij hooguit een paar minuten te laat.

    Zeer   Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk

CONDITIONAL: Als onze bus niet precies op tijd is, dan zou hij hooguit een paar minuten te laat moeten zijn.

    Zeer   Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk

CONDITIONAL: Als onze bus niet precies op tijd is, dan moet hij hooguit een paar minuten te laat zijn.

    Zeer   Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk

CONDITIONAL: Als onze bus niet precies op tijd is, dan is waarschijnlijk hooguit een paar minuten te laat.

    Zeer   Zeer
onnatuurlijk   1   2   3   4   5   6   7   natuurlijk

CONTEXT: Een farmaceutisch bedrijf is onverwacht in financiële problemen geraakt. Ze hebben besloten bijna alle werknemers ouder dan 50 te ontslaan. Mark is een werknemer van dit bedrijf.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als Mark ouder dan 50 is, dan wordt hij ontslagen.

| Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Mark ouder dan 50 is, dan zou hij ontslagen moeten worden.

| Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Mark ouder dan 50 is, dan moet hij ontslagen worden.

| Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Mark ouder dan 50 is, dan wordt hij waarschijnlijk ontslagen.

| Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

Context: Bernard is een beetje een onregelmatige student: soms werkt hij hard, maar hij kan ook lui zijn. Tot nu toe had hij uitstekende punten voor de vakken waar hij hard voor gewerkt had.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

Conditional: Als Bernard hard werkt voor het vak linguïstiek, dan haalt hij daar een uitstekend punt voor.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Bernard hard werkt voor het vak linguïstiek, dan zout hij daar een uitstekend punt voor moeten halen.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Bernard hard werkt voor het vak linguïstiek, dan moet hij daar een uitstekend punt voor halen.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

Conditional: Als Bernard hard werkt voor het vak linguïstiek, dan haalt hij daar waarschijnlijk een uitstekend punt voor.

	Zeer							Zeer
	onnatuurlijk	1	2	3	4	5	6	7	natuurlijk

CONTEXT: Het hepatitis A virus kan worden overgedragen door contact met een besmette persoon. Daarom hebben mensen die in de gezondheidszorg werken een grotere kans om ziek te worden van het virus. Het vaccin tegen dit virus is 95% effectief. Ad is recent begonnen als vrijwilliger in een ziekenhuis.

Hoe natuurlijk vindt u de volgende zinnen in deze context?

CONDITIONAL: Als Ad zich heeft laten vaccineren tegen hepatitis A, dan wordt hij niet ziek van het virus.

| | Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Ad zich heeft laten vaccineren tegen hepatitis A, dan zou hij niet ziek moeten worden van het virus.

| | Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Ad zich heeft laten vaccineren tegen hepatitis A, dan moet hij niet ziek worden van het virus.

| | Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

CONDITIONAL: Als Ad zich heeft laten vaccineren tegen hepatitis A, dan wordt hij waarschijnlijk niet ziek van het virus.

| | Zeer onnatuurlijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Zeer natuurlijk |

C

APPENDIX

This appendix presents the materials that were used in the experiment discussed in chapter 5, section 5.5.

INSTRUCTIONS

This survey is meant to determine how well particular conditional sentences (sentences of the form "If A, B") fit into a given context.

We are particularly interested in whether insertion of the word 'probably' can have an effect on how well a conditional sentence fits into a given context. Given one context, adding 'probably' to a conditional sentence may make that sentence appear more natural or fitting or reasonable to say, while given a different context, the sentence with 'probably' may seem less natural or fitting or reasonable.

Please read the contexts and conditional sentences carefully. Please also read this and the next page carefully, because you will not be able to return to them.

We start with an example:

Context: Mary has two children. She also has one sister, Sue, and no brothers. Mary and Sue's parents are Tom and Eileen.

Consider these sentences:

If Sue has one child, Tom and Eileen have three grandchildren.
If Sue has one child, Tom and Eileen probably have three grandchildren.

In the survey, you will then be asked which of these sentences - if either - fits best into the context. You will always have these four options:

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

You may think that, while neither sentence is wrong in this context, the first one is somehow more natural or reasonable, perhaps even that the second one would be a little odd. In other contexts, the additional word 'probably' might have the opposite effect on your judgment; you might then think that the second sentence fits better in the context. Another possibility is that you think both sentences fit equally well into a context: both would be reasonable things to say in that context. Finally, in some contexts neither sentence might seem to fit well (or might even fit at all).

The survey starts now.

THE GIBBARD'S STORY: CERTAIN VERSION

CONTEXT: Pete and Mr. Stone were playing poker yesterday. At some point, it was up to Pete to call (i.e., to continue playing, with the risk of losing if his cards are worse than Mr. Stone's) or to fold (i.e., to quit playing). Jack, who was in the same room, saw that, at that point, Mr. Stone's cards were better than Pete's.

Consider these sentences:

1. If Pete called, he lost.
2. If Pete called, he probably lost.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

CONTEXT: Pete and Mr. Stone were playing poker yesterday. At some point, it was up to Pete to call (i.e., to continue playing, with the risk of losing if his cards are worse than Mr. Stone's) or to fold (i.e., to quit playing). Pete is a good poker player who does not like to lose. Moreover, he was cheating: his friend, Jack, was looking at Mr. Stone's hand and, using special signs, informed Pete about what cards Mr. Stone had.

Consider these sentences:

1. If Pete called, he won.
2. If Pete called, he probably won.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

DEROSE'S STORY: CERTAIN VERSION:

CONTEXT: Jim and Steve are in the final round of a card game. They each draw one card from a deck of one hundred cards, numbered 1 through 100. Each of the players can look at his card, but not at the opponent's card. In this final round, it is up to the leader—in this case Jim—to decide whether to quit or play. If he decides to quit, he can keep the $10,000 he won before this round. If he decides to play, both players have to show their cards. If Jim's card is higher than Steve's, his winnings will be doubled. But if he decides to play, and his card is the lower one, he will lose everything. In this final round, a friend of theirs who is present sees that Jim has drawn a card with the number 12 on it whereas Steve has drawn a card with the number 78 on it.

Consider these sentences:

1. If Jim plays he will lose.
2. If Jim plays he will probably lose.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

DEROSE'S STORY: UNCERTAIN VERSION

CONTEXT: Jim and Steve are in the final round of a card game. They each draw one card from a deck of one hundred cards, numbered 1 through 100. Each of the players can look at his card, but not at the opponent's card. In this final round, it is up to the leader—in this case Jim—to decide whether to quit or play. If he decides to quit, he can keep the $10,000 he won before this round. If he decides to play, both players have to show their cards. If Jim's card is higher than Steve's, his winnings will be doubled. But if he decides to play, and his card is the lower one, he will lose everything. Before Jim made his final decision, his friend managed to see the number on Steve's card and made special hand signs to Jim to communicate the number to him.

Consider these sentences:

1. If Jim plays he will win.
2. If Jim plays he will probably win.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

MR. SMITH: CERTAIN VERSION

CONTEXT: Mr. Smith, a wealthy man, has two sons, Hank and Paul. Last week, he ordered his notary to draft a will. Mr. Smith is very fond of Hank but disappointed in Paul. The notary made the will, which mentions by mistake Paul instead of Hank as the main beneficiary of the Smith fortune. At this moment, Mr. Smith has an appointment at the notary's office to sign his will.

Consider these sentences:

1. If Mr. Smith is not making any changes to his will, he is making Paul the main beneficiary of the Smith fortune.

2. If Mr. Smith is not making any changes to his will, he is probably making Paul the main beneficiary of the Smith fortune.

Of these sentences

○ the first fits best into the context.
○ the second fits best into the context.
○ both fit equally well.
○ neither fits well.

MR. SMITH: UNCERTAIN VERSION

CONTEXT: Mr. Smith, a wealthy man, has two sons, Hank and Paul. He is very fond of Hank but disappointed in Paul. In fact, on several occasions he has expressed his intention to make Hank the main beneficiary of his fortune. Last week, he ordered his notary to draft a will. At this moment, Mr. Smith has an appointment at the notary's office to sign his will.

Consider these sentences:

1. If Mr. Smith is not making any changes to his will, he is making Hank the main beneficiary of the Smith fortune.

2. If Mr. Smith is not making any changes to his will, he is probably making Hank the main beneficiary of the Smith fortune.

Of these sentences

- ○ the first fits best into the context.
- ○ the second fits best into the context.
- ○ both fit equally well.
- ○ neither fits well.

APPLE: CERTAIN VERSION

CONTEXT: The evil Mr. Saxon has poisoned an apple that he put on the table in the kitchen that you share with your house-mate Jack. The poison used by Mr. Saxon is so effective that everyone who would eat the apple would get immediately sick. The apple is no longer on the table.
Consider these sentences:

1. If Jack ate the apple, he is sick.

2. If Jack ate the apple, he is probably sick.

Of these sentences

○ the first fits best into the context.
○ the second fits best into the context.
○ both fit equally well.
○ neither fits well.

APPLE: UNCERTAIN VERSION

CONTEXT: Your house-mate Jack refused to join you for a pizza, saying that he feels sick and cannot eat anything at all. Half an hour later you notice that the apple that was lying on the table in your shared kitchen has disappeared.

Consider these sentences:

1. If Jack ate the apple, he is well.

2. If Jack ate the apple, he is probably well.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

LINGUISTICS EXAM: CERTAIN VERSION

CONTEXT: Students can get bonus points if they hand in the weekly exercises. In this case, if they get an A for the exam, their overall result is an A+, if they get an A- for the exam, they get an A for the course, and so on. If they don't hand in the exercises, they don't get any bonus points. Jim is a very talented student who has received an A+ for most of the courses he has taken. Yesterday Jim had a linguistics exam. The teacher has a look at Jim's test paper and he marks it with an A.

Consider these sentences:

1. If Jim didn't hand in any exercises for the course, he won't get an A+ for it.

2. If Jim didn't hand in any exercises for the course, he probably won't get an A+ for it.

Of these sentences

- the first fits best into the context.
- the second fits best into the context.
- both fit equally well.
- neither fits well.

LINGUISTICS EXAM: UNCERTAIN VERSION

CONTEXT: Students can get bonus points if they hand in the weekly exercises. In this case, if they get an A for the exam, their overall result is an A+, if they get an A- for the exam, they get an A for the course, and so on. If they don't hand in the exercises, they don't get any bonus points. Jim is a very talented student who has received an A+ for most of the courses he has taken. It was often the case that if Jim thought he would be able to score an A+ even without handing in any exercises, he did not bother to do the exercises. Yesterday, Jim had a linguistics exam.

Consider these sentences:

1. If Jim didn't hand in any exercises for the course, he will get an A+ for it.

2. If Jim didn't hand in any exercises for the course, he will probably get an A+ for it.

Of these sentences

○ the first fits best into the context.
○ the second fits best into the context.
○ both fit equally well.
○ neither fits well.

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SAMENVATTING

Dit proefschrift gaat over de betekenis van conditionele zinnen in natuurlijke taal. Taalkundige overwegingen en empirische resultaten uit de psychologie van het redeneren hielpen ons filosofisch onderzoek.

In hoofdstuk 1 beschreven wij ons doel: het ontwikkelen van een empirisch gefundeerde theorie van conditionele zinnen. Wij merkten op dat de vraag naar de waarheidswaarden van conditionele zinnen begrepen kan worden als de vraag naar wat we leren wanneer wij een stukje informatie krijgen in de vorm van een indicatieve conditionele zin. Ons uitgangspunt was dat de Ramsey Test, die veel onderzoekers zien als een accurate beschrijving van het mechanisme dat ten grondslag ligt aan de interpretatie van conditionele zinnen, slechts gedeeltelijk antwoord biedt op de vraag naar wat deze zinnen betekenen.

In hoofdstuk 2 bespraken we de twee prominentste semantische theorieën van conditionele zinnen: de materiële interpretatie en Stalnakers mogelijke werelden semantiek. De tegenintuïtieve gevolgen van deze theorieën motiveerden ons eigen onderzoek. In het bijzonder zagen we dat conditionele zinnen met ware antecedenten en ware consequenten, zoals:

(101) a. Als aubergine een groente is, dan zijn wasberen Amerikaanse zoogdieren die bekend staan om hun intelligentie.

       b. Als het soms regent in Groningen, dan was Kazimierz Ajdukiewicz een prominente Poolse filosoof.

       c. Als Shakespeare "Anna Karenina" niet heeft geschreven, dan is Ljubljana de hoofdstad van Slovenië.

waar zijn volgens zowel de materiële interpretatie als volgens Stalnakers semantiek, ongeacht of deze zinnen zelf betekenisvol zijn of niet. Dit soort problemen komen voort uit het feit dat deze theorieën niet in staat zijn rekening te houden met wat naar onze mening het belangrijkste kenmerk is van conditionele zinnen; het verband tussen antecedent en consequent.

In hoofdstuk 3 introduceerden we een nieuwe semantiek voor conditionele zinnen. Deze semantiek is gebaseerd op de observatie dat het verband tussen het antecedent en de consequent

van een conditionele zin in wezen inferentieel is. Deze gevolg-trekkingsrelatie hoeft niet altijd van dezelfde soort te zijn. Veel, wellicht alle, indicatieve conditionele zinnen kunnen als deductieve, inductieve of abductieve inferentiële conditionelen geclassificeerd worden (respectievelijk DI, II en AI) (zie definities 1 en 2). Op basis van deze waarneming hebben wij de volgende waarheidsvoorwaarden voorgesteld:

DEFINITIE 3: *De uitdrukking "Als φ, ψ" door een spreker S is waar dan en slechts dan als:*

(i) *ψ een gevolg is van φ en de achtergrondkennis van S,*

(ii) *ψ niet slechts het gevolg is van de achtergrond kennis van S wanneer ψ niet uit φ alleen volgt, en*

(iii) *φ deductief consistent is met de achtergrondkennis van S of ψ een gevolg is van alleen φ,*

waar de gevolgrelatie deductief, inductief, abductief of gemengd van aard kan zijn.

We hebben vervolgens aangetoond dat de voorgestelde semantiek de paradoxen van materiële implicatie ontwijkt en het Import-Export principe bevestigt. We hebben ook beargumenteerd dat, hoewel de Or-to-if en Modus Ponens gevolgtrekkingen volgens deze semantiek ongeldig zijn, de conclusies van deze twee redeneervormen precies in die gevallen waar zijn waar ze intuïtief gesproken waar moeten zijn.

In hoofdstuk 4 rapporteerden we de resultaten van twee experimenten die de classificatie van conditionele zinnen en de daarop gebaseerde semantiek die geïntroduceerd werden in hoofdstuk 3 empirisch ondersteunen. We hebben de relatie onderzocht tussen evidentiële markeerders en verschillende soorten inferentiële conditionele zinnen, zowel in het Engels als in het Nederlands. In het bijzonder hebben wij onderzocht hoe de beweerbaarheid van een conditionele zin verandert wanneer "should," "must," en "probably" worden ingevoegd in de consequent van een conditionele zin. In de Nederlandse variant werd hetzelfde onderzocht, maar werden "zou moeten," "moet," en "waarschijnlijk" ingevoegd. De resultaten ondersteunen de hypothese dat het Engelse modale werkwoord "should" en het Nederlandse equivalent "zou moeten," functioneren als evidentiële markeerders van inductieve gevolgtrekking. Onze studie suggereert bovendien dat het Engelse modale werkwoord "must" en haar Nederlandse tegenhanger "moet," dienen als abductieve inferentiële markeerder.

Niet verwonderlijk kunnen het Engelse "probably", evenals het Nederlandse "waarschijnlijk", als markeerders van onzekerheid worden gezien. We zien deze resultaten als een bewijs dat ons voorstel correct is.

In hoofdstuk 5 analyseerden we een argument van Gibbard (1981) die probeert aan te tonen dat indicatieve conditionele zinnen geen proposities kunnen uitdrukken. Zijn argument is gericht tegen propositionele theorieën van conditionele zinnen die de wet van Conditionele-Non-Contradictie valideren. Volgens dit principe kunnen conditionelen van de vorm "Als φ, ψ" en "Als φ, niet ψ" niet allebei waar zijn (tenzij φ onmogelijk is). Gibbard beschreef een scenario waarin dit principe geschonden lijkt te worden. We hebben echter beargumenteerd dat Gibbard te overhaast een conclusie trekt. Vanuit ons voorstel bekeken wordt het principe van de Conditionele-Non-Contradictie niet werkelijk geschonden. Hoewel we de rol hebben benadrukt die de achtergrondkennis van een spreker speelt bij de interpretatie van een conditionele zin, hebben we betoogd dat onze semantiek ons behoedt voor het probleem van extreme subjectiviteit van de betekenis van conditionele zinnen, omdat ons voorstel uit kan leggen hoe een persoon een conditionele boodschap kan interpreteren zonder toegang te hebben tot de epistemische toestand van de spreker. Bovendien rapporteren we de resultaten van een experiment die onze diagnose verder ondersteunen. Als laatste kan het verhaal van Gibbard dienen ter illustratie van een probleem dat conditionele zinnen kunnen vormen voor deliberatie (DeRose 2010). Onze analyse kan ook dienen als een oplossing voor het probleem van betekenisloze conditionele zinnen in de context van besluitvorming. In het bijzonder helpt ons voorstel om de deelklasse van indicatieve zinnen te identificeren die in het besluitvormingsproces vermeden moeten worden. Dit zijn de conditionele zinnen van de abductief inferentiële soort.

In hoofdstuk 6 hebben we onze bevindingen uit eerdere hoofdstukken samengevat. Ten slotte bespraken we verschillende ideeën voor verder onderzoek m.b.t. inferentiële indicatieve zinnen.

LIST OF PUBLICATIONS

This is the list of the publications that have been incorporated in this dissertation or that are relevant to the discussed topics:

Karolina Krzyżanowska, 'Ambiguous Conditionals.' In: Piotr Stalmaszczyk (ed.): 'Philosophical and Formal Approaches to Linguistic Analysis', Ontos Verlag, pp. 315-332, 2012.

Karolina Krzyżanowska, Sylvia Wenmackers, Igor Douven, and Sara Verbrugge. 'Conditionals, Inference, and Evidentiality' in: Jakub Szymanik and Rineke Verbrugge (eds.): 'Proceedings of the Logic & Cognition Workshop at ESSLLI 2012, Opole, Poland, 13-17 August, 2012', vol. 883 of CEUR Workshop Proceedings, CEUR-WS.org, pp. 38-47, 2012.

Karolina Krzyżanowska, Sylvia Wenmackers and Igor Douven. 'Inferential Conditionals and Evidentiality.' *Journal of Logic, Language and Information*, Vol. 22 No. 3, pp. 315–334, 2013.

Karolina Krzyżanowska, 'Belief Ascription and the Ramsey Test.' *Synthese* Vol. 190, No. 1, pp. 21-36, 2013.

Karolina Krzyżanowska, Sylvia Wenmackers, and Igor Douven. 'Rethinking Gibbard's Riverboat Argument.' *Studia Logica*, Vol. 102, No. 4, pp. 771-792, 2014.

ABOUT THE AUTHOR

Karolina Krzyżanowska was born in Żyrardów, Poland, on April 4, 1985. She studied philosophy at the University of Warsaw and, as an exchange student, at the Katholieke Universiteit Leuven, where she followed courses in philosophy, linguistics and cognitive science. In 2009 she obtained her master's degree in philosophy with a thesis on belief ascriptions.

In November 2009, she joined the Formal Epistemology Project at the Centre for Logic and Analytic Philosophy in Leuven, where she started working under the supervision of Professor Igor Douven. In 2010, following her supervisor, she moved to the Netherlands. As a PhD student at the Faculty of Philosophy of the University of Groningen, she was exploring, both theoretically and experimentally, various issues related to semantics and pragmatics of natural language conditionals.

Currently, Karolina is a postdoctoral research fellow at the Munich Center for Mathematical Philosophy at the Ludwig-Maximilians-Universität München.