Natural Language Semantics (2005) 13:383–410
DOI 10.1007/s11050-005-2052-7


BART GEURTS

# ENTERTAINING ALTERNATIVES: DISJUNCTIONS AS MODALS*

Following Zimmermann (2000), I propose that disjunctions are to be treated as conjunctions of modal propositions, and that the essential contribution of 'or' is merely to present a list of alternatives. Any further ingredients in the interpretation of a disjunctive sentence (such as exhaustivity) are due to extraneous factors; they are not part of the meaning of 'or'. My analysis differs from Zimmermann's in that it is more general and renders the logical form of disjunctive sentences less complex, but the main innovation is that the context dependence of modality is called upon to play a leading role. The theory applies not only to disjunctions of 'may'-sentences but also covers universal modalities and conditional disjuncts. The paper concludes with a discussion of narrow-scope 'or'.

## 1. Introduction

In this paper I shall mainly be concerned with the following data:

(1) a. You may do this or (else) you may do that.
b. You must do this or (else) you must do that.
c. You may do this or (else) you must do that.
d. ?You must do this or (else) you may do that.

(2) a. It may be here or (else) it may be there.
b. It must be here or (else) it must be there.
c. It may be here or (else) it must be there.
d. ?It must be here or (else) it may be there.

(So as to forestall referential confusions regarding the second batch of examples, let us assume that 'It' is the name of a runaway chicken.) The most pressing problem presented by the sentences in (1) is that, on one of its readings, (1a) seems to imply both that the addressee may do this and that he may do that (though not both, presumably), whilst (1b) does not license the corresponding inferences; that is, it does not imply that the addressee must do this, nor that he must do that. Another problem, which is less well known, is the contrast between (1c) and (1d). It may be that (1c) is less than

* I am indebted to Fabian Battaglini, Mandy Simons, Anna Szabolcsi, and Ede Zimmermann, who provided me with helpful comments on the first version of this paper, and to Phil Johnson-Laird and Keith Stenning, who commented on the paper's grandmother (now deceased).

fully acceptable to some speakers, but everyone concurs that (1d) is a lot worse. This asymmetry is entitled to an explanation, too. The sentences in (2) raise analogous problems.

It may be objected at this point (already) that the sentences above are *all* marked to some degree, and that a more natural way of expressing the intended reading of (2b), for instance, is by means of (3):

(3) It must be here or there.

However, although I agree that (3) is more likely to occur than (2b), I do believe that the latter is felicitous, too, and quite capable of conveying the same message as the former. That (2b) is slightly marked is unsurprising, given the availability of (3), and no cause for concern.[1] I will come back to sentences like (3) in section 6, where I argue that they are to be construed as wide-scope disjunctions of the type exemplified in (1) and (2).

The theory presented in this paper may be seen as an attempt to remedy various problems with Zimmermann's (2000) account, and therefore I start off by discussing Zimmermann's original proposal in some detail.

## 2. Disjunctions as Epistemic Modals

The key innovation in Zimmermann's analysis is that natural language 'or' expresses not a truth-functional but a modal concept: someone who utters a sentence of the form '$S_1$ or … or $S_n$' presents his audience with a list of epistemic alternatives. For example, to say that Brown is either in Lagos or in Harare is to convey that, for all the speaker knows: Brown may be in Lagos, Brown may be in Harare, and there are no other places where Brown might be. In general, someone who utters '$S_1$ or … or $S_n$' asserts (a) that any of $S_1$ … $S_n$ may be true, and (b) that, between them, $S_1$ … $S_n$ cover all relevant possibilities. Zimmermann proposes to keep (a) and (b) separate: the essential contribution of a disjunctive sentence, according to Zimmermann, is of the form $\Diamond A_1 \wedge \ldots \wedge \Diamond A_n$, or in terms of possible worlds:[2]

(4) $E \cap A_1 \neq \emptyset$ and … and $E \cap A_n \neq \emptyset$

[1] Schulz (2003) finds that sentences like (1b) are infelicitous. I disagree, and so does Simons (to appear). Schulz's example is:

(i) Mr. X must be in Amsterdam or Mr. X must be in Frankfurt.

I concur with Schulz's judgment that this sentence is odd, but submit that its oddity is due to the fact that the term 'Mr. X' is reiterated for no good reason. Replace the second occurrence with a pronoun, and the sentence becomes perfect.

[2] Here and in the following I use capitals not only as sentence letters but also to refer to their semantic values (i.e. sets of possible worlds). I also adopt the policy of suppressing subscripts for contexts, worlds, speakers, etc., unless they play a vital role in the analysis.

where 'E' denotes a set of possible worlds representing an epistemic background, which is normally given by what the speaker considers to be ways the world might be. (4) represents the core meaning of disjunction, and it does not entail that, between them, $A_1 \ldots A_n$ cover E. This is as it should be, because not all disjunctions are 'closed', as witness the contrast between (5a) and (5b):

(5) Where shall we go next:

a. $B^{i^{s^{s^{a^u}}}}$ or $H^{a^{r^{a^{r^e}}}}$ or $L^{a^{g^{o^s}}}$

b. $B^{i^{s^{s^{a^u}}}}$ or $H^{a^{r^{a^{r^e}}}}$ or $La_{g_{o_s}}$

Whereas the terminal fall in (5b) signals that the speaker considers his list of options to be exhaustive, the terminal rise in (5a) conveys the opposite. On Zimmermann's analysis, this means that it is the intonation contour, rather than disjunction *per se*, which encodes exhaustivity.

Zimmermann defines exhaustivity as follows:

(6) $E \subseteq A_1 \cup \ldots \cup A_n$

Zimmermann urges that this be thought of as a semantic constraint: exhaustivity is literally denoted by intonation or other devices, such as the particle 'either' in 'either … or'.[3] The distinction between exhaustive and non-exhaustive disjunctions does not play a central role in Zimmermann's proposal, and no harm will be done if we set it aside for the time being (the distinction will surface again when I present my own analysis, in which exhaustivity is essential).

Ignoring exhaustivity, then, the logical form Zimmermann attributes to (7a) is (7b):

(7) a. It may be here or it may be there.
b. $\Diamond\Diamond A \wedge \Diamond\Diamond B$

In order to account for the intuition that (7a) implies 'It may be here' as well as 'It may be there', Zimmermann appeals to what he calls the Self-Reflection Principle:

[3] According to Mandy Simons (p.c.), the use of 'either' is compatible with a rising intonation contour, the combination yielding a non-exhaustive interpretation. Not being a native speaker of English, I have no opinion one way or the other. Incidentally, Paris (1973) presents experimental evidence that disjunctions with 'either' are more likely to be construed exclusively than their 'either'-less counterparts, though the margin is rather small (75% vs. 67.5% according to Paris's data).

*Self-Reflection Principle:*
If $E_{a,w}$ is the set of epistemic alternatives open to an agent $a$ in $w$, then $E_{a,w} = E_{a,w'}$ for any $w' \in E_{a,w}$.

Speaking somewhat loosely, this principle is meant to capture the notion that an agent knows what he knows. (The Self-Reflection Principle is perhaps unduly severe, but as we will see later on, Zimmermann's analysis doesn't actually require a constraint that is quite as stringent as this.) It is easy to see that, on the assumption that Self-Reflection holds, $\Diamond\Diamond A$ entails $\Diamond A$, hence (7a) entails 'It may be here' as well as 'It may be there'.

The logical form Zimmermann attributes to (8a) is (8b) (in which '$\diamondsuit$' represents deontic possibility):

(8) a. You may do this or you may do that.
b. $\diamondsuit\diamondsuit A \wedge \diamondsuit\diamondsuit B$

In order to account for the intuition that (8a) implies 'You may do this' as well as 'You may do that', Zimmermann appeals to what he calls the Authority Principle, In essence, $a$'s knowledge of a proposition A is authoritative if $a$ knows the extension of A in any one of $a$'s epistemic alternatives:[4]

*Authority Principle:*
If $a$ is an authority on A in $w$ and $E_{a,w} \cap A \neq \emptyset$, then $E_{a,w} \subseteq A$.

Suppose that my knowledge of African capitals is infallible. Then, according to the Authority Principle, my considering it possible that Harare is the capital of Zimbabwe entails that I know that Harare is the capital of Zimbabwe. Similarly, assuming $a$'s knowledge concerning his own permission granting is authoritative, then if $a$ considers it possible that $b$ is allowed to do such-and-such, $a$ knows that $b$ is allowed to do such-and-such.

Note that, whereas the Self-Reflection Principle takes us from $\Diamond\Diamond A$ to $\Diamond A$, the Authority Principle takes us not from $\diamondsuit\diamondsuit A$ to $\diamondsuit A$, as one should expect, but rather from $\diamondsuit\diamondsuit A$ to $\Box\diamondsuit A$. Hence, there is a minor discrepancy between Zimmermann's treatments of epistemic and deontic modality–which I propose to ignore. With this proviso, if and when the Authority Principle holds, (8a) entails 'You may do this' as well as 'You may do that'.

Apart from the one just noted, there is another and more important asymmetry in Zimmermann's account. As Zimmermann sees it, Self-Reflection is a fully general epistemological principle which applies

[4] In Zimmermann's own exposition, authority is a relation between agents and properties. Nothing hinges on this for our purposes (nor for Zimmermann's, as far as I can tell).

across the board. But whether or not the Authority Principle is applicable is to be determined case by case: speakers are authoritative on some subjects but not on all. Zimmermann takes this to explain why inferences licensed by the Authority Principle are context dependent in a way that inferences licensed by Self-Reflection are not. For example, (9a) may be read as implying (9b) and (9c), or as implying that speaker doesn't know which of (9b) and (9c) is the case; the latter construal is mandatory if the speaker adds, 'I don't know which,' say.

(9) a. You may eat an apple or a pear.
b. You may eat an apple.
c. You may eat a pear.

On Zimmermann's account, (9a) is not ambiguous. On both 'readings' the sentence has the same logical form, to wit (8b), and in either case it presents a list of *epistemic* possibilities. What causes the illusion of ambiguity, according to Zimmermann, is just our awareness that the Authority Principle may or may not be applicable in any given case.

Perhaps the most obvious complaint about Zimmermann's theory is that it forswears the austere beauty of the standard truth-functional analysis, only to replace it with a treatment that is *ad hoc* or worse. In my opinion, this line of criticism is off the mark. To begin with, in the past few decades the view that meaning is to be explained in terms of information and information exchange has gained considerable support, and even though this view is not universally accepted, it is no longer self-evident that connectives are to be treated as truth-functional by default. Secondly, apart from the way it deals with the interaction between modals and disjunction, Zimmermann's treatment of 'or' has a number of appealing features. One is his explanation of the contrast in (5). Another is that on Zimmermann's account disjunction introduction is not a valid inference, which is attractive in view of the fact that arguments like the following, which are valid in classical logic, are rejected by most informants:

(10) Green is in Yaounde, and therefore Green is either in Yaounde or in Bujumbura.

Results like these make essential use of, and thus lend support to, the modal analysis of disjunction.

The real problems are not with Zimmermann's general programme but rather with the details of its implementation. To explain this, let us have a

second look at Zimmermann's treatment of disjunctions with epistemic modals:

(11) a. It may be here or it may be there.
b. $\Diamond\Diamond A \wedge \Diamond\Diamond B$

The precarious passage in Zimmermann's analysis is his explanation of why (11b), which he takes to be the logical form of (11a), should give rise to the inferences that $\Diamond A$ and $\Diamond B$ hold. In order to secure these inferences, Zimmermann introduces the Self-Reflection Principle, and I maintain that this strategy is misguided. To justify this claim, I propose to start with the following variation on (11):

(12) a. It must be here or it must be there.
b. $\Diamond\Box A \wedge \Diamond\Box B$

By parity of analysis, the logical form of (12a) should be (12b), from which it follows, by courtesy of the Self-Reflection Principle, that $\Box A$ as well as $\Box B$. Hence, Zimmermann's analysis predicts that (12a) entails that It must be here *and* there, which is clearly wrong.

This erroneous prediction can be suppressed if we are willing to trade in Self-Reflection for a weaker requirement. Formally, the epistemic background of a disjunctive statement is determined by an accessibility relation R between worlds. The Self-Reflection Principle says that R has the following property:

*Self-Reflection:*
If $wRw'$ then $w'Rw''$ iff $wRw''$.

An accessibility relation is self-reflective iff it is transitive and euclidean:

*Transitivity:*
If $wRw'$ and $w'Rw''$ then $wRw''$.

*Euclideanness:*
If $wRw'$ and $wRw''$ then $w'Rw''$.

These properties correspond with the following theorems of standard epistemic logic:

*Positive Introspection:*
If $\Box A$ then $\Box\Box A$

*Negative Introspection:*
If $\neg\Box A$ then $\Box\neg\Box A$

Positive Introspection is valid on all and only such frames that are transitive; what it says is that if you know something, you know that you know it. Negative Introspection is valid on all and only such frames that are euclidean, and it says that if there is something you don't know, then you know that you don't know it.

As it turns out, the inference from $\Diamond\Diamond A$ to $\Diamond A$ is valid iff Positive Introspection holds, while the inference from $\Diamond\Box A$ to $\Box A$ is valid iff Negative Introspection holds. Hence, the obvious solution to the problem noted above is to give up Self-Reflection in favour of Positive Introspection. This amendment blocks the unwanted inference in (12), while the corresponding inference in (11) remains valid, as it should. That Negative Introspection can be dispensed with is an additional boon, or so it might be thought, since this principle has always been more controversial than its positive counterpart.

However, this solution is not as neat as it may seem. First, it may be argued that, even if Negative Introspection is implausibly strong as a general requirement on knowledge, it is entirely appropriate in the cases at hand. According to Zimmermann's analysis, a speaker who utters (12a) is explicitly reflecting on his knowledge of It's whereabouts, and under these circumstances Negative Introspection seems quite reasonable. Secondly, if Negative Introspection is abandoned, it seems that Zimmermann's *Authority Principle* will take over in cases like (12a), bringing in the unwanted inference through the backdoor.[5] Thirdly, even if the inference from $\Diamond\Box A$ to $\Box A$ can be excluded on principled grounds, (12a) continues to haunt Zimmermann's proposal, because it still has to be explained why, on its most natural reading, (12a) is synonymous not with (13b) but rather with (13a):

(13) a. It must be here or there.
b. One of the following obtains: (i) It must be here. (ii) It must be there.

Zimmermann's analysis of disjunctions with deontic modals suffers from problems similar to the ones just raised. As we have seen, Zimmermann

[5] Schulz (2003) observes that, logically speaking, the Authority Principle could do all the work of the Self-Reflection Principle, and she wonders why Zimmermann should have introduced the latter at all. The answer, I suspect, is that Zimmermann assumes that, whereas Self-Reflection applies across the board, the Authority Principle may not hold all the time.

resorts to the Authority Principle to explain why (14a) is felt to imply (14b) and (14c):

(14) a. You may do this or you may do that.
b. You may do this.
c. You may do that.

But if this is right the Authority Principle also predicts that (15b) and (15c) follow from (15a); which is certainly wrong.

(15) a. You must do this or you must do that.
b. You must do this.
c. You must do that.

The problems caused by these false predictions are worse than the parallel problems with epistemic modals, because this time there is no intuitive basis at all for diluting the Authority Principle to a point where it yields the right predictions for (14) as well as (15). For if I can be an authority on granting permission of a certain kind, why can't I be an authority on giving orders of the same kind? Indeed, isn't this practically the same thing?

All the foregoing objections point in the same direction. On Zimmermann's analysis, it is crucial that $\Diamond A$ and $\diamond A$ be derivable from $\Diamond\Diamond A$ and $\diamond\diamond A$, respectively, and the problem appears to be that a principled account of why and when these inferences obtain is hard to get by. The principles espoused by Zimmermann are not adequate to the task, and if it is true, as Zimmermann argues (cogently, in my view), that these principles are perfectly sound as they stand, then perhaps we should reconsider the task, So that is what I will do.

## 3. Disjunction in Context

The theory to be expounded in the remainder of this paper is indebted to Zimmermann's in two major respects. First, and most importantly, disjunctions will be analysed as conjunctions of modal propositions. Secondly, I adopt Zimmermann's idea that the essential contribution of 'or' is merely to present a list of alternatives. Any further ingredients in the interpretation of a disjunctive construction (such as exhaustivity) are contributed by extraneous factors; they are not part of the meaning of 'or'. It will transpire that this assumption is more important to my account than it is to Zimmermann's.

I depart from Zimmermann's original proposal in three ways. First, I will drop the premiss that disjunctions are always *epistemic* modals. I find it

implausible that, for example, a permission-giving sentence like (14a) should actually present a list of epistemic alternatives. Intuitively, the function of 'or' is just to present alternatives, not to settle their modal status. It is not for the meaning of 'or' to decide whether its arguments are epistemic or deontic or something else, though it may well be that disjunctions are epistemic by default.

The second difference between Zimmermann's theory and mine concerns the logical form of disjunctive sentences. According to Zimmermann, the logical form of (14a) contains four modal operators. I maintain that there are just two: the overt modals *fuse* with the covert modals introduced by the disjunction (a process that occurs in the interpretation of conditionals, too, according to widely held opinion). Hence, to a first approximation at least, the logical form I propose for (14a) is simply $\Diamond A \wedge \Diamond B$; from which it follows straightaway that $\Diamond A$ and that $\Diamond B$. However, this is just the beginning of my story. For if the same analysis is applied to (15a), for example, what we get is $\Box A \wedge \Box B$; and I wouldn't want to predict that (15a) requires the addressee to do this *and* that. The solution, I believe, lies in the way modals interact with the context in which they are interpreted. This context dependence is the fulcrum of my analysis, and the third respect in which I deviate from Zimmermann's model. In the following I spell out these ideas in more detail, starting with the last.

It is a familiar observation that the meaning of a modal expression is dependent on contextual factors.[6] This context dependence is manifest in examples like the following:

(16) Your teeth might fall out.

In this example it is perfectly clear, in informal terms at least, what kind of contextual information the sentence requires: (16) means something like 'If the circumstances were to be such and such, your teeth might fall out', and unless the context settles what 'such and such' is, the sentence will be unintelligible. Consequently, it is difficult to imagine a conversation opening with an utterance of (16). As I have argued elsewhere, this context dependence seems to be of a presuppositional nature (Geurts 1999). A speaker who utters (16) presupposes that certain circumstances are given, in the sense that they are already under consideration, and if a suitable set of circumstances is not given, it will have to be accommodated.

[6] See Kratzer (1991b) for an introduction and references. Kratzer traces back the key observations to C.S. Peirce.

(17) Q: What if I don't brush my teeth anymore?
A: Your teeth will fall out.

Here the modal 'will' is confined to the range of possibilities brought into focus by the question, and thus the presupposition induced by the modal is contextually bound. If, however, (17A) were uttered out of the blue, a suitable range of possibilities would have to be accommodated.[7]

Simple modal sentences like (16) and (17A) don't impose overt restrictions on their domains. Such restrictions can be communicated, if need be, by means of an *if*-clause:

(18) If you don't brush your teeth anymore, they will fall out.

Sentence (18) may have the same interpretation as (17A), but here it is the *if*-clause that furnishes the constraints on the modal domain that were previously derived from the context.[8] This is not to say, however, that the *if*-clause supplants the context altogether, for conditional modals like (18) are context dependent just as simple modals are. For example, if (18) is continued as follows:

(19) … and if your teeth fall out, you'll be sorry you didn't brush them.

the states of affairs under consideration are those in which the addressee's teeth fall out because she didn't brush them, though the sentence doesn't say so explicitly.

According to Kratzer's (1979, 1991a) theory of conditionals, which I endorse, the purpose of an *if*-clause is always to restrict the domain of some quantifier or other (cf. also Lewis 1975):

> The history of the conditional is the history of a syntactic mistake. There is no two-place *if … then* connective in the logical forms for natural languages. *If*-clauses are devices for restricting the domains of various operators. Whenever there is no explicit operator, we have to posit one. (Kratzer 1991a: 656)

(Kratzer says that the covert operator will be epistemic necessity by default, and I will assume so, too.) There are two ways of reading this. One is that an overt operator is posited only if a covert one is not present; on this inter-

[7] Note that this type of accommodation is easier in some cases than it is in others. Intuitively, (16) is harder to interpret by way of accommodation than (17A) is. I don't have an explanation for this.

[8] Frank (1997) has shown that this treatment of *if*-clauses will yield incorrect predictions in certain cases (cf. also Zvolenszky 2002). Frank's problem would seem to disappear, however, once it is recognised that sentences like (18) are systematically ambiguous (see below).

pretation, an *if*-clause always restricts an overt quantifier if there is one. On the other reading, the two strategies for interpreting *if*-clauses are independent: an *if*-clause needs to restrict some quantifier or other, and though there is a preference for having it restrict an overt quantifier, the two strategies are generally available. I believe the second alternative is the best. If this is so, the interplay between conditionals (or rather *if*-clauses) and quantified expressions will always result in ambiguity, although it need not be apparent in all cases. This prediction appears to be correct (see Geurts 2004 for a more elaborate defense than can be given here).

All things being equal, (20a) is more or less equivalent to (20b):[9]

(20) a. If White isn't in Lagos, she is in Harare.
b. If White isn't in Lagos, she must be in Harare.

If my version of the Kratzer doctrine is correct, (20b) should be ambiguous between a reading with one and another with two modal operators, but as these readings are equivalent, the ambiguity is a spurious one. To show that the ambiguity is there, a different type of modal is needed:

(21) If Brown is depressed, he has to recite one of his poems.

This may be understood as saying that Brown has to recite one his poems whenever he feels down, or as saying that his being depressed indicates that Brown has to recite one of his poems. On the first construal, the sentence contains one modal operator; on the second construal, it contains two modals, one of which is overt while the other is covert.

To summarise the foregoing considerations, the general schema for the interpretation of a conditional sentence 'If $S_1$ then $S_2$' is 'AM…', where A is corresponds to $S_1$ and M is a generalised quantifier that defaults to epistemic necessity. If $S_2$ contains an overt modal, i.e. if its underlying form is NB, there are two ways of combining the two. Either N is taken to *be* the modal required by the *if*-clause, in which case I say M and N fuse, or NB goes into the slot marked by the dots, leaving M free. In the former case, the resulting interpretation will be of the form ANB; in the latter, it will be AMNB, with M defaulting to epistemic necessity.

In order to capture the context dependence of modal expressions, I assume that modals are explicitly represented as relations between sets of worlds.[10] For example, the logical form of (16) is A◇B, where A represents the domain

[9] 'More or less,' because (20a) sounds more resolute than (20b). It isn't clear to me why this should be so.

[10] As for present purposes it doesn't really matter whether or not the context dependence of modality is treated as presuppositional, I will develop my proposal in strictly semantic terms, without taking recourse to the theory of presupposition projection I have used elsewhere.

of the modal and B stands for the sentence's descriptive content, and the sentence is true iff $A \cap B \neq \emptyset$. The linguistic surface form of a sentence like this leaves the domain of the modal quantifier virtually unrestricted, although modal expressions usually impose certain basic constraints on their domains, as witness the difference between 'can' and 'may', for example. But it is clear that, in general, the domain of a modal is determined chiefly by the context. In the following I will assume, therefore, that a modal proposition is always interpreted against a given 'background' (i.e. a set of worlds), which depending on the occasion is to be thought of as epistemic, deontic, etc. The domain argument of a modal quantifier links up to this background as follows: if C is the background against which AMB is being processed, then $A \subseteq C$, and by default $A = C$. In other words, the hearer first attempts to equate the quantifier domain with the background set, and only if that fails will he try the hypothesis that the domain is a subset of the background.[11]

Generalising Zimmermann's analysis, I assume that the logical form of a sentence '$S_1$ or … or $S_n$' is a conjunction of propositions of the form $A_i M_i B_i$, where $M_i$ is a modal quantifier. The lexical meaning of 'or' doesn't say which quantifier $M_i$ is, though it may specify that, all things being equal, $M_i$ is epistemic and existential. However, in the cases we are concerned with all things are not equal, because the arguments of 'or' are modal propositions, which usually means that the identity of $M_i$ is settled by $S_i$. That is to say, the logical forms of (22a) and (23a) are (22b) and (23b), respectively:

(22) a. It must be here or it must be there.
b. $A\Box B \wedge A'\Box B'$

(23) a. It may be here or it may be there.
b. $A\Diamond B \wedge A'\Diamond B'$

As in conditionals with modal consequents (cf. (20b)), the modal verbs in (22a) and (23a) make explicit the modal operators covertly required by 'or'. This is the normal case; there are also cases in which overt and covert modals will not amalgamate:

(24) You may do this or you may do that.

Unlike Zimmermann, I maintain that this sentence is ambiguous, and the ambiguity has the same source as the one we observed in conditionals like

[11] Perhaps the assumption that the link between domain and background may be weakened from $A = C$ to $A \subseteq C$ is *ad hoc*. Observe, however, that the work which is being done by this assumption could be done otherwise. For example, we might assume that, in addition to C, there are subsets of C available to be picked up by modal propositions, and perhaps these subsets are introduced into the discourse by the very principles that I will discuss below.

(21). On one reading, the speaker grants the addressee permission to do this or that; in which case overt and covert modals fall together, and the logical form of (24) mirrors that of (23a). On the other reading, the speaker doesn't give permission but considers what is permitted. For this reading, I adopt roughly the same logical form as does Zimmermann, according to which each disjunct contains an epistemic modal which has a deontic modal in its scope.

Again following Zimmermann's lead, I assume that the interpretation of disjunction is usually restricted by constraints other than the meaning of 'or' itself. The two main constraints are the following. Let $A_1 M_1 B_1 \wedge \cdots \wedge A_n M_n B_n$ be the logical form of a sentence '$S_1$ or … or $S_n$', which is interpreted against a contextually given background set C:

*Exhaustivity:*
$C \subseteq (A_1 \cap B_1) \cup \ldots \cup (A_n \cap B_n)$

*Disjointness:*
If $1 \leq i, j \leq n$, then $A_i \cap B_i \cap A_j \cap B_j = \emptyset$

My Exhaustivity constraint is almost identical to Zimmermann's, the main difference being that my background set C is not necessarily epistemic. The second constraint gives rise to what is generally known as the exclusive interpretation of disjunction.[12] Both constraints can be triggered by a variety of factors: intonation, certain keywords ('either', 'else'), and background knowledge.

One further constraint that we will need is the following:

*Non-triviality:*
$A \neq \emptyset$, for any AMB

This says that the domain of a modal proposition may not be empty, and can be seen as a crude way of spelling out a requirement that in ordinary quantifiers goes under the name of 'existential import' (see Geurts, to appear).

It goes without saying that these constraints are supposed to be motivated on independent grounds. I take it that this assumption is obviously justified for Non-triviality, and to the extent that Disjointness and Exhaustivity can be attributed to world knowledge or phonological or lex-

[12] Note that, as formulated here, the Disjointness constraint is comparatively weak; it could be strengthened by requiring that $B_i \cap B_j = \emptyset$. This would be one way of accounting for the fact that, generally speaking, a disjunction is infelicitous if one of its members is entailed by another. As pointed out to me by Mandy Simons, the present system doesn't predict the infelicity as it stands, and reinforcing Disjointness might the best solution.

ical sources, it shouldn't be problematic for these constraints, either. But this is not to say that their status, and in particular that of Disjointness, is entirely clear. I will return to this issue in section 5 below.

In the remainder of this section I will illustrate the workings of my theory with a number of case studies.

**Case #1**:

(25) It may be here or it may be there.

The logical form of this sentence is $A\Diamond B \wedge A'\Diamond B'$. Let us start with an epistemic construal of the modals, and assume accordingly that (25) is interpreted against an epistemic background C. By default, A and A′ are bound to C, i.e. $A = A' = C$. Thus we get $C \cap B \neq \emptyset$ (from the first disjunct) and $C \cap B' \neq \emptyset$ (from the second disjunct). Hence, it follows more or less directly that It may be here and that It may be there, provided these claims are interpreted against the same background.

Without further constraints, (25) does not exclude the possibility that It may be neither here nor there. This possibility is ruled out if the Exhaustivity constraint applies, because then it holds that $C \subseteq B \cup B'$. Thus Exhaustivity in effect turns (25) into the statement that It *must* be here or there – which is perhaps the most natural reading for (25) to have.

**Case #2**:

(26) You may do this or you may do that.

On the account proposed here, this is about the same as (25), except of course that this sentence is to be interpreted against a deontic background. Furthermore, the tendency to assume that Exhaustivity holds may not be as strong in this case as it is in the previous one, but this is a difference in degree, not in kind; for (26) may well be used to tell the addressee that he must do either this or that.

The proposed analysis of disjunctions with existential modals ('may' and its kin) is straightforward enough. It remains to be seen how well the theory handles the universal modals that present problems for Zimmermann's theory, as we saw in the last section.

**Case #3**:

(27) It must be here or it must be there.

The logical form of this sentence is $A\Box B \wedge A'\Box B'$, and it is interpreted against an epistemic background C. The main difference between this

example and its existential counterpart in (25) consists in the presuppositional link between A and A′ on the one hand and the background set C on the other. For if $A = A' = C$, the sentence entails that It must be here and there, which is inconsistent with the fact that, as a rule, a chicken cannot be in more than one place at a time. More generally, Disjointness and Non-triviality cannot be satisfied together if either $A = C$ and $A' \subseteq C$ or $A' = C$ and $A \subseteq C$. Therefore, A and A′ are allowed to cover only part of C, i.e. $A \subseteq C$ and $A' \subseteq C$, which results in the following picture:

| | |
|---|---|
| First disjunct: | $A \subseteq B$ |
| Second disjunct: | $A' \subseteq B'$ |
| Exhaustivity: | $C \subseteq A \cup A'$ |
| Disjointness: | $A \cap A' = \emptyset$ |

Assuming Exhaustivity, (27) states that all C-worlds are either B-worlds or B′-worlds, so It must be here or there. And if Disjointness holds as well, C is partitioned into A and A′. This seems to capture the intended reading of (27) quite well. In particular, on the present analysis, it does not follow from (27) that It must be here, nor does it follow that It must be there.

**Case #4:**

(28) You must do this or you must do that.

This is analogous to (27), except that C is now a deontic background.

**Case #5:**

(29) It may be here or (else) it must be there.

The logical form of this sentence is $A\Diamond B \wedge A'\Box B'$, and in this case it is possible to identify A, though not A′, with the epistemic background C; hence $A = C$ and $A' \subseteq C$. Now we get the following:

| | |
|---|---|
| First disjunct: | $C \cap B \neq \emptyset$ |
| Second disjunct: | $A' \subseteq B'$ |
| Exhaustivity: | $C \subseteq B \cup A'$ |
| Disjointness: | $B \cap A' = \emptyset$ |

An important difference between this example and the preceding ones lies in the relationship between the modal domains and the background set. In the foregoing, the domain sets A and A′ either coincided with C or they determined each other: in (27) and (28) C was partitioned by A and A′. In

this example, by contrast, the only way to characterise A′ in terms of the other sets is as follows: A′ = C − B; i.e. A′ contains all and only the non-B worlds in C. That is, in order to identify the domain of the second disjunct we require the descriptive content of the first. My suggestion is that this explains why (29) is so much better than (30):

(30) ?It must be here or (else) it may be there.

Here the domain of the first modal is dependent on the descriptive content of the second, which is awkward for the same reason that forward reference is, in general, awkward.

## 4. Conditionals

A few years ago Johnson-Laird and his associates announced the discovery of 'a novel class of erroneous deductions' (Johnson-Laird and Savary 1996), which they call 'illusory inferences':[13]

> A surprising, and only recently discovered, consequence of the theory of mental models is its prediction of illusory inferences, that is, inferences that lead to compelling but fallacious conclusions. (Johnson-Laird and Savary 1999: 219)

The ur-specimen of illusory inference was discovered by Johnson-Laird and Savary (1999) when they presented their subjects with the following task (without the labeling, of course):

> Suppose you know the following about a specific hand of cards:
>
> (31) a. If there is a king in the hand then there is an ace in the hand, or else
> b. if there isn't a king in the hand then there is an ace in the hand.
>
> (32) There is a king in the hand.
>
> What, if anything, follows?

If you are inclined to conclude that there must be an ace in the hand, you have succumbed to an illusion; or so say Johnson-Laird and Savary (J-L & S), who argue as follows. The first premiss, (31a, b), allows for the possibility that one of its disjuncts is false; so even though (31a) and (32) would yield the conclusion that there is an ace in the hand, (31a) might be false, and it does not

[13] Apparently, what distinguishes illusory inferences from ordinary fallacies, according to Johnson-Laird and Savary, is that they are compelling. It should be noted, however, that the epithet 'compelling but fallacious' is a pleonasm; fallacies are compelling by definition. An invalid argument that fails to fool anyone simply doesn't count as a fallacy.

follow that there is an ace in the hand. The argument is brief and simple, so it really is remarkable that all of J-L & S's subjects got it wrong. Even more remarkable, perhaps, is the fact that experts fall into the same mistake:

> We have also observed the same response informally, only one person among the many distinguished cognitive scientists to whom we have given the problem made a correct response. Several hundred individuals at public lectures from Stockholm to Seattle have made the same error, just one person asserted that nothing followed from the premises. And less than 2% of nearly a thousand prospective students at the University of Padua avoided the error (Vittorio Girotto, personal communication). Yet, the conclusion that there is an ace is invalid. (Johnson-Laird and Savary 1999: 219)

This should let us pause for a moment. If laymen and experts alike endorse a conclusion that is so easily shown to be fallacious, shouldn't we seriously consider the possibility that it isn't a fallacy in the first place?

In the philosophical literature on conditionals, it has been known for some time that a truth-functional interpretation of the connectives yields paradoxical results for sentences like J-L & S's (31), which come out as tautologies (Edgington 1995, Woods 1997). The reason why J-L & S deem their argument fallacious is that they endorse the standard truth-functional treatment of the connectives. J-L & S more or less take it for granted that the truth values of '$S_1$ or $S_2$' and 'if $S_1$ then $S_2$' are determined by the truth values of $S_1$ and $S_2$. They simply ignore the possibility that non-truth-functional factors might be involved in the interpretation of 'or'. Concerning conditionals they are more circumspect, conceding as they do that 'if … then' doesn't always behave as a material implication; but such construals can be safely ignored, according to J-L & S:

> … the studies that follow concern conditionals with antecedents that describe the contexts as completely as necessary. Thus, the antecedent of the following conditional tells the participants all they need to know about the context:
>
> If there was a king in the hand then there was an ace in the hand
>
> Such conditionals *are* akin to material conditionals. Hence, possibilities in which the antecedent is false are consistent with the conditional – they are true possibilities. (pp. 197–198)

This argument appears to consist of two parts. First, conditionals are truth functional whenever arguments 'describe the contexts as completely as necessary.' This claim is vague, and could be made more precise in any number of ways, though I can't think of any that would make it true. Secondly, J-L & S assure us that, in their experiments, the antecedent of a conditional always told subjects 'all they need to know about the context.' This is vague, too, but at least it is debatable. Suppose that, out of the blue, a subject is presented with the task quoted above, which pretends to be about 'a specific hand of cards.' Presumably, the cards are playing cards, and

'a king' is not intended to refer to an institution or a person of flesh and blood, but how many cards are there? If there is only one, then there can't be an ace in the hand as well. And whose hand is it anyway? Questions, questions. So even if J-L & S judged their materials to be sufficiently explicit, it is by no means certain that their subjects would agree.

J-L & S's claim that the subjects in their experiment can be relied upon to have interpreted conditionals as material implications is flatly contradicted by the second experiment of Barrouillet and Lecas (2000), who administered a multiple-choice task in which subjects were invited to say what can be concluded if the following statement is false: 'If there is a king there is an ace'. The only correct answer, by J-L & S's truth-functional lights, is that there is a king and no ace. The rate at which this answer was chosen was a meagre 12%.

The upshot of the foregoing ruminations is that there is no good reason for accepting J-L & S's claim that, in the context of their experiments, 'or' and 'if … then' may be regarded as truth-functional expressions. Hence, their grounds for maintaining that the argument in (31)–(32) is fallacious are inconclusive.

But what *is* the status of this argument? In particular, what is the status of (31)? There has been some discussion in the literature over whether such sentences are felicitous at all, and it must be conceded that J-L & S's example is decidedly unnatural. But then there are instances of the same pattern that are quite acceptable, like the following, which are due to Woods (1997: 63):

(33) a. Either he will stay in America if he is offered tenure or he will return to Europe if he isn't.
b. Either she left in disgust, if she found no one there, or she never came in the first place, if the letter changing the date never reached her.
c. Either he is in Rome, if he is in Italy, or he is in Bordeaux, if he is in France.

According to Woods, each of these sentences entails the disjunction of its two consequents, and if he is right about this, as I think he is, J-L & S's purported fallacy is truly and simply valid. Indeed, if Woods is right, J-L & S's argument is valid on the strength of its first premiss alone. Woods maintains that a sentence of the form

(34) If $S_1$ then $S_1'$ or if $S_2$ then $S_2'$

is really a 'telescoped version' of

(35) $S_1'$ or $S_2'$; if $S_1$ then $S_1'$; if $S_2$ then $S_2'$

Although this line of explanation gives us what we want, it is plainly *ad hoc*,[14] and I think we can do better.

Following up on the discussion of modals and conditionals in section 3, I assume that the logical form underlying (34) must bring out the fact that an *if*-clause restricts the domain of a modal operator, which defaults to epistemic necessity:

(36) $A_1 \cdot B_1 \Box B'_1 \wedge A_2 \cdot B_2 \Box B'_2$

Here, $B_1$, $B'_1$, $B_2$, and $B'_2$ correspond to $S_1$, $S'_1$, $S_2$, and $S'_2$, respectively, while $A_1$ and $A_2$ encode the context-dependent domains of the two modals. A conditional $A \cdot B \Box B'$ is interpreted just like an ordinary modal, though with the additional requirement that $A = C \cap B$, i.e. the presupposed domain A is to contain all and only those worlds in the background set C that verify the antecedent of the conditional. Thus we obtain the following interpretation for sentences of the form (34), as interpreted against background C, with $A_1 \subseteq C$ and $A_2 \subseteq C$:

| | |
|---|---|
| First disjunct: | $C \cap B_1 \subseteq B'_1$ |
| Second disjunct: | $C \cap B_2 \subseteq B'_2$ |
| Exhaustivity: | $C \subseteq B_1 \cup B_2$ |
| Disjointness: | $C \cap B_1 \cap B_2 = \emptyset$ |

It follows from this that all worlds in C are $B'_1$-worlds or $B'_2$-worlds, and thus Woods's intuition that (34) entails $S'_1$ or $S'_2$ is vindicated without grammatical trickery.

To conclude this section, let us have a last look at Johnson-Laird and Savary's example (31), which I repeat here for convenience:

(37) If there is a king in the hand then there is an ace in the hand, or else if there isn't a king in the hand then there is an ace in the hand.

I have tried to show why, contrary to what Johnson-Laird and Savary contend, this sentence does entail that there is an ace in the hand. But it was also noted that this sentence is barely acceptable. The analysis I have proposed explains why this is so. It is because there is a much shorter way of

[14] I should note that Woods's own argument is not affected by this, because his point is that conditionals don't have truth values, and therefore resist being embedded under truth-functional operators, in the first place. Consequently, Woods suggests, conditionals that do occur in such an environment cannot be interpreted except by way of *ad hoc* strategies.

expressing what (37) says, viz. 'There is an ace in the hand.' Moreover, even if the second consequent in (37) had been different from the first, the second antecedent would still be redundant.

## 5. Exclusive 'Or' and Disjointness

It is widely held that the exclusive interpretation of 'or' is due to a scalar implicature. On this view, it is taken for granted that 'or' and 'and' form an entailment scale: a conjunction entails the corresponding disjunction, but not vice versa, and therefore a speaker who utters the latter will be taken to believe that the former is false – whence the exclusive interpretation of 'or'. For example, someone who states (38a) ostensibly fails to produce the stronger statement in (38b), thus implicating that it is false:

(38) a. Gray is a professor of law or a judge.
b. Gray is a professor of law and a judge.

That the standard account of exclusive 'or' is flawed is shown by the following variation on (38a):

(39) Gray is either a professor of law or a professor of law and a judge.

On the standard view (39), though stronger than (38a), is still weaker than (38b). Therefore, it too should implicate that (38b) is false, which it doesn't.[15] This is a problem for the scalar account, obviously, and it is acerbated by the fact that the most natural reading of (39) *is* exclusive in a way. For the sentence would normally be construed as conveying that:

(40) Gray is either a professor of law and not a judge or a professor of law and a judge.

Somewhat paradoxically, the same holds for examples that are routinely used to illustrate that 'or' can be read inclusively, like the following:

(41) Gray is either a professor of law or a judge or both.

Clearly, what this is to convey is that there are three distinct possibilities: Gray has both professions or either one to the exclusion of the other. This is

[15] This is not intended as knock-down argument, because it may still be argued, following Gazdar (1979), that the scalar implicature is cancelled by a clausal implicature. Believers in inter-implicature warfare will find this a plausible line of defense; non-believers won't.

an exclusive reading, to be sure, though not in the sense of the standard analysis.[16]

If disjunctions are covert modals, as I have been arguing in this paper, a conjunction does not entail the corresponding disjunction, so there is no good reason for assuming that 'and' and 'or' form a pragmatic scale. Hence, on the present account there is no obvious way of obtaining the scalar implicature that is usually held responsible for the exclusive reading of 'or'. The theory I propose accounts for exclusive construals of 'or' by means of the Disjointness constraint. This account has all the advantages and none of the drawbacks of the standard theory. By way of illustration, let us consider how the modal theory handles (39). The logical form of this sentence is $A\Diamond B \wedge A'\Diamond(B \wedge B')$, and it is interpreted against an epistemic background C. By default A and A′ would be equated with C, but as Disjointness is violated if $A = C$, we assume that $A \subseteq C$ and $A' = C$. Then we get the following:

| | |
|---|---|
| First disjunct: | $A \cap B \neq \emptyset$ |
| Second disjunct: | $B \cap B' \cap C \neq \emptyset$ |
| Exhaustivity: | $C \subseteq B \cap (A \cup B')$ |
| Disjointness: | $A \cap B \cap B' = \emptyset$ |

Assuming Exhaustivity and Disjointness, it must be the case that all C-worlds are B-worlds, that some C-worlds are B′-worlds, and that some C-worlds are non-B′-worlds. Hence (39) implies that Gray must be a law professor, and that he may or may not be a judge; which is the reading we had to account for.

Thus far I have wielded the Disjointness constraint without stopping to ask where it comes from. But surely this constraint, intuitively appealing though it may be, will have to be motivated somehow, especially if it is to provide an alternative to the standard story about exclusive 'or'. What underlies the Disjointness constraint, I would like to suggest, is a conversational implicature of sorts, though it is not a scalar implicature.[17]

(42) a. Gray is a professor of law.
b. Gray may be a professor of law.

An utterance of (42a) would normally suggest that, according to the speaker, Gray has no other jobs besides being a professor of law, and

[16] See Simons (1998) and references cited there for further discussion of the scalar account of exclusive 'or'.

[17] In the following sketch I am indebted to Groenendijk and Stokhof (1984). Simons (1998) develops a closely related view.

similarly, (42b) would normally be used for entertaining the possibility that that is Gray's one and only profession. Such effects are usually explained in Gricean terms. A sentence like (42a) will typically be used for addressing the question what Gray does for a living, and if a speaker volunteers this sentence there is an expectation that he intends his answer to be complete: if the speaker knew or suspected that Gray has more than one job, (42a) would be a misleading thing to say. The same holds, *mutatis mutandis*, for (42b).

Now according to the modal analysis of disjunction, sentence (43a) should be more or less equivalent to (43b):

(43) a. Gray is a professor of law or a judge.
b. Gray might be a professor of law and he might be a judge.

The two sentences are not fully equivalent, because it seems harder for the first to have a non-exhaustive reading than it is for the second, but that is as it may be. Crucially, both sentences seem to prefer a reading that is exclusive in the sense that in both alternatives under consideration Gray has only one job. In the case of (43b) this cannot be due to a scalar implicature, evidently, and the most natural explanation is an extension of the suggestion made in the last paragraph. That is to say, the two conjuncts of (43b) address the same question, say, what Gray's job is or might be, and as the speaker is supposed to be cooperative, there is a presumption to the effect that he will attempt to specify each alternative in all relevant respects. Hence, in both possible cases entertained by the speaker we are entitled to assume that Gray has just a single job, as a corollary of which it follows that in the first case he is not a judge and in the second he is not a law professor. Whence the exclusive interpretation of (43b). I submit that exactly the same applies for the disjunction in (43a).

It should be observed that, if these remarks are on the right track, what underlies Disjointness is actually a form of exhaustivity. It may not be exactly the same as what I have dubbed the Exhaustivity constraint, but the family resemblance is unmistakable. In view of the waxing popularity of the notion that exhaustivity plays a key role in interpretation (e.g. van Rooy and Schulz 2004), this is surely an appealing result, as it suggests the possibility that the essential constraints on the interpretation of disjunction may all be subsumed by a general theory of exhaustivity. The details of such a reductive account remain to be clarified.

## 6. Narrow Disjunction

Thus far all occurrences of 'or' we encountered were analysed as having wide scope. It would seem, however, that the same problems we have been

concerned with may also occur with narrow-scope disjunctions. For example, (44a) licenses the same inferences as does (44b):

(44) a. It may be here or there.
b. It may be here or it may be there.

The preferred construal of (44a) is the same as that of (44b), and by way of explanation I propose that the former should be analysed on the model of the latter. That is to say, in order to explain why (44a) implies that It may be here and that It may be there, I would assume that 'or' takes wide scope, as it evidently does in (44b). Some authors have expressed doubts about this assumption. For example, Kamp (1979) contends that there are syntactical considerations that militate against a wide-scope construal of 'or' in (44a). I have my doubts about this line of argument. For one thing, it presupposes that scope taking is a syntactic phenomenon, which need not, or not always, be the case. For another, it is easy to construct examples in which a seemingly narrow-scope disjunction must have wide scope:

(45) a. Brown believes that Douala is in Bulgaria or Albania – I forget which.
b. Everyone had either an apple or a pear – I forget which.

It is hard to see how these sentences can be construed other than with 'or' having wide scope, and if this is so, it is unfair to deny (44a) this option.

None of this is to imply that there aren't any problems with narrow-scope disjunction. On the contrary, it is plain that not all occurrences of 'or' can be interpreted as having wide scope, and that for a modal analysis of disjunction this is a cause for concern. I will end this paper with a number of tentative remarks about this problem.

Let me begin by accentuating the positive: some instances of narrow-scope disjunction actually support a modal analysis of 'or':

(46) a. If the first letter is a C, then the last one may be a T or a K.
b. Brown believes that Douala may be in Albania or Bulgaria.

On its most salient interpretation, (46a) has a conditional free-choice reading, which is precisely what we get on the modal account: the antecedent of the conditional restricts the background to those worlds in which the first letter is a C, and the consequent says, with respect to this restricted background, that the last letter may be a T and that it may be a K. (46b) has two readings, depending on whether the disjunction outscopes the attitude verb. The wide-scope reading is unproblematic, as we have just seen (cf. (45a)). If, on the other hand,

'or' is within the scope of 'believes', the disjunction can select Brown's doxastic context as its background. This yields a reading according to which (46b) implies that Brown believes that Douala may be in Albania and that he believes that Douala may be in Bulgaria – which is as it should be.

While the foregoing examples unequivocally support the modal theory of disjunction, there are other instances of narrow-scope 'or' that, *prima facie* at least, don't:

(47) a. Green never went to Yaounde or Bujumbura.
b. If the last letter is a T or a K, the first one must be a C.

We don't have to enter into details to see that these sentences are troublesome. The problem exemplified by (47a) is that a negated disjunction should entail the negation of either disjunct. But since we are treating disjunctions as conjunctions it is unclear how we could capture this observation. That (47b) is problematic can be seen as follows. I have claimed that one of the virtues of the modal analysis is that it blocks disjunction introduction: if S holds we cannot infer that S or S′ holds. This is plausible, even desirable, because untutored informants usually reject arguments of this form. But if (47b) is given and it is given that the last letter is a T, then we should be entitled to infer that the first letter is a C, and this inference remains unaccounted for, because it requires disjunction introduction. Strangely enough, the modal analysis runs into trouble if 'or' occurs in the antecedent of a conditional but not if it occurs in the consequent, as we saw in our discussion of (46a).

On the face of it, the way negation interacts with disjunction, as illustrated by (47a), also seems to favour a Boolean account of the connectives. On closer inspection, however, it appears that Boolean theories have their share of worries, too:

(48) a. Brown isn't tall and handsome.
b. Why didn't she stand up and sing the national anthem?

Clearly, the default interpretation of (48a) is that Brown is neither tall nor handsome, and (48b) is preferably heard as implying that the woman in question didn't stand up and didn't sing the national anthem (cf. Szabolcsi and Haddican 2004). In these cases, the reading predicted by a Boolean account of negation and conjunction is marked, though it can be brought to the fore by stressing 'and':

(49) Brown isn't tall AND handsome; he is just tall.

Two lessons may be drawn from these observations. One is that Boolean theories fail precisely where they should outshine alternative accounts, that

is, when the interplay between connectives is essential. Another is that examples like (47a) are not as damaging to the modal account as they initially seem. For, given the data in (48), we might conjecture that whatever turns out to be the right analysis of negated conjunctions will carry over to negated disjunctions, which on a modal analysis *are* negated conjunctions.

However, there is also another, more ecumenical, way of approaching the issue of narrow-scope 'or'. In order to explain how, let us have a closer look at conditionals. According to the analysis adopted here, the two sentential constituents of a conditional are quite different in status, as in a proposition of the form 'If A then B', the A-part serves to restrict the range of application of the B-part. This view implies, or may be taken to imply, that the antecedent really isn't part of the speech act the conditional is used to make; it is presupposed. This diagnosis is confirmed by the fact that non-declaratives may occur as consequents but not as antecedents:

(50) a. If Brown is in Ouagadougou, where is Green?
b. *If where is Green, Brown is in Ouagadougou.

(51) a. If Jones calls, tell him to drop dead.
b. *If tell Jones to drop dead, he calls.

Another observation that points towards a fundamental asymmetry between antecedents and consequents is that one environment restricts the interpretation of modals in a way the other does not. In particular, what we might call 'de se' modality seems to be confined to conditional consequents:

(52) a. If you will give me an apple, you may have a pear.
b. If you may have a pear, you will give me an apple.

(53) a. If Brown is in Ouagadougou, Green may be with him.
b. If Green may be in Ouagadougou, Brown is with her.

Clearly, the 'may' in (52b) cannot have the permission-giving reading that it has in (52a), and the 'may' in (53b) cannot have the epistemic reading that it has in (53a).

It appears, therefore, that antecedents and consequents deal in different kinds of information. The latter serve to commit the speaker to an opinion, a desire, a course of action, or whatever, while the former demarcate the domain within which such commitments holds. Let us call these two types of content 'speaker's content' and 'factual content', respectively.

In this paper I have been primarily concerned with the speaker's content of disjunctive and modal propositions, and it is implicit in the proposal I

have made that the primary use of modals and disjunctions is to express commitments on the part of the speaker. But perhaps modals and disjunctions have factual as well as speaker's content, and if they have, the factual content of 'or' would be our old friend, Boolean disjunction. What I am suggesting, then, is that a sentence like (54) can be analysed on two levels. On the level of speaker's content, the question is what commitments a speaker incurs by uttering this sentence. On the level of factual content, the question is what facts would verify or falsify his statement.

(54) It is here or there.

If we distinguish between speaker's content and factual content, how are the two related? The answer, I would like to suggest, is that one type of content is derivable from the other, though not in the way one might expect. For, if the modal analysis of disjunction is on the right track, it is not always possible to infer the speaker's content of a disjunctive sentence from its factual content. The easiest way of showing this is that Boolean disjunction would make every occurrence of 'or' exhaustive, and one of the pillars of the modal account is that Exhaustivity does *not* hold across the board. However, it is possible to derive the factual content of a disjunction from its speaker's content, and in a straightforward fashion, too. According to the modal theory, the speaker's content of (54) would be that he considers it possible that It is here and that It is there, and that he does not consider it possible that It is somewhere else. What must the world be like to *justify* the speaker's opinion? Obviously, the speaker is right if the actual world is among the worlds he considers possible; that is, he is right if It is here or there, and wrong otherwise. Thus the factual content of a disjunction derives from its speaker's content.

If this is how factual content and speaker's content hang together, then many sentences don't have factual content. For example, deontic modals are not justified by the way the world is. Nor would it be correct to say that all epistemic modals have factual content, in my sense of the word. If I say that it must be raining, then I'm right iff it is raining; but if I say that it may be raining, and it isn't raining, then I am not wrong (though I am not right, either). Similarly, it follows that not all epistemic disjunctions have factual content. In particular, if a disjunction '$S_1$ or … or $S_n$' is construed in a non-exhaustive way, it leaves open the possibility that none of $S_1$ … $S_n$ is true, and therefore does not have factual content.

Suppose now that certain linguistic environments coerce factual construals, while others don't. Suppose, in particular, that if a modal or a disjunction occurs in the antecedent of a conditional or within the scope of a

negation sign, it is factual content that is called for, rather than speaker's content. Then we can account for negated disjunctions and the curious asymmetry between the antecedent and the consequent of a conditional. Hence, the Boolean story is vindicated, after all, though within rather narrow limits.

## References


Barrouillet, P. and J.-F. Lecas: 2000, 'Illusory Inferences from a Disjunction of Conditionals: A New Mental Models Account', *Cognition* **76**, 167–173.

Edgington, D.: 1995, 'On Conditionals', *Mind* **104**, 235–329.

Frank, A.: 1997, *Context Dependence in Modal Constructions*, Doctoral dissertation, University of Stuttgart.

Gazdar, G.: 1979, *Pragmatics: Implicature, Presupposition, and Logical Form*. Academic Press, New York.

Geurts, B.: 1999, *Presuppositions and Pronouns*. Elsevier, Oxford.

Geurts, B.: 2004, 'On an Ambiguity in Quantified Conditionals', ms, University of Nijmegen.

Geurts, B.: (to appear), 'Existential Import', in I. Comorovski and K. von Heusinger (eds.), *Existence: Syntax and Semantics*. Kluwer, Dordrecht.

Groenendijk, J. and M. Stokhof: 1984, *Studies on the Semantics of Questions and the Pragmatics to Answers*, Doctoral dissertation, University of Amsterdam.

Johnson-Laird, P. and F. Savary: 1996, 'Illusory Inferences about Probabilities', *Acta Psychologica* **93**, 69–90.

Johnson-Laird, P. and F. Savary: 1999, 'Illusory Inferences: A Novel Class of Erroneous Deductions', *Cognition* **71**, 191–229.

Kamp, H.: 1979, 'Semantics versus Pragmatics', in F. Guenthner and S. Schmidt (eds.), *Formal Semantics and Pragmatics of Natural Language*, pp. 255–287. Reidel, Dordrecht.

Kratzer, A.: 1979, 'Conditional Necessity and Possibility', in R. Bäuerle, U. Egli, and A. von Stechow (eds.), *Semantics from Different Points of View*, pp. 117–147. Springer-Verlag, Berlin.

Kratzer, A.: 1999a, 'Conditionals', in A. von Stechow and D. Wunderlich (eds.), *Semantics: An International Handbook of Contemporary Research*, pp. 651–656. De Gruyter, Berlin.

Kratzer, A.: 1999b, 'Modality', in A. von Stechow and D. Wunderlich (eds.), *Semantics: An International Handbook of Contemporary Research*, pp. 639–650. De Gruyter, Berlin.

Lewis, D. K.: 1975, 'Adverbs of Quantification', in E. L. Keenan (ed.), *Formal Semantics of Natural Language*, pp. 3–15. Cambridge University Press, Cambridge.

Paris, S.: 1973, 'Comprehension of Language Connectives and Propositional Logical Relationships', *Journal of Experimental Child Psychology* **16**, 278–291.

Schulz, K.: 2003, *You May Read It Now or Later: A Case Study on the Paradox of Free Choice Permission*, Master thesis, University of Amsterdam.

Simons, M.: 1998, *Issues in the Semantics and Pragmatics of Disjunction*, PhD thesis, Cornell University.

Simons, M. (to appear), 'Dividing Things Up: The Semantics of *Or* and Model/*Or* Interaction', *Natural Language Semantics*.

Szabolcsi, A. and B. Haddican: 2004, 'Conjunction Meets Negation: A Study in Crosslinguistic Variation', *Journal of Semantics* **21**, 219–249.

van Rooy, R. and K. Schulz: 2004, 'Exhaustive Interpretation of Complex Sentences', *Journal of Logic, Language and Information* **13**, 491–519.

Woods, M.: 1997, *Conditionals*. Clarendon Press, Oxford.

Zimmermann, T. E.: 2000, 'Free Choice Disjunction and Epistemic Possibility', *Natural Language Semantics* **8**, 255–290.
Zvolenszky, Z.: 2002, 'Is a Possible Worlds Semantics of Modality Possible? A Problem for Kratzer's Semantics', in B. Jackson (ed.), *Proceedings of SALT 12*, pp. 339–358. CLC Publications, Ithaca, N.Y.

Philosophy Department
University of Nijmegen
P.O. Box 9103
6500 HD Nijmegen
The Netherlands
E-mail: bart.geurts@phil.kun.nl