

DISJUNCTION IN ALTERNATIVE SEMANTICS

A Dissertation Presented

by

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I came to Amherst in 1998 fleeing a small provincial university in rainy Northern Spain. A year before, on my own, I had come across a handbook paper on modality by Angelika Kratzer. It had been my first encounter with formal semantics. I still remember the fascination. I also remember the disappointment: I knew nothing about formal linguistics and didn't understand a word. Who would have imagined back then that I would be writing this dissertation?

This dissertation owes its existence to the dedicated effort, contagious energy, and infectious optimism of my many teachers and friends at South College. I am truly indebted to everybody who makes the Department of Linguistics at UMass Amherst such a utopian learning environment. The members of my dissertation committee — Kai von Fintel, Lyn Frazier, Kevin Klement, Barbara Partee, Chris Potts — and quite especially its chair — Angelika Kratzer — have played an important role in my education and deserve my deepest gratitude.

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Meeting Sandy — who, by the way, prefers chocolate to ice cream or cake — was a miracle. Since we first started talking about the meaning of life in the parks of Oviedo

and Avilés, she has been my best friend, and the best accomplice for all kinds of crazy journeys. This was no different. I would not have survived this dissertation without her constant support, encouragement, *really* twisted sense of humor, and incredulous smile. I owe her much more than I could ever acknowledge here.

ABSTRACT

DISJUNCTION IN ALTERNATIVE SEMANTICS

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The standard semantic analysis of natural language disjunction maintains that *or* is the Boolean join. This dissertation makes a case for a Hamblin-style semantics, under which disjunctions denote *sets* of propositions.

Chapter 2 shows that the standard semantics does not capture the natural interpretation of counterfactual conditionals with disjunctive antecedents. Together with a standard minimal change semantics for counterfactuals, the standard semantics predicts that these counterfactuals are evaluated by selecting the closest worlds from the union of the propositions that *or* operates over. Their natural interpretation, however, requires selecting the closest worlds from each of the propositions that *or* operates over. This interpretation is predicted under a Hamblin-style semantics if conditionals are analyzed as correlative constructions.

Chapter 3 deals with the exclusive component of unembedded disjunctions. The exclusive component of a disjunction *S* with more than two atomic disjuncts can be derived as an implicature if *S* competes in the pragmatics with all the conjunctions that can be formed out of its atomic disjuncts. The generation of these pragmatic competitors proves challenging

under the standard analysis of *or*, because the interpretation system does not have access to the atomic disjuncts. Under a Hamblin semantics, however, the required pragmatic competitors can be generated by mapping each non-empty subset \mathcal{B} of the denotation of *S* to the proposition that is true in a world w if and only if all the members of \mathcal{B} are true in w .

Chapter 4 investigates the interpretation of disjunctions under the scope of modals. When uttered by a speaker who knows who may have what, a sentence of the form of *Sandy may have ice cream or cake* naturally conveys that Sandy has two rights: the right to have ice cream, and the right to have cake. Under the standard analysis of *or* and modals, however, the sentence is predicted to be true as long as Sandy has at least one of the rights. A Hamblin style analysis allows for the derivation of the requirement that Sandy has two rights as an implicature of domain widening.

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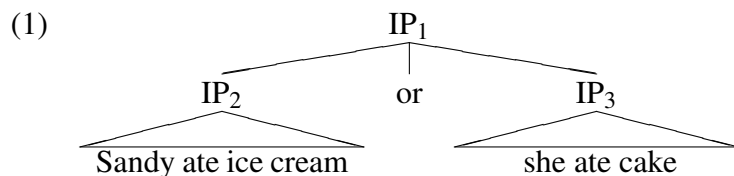
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CHAPTER 1

INTRODUCTION

1.1 The thesis

The standard textbook analysis assumes that natural language disjunction (henceforth *or*) is the binary inclusive disjunction of propositional logic.¹ This analysis has been generalized to cover the cases where *or* operates over constituents whose denotations are not truth-values, but are in domains with Boolean structure.² Consider, for instance, the disjunction in (1):



We will assume that *or* operates over two propositions in (1). According to the standard semantic analysis, *or* is set union. In the structure in (1), *or* maps the proposition in (2a) and the proposition in (2b) to the set of possible worlds containing the worlds where Sandy ate ice cream and the worlds where she ate cake.

- (2)
- a. $\llbracket \text{Sandy ate ice cream} \rrbracket = \{w \mid \text{Sandy ate ice cream in } w\}$
 - b. $\llbracket \text{Sandy ate cake} \rrbracket = \{w \mid \text{Sandy ate cake in } w\}$
 - c. $\llbracket \text{IP}_1 \rrbracket = \llbracket \text{Sandy ate ice cream} \rrbracket \cup \llbracket \text{Sandy ate cake} \rrbracket$

¹David Dowty and Peters (1981, 33), de Swart (1998, 56-57), Chierchia and McConnell-Ginet (2000, 80), Kamp and Reyle (1993, 192), among others, discuss this analysis.

²See, for instance, Gazdar 1979, von Stechow 1974, Keenan and Faltz 1978, Keenan and Faltz 1985, and Partee and Rooth 1983. Those readers that are not familiar with the cross-categorial analysis of *or* as the Boolean join can check appendix C on page 211 for a short review.

This dissertation makes a case for a different semantics, under which *or* introduces into the semantic derivation a set of propositional alternatives. The disjunction in (1) denotes, under this view, the set of propositions containing the proposition that Sandy ate ice cream and the proposition that Sandy ate cake.

$$(3) \quad \llbracket \text{IP}_1 \rrbracket = \left\{ \begin{array}{l} \llbracket \text{Sandy ate ice cream} \rrbracket, \\ \llbracket \text{Sandy ate cake} \rrbracket \end{array} \right\}$$

The case for this semantics is built on the investigation of three long-standing problems for the standard analysis of *or*: chapter 2 deals with the interpretation of counterfactuals with disjunctive antecedents, chapter 3 with the derivation of the exclusive component of unembedded disjunctions, and chapter 4 with the interpretation of disjunctions under the scope of modals.

1.2 Disjunctive counterfactuals

The standard analysis of *or* does not capture the natural interpretation of counterfactuals with disjunctive antecedents.

Consider, for instance, the counterfactual in (4) below.

- (4) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. (A variation on an example in Nute 1975)

Suppose that the sentence in (4) is uttered by a farmer who is complaining about the many pumpkin plants that the bad weather ruined this summer. It would be natural to disagree with him on the basis of the observation that the crop would have been ruined if the sun had grown cold. The standard analysis of *or*, however, when coupled with a standard minimal change semantics for counterfactuals (Stalnaker, 1968; Stalnaker and Thomason, 1970; Lewis, 1973) predicts the counterfactual in (4) to be true.

In a minimal change semantics, the counterfactual in (4) is predicted to be true in the actual world if and only if the proposition expressed by its consequent is true in all worlds

where its antecedent is true that are most similar to the actual world.³ According to the standard analysis of *or*, the antecedent of the counterfactual in (4) denotes the union of the set of worlds where we had good weather this summer and the set of worlds where the sun grew cold:

$$(5) \quad \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \text{or} \\ \text{the sun had grown cold} \end{array} \right] = \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \cup \\ \text{[[the sun had grown cold]]} \end{array} \right]$$

The possible worlds where the sun grows cold are less similar to the actual world than the worlds where we have a good summer: in a world where the sun grows cold, many more things have to be different from the actual way things are than in a world where we have a good summer. That means that the worlds in the set in (5) that come closest to the actual world are all worlds where we have a good summer. Since, presumably, in all the closest worlds where we have a good summer, we have a bumper crop, the counterfactual in (4) is predicted to be true.⁴

Under its natural interpretation, the counterfactual in (4) claims that all the closest worlds in which we have a good summer are worlds where we have a bumper crop, and that so are all the closest worlds in which the sun grows cold. Looking at the closest worlds in the union of the propositions that *or* operates over is not enough. To capture its natural interpretation, the semantic composition of the counterfactual in (4) needs to select from the denotation of the antecedent the closest worlds in each of the propositions that *or* operates over.

³The reader is referred to chapter 2, section 2.2 (page 15) for a more rigorous presentation of the minimal change semantics that I am assuming here.

⁴The problem was spotted right after Lewis 1973 came out (Creary and Hill, 1975; Nute, 1975; Ellis *et al.*, 1977; Fine, 1975). Lewis' short answer to the problem can be found in Lewis 1977. Nute 1984 provides an overview of the work on the topic in the philosophical literature (Nute 1978, Humberstone 1978, Hardegreve 1982, Nute 1980, Warmbröd 1981, among others). Lycan 2001 and Bennett 2003 are more recent references that contain brief discussions of the problem.

Chapter 2 shows that this interpretation is predicted if conditionals are analyzed as correlative constructions (as argued for in von Stechow 1994, Izvorski 1996, Bhatt and Pancheva 2006 and Schlenker 2004) and an alternative based semantics for *or* is adopted, under which the antecedent of the counterfactual in (4) denotes the set of propositions in (6).

$$(6) \quad \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \text{or} \\ \text{the sun had grown cold} \end{array} \right] = \left\{ \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \text{[[the sun had grown cold]]} \end{array} \right], \right\}$$

1.3 The exclusive component

In a short reply to his critics (Lewis, 1977), David Lewis suggested in passing moving beyond the standard analysis of *or* to capture the natural interpretation of disjunctive counterfactuals. He justified the move as follows:

Isn't it badly *ad hoc* to solve a problem in counterfactual logic by complicating our treatment of 'or'? When we have a simple, familiar, unified treatment (marred only by the irrelevant question of exclusivity) wouldn't it be more sensible to cherish it? I reply that if I considered our present problem in isolation, I would share these misgivings. But parallel problems arise from other constructions, so our nice uncomplicated treatment of 'or' is done for in any case. Consider:

- (4) I can lick any man in the house, or drink the lot of you under the table.
- (5) It is legal for you to report this as taxable income or for me to claim you nas a dependent.
- (6) Holmes now knows whether the butler did it or the gardener did.

Take the standard treatment of 'or'. Try wide or narrow scope; try inclusive or exclusive. (4-6) will prove as bad as (1).

- (1) If either Oswald had not fired or Kennedy had been in a bullet-proof car, then Kennedy would be alive today.

(Lewis, 1977, 360-361)

Following Lewis' observation, the case for an alternative semantics of *or* is strengthened by investigating other constructions where, as in the case of disjunctive counterfactuals, each atomic disjunct must be visible to the interpretation mechanism. Chapter 3 deals

with the interpretation of unembedded disjunctions, and Chapter 4 with the interpretation of sentences like Lewis' example (4), where disjunction is under the scope of a modal.

Unembedded disjunctions are usually interpreted as providing a list of mutually exclusive epistemic possibilities. Consider, for instance, the dialogue in (7) below:

- (7) a. Dad: "What did Sandy eat for dessert?"
b. Mom: "She ate ice cream, cake, or *crème caramel* — I am not sure which."

Mom's utterance in (7b) naturally conveys that Sandy ate exactly one of the three desserts. Chapter 3 discusses the derivation of this meaning component, which I will call, from now on, 'the exclusive component'.

To capture the exclusive component of *or*, the interpretation mechanism needs to have access to all atomic disjuncts. To see why, assume, for instance, that the exclusive component is to be captured by means of an exclusive disjunction connective.⁵ The formula in (8) below translates *or* with a binary exclusive connective:

$$(8) (I \vee C) \vee K$$

The truth-conditions of the formula in (8) do not capture the exclusive component of (7b), because the formula in (8) is true if and only if Sandy ate at most one or else *all three* desserts. If the exclusive component of *or* is to be captured by an exclusive disjunction connective, it should be one that conveys that exactly one of its *atomic* disjuncts is true.⁶

A similar problem arises under the textbook analysis if the exclusive component is to be derived as a scalar implicature.⁷ The exclusive component of a disjunction with two atomic disjuncts, like the one in (9a), can be captured by assuming that its scalar alternative

⁵Notation: ' \vee ' is a binary exclusive disjunction connective (a function which maps a pair of propositions A and B to the proposition that is true if and only if exactly one of the two propositions is true). 'I', 'C', and 'K' stand for the propositions that Sandy ate ice cream, that she ate cake, and that she ate *crème caramel*.

⁶The observation that the interpretation mechanism needs access to each atomic disjunct can be traced back to Reichenbach (1947).

⁷See McCawley 1993, Lee 1995, Lee 1996, and Simons 1998.

in (10a) is false (Horn, 1972; Gazdar, 1979): if (9b) is true, and (10b) is false, then either Sandy ate ice cream, but not *crème caramel*; or she ate *crème caramel*, but not ice cream.

(9) a. Sandy ate ice cream or *crème caramel*.

b. $I \vee K$

(10) a. Sandy ate ice cream and *crème caramel*.

b. $I \& K$

But consider now a disjunction with three atomic disjuncts, like the one in (11a) below.

(11) a. Sandy ate ice cream, cake, or *crème caramel*.

b. $(I \vee C) \vee K$

The negation of none of the claims in (12a-12c) derives the exclusive component of (11a): the negation of (12a) entails that Sandy didn't eat *crème caramel*, the negation of (12b) is compatible with Sandy having eaten both ice cream and cake, and the negation of (12c) is compatible with Sandy having eaten two of the desserts.

(12) a. $(I \& C) \vee K$

b. $(I \vee C) \& K$

c. $(I \& C) \& K$

If the computation of the exclusive component could have access to the atomic disjuncts of (11a), the derivation of its exclusive component would not be challenging. The exclusive component of (11a) can be captured by negating all the stronger claims in (13), which correspond to the conjunction of the atomic disjuncts of (11a).

(13) a. $I \& C$

b. $I \& K$

c. $K \& C$

But how do these claims enter the computation of the exclusive component?

Under the alternative based semantics, the disjunction in (11a) denotes the set containing the proposition that Sandy ate ice cream, the proposition that she ate cake, and the proposition that she ate *crème caramel*.

- (14) a. Sandy ate ice cream, cake, or *crème caramel*.
 b. $\llbracket(14a)\rrbracket = \{I, C, K\}$

We can generate the propositions in (13) by mapping every non-empty subset of (14b) \mathcal{B} to the proposition that is true in a world w if and only if all members of \mathcal{B} are true in w :

- (15) a. For any sentence S ,

$$\llbracket S \rrbracket_{\text{ALT}, \cap} = \{p \mid \exists \mathcal{B} [\mathcal{B} \in \wp(\llbracket S \rrbracket) \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cap \mathcal{B}]\}$$

 b. $\llbracket(14a)\rrbracket_{\text{ALT}, \cap} = \left\{ \begin{array}{c} I \ \& \ C \ \& \ K, \\ I \ \& \ C, I \ \& \ K, C \ \& \ K, \\ I, C, K \end{array} \right\}$

The proposal presented in Sauerland 2004 generates the competing claims in (13) without moving beyond the textbook semantics of *or* by resorting to an algorithm that retrieves each atomic disjunct syntactically. Fox 2006 presents a strengthening procedure that delivers the exclusive component for disjunctions with more than two disjuncts by assuming the Sauerland algorithm. In chapter 3 we will see that, because (16a) and (17a) are equivalent under the standard analysis, the algorithm generates the same competing claims for (16a) and (17a), and, as a result, the strengthening of either sentence conveys that Sandy didn't eat both ice cream and cake.

- (16) a. Sandy ate ice cream or cake.
 b. $I \vee C$
 (17) a. Sandy ate ice cream, cake, or both.
 b. $(I \vee C) \vee (I \ \& \ C)$

Assuming an alternative semantics for *or* will allow for a natural extension of the strengthening procedure in Fox 2006 that avoids this unwelcome prediction.

1.4 Disjunction and modals

Chapter 4 investigates the interpretation of disjunctions under the scope of modals.

Suppose that Sandy's dad, who decides who may have what for dessert, were to utter the sentence in (18) below:

(18) Sandy may have cake or ice cream.

His utterance would naturally convey that Sandy has two rights (the right to have cake and the right to have ice cream). The standard analysis of *or*, however, when taken together with the standard analysis of *may* fails to predict that.⁸

According to the standard analysis, *may* denotes a function from propositions to propositions that takes a proposition p — its *prejacent*, following the usage in von Stechow (2006) — and returns the proposition that is true in a world w if and only if p contains at least one world w' that is permitted in w . Suppose that the prejacent of *may* in (18) is the proposition expressed by the sentence in (19) below:

(19) Sandy has cake or ice cream.

According to the standard analysis of *or*, the sentence in (19) expresses the proposition in (20): the union of the set of worlds where Sandy has cake and the set of worlds where she has ice cream.

(20) $\llbracket \text{Sandy has cake} \rrbracket \cup \llbracket \text{Sandy has ice cream} \rrbracket$

The sentence in (18) is then predicted to be true in a world w if and only if the proposition in (20) contains at least one world that is permitted in w .

⁸The problem was first discussed in recent times in the literature on deontic logic (von Wright, 1968, 1981) and brought into linguistics by Hans Kamp (Kamp, 1973, 1978).

These truth-conditions are too weak. They do not make sure that Sandy has both the right to have cake and the right to have ice cream. The sentence in (18) is predicted to be true in a world w in which Sandy is permitted to have that cake, but is not permitted to have ice cream. Claiming that there is at least one permitted world in the union of the propositions that *or* operates over is not enough. The sentence in (18) conveys that there is at least one permitted world in *each* of the propositions that *or* operates over. The interpretation mechanism must then entertain representations where the modal combines with each individual disjunct on its own.

This conclusion has prompted the move to an alternative semantics for *or* (Aloni, 2003; Simons, 2005). If the disjunction in (18) were to denote the set of propositions in (21), the modal could access each atomic disjunct in the semantics, and it could be taken to claim that *all* atomic disjuncts are permitted. The proposition expressed by the sentence in (21) would then be true in a world w if and only if Sandy has both the right to have cake and the right to have ice cream in w .

$$(21) \quad \left\{ \begin{array}{l} \llbracket \text{Sandy has cake} \rrbracket, \\ \llbracket \text{Sandy has ice cream} \rrbracket \end{array} \right\}$$

The analysis presented in chapter 4 follows Aloni 2003 and Simons 2005 in resorting to an alternative semantics to capture the requirement that each disjunct be permitted (which I call ‘the distribution requirement’, following Kratzer and Shimoyama 2002), but it departs from those analyses — and others, like the ones presented in Zimmerman 2001 and Geurts 2005 — in that it does not assume that the distribution requirement is truth-conditional. The analysis that I pursue in chapter 4 shows that if an alternative semantics for *or* is assumed, the distribution requirement can be derived as a domain widening implicature.

1.5 Disjunction in a Hamblin semantics

The proposal that *or* introduces a set of propositional alternatives will be cast in a Hamblin-style alternative semantics.⁹

In a Hamblin semantics, expressions of type τ are mapped to sets of objects in D_τ . Most lexical items denote singletons containing their standard denotations: the individual-denoting DPs in (22a-22c) are mapped to singletons containing an individual, the verbs in (23) are mapped to singletons containing a property, and the modals in (24) to singletons containing a function from propositions to propositions.¹⁰

$$(22) \quad \text{a. } \llbracket \text{Sandy} \rrbracket = \{\mathbf{s}\}$$

$$\text{b. } \llbracket \text{Moby Dick} \rrbracket = \{\mathbf{m}\}$$

$$\text{c. } \llbracket \text{Huckleberry Finn} \rrbracket = \{\mathbf{h}\}$$

$$(23) \quad \text{a. } \llbracket \text{sleep} \rrbracket = \{\lambda x. \lambda w. \text{sleep}_w(x)\}$$

$$\text{b. } \llbracket \text{read} \rrbracket = \{\lambda y. \lambda x. \lambda w. \text{read}_w(x, y)\}$$

(24) Where \mathcal{D}_w is the set of worlds deontically accessible from w ,

$$\text{a. } \llbracket \text{may} \rrbracket = \{\lambda p_{\langle s, t \rangle}. \lambda w. \exists w' [w' \in \mathcal{D}_w \ \& \ p(w')]\}$$

$$\text{b. } \llbracket \text{must} \rrbracket = \{\lambda p_{\langle s, t \rangle}. \lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow p(w')]\}$$

Within this setup, it is natural to assume that the only role of *or* is to introduce into the semantic derivation the denotation of its disjuncts as alternatives.¹¹

⁹Charles Leonard Hamblin developed an alternative semantics in his analysis of questions (Hamblin, 1973). A Hamblin semantics has been invoked in the analysis of focus (Rooth, 1985, 1992), and indeterminate pronouns (Ramchand, 1997; Hagstrom, 1998; Kratzer and Shimoyama, 2002; Alonso-Ovalle and Menéndez-Benito, 2003)

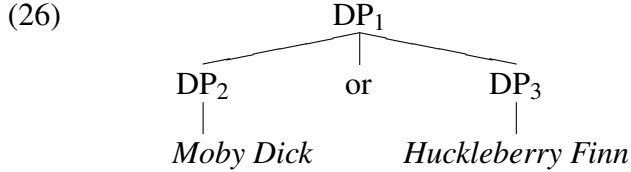
¹⁰I use a two-typed language as my metalanguage (Gallin, 1975). World arguments are subscripted.

¹¹I will represent the internal structure of disjunctions at LF as flat. It is immaterial for the present analysis whether it is, but the reader is referred to Munn 1993 and den Dikken 2003, where the internal structure of disjunctive constituents is assumed *not* to be flat.

(25) *The Or Rule*

$$\text{Where } \llbracket \mathbf{B} \rrbracket, \llbracket \mathbf{C} \rrbracket \subseteq D_\tau, \left[\begin{array}{c} \mathbf{A} \\ \swarrow \quad \downarrow \quad \searrow \\ \mathbf{B} \quad \text{or} \quad \mathbf{C} \end{array} \right] \subseteq D_\tau = \llbracket \mathbf{B} \rrbracket \cup \llbracket \mathbf{C} \rrbracket$$

Take, as an illustration, the DP disjunction below:



Each disjunct denotes a singleton containing an individual:

- (27) a. $\llbracket \text{DP}_2 \rrbracket = \{\mathbf{m}\}$
 b. $\llbracket \text{DP}_3 \rrbracket = \{\mathbf{h}\}$

The denotation of the disjunction is the set containing both individuals:

(28) $\llbracket \text{DP}_1 \rrbracket = \llbracket \text{DP}_2 \rrbracket \cup \llbracket \text{DP}_3 \rrbracket = \{\mathbf{m}, \mathbf{h}\}$

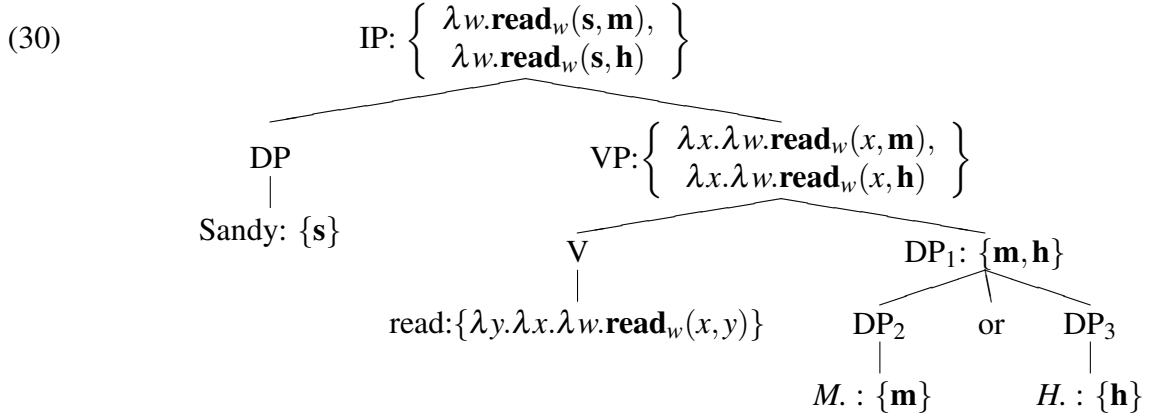
We will only be concerned for the most part with the way expressions combine by functional application. In a Hamblin semantics, a pair of expressions denoting a set of objects of type $\langle \sigma, \tau \rangle$ and a set of objects of type σ combine by means of a pointwise functional application rule: every object of type $\langle \sigma, \tau \rangle$ applies to every object of type σ , and the outputs are collected in a set.

(29) *The Hamblin Rule*

If $\llbracket \alpha \rrbracket \subseteq D_{\langle \sigma, \tau \rangle}$ and $\llbracket \beta \rrbracket \subseteq D_\sigma$, then

$$\llbracket \alpha(\beta) \rrbracket = \{ c \in D_\tau \mid \exists a \in \llbracket \alpha \rrbracket \exists b \in \llbracket \beta \rrbracket (c = a(b)) \} \quad (\text{Hamblin, 1973})$$

The alternatives introduced by *or* determine, via the successive application of the Hamblin Rule, a set of propositional alternatives. The process is illustrated in the tree in (30) below:



A number of propositional operators can combine with the propositional alternatives introduced by *or*. In chapter 2 I will argue that the propositional alternatives introduced by *or* set up the domain of quantification of a universal quantifier associated with conditionals, which will be analyzed as correlative constructions. In chapter 4 we will assume that the propositional alternatives introduced by *or* can be caught by an Existential Closure operator triggered under the immediate scope of modals. This Existential Closure operator maps a set of propositional alternatives \mathcal{A} into the singleton containing the proposition that is true in a world w if and only if at least one of the propositions in \mathcal{A} is true in w .

(31) *Existential Closure*

$$\text{Where } \llbracket \mathbf{A} \rrbracket \subseteq D_{\langle s, t \rangle}, \quad \left[\left[\begin{array}{c} \exists \mathbf{P} \\ \wedge \\ \exists \mathbf{A} \end{array} \right] \right] = \{\lambda w. \exists p [p \in \llbracket \mathbf{A} \rrbracket \ \& \ p(w)]\}$$

Chapters 3 and 4 deal with the pragmatics of using a specific set of alternatives in the semantic derivation. It will be argued that a set of propositional alternatives \mathcal{A} determines two types of scalar competitors. The first type, which I will call ‘the conjunctive competitors’, is determined, as we saw before in (15a), by mapping any subset \mathcal{B} of \mathcal{A} to the proposition that is true in a world w if and only if all propositions in \mathcal{B} are true in w .

(32) Where $\llbracket \mathbf{A} \rrbracket \subseteq D_{\langle s, t \rangle}$,

$$\llbracket \mathbf{A} \rrbracket_{\text{ALT}, \cap} = \{p \mid \exists \mathcal{B} \in \wp(\llbracket \mathbf{A} \rrbracket) \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cap \mathcal{B}\}$$

The second type, which I will call ‘the subdomain competitors’, is determined by mapping each non-empty subset \mathcal{B} of \mathcal{A} to the proposition that is true in a world w if and only if at least one of the propositions in \mathcal{B} is true in w .

$$(33) \quad \text{Where } \llbracket A \rrbracket \subseteq D_{\langle s,t \rangle}, \\ \llbracket A \rrbracket_{\text{ALT}, \cup} = \{p \mid \exists \mathcal{B} \in \wp(\llbracket A \rrbracket) \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cup \mathcal{B}\}$$

1.6 A research agenda

To conclude this brief introduction, let me mention that adopting a Hamblin semantics for *or* opens up a number of questions which I will not be able to explore in any detail in this dissertation.

In chapter 5, for instance, I point out there is a well attested crosslinguistic connection between *or* and a number of propositional operators — like negation, or the question forming operator (Haspelmath, to appear). Assuming that the only role of *or* is to introduce a number of propositional alternatives naturally leads to exploring the connection between disjunction and the propositional operators that it associates with in language after language, but I will not attempt to do so here.

Another question that I will not attempt to explore is the relation between *or* and *and*. Under the setup that I presented, *or* does not have any existential force of its own. Its only role is to introduce a set of propositional alternatives into the semantic derivation. An external Existential Closure operator is responsible for the existential force traditionally associated with *or*. It remains to be seen whether there are reasons to believe that the universal force of *and* is also external.

For the phenomena that I do explore, the important property of the Hamblin semantics that I want to endorse is that it allows for the interpretation mechanism to have access to each of the propositional alternatives introduced by *or*. Every disjunct will be visible either in the semantics proper, or in the pragmatics. It is the visibility of each disjunct in the semantic derivation that allows for capturing the natural interpretation of disjunctive

conditionals, the exclusive component of unembedded disjunctions, and the distribution requirement. To see why, let us get started by looking at the interpretation of counterfactuals with disjunctive antecedents.

CHAPTER 2

DISJUNCTIVE COUNTERFACTUALS

2.1 Overview

This chapter deals with the interpretation of counterfactuals with disjunctive antecedents. Section 2.2 shows that the natural interpretation of counterfactuals with disjunctive antecedents requires selecting from each of the disjuncts the worlds that come closest to the world of evaluation. This poses a problem: selecting the closest worlds from each disjunct requires accessing the denotation of the disjuncts from the denotation of the disjunctive antecedent, which the standard analysis of *or* does not allow. Section 2.3 shows that the problem can be solved if *or* is taken to introduce into the semantic derivation a set of propositional alternatives, and provides a compositional analysis of counterfactuals as correlative constructions, building on work on the semantics of correlatives by Veneeta Dayal (Srivastav, 1991b,a; Dayal, 1995, 1996). The chapter concludes by discussing in section 2.4 the shortcomings of two alternative approaches to the problem that assume a textbook semantics for *or*.

2.2 Counterfactuals with disjunctive antecedents

2.2.1 *Would* counterfactuals

Consider the following scenario. The summer is over. You and I are visiting a farm. The owner of the farm is complaining about the weather that we have had this summer. To give us an example of the effects of the bad weather, he shows us the site where pumpkins used to grow in previous years. There is a bunch of immature pumpkins and there are many

ruined pumpkin plants. In this situation, the owner of the farm utters the counterfactual in (1):

- (1) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. (A variation on an example in Nute 1975)

We have a strong intuition that the counterfactual in (1) is false: if we had had a good summer, the farmer would have had a good crop; but we know for sure that if the sun had grown cold, the pumpkins, much as everything else, would have been ruined. The problem is that the standard analysis of *or*, together with a standard minimal change semantics for counterfactuals (Stalnaker, 1968; Stalnaker and Thomason, 1970; Lewis, 1973) predicts the counterfactual in (1) to be true.

To illustrate why the problem arises, we need to have a minimal change semantics for counterfactuals in place: we want to say that *would*-counterfactuals are true in the actual world if and only if the consequent is true in all worlds where the antecedent is true that differ as little as possible from the way things are in the actual world.

The truth-conditions of counterfactuals will be stated relative to a relation of comparative similarity defined for the set of accessible worlds W . We will adopt the following notation in the metalanguage: for any world w , ' $w' \leq_w w''$ ' says that w' is at least as similar to w as w'' is. Following Lewis (1973, 48), we will assume that any admissible similarity relation \leq_w is a weak ordering of the set of accessible worlds W , with the world w alone at the bottom of the ordering (w is more similar to w than any other world w').¹ We will also

¹A weak ordering is a relation that is transitive and strongly connected. Unlike a *strong* ordering, ties are permitted (two different elements can stand in the relation to each other). 'Being as old as', 'being at least as far from Boston as' are weak orderings. To convey a notion of comparative similarity among worlds, Lewis (1973, 48) requires the following properties of any relation \leq_w :

1. The relation \leq_w should be transitive (for any worlds w', w'', w''' , whenever $w' \leq_w w''$ and $w'' \leq_w w'''$, then $w' \leq_w w'''$).
2. The relation \leq_w should be strongly connected: for any worlds w' and w'' , either $w' \leq_w w''$ or $w'' \leq_w w'$.

Besides these conditions, Lewis requires the following conditions on the set of accessible worlds \mathcal{S} .

1. The world w is *self-accessible*: $w \in \mathcal{S}$

make what Lewis calls ‘the Limit Assumption’: for any world w and set of worlds W we assume that there is always at least one world w' in W that come closest to w .

The semantics of *would* counterfactuals can be formalized now with respect to any such admissible relation of similarity by means of a class selection function f that picks up for any world of evaluation w , any relation of comparative similarity \leq , and any proposition p , the worlds where p is true that come closest to w .²

(2) For any proposition p , any world w , and any relation of relative similarity \leq ,

$$f_{\leq_w}(p) = \{w' \mid p(w') \ \& \ \forall w'' [p(w'') \rightarrow w' \leq_w w'']\}$$

We can now state the truth-conditions of *would*-counterfactuals as follows: a *would* counterfactual is true in a world w (with respect to an admissible ordering \leq) if and only if all the closest worlds to w in which the antecedent is true are worlds in which the consequent is true.

(3) $\llbracket \text{If } \phi, \text{ then would } \psi \rrbracket^{\leq}(w) \Leftrightarrow \forall w' [f_{\leq_w}(\llbracket \phi \rrbracket)(w') \rightarrow \llbracket \psi \rrbracket(w')]$

We will use the counterfactual in (1) to illustrate the problem of counterfactuals with disjunctive antecedents. Under the standard semantics for *or*, the proposition expressed by the *if*-clause is the union of the set of worlds where we have a good summer and the set of worlds where the sun grows cold.

$$(4) \quad \text{a.} \quad \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \end{array} \right] = \left\{ w \mid \begin{array}{l} \text{we have good weather} \\ \text{this summer in } w \end{array} \right\}$$

$$\llbracket \text{The sun had grown cold} \rrbracket = \{w \mid \text{the sun grows cold in } w\}$$

-
- 2. Inaccessible worlds are \leq_w maximal: if w' does not belong to \mathcal{S} , then for any world $w'', w'' \leq_w w'$
 - 3. Accessible world are more similar to w than inaccessible worlds: if w' belongs to \mathcal{S} and w'' does not, then $w' <_w w''$.

We will assume that all worlds are accessible.

²Lewis takes John Vickers and Peter Woodruffs to be the pioneers in the use of class selection functions in the semantics of counterfactuals (Lewis, 1973, 58). (Lewis, 1973, 57-60) discusses the use of class selection functions. See Nute 1984 for an overview of the different flavors minimal change semantics come in.

$$\text{b. } \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \text{or} \\ \text{the sun had grown cold} \end{array} \right] = \left[\begin{array}{c} \text{We had had good weather} \\ \text{this summer} \\ \cup \\ \llbracket \text{the sun had grown cold} \rrbracket \end{array} \right]$$

The counterfactual in (1) is then predicted to be true in the actual world if and only if the closest worlds where the proposition in (4b) is true are all worlds where we have a bumper crop.

$$(5) \quad \llbracket (1) \rrbracket^{\leq}(w_0) \Leftrightarrow \forall w' [f_{\leq w_0}(\llbracket (4b) \rrbracket)(w') \rightarrow \llbracket \text{we have a bumper crop} \rrbracket(w')]$$

The problem is that the truth-conditions in (5) are too weak. We have an intuitive notion of similarity according to which the possible worlds where the sun grows cold are more remote from the actual world than the possible worlds where we have a good summer. The situation is depicted in fig. 2.1 on page 19: each circle represents a set of worlds that are equally close to the actual world. The dotted line surrounds the worlds where the sun gets cold, the solid line the worlds where there is good weather this summer. None of the worlds in the proposition in (4b) where the sun grows cold can count as closer than the worlds where we have a good summer. The selection function only returns worlds where we have a good summer. Since in all the closest worlds where we have a good summer it is true that we have a bumper crop, the counterfactual in (1) is predicted to be true, contrary to our intuition.

2.2.2 *Might counterfactuals*

Might counterfactuals with disjunctive antecedents pose the same problem. Consider the following scenario. Suppose that we are watching a magic show. The magician mysteriously bends a fork with the power of his mind. We are shocked. I then utter the counterfactual in (6):

- (6) If you had a good magic book or you were a newborn child, you might have bent that fork too.

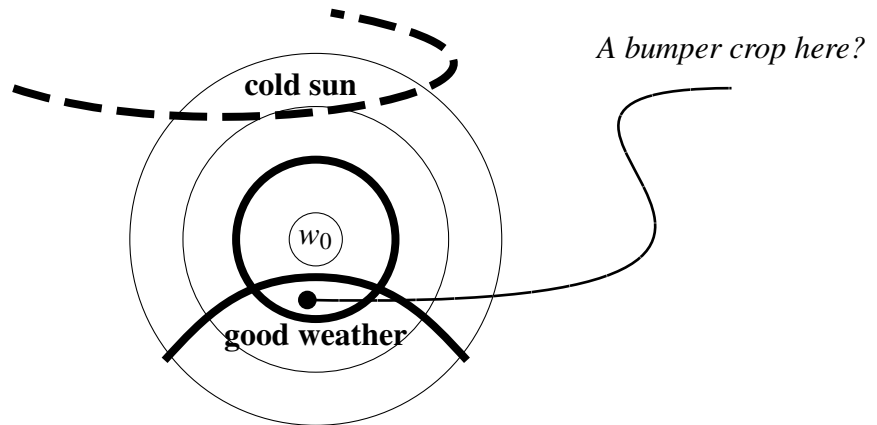


Figure 2.1. The problem of disjunctive antecedents.

What would be your reaction? I think you would conclude that the counterfactual in (6) is false. Perhaps you think one could learn to bend forks from magic books (you certainly can), but if you were a newborn child, you know you would not have bent that fork. The problem, again, is that, under the standard semantics for *or*, a minimal change semantics for *might* counterfactuals predicts the counterfactual in (6) to be true. Let me illustrate briefly why.

We will assume that *might* counterfactuals are the duals of *would* counterfactuals. A *might* counterfactual is true in a world w (with respect to an admissible ordering) if and only if the proposition expressed by the consequent is compatible with the set of worlds where the proposition expressed by the antecedent is true that come closest to w .

$$(7) \quad \llbracket \text{If } \phi, \text{ then might } \psi \rrbracket^{\leq}(w) \Leftrightarrow \exists w' [f_{\leq w}(\llbracket \phi \rrbracket)(w') \ \& \ \llbracket \psi \rrbracket(w')]$$

The standard analysis of *or* has it that the antecedent of the counterfactual in (6) denotes the union of the set of possible worlds where you have a good magic book and the set of worlds where you are a newborn child.

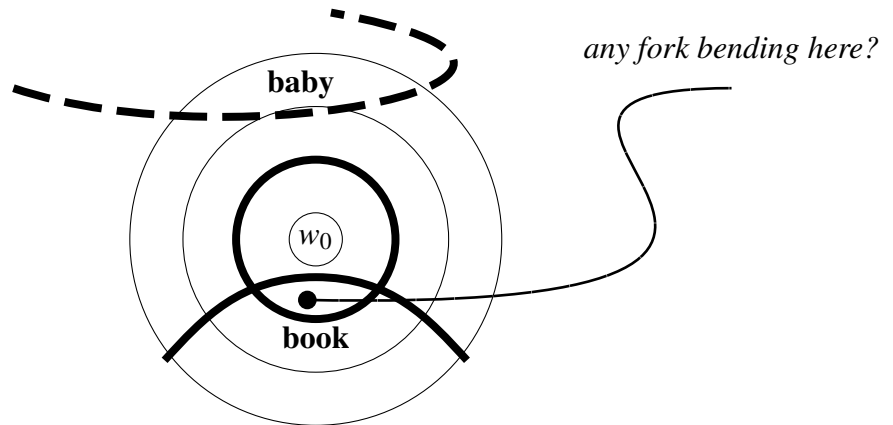


Figure 2.2. The problem of disjunctive antecedents: *might* counterfactuals.

$$(8) \quad \left[\begin{array}{c} \text{you have a good magic book} \\ \text{or} \\ \text{you are a newborn child} \end{array} \right] = \begin{array}{c} \llbracket \text{you have a good magic book} \rrbracket \\ \cup \\ \llbracket \text{you are a newborn child} \rrbracket \end{array}$$

The counterfactual in (6) is then predicted to be true in the actual world (with respect to a certain ordering) if and only if the consequent is true in at least one of the worlds in the set in (8) that come closest to the actual world.

These truth-conditions are too weak. Take the picture in fig. 2.2. The counterfactual in (6) is likely to be evaluated with respect to an intuitive notion of similarity according to which the worlds where you are a newborn baby are more remote than the worlds where you have a good book on magic (more actual facts have to be false in a world where you are a newborn baby than in the worlds where you have a good book on magic). That means that the closest worlds where the antecedent of (6) is true — the closest worlds in the set in (8) — are all worlds where you have a magic book. Since, presumably, there are worlds among the closest worlds where you have a good magic book in which you bend the fork, the counterfactual is predicted to be true with respect to this notion of similarity, contrary to our intuitions.

2.2.3 The problem

Would counterfactuals are naturally interpreted as claiming that the closest worlds in each disjunct are worlds where the consequent is true, and *might* counterfactuals are naturally interpreted as claiming that the consequent is compatible with the closest worlds in *each* disjunct. In the scenarios that we have just gone through, the worlds in one of the disjuncts are more remote than the worlds in the other. Given the textbook semantics for *or*, that means that the selection function returns none of the worlds in the disjunct that contains the most remote worlds. To capture the intuitive interpretation of counterfactuals with disjunctive antecedents, the selection function needs to select the closest worlds in *each* disjunct. That means that there must be a way for the selection function to access the denotation of the disjuncts from the denotation of the disjunction.

The next section shows that once an alternative semantics for *or* is assumed, the selection function can have access to the meaning of each disjunct and, therefore, the intuitive interpretation of counterfactuals with disjunctive antecedents can be captured.

2.3 The analysis

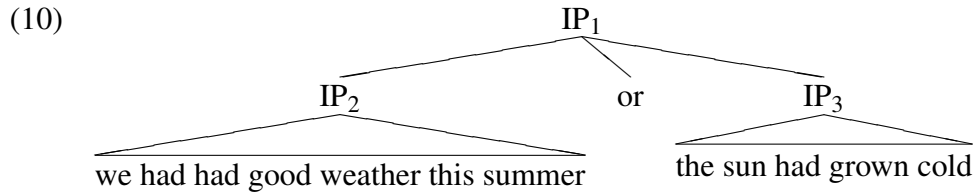
This section presents a compositional semantic analysis of counterfactuals with disjunctive antecedents that assumes (i) that *or* introduces a set of propositional alternatives in the semantic derivation, and (ii), building upon work on the semantics of correlatives by Veneeta Dayal (Srivastav, 1991b,a; Dayal, 1995, 1996), that conditionals are correlative constructions (von Stechow, 1994; Izvorski, 1996; Bhatt and Pancheva, 2006; Schlenker, 2004).

2.3.1 The antecedent denotes a set of alternatives

Consider the counterfactual in (1), repeated in (9) below:

- (9) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. (A variation on an example in Nute 1975)

We will assume, as we did before, that the relevant interpretable structure of the disjunction within the *if*-clause is the one in (10) below:



In the discussion of the example in section 2.2, we took for granted the textbook semantics for *or*, under which IP_1 denotes a proposition. We will now drop that assumption, and assume, instead, an alternative semantics of the type presented in the introduction, under which IP_1 denotes a set of propositions.

In an alternative semantics, expressions are assigned sets of semantic objects as their denotations. IP_1 denotes the singleton containing the proposition that we have good weather this summer, and IP_2 the singleton containing the proposition that the sun grows cold.³

- (11) a. $\llbracket \text{We had had good weather this summer} \rrbracket = \{\lambda w.\mathbf{good-weather}_w\}$
 b. $\llbracket \text{The sun had grown cold} \rrbracket = \{\lambda w.\mathbf{grow-cold}_w(s)\}$

I assume that *or* collects the denotation of its disjuncts in a set:

(12) *The Or Rule*

$$\text{Where } \llbracket B \rrbracket, \llbracket C \rrbracket \subseteq D_\tau, \left[\begin{array}{c} A \\ \swarrow \quad \downarrow \quad \searrow \\ B \quad \text{or} \quad C \end{array} \right] \subseteq D_\tau = \llbracket B \rrbracket \cup \llbracket C \rrbracket$$

Under these assumptions, the denotation of the disjunction in (10) is the set containing the proposition that we have good weather this summer and the proposition that the sun grows cold.

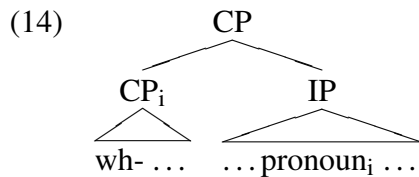
$$(13) \quad \llbracket IP_1 \rrbracket = \left\{ \begin{array}{l} \lambda w.\mathbf{good-weather}_w, \\ \lambda w.\mathbf{grows-cold}_w(s) \end{array} \right\}$$

³Notation: I take **good-weather** to be a predicate of worlds, just for the purposes of illustration. I disregard for the time being the contribution of mood marking.

The meaning of the disjunction retains now the meaning of the disjuncts. In principle, the semantic composition of conditionals can now access each disjunct to select the worlds that come closest to the world of evaluation. How does this set of propositions contribute to the semantic composition of conditionals? To answer this question we need to commit ourselves to a certain semantic analysis of conditionals.

2.3.2 Conditionals as correlatives

We will assume that conditionals are correlative constructions (von Stechow, 1994; Izvorski, 1996; Bhatt and Pancheva, 2006; Schlenker, 2004). In correlatives, a relative clause adjoined to the matrix clause provides an anaphoric pronoun inside the main clause with an antecedent.



The construction is illustrated in (15) with a few examples from Hindi.

- (15) a. [jo laRkii khaRii hai]_i vo_i lambii hai
 which girl standing be-present she tall be-present
 ‘Which girl is standing, that one is tall.’ (Dayal, 1996, 188)
- b. [jo laRkiyaaN khaRii haiN]_i ve_i lambii haiN
 which girls standing be-present they tall be-present
 ‘Which girls standing are, they are tall.’ (Dayal, 1996, 192)
- c. [jo do laRkiyaaN khaRii haiN]_i ve_i lambii haiN
 which two girls standing be-present they tall be-present
 ‘Which two girls are standing, they are tall.’ (Dayal, 1996, 192)

Languages with a productive correlative paradigm, like Indo-Aryan languages, exploit that strategy for conditionals. Marathi, for instance, has not only the adverbial correlative

structures *jehva...tevha* ('when...then') and *jithe...tithe* ('where...there'), but also the conditional *jər...tər* ('if...then'):⁴

- (16) a. Jər to ithə yel, tər mi tya-la goli marin
 if he here comes then 1-inst he-dat bullet kill-fut
 'If he comes here, then I'll kill him.' (Andrews (1975, 64-73) and also
 Lehmann (1984, 324), quoted from von Fintel (1994, 86))
- b. (dzar) tyāne abhyās kelā tar to pā hoīl
 if he-ag studying do-past-3-ms-sg then he pass be-fut-3-S
 'If he studies, he will pass (the exam).' (Bhatt and Pancheva, 2006, 26)

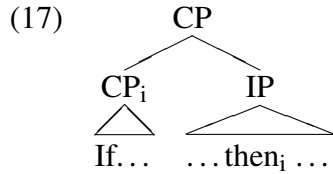
It is then natural to treat the English *if...then* construction as a correlative too.⁵ The analysis that I present next builds on work on the semantics of correlatives by Veneeta Dayal (Srivastav, 1991b,a; Dayal, 1995, 1996). There are two main components to it. First, the consequent of a conditional is analyzed as denoting a property of propositions, much as the main clause of a correlative denotes a property of individuals. This is possible once *then* is analyzed as a propositional anaphor. Second, *if*-clauses are analyzed as universal quantifiers ranging over propositions, much as antecedents of correlatives universally quantify over individuals.

2.3.3 *Then as a resumptive pronoun*

In conditionals, *then* has been analyzed as a resumptive pronoun that picks up the denotation of the *if*-clause as its antecedent (Iatridou, 1991b,a, 1994; von Fintel, 1994; Hegarty, 1996), much as in other types of correlatives a pronoun ranging over individuals picks up the denotation of the relative clause that serves as its antecedent. We will follow this analysis.

⁴I follow the transcriptions of the originals.

⁵In fact, Geis (1985) treats the English *if...then* construction as a remnant of a productive paradigm of correlatives.



As other natural language quantifiers do, modals range over a contextually supplied domain. We will capture this contextual dependency by assuming that they take as an argument a pronoun ranging over propositions (von Stechow, 1994). *Then*, I want to assume, is one such pronoun, which is in complementary distribution with a covert counterpart.⁶ Its interpretation, like the interpretation of other pronouns, is provided by the variable assignment. At LF, *then* bears an index. In the type of alternative semantics that I am assuming, *then* denotes a singleton containing the proposition that the variable assignment maps its index to:⁷

$$(18) \quad \llbracket \text{then}_{\langle 7, \langle s, t \rangle} \rrbracket^g = \{g(\langle 7, \langle s, t \rangle \rangle)\}$$

What is the semantic import of the anaphoric link between the *if*-clause and the pronoun *then* in the main clause? Dayal (1996) assumes that the anaphoric relation between the relative and the pronoun in the main clause is a case of variable binding. The antecedent of a correlative is a generalized quantifier, which takes as an argument the property that results from abstracting over the pronoun in the main clause, as illustrated below with a plural correlative.⁸

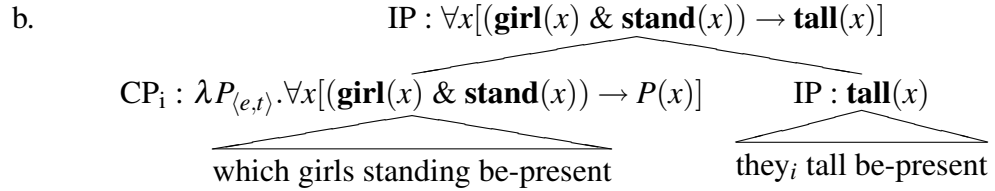
⁶This is a simplification. Schlenker (2004) argues that *then* is really doubling an implicit argument.

⁷A variable assignment is assumed to be a function from pairs of natural numbers and type specifications to entities of the right type. In what follows, I will use a slightly different notation: instead of writing ‘ $\text{then}_{\langle 7, \langle s, t \rangle} \rangle$ ’, I will write ‘ $\text{then}_{7 \langle s, t \rangle}$ ’.

⁸In the illustration in (19b), I simplify a bit for expository reasons. Srivastav (1991a, 668) assumes that the domain of individuals is closed under sum formation and treats the antecedent of a plural correlative as a universal quantifier whose domain of quantification is the supremum of the set of girls who are standing, as in (i) below. If the predicate abstract with which this quantifier combines is distributive, as in the example in (19b), the resulting truth conditions are equivalent.

(i) $\lambda P_{\langle e, t \rangle} . \forall x [(x = \iota x . (*\text{girl}(x) \ \& \ \text{stand}(x)) \rightarrow P(x)]$

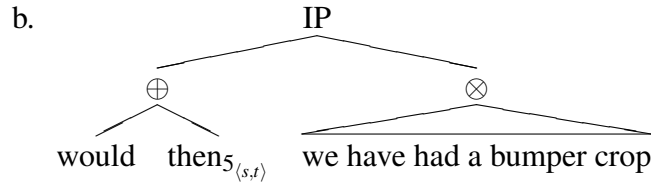
- (19) a. jo laRkiyaaN khaRii haiN ve lambii haiN
 which girls standing be-PR they tall be-PR
 ‘Which girls are standing, they are tall.’ (Dayal, 1996, 192)



Once *then* is analyzed as a propositional anaphor, we can analyze the consequent of a conditional as denoting a property of propositions, much as the consequent of a correlative denotes a property of individuals.

Consider, for instance, the consequent of the counterfactual in (1), repeated in (20a) below. We will assume that (20b) is its LF.

- (20) a. If we had had good weather this summer or the sun had grown cold, (then) we would have had a bumper crop. (A variation on an example in Nute 1975)



Would is assumed to be a function that takes two propositions p and q as arguments and returns (the singleton) containing the proposition that is true in a world w if and only if the closest worlds to w where p is true are all worlds where q is true.⁹

$$(21) \quad \llbracket \text{would} \rrbracket^{\leq, g} = \{ \lambda p_{\langle s,t \rangle} . \lambda q_{\langle s,t \rangle} . \lambda w . \forall w' [f_{\leq w}(p)(w') \rightarrow q(w')] \}$$

With respect to any admissible similarity relation \leq , the LF in (20b) denotes the singleton containing the proposition that is true in a world w if and only if the worlds in the proposition that *then* takes as its antecedent that come closest to w with respect to the similarity relation are all worlds where we have a bumper crop.

⁹The interpretation function is relative to a variable assignment and an admissible ordering of relative similarity.

$$(22) \quad \llbracket (20b) \rrbracket^{\leq, g} = \left\{ \lambda w. \forall w' \left[\begin{array}{c} f_{\leq w}(g(\mathfrak{S}_{\langle s, t \rangle}))(w') \\ \rightarrow \\ \mathbf{have-a-bumper-crop}_{w'}(\mathbf{we}) \end{array} \right] \right\}$$

By abstracting over *then* in (20b), we end up with (a set containing) a function from propositions to propositions that maps any proposition p into the proposition that is true in a world w if and only if the p -worlds that come closest to w are all worlds where we have a bumper crop.¹⁰

$$(23) \quad \left[\begin{array}{c} \odot \\ \swarrow \quad \searrow \\ \mathfrak{S}_{\langle s, t \rangle} \quad \text{IP} \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \oplus \quad \otimes \\ \text{would} \quad \text{then}_{\mathfrak{S}_{\langle s, t \rangle}} \quad \text{we have had a bumper crop} \end{array} \right]^{\leq, g} = \left\{ \lambda p_{\langle s, t \rangle}. q_{\langle s, t \rangle} \mid q \in \llbracket (20b) \rrbracket^{\leq, g[p/\mathfrak{S}_{\langle s, t \rangle}]} \right\}$$

2.3.4 *If*-clauses as quantifiers over propositions

What is the denotation of the *if*-clause? The antecedent of a correlative denotes, under Dayal’s analysis, a generalized quantifier: a property of properties of individuals. The relative in the example in (30b) denotes a property of properties of individuals that holds of any property P if and only if P holds of every individual which is a girl and is standing. Under the alternative analysis of disjunction I am advocating, we can treat the *if*-clause in parallel to Dayal’s analysis as denoting a property of properties of propositions which holds of any property of propositions $P_{\langle \langle s, t \rangle, \langle s, t \rangle \rangle}$ if and only if $P_{\langle \langle s, t \rangle, \langle s, t \rangle \rangle}$ holds of every proposition in the set of propositional alternatives introduced by *or*.¹¹

¹⁰For ease of exposition, I assume that the lambda abstraction is represented at LF by means of an index, as in Heim and Kratzer 1998. From now on, I will use the expression ‘the p -worlds’ to refer to the worlds where a certain proposition p is true.

¹¹We will discuss later, in section 2.3.6, whether this universal force is best captured by a universal quantifier ranging over propositions or a definite description operator.

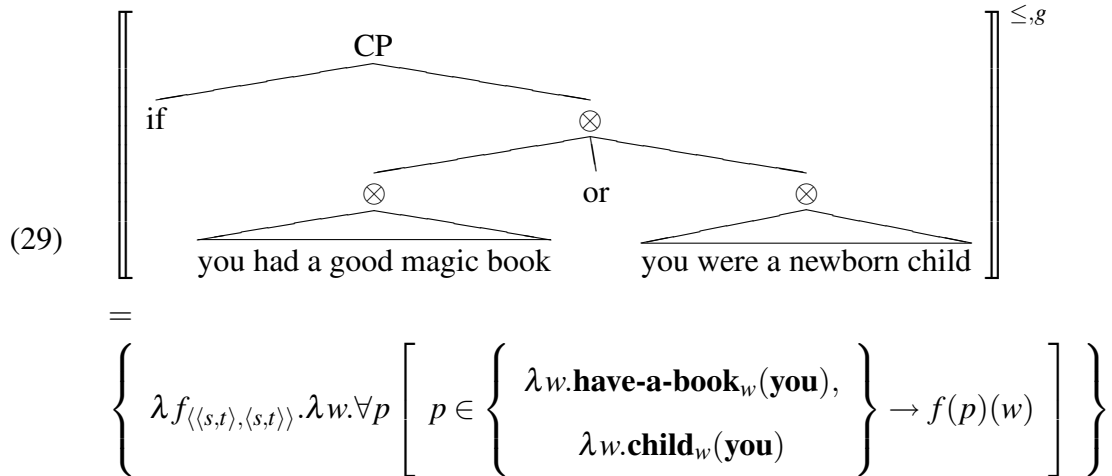
Might combines with *then* and with the proposition that you have bent that fork to yield a (singleton containing the) proposition that is true in a world w if and only if the set of worlds in the denotation of the antecedent of *then* that come closest to w is compatible with the proposition that you have bent that fork.

$$(27) \quad \left[\left[\begin{array}{c} \text{IP} \\ \oplus \qquad \qquad \qquad \otimes \\ \text{might} \quad \text{then}_{7\langle s,t \rangle} \quad \text{you have bent that fork} \end{array} \right] \right]^{\leq, g} = \{ \lambda w. \exists w' [f_{\leq w}(g(7_{\langle s,t \rangle}))(w') \ \& \ \text{bend}_{w'}(\text{you, that-fork})] \}$$

Abstracting over the denotation of *then*, we get a singleton containing a function from propositions to propositions that maps any proposition p into the proposition that is true in a world w if and only if the set of p -worlds that come closest to w is compatible with the set of worlds where you bend that fork.

$$(28) \quad \left[\left[\begin{array}{c} \otimes \\ 7_{\langle s,t \rangle} \qquad \qquad \qquad \text{IP} \\ \oplus \qquad \qquad \qquad \otimes \\ \text{might} \quad \text{then}_{7\langle s,t \rangle} \quad \text{you have bent that fork} \end{array} \right] \right]^{\leq, g} = \{ \lambda p_{\langle s,t \rangle}. q_{\langle s,t \rangle} \mid q \in \left[\left[(27) \right] \right]^{\leq, g[p/7_{\langle s,t \rangle}]} \}$$

The *if*-clause denotes a set containing a function of type $\langle \langle \langle s, t \rangle, \langle s, t \rangle \rangle, \langle s, t \rangle \rangle$ that maps the function in the set in (28) to the proposition that is true in any world w if and only if the set of worlds where you have a good magic book that come closest to w is compatible with the proposition that you bend that fork, and the set of worlds where you are a newborn child that come the closest to w is also compatible with the proposition that you bend that fork.



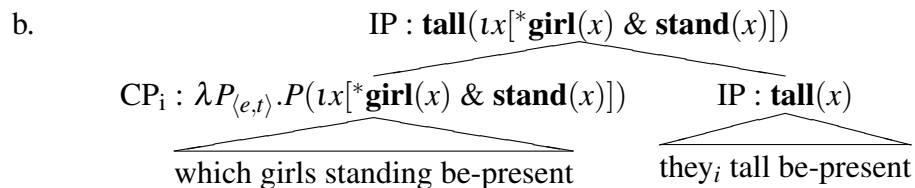
The analysis predicts the sentence in (20a) to be false in the context presented in section 2.2.2, because, under the relevant ordering, none of the closest worlds to the actual world where you are a newborn child are worlds where you bend the fork.

2.3.6 Maximality and universal force

Before concluding this section, I would like to address the source of the universal component involved in the interpretation of disjunctive counterfactuals.

I have treated *if*-clauses as universal quantifiers ranging over propositions. Dayal (1996) treats the antecedent of correlatives as definite descriptions: the antecedent of the plural correlative in (30) below denotes the maximal sum of girls that are standing. Since the main clause is associated with a distributive property, the whole correlative is predicted to be true if and only if every girl is tall.

- (30) a. jo laRkiyaaN khaRii haiN ve lambii haiN
 which girls standing be-PR they tall be-PR
 ‘Which girls are standing, they are tall.’ (Dayal, 1996, 192)



This is, of course, compatible with one of them being true. The possibility of continuing (32) as in (34) shows that this is the case.

(34) ... There is enough evidence showing that he might have objected to Spain joining the U.S. If she had joined Germany, he would have been pleased, of course.

(Kratzer, p.c.)

The same argument can be constructed for *might* counterfactuals:

(35) It is plain false that Hitler might have been pleased if Spain had joined Germany or the U.S. There is enough evidence showing that he might have objected to Spain joining the U.S. If she had joined Germany, he would have been pleased, of course.

If *if*-clauses denoted sums of propositions, and the predicate abstracts associated with the consequents were distributive, the disjunctive counterfactual in (32) could also in principle be true if the predicate abstract is not true of all the propositional alternatives introduced by *or* (but just of one of them), but plural definite descriptions are known to interact with negation in a peculiar way: the sentence in (36) conveys that Sandy saw none of the cats, not just that Sandy didn't see every cat.

(36) Sandy didn't see the cats.

To capture this, a 'homogeneity' presupposition (Loebner, 1998; Schwarzschild, 1994) is usually invoked. Beck (2001) formulates homogeneity as follows (where P is a predicate of atomic individuals, $*P$ a pluralized distributive predicate, and A a plurality):

(37) $*P(A) = 1$ iff $\forall x[x \in A \rightarrow P(x)]$

$*P(A) = 0$ iff $\forall x[x \in A \rightarrow \neg P(x)]$

(undefined otherwise)

Disjunctive counterfactuals do not seem to behave like plural definite descriptions, then. Under negation, they do not convey that the predicate abstract associated with the consequent is true of none of the propositional alternatives introduced by *or*.

2.3.7 Conclusion

Section 2.2 shows that a minimal change semantics cannot capture the natural interpretation of counterfactuals with disjunctive antecedents when the textbook semantics for disjunction is assumed. To capture the natural interpretation of counterfactuals with disjunctive antecedents we need to abandon the minimal change semantics, or the textbook semantics for *or*.

The analysis presented in this section solves the problem by abandoning the textbook semantics for *or*. If *or* introduces a set of propositional alternatives, and *if*-clauses convey universal quantification, like the antecedent of other types of correlatives, the semantic composition of disjunctive counterfactuals can select the closest worlds in each of the individual disjuncts.

To conclude this chapter, I would like to discuss two different answers to the problem that aim at preserving the textbook semantics of *or*.

2.4 Two different answers to the problem

2.4.1 Downward monotone counterfactuals?

The first answer to the problem that I want to discuss preserves the textbook semantics of *or*, but moves beyond a minimal change semantics for counterfactuals.

The argument goes as follows. Counterfactuals are known to license negative polarity items, much as other types of conditionals do. This is illustrated in (38) below:

- (38) a. If you had left any earlier, you would have missed the plane.

(von Fintel, 1999, 33)

- b. If you had ever heard my album, you would know that I could never consider the music business.

(www.brainyquote.com/quotes/quotes/d/dwaynehick217577.html)

NPI-licensing can be taken to be a reliable sign of downward monotonicity. And if counterfactuals are downward monotone, the interpretation of *would* counterfactuals with disjunctive antecedents is to be expected. For suppose that *would* counterfactuals were to be analyzed as *strict* conditionals (material conditionals under the scope of a necessity operator (Lewis, 1973, 4)). The counterfactual in (39a) would claim that *all* worlds in which the actual laws of nature hold and in which kangaroos have no tails are worlds where they topple over.

(39) a. If kangaroos had no tails, they would topple over. (Lewis, 1973, 1).

b. Where \mathcal{D}_w is the set of worlds w' in which the physical laws of w hold true,

$$\llbracket(39a)\rrbracket(w) \Leftrightarrow (\llbracket\text{kangaroos have no tails}\rrbracket \cap \mathcal{D}_w) \subseteq \llbracket\text{kangaroos topple over}\rrbracket$$

In general:

(40) Where \mathcal{D}_w is some set of worlds accessible from w ,

$$\llbracket\text{If } \phi, \text{ then would } \psi\rrbracket(w) \Leftrightarrow (\llbracket\phi\rrbracket \cap \mathcal{D}_w) \subseteq \llbracket\psi\rrbracket$$

Assume the textbook semantics for *or* and consider the truth-conditions of a counterfactual with a disjunctive antecedent under the strict conditional analysis in (40).

(41) Where \mathcal{D}_w is some set of worlds accessible from w ,

$$\llbracket\text{If } \phi \text{ or } \psi, \text{ then would } \xi\rrbracket(w) \Leftrightarrow ((\llbracket\phi\rrbracket \cup \llbracket\psi\rrbracket) \cap \mathcal{D}_w) \subseteq \llbracket\xi\rrbracket$$

Under this analysis, if a disjunctive counterfactual of the form in (41) is true in a world w with respect to a domain of accessible worlds \mathcal{D}_w , both counterfactuals of the form in (42) must be true in w — assuming that they are evaluated with respect to the same set of accessible worlds.

(42) a. If ϕ then would ξ .

b. If ψ then would ξ .

The interpretation of *would* counterfactuals illustrated in section 2.2 is then captured.¹³

Adopting a strict conditional analysis poses two problems. The first problem is that there are well-known counterexamples to the monotonicity of counterfactuals. The second problem is that a downward monotone semantics for counterfactuals fails to derive the interpretation of *might* counterfactuals. In the next two sections I illustrate these problems and discuss two possible ways to overcome them, none of which, I conclude, helps capturing the interpretation of counterfactuals with disjunctive antecedents.

2.4.2 Strawson downward entailingness?

2.4.2.1 Lewis' counterexamples

Lewis (1973) presents several counterexamples to the monotonicity of *would* counterfactuals. The inference from (43a) to (43b) below (an instance of the pattern known as 'Strengthening the Antecedent') is not valid.

(43) a. If kangaroos had no tails, they would topple over. (Lewis, 1973, 1)

b. If kangaroos had no tails but used crutches, they would topple over.

(Lewis, 1973, 9)

Under the downward monotonic analysis, the inference should be valid: if all the accessible worlds where kangaroos have no tails (say, for instance, the worlds where the physical laws are the same as the ones in the actual world) are worlds where they topple over, all worlds where kangaroos have no tails but use crutches (a subset of the worlds where kangaroos have no tails) must be worlds where they topple over.

Or take the argument that has (44b) and (44a) as premises and (44c) as a conclusion (an instance of the pattern known as 'Hypothetical Syllogism').

¹³An answer along these lines is presented in Herburger and Mauck 2005. Although Herburger and Mauck (2005) do not assume a world-based strict conditional analysis, they rely on an event based semantics for counterfactuals that makes them downward entailing. For them the inference illustrated in section 2.2 is a downward entailing inference. In their system, *would* counterfactuals are claimed to quantify over all prototypical instances of events that instantiate the event description denoted by the antecedent.

- (44) a. If Hoover had been born in Russia, he would have been a Communist.
b. If Hoover had been a Communist, he would have been a traitor.
c. If Hoover had been born in Russia, he would have been a traitor.

(Lewis (1973, 33), attributed to Stalnaker (1968))

The argument, intuitively, is not valid, although it should be, under the monotonic analysis: if all accessible worlds where Hoover is born in Russia are accessible worlds where he is a Communist and all accessible worlds where he is a Communist are worlds where he is a traitor, it follows that all accessible worlds where he is born in Russia must be worlds where he is a traitor.

Likewise for the pattern illustrated in (45) (known as ‘Contraposition’):

- (45) a. If Goethe had survived the year 1832, he would nevertheless be dead by now.
(Kratzer, 1979, 128)
b. If Goethe were alive now, he would have died in 1832.

Suppose that the set of accessible worlds where Goethe does not die in 1832 is a subset of the worlds where he is dead now. It must then follow that the set of accessible worlds where he is alive by now is a subset of the set of worlds where he dies in 1832. Yet the inference from (45a) to (45b) does not seem to be valid.

Lewis’ counterexamples to the monotonicity of *would* counterfactuals pose a problem to the strategy of deriving the interpretation of *would* counterfactuals with disjunctive antecedents as a downward monotone inference. If the inferences illustrated in section 2.2.1 are to be captured by adopting a downward entailing semantics for *would* counterfactuals, Lewis’ counterexamples must be accounted for.

Kai von Fintel (2001) has argued that counterfactuals are *close* to downward entailing. They are not downward entailing in the strict sense, but they show limited downward entailingness, what he dubbed ‘Strawson downward entailingness.’ It is this property, he argues, that licenses NPIs. The next section shows that the assumption that counterfactu-

als are Strawson downward monotonic does not help to solve the problem of disjunctive antecedents.¹⁴

2.4.2.2 Strawson downward entailingness does not solve the problem

Under von Fintel’s analysis, counterfactuals are evaluated with respect to a contextually fixed accessibility function f , which changes as discourse evolves. The accessibility function, which he calls the ‘modal horizon’, assigns to any world of evaluation w a set of worlds that come closest to w (with respect to an admissible ordering of relative similarity). Counterfactuals carry the presupposition that the modal horizon assigns to the world of evaluation worlds where the antecedent is true. Accommodating that presupposition is what makes the modal horizon evolve. In the initial context the modal horizon assigns to any world w the singleton that contains w . If, by the time a counterfactual is asserted, the modal horizon f does not assign to the world of evaluation w any worlds where the antecedent is true — as it typically happens with respect to an initial context — those worlds that are at least as close to w as the closest antecedent worlds are added to the worlds that f assigns to w .¹⁵

(46) Where f is an accessibility function and \leq a relation of relative similarity,

$$f \text{ |If } \phi, \text{ then would } \psi \text{ |}^{\leq} = \lambda w. f(w) \cup \{w' \mid \forall w'' \in \llbracket \phi \rrbracket^{f, \leq} : w' \leq_w w''\}$$

(von Fintel, 2001)

The proposition expressed by the conditional is then computed with respect to the updated modal horizon. With respect to a modal horizon f (and ordering \leq) that assigns to any world w some worlds where its antecedent is true, a *would* counterfactual expresses the

¹⁴Kai von Fintel himself discussed the problem in some unpublished notes (von Fintel, 1997).

¹⁵Notation: ‘ $f \text{ |If } \phi, \text{ then would } \psi \text{ |}^{\leq}$ ’ is the modal horizon that results from accommodating the presupposition that f assigns to any world w the closest worlds to w (with respect to \leq) where ϕ is true. Kai von Fintel notes in his paper that the context change potential that I am reporting here has no provision for embedded conditionals. He offers a more complex one that does (von Fintel, 2001, 21). The context change potential that we are using here will do for our purposes of illustrating that this analysis of counterfactuals does not solve the problem of disjunctive counterfactuals.

proposition that is true in w if and only if all worlds in $f(w)$ where the antecedent is true are worlds where the consequent is true.

$$(47) \quad \llbracket \text{If } \phi, \text{ then would } \psi \rrbracket^{f, \leq}(w) \Leftrightarrow \forall w' \in f \mid \llbracket \text{If } \phi, \text{ then would } \psi \rrbracket^{\leq}(w) \left[\begin{array}{c} \llbracket \phi \rrbracket^{f, \leq}(w') \\ \rightarrow \\ \llbracket \psi \rrbracket^{f \mid \text{If } \phi, \text{ then } \psi \rrbracket^{\leq, \leq}(w') \end{array} \right] \quad (\text{von Fintel, 2001})$$

Most of the monotonic inferences are invalid in this system. Strengthening the Antecedent is. Consider as illustration the inference from (48a) to (48b):

- (48) a. If kangaroos had no tails, they would topple over. (Lewis, 1973, 1)
 b. If kangaroos had no tails but used crutches, they would topple over.
 (Lewis, 1973, 9)

Is the inference from (48a) to (48b) valid? In classic logic, it is required that the context remain stable when assessing the validity of arguments. Shifting the context is considered a fallacy (the so-called ‘fallacy of equivocation’). We are now assuming that counterfactuals can shift the context. We then need to take this fact into account when assessing the validity of arguments. To assess the validity of the inference from (48a) to (48b) we will consider the following *dynamic* notion of entailment:

$$(49) \quad \textit{Dynamic entailment} \\ \phi_1, \dots, \phi_n \models_{\text{dynamic}} \psi \text{ iff for all contexts } c, \llbracket \phi_1 \rrbracket^c \cap \dots \cap \llbracket \phi_n \rrbracket^{c \mid \phi_1 \mid \dots \mid \phi_{n-1}} \subseteq \llbracket \psi \rrbracket^{c \mid \phi_1 \mid \dots \mid \phi_n} \\ (\text{von Fintel, 2001, 24})$$

Strengthening the Antecedent is not dynamically valid. Take an arbitrary context c and an arbitrary world w . Assume the counterfactual in (48a) is true with respect to c in w . For that to be the case, the modal horizon in that context must assign to w worlds where kangaroos have no tails. The counterfactual in (48b) can be undefined in w if $f(w)$ contains no worlds where kangaroos have no tails but use crutches.

Let us now consider the case of counterfactuals with disjunctive antecedents.

- (50) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop (Nute, 1975)

The inference from (50) to (51a) and (51b) below is not dynamically valid: the counterfactual in (50) could be true in a world w with respect to a modal horizon f and yet (51b) could be undefined for w . That would be the case if, for instance, none of the closest worlds to w where the antecedent of (50) is true are worlds where the sun grows cold.

- (51) a. If we had had good weather this summer, we would have had a bumper crop.
 b. If the sun had grown cold, we would have had a bumper crop.

For the inference to go through, there must be worlds in the modal horizon of the type described by each disjunct, but this condition cannot be stated with respect to the semantic object denoted by the disjunctive antecedent under the standard semantics of *or*. Under the standard semantics of *or* the disjunctive antecedent is a set of worlds, a semantic object that retains no trace of the disjuncts. The problem persists.

There is a weaker notion of validity that can be formulated in the system. We can check whether the propositions expressed by the premises of an argument with respect to a context that satisfies the presuppositions of both the premises *and* the conclusion entail the conclusion. This special notion of entailment is claimed to be the one that NPIs are sensitive to (von Fintel, 1999).

- (52) *Strawson entailment*

$$\begin{aligned} \phi_1, \dots, \phi_n \models_{\text{Strawson}} \psi \text{ iff for all contexts } c \text{ such that } c = c|\phi_1| \dots |\phi_n| |\psi|, \\ \llbracket \phi_1 \rrbracket^c \cap \dots \cap \llbracket \phi_n \rrbracket^c |\phi_1| \dots |\phi_{n-1}| \subseteq \llbracket \psi \rrbracket^c |\phi_1| \dots |\phi_n| \end{aligned} \quad (\text{von Fintel, 2001, 26})$$

Strengthening the Antecedent *is* Strawson-valid. Take any arbitrary context c whose modal horizon f is already such that (48a) and (48b) will not expand it anymore. For any world w , $f(w)$ will include worlds where kangaroos have no tails but use crutches.

Assume that (48a) is true in a world w with respect to f . All the worlds in $f(w)$ where kangaroos have no tails are worlds where they topple over. Since $f(w)$ includes worlds where kangaroos do not have tails, but use crutches, the counterfactual in (48b) must be true in w with respect to f .

Consider now the inference from (50) to (51b). Take a context c whose modal horizon f is such that (50) and (51b) will not expand its modal horizon. Such a modal horizon will already include worlds where the sun grows cold. Assume that the proposition expressed by (50) with respect to such modal horizon is true in a world w . All worlds in $f(w)$ where the antecedent of (50) is true will be worlds where we have a bumper crop. That means that all worlds in $f(w)$ where we have good weather this summer are worlds where we have a good crop and all worlds in $f(w)$ where the sun grows cold are worlds where we have a bumper crop. The counterfactual in (51b) must be true in w with respect to f . We can reason likewise to show that the inference from (50) to (51b) is Strawson-valid.

Where does this discussion leave us? The analysis of counterfactuals presented in von Fintel 2001 treats the inference from (50) to both (51a) and (51b) on a par with Strengthening the Antecedent. Neither is dynamically valid. Yet there seems to be a difference between these two inference patterns. The pattern in the interpretation of disjunctive counterfactuals we are trying to capture seems to be reliable and stable. It does not depend on any contextual shift. Strengthening the Antecedent is not.

2.4.3 *Might* counterfactuals

2.4.3.1 *Might* counterfactuals as duals of *would* counterfactuals

Might counterfactuals pose a second problem. Consider as illustration the counterfactual in (53).

- (53) If you had a good book on magic or you were a newborn child, you might have bent that fork too.

According to the interpretation discussed in section 2.2.2, the counterfactual in (53) conveys that you might have bent that fork if you had a good magic book and that you might have bent that fork if you were a newborn child. The strict conditional analysis fails to predict this. For suppose we take *might* conditionals to be the duals of *would* counterfactuals. The counterfactual in (53) would be claiming that the proposition expressed by the consequent is compatible with the set of accessible worlds in the proposition expressed by the antecedent, which, under the textbook semantics for *or*, is the union of the set of worlds where you have a good magic book and the set of worlds where you are a newborn child.

$$(54) \quad \text{Where } \mathcal{D}_w \text{ is the set of worlds } w' \text{ accessible from } w,$$

$$\llbracket (53) \rrbracket(w) \Leftrightarrow \left(\left(\begin{array}{c} \llbracket \text{you have a good magic book} \rrbracket \\ \text{or} \\ \llbracket \text{you are a newborn child} \rrbracket \end{array} \right) \cap \mathcal{D}_w \right) \cap \llbracket \begin{array}{c} \text{you bend} \\ \text{that fork} \end{array} \rrbracket \neq \emptyset$$

According to these truth-conditions, the sentence will come out true in a world w in which there are accessible worlds of the type described by each disjunct if the consequent is incompatible with the set of accessible worlds in one of the two disjuncts — as long as it is compatible with the set of accessible worlds in the other disjunct.

In general, if disjunctive *might* counterfactuals are to be interpreted as in (55), they will not entail the corresponding counterfactuals in (56). A disjunctive counterfactual of the form in (55) can be true in a world w where there are no ϕ -worlds in \mathcal{D}_w or in which there are ϕ -worlds in \mathcal{D}_w but none of them is a ξ -world. In either type of world, under the strict conditional analysis, the counterfactual in (56a) will be false.

$$(55) \quad \text{Where } \mathcal{D}_w \text{ is some set of worlds accessible from } w,$$

$$\llbracket \text{If } \phi \text{ or } \psi, \text{ then might } \xi \rrbracket(w) \Leftrightarrow ((\llbracket \phi \rrbracket \cup \llbracket \psi \rrbracket) \cap \mathcal{D}_w) \cap \llbracket \xi \rrbracket \neq \emptyset$$

- (56) a. If ϕ , then might ξ .
 b. If ψ , then might ξ .

If *might* counterfactuals are the duals of *would* counterfactuals, a monotone semantics for counterfactuals cannot capture the interpretation of *might* counterfactuals with disjunctive antecedents.

One could conclude that the assumption that *might* counterfactuals are the duals of *would* counterfactuals should be rejected. Stalnaker (1984) assumes that *might* counterfactuals are actually *would* counterfactuals with an epistemic operator on top. To conclude, I want to show that rejecting the duality of *would* and *might* counterfactuals does not help much, because the problem arises with other possibility modals, for which a Stalnaker-type analysis is not plausible.

2.4.3.2 Stalnaker on *might* counterfactuals

There is a debate in the literature on minimal change semantics for conditionals between Lewis (1973) and Stalnaker (1984) that focuses on the duality of *would* and *might* counterfactuals. Lewis sticks to the assumption that *would* and *might* counterfactuals are duals of each other. Stalnaker doesn't. Stalnaker's semantics for *would* conditionals makes use of a selection function that picks up for any world of evaluation w , *the* closest world to w in which the antecedent is true. A *would* conditional says that *the* closest world where the antecedent is true is one where the consequent is. Since *would* counterfactuals are not universal quantifiers, they do not have duals. In Stalnaker's system *might* counterfactuals are epistemically qualified versions of *would* counterfactuals:¹⁶

... *might*, when it occurs in conditional contexts, has the same range of senses as it has outside of conditional contexts. Normally, but not always, it

¹⁶The main motivation for Stalnaker's analysis is that it is hard to follow the denial of a *would* counterfactual with a *might* counterfactual, as the following example illustrates:

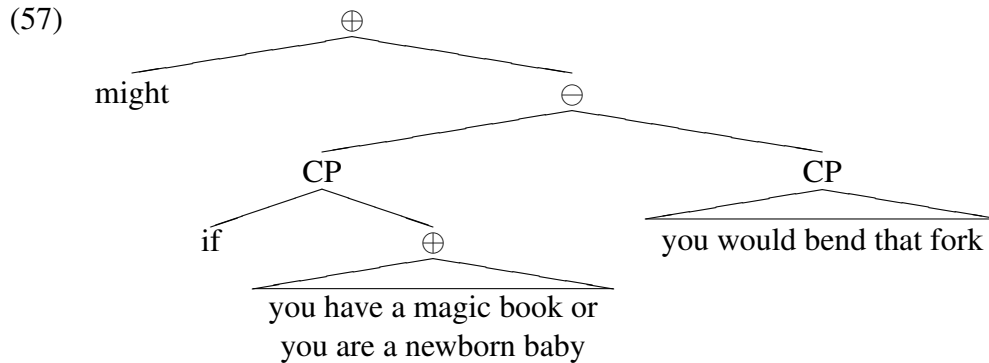
- (i) a. Would President Carter have appointed a woman to the Supreme Court last year if a vacancy had occurred?
- b. # No, certainly not, although he might have appointed a woman. (Stalnaker, 1984, 144)

This is unexpected under Lewis' analysis: it could very well be that not all closest worlds of the antecedent type are worlds of the consequent type, while some of them are.

expresses epistemic possibility. The scope of *might*, when it occurs in conditional contexts, is normally the whole conditional and not just the consequent ... the wide scope interpretation is supported by the fact that *might* conditionals can be paraphrased with the *might* preceding the antecedent: *it might be that if John had been invited, he would have come to the party.*

(Stalnaker, 1984, 144)

Under Stalnaker's analysis, the example in (53) would receive the LF below:



If *might* counterfactuals are analyzed as *would* counterfactuals embedded under epistemic *might*, the sentence in (58) will entail both (59a) and (59b) under the strict conditional analysis of *would* counterfactuals. Let us see why.

(58) If you had a good book on magic or you were a newborn baby, you might have bent that fork.

(59) a. If you had a good book on magic, you might have bent that fork.

b. If you were a newborn baby, you might have bent that fork.

Might is to be interpreted as a possibility epistemic modal. It denotes the function from propositions to propositions that maps any proposition p into the proposition that is true in any world w if and only if p is consistent with the set of epistemically accessible worlds.

(60) Where \mathcal{E}_w is the set worlds epistemically accessible from w ,

$$\llbracket \text{might} \rrbracket = \lambda p. \lambda w. \exists w' [w' \in \mathcal{E}_w \ \& \ p(w')]$$

The LF in (57) denotes the proposition that is true in any world w if and only if there is at least one world epistemically accessible from w in which the embedded *would* counterfactual is true. Under the strict conditional analysis, the counterfactual embedded under *might*

in (57) denotes a proposition that is true in a world w if and only if all accessible worlds in the union of the set of worlds where you have a good magic book and the set of worlds where you are a newborn child are worlds where you bend that fork.

$$(61) \quad \text{Where } \mathcal{D}_w \text{ is the set of words } w' \text{ accessible from } w,$$

$$\llbracket \ominus \rrbracket(w) \Leftrightarrow \left(\left(\left(\begin{array}{c} \llbracket \text{you have a magic book} \rrbracket \\ \cup \\ \llbracket \text{you are a newborn baby} \rrbracket \end{array} \right) \cap \mathcal{D}_w \right) \subseteq \llbracket \text{you bend that fork} \rrbracket \right)$$

Suppose that (58) is true in a world w , but (59a) is *false*. There must then be at least one world w' epistemically accessible from w such that the set of worlds accessible from w' where you have a good book on magic is a subset of the worlds where you bend that fork. Call that world w_1 . If the sentence in (59a) is false in w , there should not be any world w' epistemically accessible from w such that the set of accessible worlds from w' where you have a good magic book is a subset of the worlds where you bend that fork. That contradicts the conclusion that w_1 is one such world. Reasoning likewise, we conclude that (58) also entails (59b). Stalnaker's analysis of *might* counterfactuals could then capture the desired entailments.

But the problematic entailments do not only arise with *might* counterfactuals: they also arise with other types of conditionals with possibility modals, for which Stalnaker's analysis seems less plausible. Take, for instance deontic *may*:

(62) Mom, to Dad: "If Sandy does her homework or yours, she may eat this ice cream."

It seems natural to conclude from (62) that both sentences below are true:

- (63) a. If Sandy does her homework, she may eat this ice cream.
 b. If Sandy does your homework, she may eat this ice cream.

In fact, the following discourse sounds contradictory:

(64) # If Sandy does her homework or her sister's, she may eat this ice cream, but if she does her homework, she may not eat it.

The analysis presented in section 2.3 derives these facts, because the conditional in (62) is interpreted as claiming that the conditionals in (63a) and (63b) are both true. Stalnaker's strategy would then have to extend to these deontic conditionals too. I fail to see how: the conditional in (63b) is not equivalent to the one in (65b).

- (65) a. If Sandy does her homework, she may eat this ice cream.
b. It might be the case that if Sandy does her homework, she must eat this ice cream.

2.4.4 A manner implicature?

There is a second reaction to the problem of the interpretation of disjunctive counterfactuals. It assumes, like the first reaction does, a textbook semantics for *or*. Unlike the first reaction, it also assumes a minimal change semantics for counterfactuals. The idea is to derive the interpretation of disjunctive counterfactuals by resorting to a conversational implicature. The following quote illustrates the spirit of the proposal:¹⁷

There is certainly evidence for SDA. From the statement
D: If there had been rain or frost, the game would have been called off.
one naturally infers both of these:
D_r: If it had rained, the game would have been called off.
D_f: If there had been frost, the game would have been called off.

What validates those inferences if SDA is not valid? [...]

The explanation is Gricean. D would be a sensible, decent, verbally economical thing to say *only* [emphasis added — L.A.O] for someone who did think that D_r and D_f are both true. Consider a person who asserts D because he is confident of D_r, he regards the closest Freeze-worlds as remote, and does not believe D_f. What this person asserts is true if he is right about D_r; but asserting it on this basis is bad behaviour. It is of the same general kind — though perhaps not so bad in degree — as your saying 'If there had been rain or 90 per cent of the world's Buddhist priests had converted to Catholicism overnight, the game would have been called off.' The second disjunct is pointless in this

¹⁷Many thanks to Kai von Fintel and Chris Potts for helping me think about this proposal. In the quote below, 'SDA' stands for the 'simplification of disjunctive antecedents' inference pattern, the name philosophers used to refer to the interpretation of disjunctive counterfactuals illustrated in section 2.2.

case. There would be a point in including it only if it too had some bearing on the consequent.

(Bennett, 2003, 168-170)

How should this type of argument be spelled out? Consider again, as illustration, the disjunctive *might* counterfactual that we discussed in section 2.2.2, together with the simpler counterfactuals in (67a) and (67b).

(66) If you had a good magic book or you were a newborn child, you might have bent that fork.

(67) a. If you had a good magic book, you might have bent that fork.

b. If you were a newborn child, you might have bent that fork.

The starting point for this line of reasoning is the observation that it does not seem cooperative for a speaker to utter the disjunctive counterfactual in (66) if, for any world w compatible with what the speaker believes, the closest worlds to w where you have a good magic book are closer to w than the closest worlds where you are a newborn child. Why? If for any world w compatible with what the speaker believes, the closest worlds to w where you have a magic book are closer to w than the closest worlds where you are a newborn baby, the disjunctive counterfactual in (66) will be true in a world w compatible with what the speaker believes if and only if the simpler counterfactual in (67b) is. But the disjunctive counterfactual in (66) is a more complex (longer) expression than the counterfactual in (67a). Some kind of economy principle should rule out uttering (67b) instead of the simpler (67a) in this situation. What kind of economy principle can we appeal to? Grice's maxim of manner seems to be a possibility. Let's see what it takes to appeal to the maxim of manner.

The sentences in (66) and (67a) are not logically equivalent, so the manner reasoning cannot rely on comparing two expressions that share the same meaning, but maybe it is enough to assume that what is being compared here are two sentences — one of which

is more complex than the other — that are truth-conditionally equivalent throughout the speaker's belief state. Let us then assume tentatively the following principle:

- (68) Suppose the sentence S contains a proper subset of the lexical items (subtrees . . .) of the sentence S' . If S and S' have identical semantic interpretation in the speaker's belief state, then S' cannot be uttered felicitously.

By assuming that the speaker is obeying the principle in (68), the hearer could reason as follows:

- (69) The speaker is obeying the principle in (68). Thus, if the speaker uses a complex form S' , then no simpler sentence S has identical semantic interpretation in the speaker's belief state.

The principle in (69) does not justify concluding from an utterance of (66) that both (67a) and (67b) are true. What the hearer can conclude from (69) is that there must be at least one world compatible with what the speaker believes where (66) is true, but (67a) isn't; and that there must be a world compatible with what the speaker believes where (66) is true, but (67b) isn't. That cannot be the case if in all worlds w compatible with what the speaker believes, the closest worlds to w where the antecedent of (66) is true are all worlds where you have a good magic book (because in that case the sentence in (67a) would have to be true in all worlds w compatible with what the speaker believes), but we cannot yet conclude that for any world w compatible with what the speaker believes, both (67a) and (67b) must be true in w : for let us suppose that the worlds where you have a good magic book and the worlds where you are a newborn child are equally close to any world w compatible with what the speaker believes; and let us also suppose that there are only two types of worlds compatible with what the speaker believes: worlds w in which the closest worlds where you have a book magic book are compatible with your bending that fork, but in which you don't bend that fork in any of the closest worlds where you are a newborn child (as illustrated in figure 2.3, page 48); and worlds w where the closest worlds where

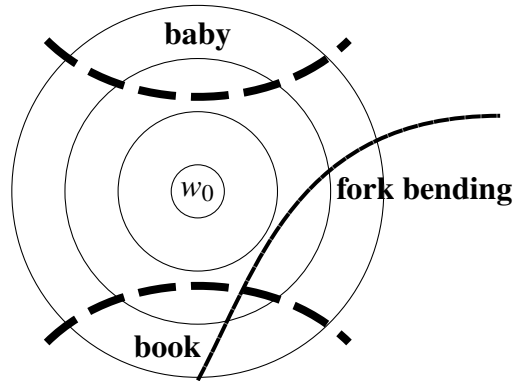


Figure 2.3. *If you had a good magic book, you might have bent that fork.*

you are a newborn child are compatible with your bending that fork, but in which none of the closest worlds where you have a good magic book are (as illustrated in figure 2.4, page 49). In all worlds w compatible with what the speaker believes, the sentence in (66) is true, but neither (67a) or (67b) is true in all those worlds. The discourse below is not predicted to be deviant.

- (70) # If you had a good magic book or you were a newborn child, you might have bent that fork; but, for all I know, it is possible that if you have a good magic book you might not have bent that fork.

Appealing to the principle in (69) does not seem to be enough.

What other principle could be ruling out uttering the disjunctive conditional in the scenarios where it quantifies over worlds that are only in one of the two disjuncts? The reasoning that Bennett entertains is slightly different from the one illustrated above. What Bennett seems to be assuming is that the hearer can conclude from an utterance of (66) that the speaker is not in a belief state in all whose worlds (67a) is true, *but* (67b) is false. Why is that so? The idea seems to be that when (66) is true in any world w compatible with what the speaker believes if and only if (67a) is, the second disjunct seems to have no role what-

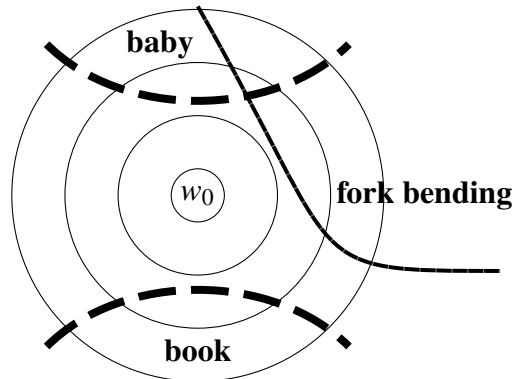


Figure 2.4. *If you were a newborn child, you might have bent that fork.*

soever. But even if the selection function were to pick up some worlds where the second disjunct is true, what makes sure that both (67a) and (67b) are true? The counterfactual in (66) can be true in a world w , whose closest counterparts include worlds where you have a magic book and worlds where you are a newborn child, in case none of the worlds where you are a newborn baby are worlds where you bend that fork.

2.5 Conclusions

We have seen that the interpretation of counterfactuals with disjunctive antecedents makes reference to the closest worlds in each of the propositions that *or* operates over. To capture this interpretation, the disjuncts have to be kept distinct, unlike what happens under the standard analysis of *or*. A standard minimal change semantics for counterfactuals, together with the standard semantics for *or*, fails to capture the desired interpretation.

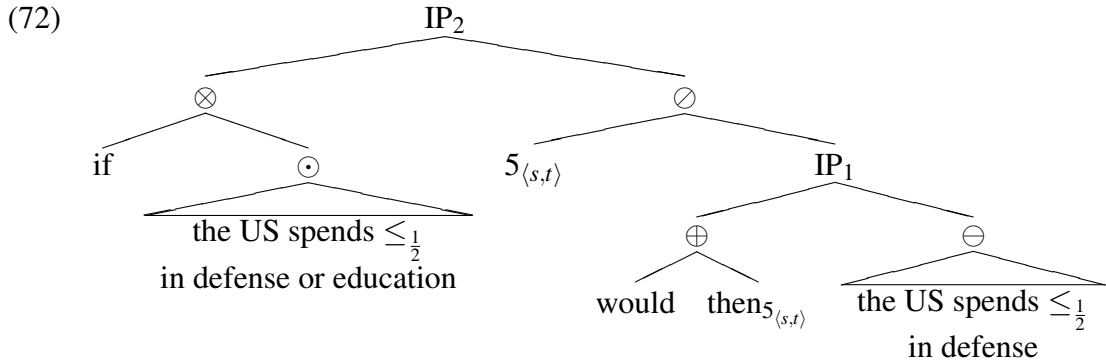
To conclude, I want to discuss a particular type of example that remains problematic under the present proposal. There is a known recipe to construct counterexamples to the general pattern of interpretation under which the closest worlds in *each* disjunct are claimed to be worlds where the consequent is true: make up a disjunctive counterfactual of the type

we have been looking at (the type where one of the disjuncts is more remote than the other), and be sure that the consequent denotes the proposition expressed by one of the disjuncts. Here's a famous case:

- (71) If the U.S. devoted more than half of its budget to defense or to education, it would devote more than half of its budget to defense. (Nute, 1984)

Let us see why examples like (71) pose a problem.

The analysis that I have presented assumes that the counterfactual in (71) has the LF in (72) below. The semantic composition is illustrated in (73).



- (73) a. $\llbracket \otimes \rrbracket^{\leq, g} = \left\{ \lambda f_{\langle \langle s,t \rangle, \langle s,t \rangle \rangle} \cdot \lambda w. \forall p \left[p \in \left\{ \begin{array}{l} \lambda w. \text{spend-}_w \leq \frac{1}{2} (\text{us, ed}), \\ \lambda w. \text{spend-}_w \leq \frac{1}{2} (\text{us, df}) \end{array} \right\} \rightarrow f(p)(w) \right] \right\}$
- b. $\llbracket \ominus \rrbracket^{\leq, g} = \{ \lambda p_{\langle s,t \rangle} \cdot q_{\langle s,t \rangle} \mid q \in \llbracket \text{IP}_1 \rrbracket^{\leq, g[p/5_{\langle s,t \rangle}]} \}$
- c. $\llbracket \text{IP}_2 \rrbracket^{\leq, g} = \llbracket \otimes \rrbracket^{\leq, g} (\llbracket \ominus \rrbracket^{\leq, g})$

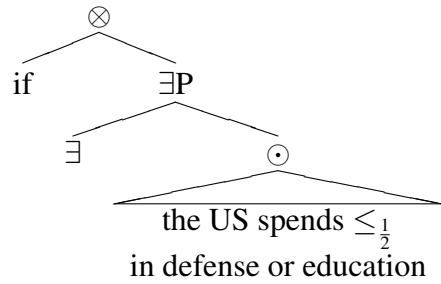
The result of combining the interpretation of the *if*-clause with the interpretation of the consequent is a singleton containing a proposition. For that proposition to be true in a world w , it has to be the case that the closest worlds to w where the U.S. spends more than half of its budget in defense are all worlds where the U.S. spends more than half of its budget in defense, and the closest worlds to w where the U.S. spends more than half of its budget in education are all worlds where it spends more than half of its budget to defense. But given the properties of the selection function we are assuming, the closest worlds where

the U.S. devotes more than half of its budget to education must be worlds where the U.S. devotes more than half of its budget to education and none of them can possibly be worlds where the U.S. devotes more than half of its budget to defense. There is no world where this proposition can be true, then. And yet, the sentence seems to be intuitively true.

The standard theory of *or* fares better here. Suppose that the antecedent expressed the proposition that at least one of the disjuncts is true (the union of the set of worlds where the U.S. devotes more than half of its budget to defense and the set of worlds where it devotes more than half of its budget to education). Now suppose that the selection function were to pick up the closest worlds from that set. In the actual world, given the intuition that the worlds where the U.S. spends more than half of its budget in defense are closer than the worlds where it spends more than half of its budget in education, the selection function will only pick up worlds where the U.S. devotes more than half of its budget to defense. The counterfactual is then predicted to be true, according to our intuitions.

We can capture the interpretation that we want by letting an Existential Closure operation range over the set of propositional alternatives introduced by *or*, as illustrated below.

(74)



$$\text{a. } \llbracket \otimes \rrbracket^{\leq, g} = \{ \lambda f_{\langle \langle s, t \rangle, \langle s, t \rangle \rangle} \cdot \lambda w. \forall p [p \in \llbracket \exists P \rrbracket^{\leq, g} \rightarrow f(p)(w)] \}$$

$$\text{b. } \llbracket \exists P \rrbracket^{\leq, g} = \left\{ \lambda w'. \exists p \in \left\{ \begin{array}{l} \lambda w. \text{spend-}_w \leq \frac{1}{2} (\mathbf{us}, \mathbf{ed}), \\ \lambda w. \text{spend-}_w \leq \frac{1}{2} (\mathbf{us}, \mathbf{df}) \end{array} \right\} \& p(w') \right\}$$

$$\text{c. } \llbracket \odot \rrbracket^{\leq, g} = \left\{ \begin{array}{l} \lambda w. \text{spend-}_w \leq \frac{1}{2} (\mathbf{us}, \mathbf{ed}), \\ \lambda w. \text{spend-}_w \leq \frac{1}{2} (\mathbf{us}, \mathbf{df}) \end{array} \right\}$$

The selection function will now apply to the proposition that is true in any world w if at least one of the propositions in the set in (74c) is true in w (the proposition that the disjunc-

tion would denote under the standard analysis). Given our intuitive notion of similarity, that means that, as we have just said, the modal will only range over the closest worlds where the U.S. devotes more than half of its budget to defense.

We can capture the interpretation we want, but we are left with an important question: what triggers Existential Closure? We could say that disjunctive counterfactuals are ambiguous. But that doesn't seem right. If disjunctive counterfactuals were ambiguous and their LFs could optionally include an Existential Closure operator under the scope of *if*, the counterfactuals we discussed in this chapter should have the reading predicted by the standard analysis of *or*, but they don't seem to.

If we want to capture the interpretation of examples like (71) by resorting to an operation of Existential Closure, we seem to be forced to conclude that the operation is a last resort strategy to avoid interpreting examples like (71) as contradictions. Maybe one could reason as follows: the analysis predicts that the example in (71) can only be true if the proposition that the U.S. devoted more than half of its budget to education were the impossible proposition (the proposition that is true in no world). Here's why: the analysis predicts the sentence to be true if and only if the closest worlds where the U.S. spends more than half of its budget in education are all worlds where it spends more than half of its budget in defense *and* the closest worlds where the U.S. spends more than half of its budget in defense are all worlds where it spends more than half of its budget in education. As long as there are worlds where the U.S. spends more than half of its budget in education, these truth-conditions will not be satisfied in any world, because, given our assumptions about the selection function, if there are worlds where the U.S. spends more than half of its budget in education, when applied to the proposition that the U.S. spends more than half of its budget in education, the selection function will return no world where the U.S. spends more than half of its budget in defense. If there were no possible worlds where the U.S. spends more than half of its budget to education, the selection function will return the empty set. And since the empty set is a subset of any set, it will be a subset of the set of

worlds where the U.S. devotes more than half of its budget to defense. The sentence could then be true. Now, since the proposition that the U.S. devotes more than half of its budget to education is not the impossible proposition, the hearer knows that the sentence in (71) is a contradiction. For (71) to be contingent, Existential Closure should be triggered.

I am not fully convinced that this is all there is to be said about the pattern that (71) illustrates. Consider for instance the following example, with exactly the same characteristics:

(75) If I earned at most \$30,000 or more than a billion, I would surely earn at most \$30,000.

The example sounds contradictory to me, unless it is forced to be interpreted as the following more verbose examples:

- (76) a. If I *were to* earn at most \$30,000 or more than a billion, I *would* earn at most \$30,000.
- b. If I *might* earn at most \$30,000 or more than a billion, I *would* earn at most \$30,000.
- c. (Even) if it were possible that I earned at most \$30,000 and it were also possible that I earned more than a billion, I would nevertheless earn at most \$30,000.

Similarly, I think Nute's example accepts the following paraphrases:

- (77) a. If the U.S. *were to* devote more than half of its budget to defense or education, it would devote more than half of its budget to defense.
- b. If it were the case that the U.S. *might* devote more than half of its budget to defense or to education, it *would* devote more than half of its budget to defense.
- c. (Even) if it were possible that the U.S. devoted more than half of its budget to defense and it were possible that the U.S. devoted more than half of its budget to education, the U.S. would nevertheless devote more than half of its budget to defense.

I think there is more to the interpretation of Nute's examples than meets the eye. The paraphrases reveal some implicit modality. The disjunctions in the antecedent could be under the scope of a modal. There is then much more to say about these examples. We need to know where the implicit modality comes from, and we need to know how the propositional alternatives introduced by disjunction interact with modals. I will leave the former issue open for further research. The interpretation of disjunctions under the scope of modals will be the topic of chapter 4.

CHAPTER 3

THE EXCLUSIVE COMPONENT

3.1 Overview

Unembedded disjunctions are usually interpreted as providing a list of mutually exclusive epistemic possibilities. Consider, for instance, the dialogue in (1):

- (1) a. Mom: “What is Sandy reading?”
b. Dad: “(She is reading) *Moby Dick*, *Huckleberry Finn*, or *Treasure Island* — I don’t know which.”

Every weekend Sandy’s teacher assigns her a book to read. Mom, who has been out of town, wants to know what Sandy is reading this weekend, and asks Dad the question in (1a). Dad does not know what Sandy is reading, but has seen her carry three books to her bedroom: *Moby Dick*, *Huckleberry Finn*, and *Moby Dick*. He gives Mom the answer in (1b). Mom can naturally understand Dad’s answer as conveying (i) that Sandy is reading (exactly) one book, and (ii) that there are three books that, according to what Dad knows, might be the one that she is reading (*Moby Dick*, *Huckleberry Finn*, and *Treasure Island*). This chapter deals with the first meaning component, which I will call *the exclusive component*.

We have seen in chapter 2 that capturing the natural interpretation of counterfactuals with disjunctive antecedents requires the semantics to access each atomic disjunct. In this chapter we will see that, in order to capture the exclusive component of unembedded disjunctions, each atomic disjunct must be visible in the pragmatics.

Sections 3.2 and 3.3 show that capturing the exclusive component of disjunctions with more than two atomic disjuncts is challenging if *or* is assumed to be a binary connective,

as the textbook analysis does — even if *or* is interpreted as exclusive disjunction (Reichenbach, 1947) — because the interpretation mechanism does not have access to all atomic disjuncts. Sections 3.4 and 3.5 introduce the technique for the computation of the exclusive component as a scalar implicature presented in Fox 2006. The proposal assumes that the syntactic algorithm for the generation of scalar alternatives to disjunctions introduced in Sauerland 2004 makes visible in the pragmatics all atomic disjuncts and their conjunctions. Section 3.6 points out that the technique allows for the interpretation mechanism to ignore some disjuncts, which leads to the wrong strengthenings: because (2a) and (3a) are truth-conditionally equivalent under the standard analysis of *or*, the technique predicts that they both convey that Sandy is reading at most one of the two books.¹ Section 3.8 shows that the algorithm can be naturally extended to make the correct prediction for disjunctions like (2a) if an alternative semantics for *or* is assumed.

- (2) a. Sandy is reading *Moby Dick*, *Huckleberry Finn*, or both.
- b. $(M \vee H) \vee (M \& H)$
- (3) a. Sandy is reading *Moby Dick* or *Huckleberry Finn*.
- b. $M \vee H$

3.2 The Reichenbach-McCawley puzzle

The observation that the interpretation mechanism needs access to each individual disjunct to capture the exclusive component of disjunctions can be traced back to Reichenbach 1947.² Reichenbach (1947, 45) shows that if *or* is to be interpreted as exclusive disjunction,

¹I assume the following abbreviations: ‘M’ stands for the proposition that Sandy read *Moby Dick*, ‘H’ for the proposition that Sandy read *Huckleberry Finn*, and ‘T’ for the proposition that Sandy read *Treasure Island*.

²See Merin 2003 for an overview of the problem. To the best of my knowledge, the problem was first discussed in the linguistics literature in McCawley 1981.

it cannot be a binary connective, because a binary exclusive connective does not capture the exclusive component of disjunctions with more than two atomic disjuncts. In his words:

... ternary operations can be dispensed with because all such operations can be expressed in terms of monary and binary operations. For associative operations, such as conjunction and disjunction, this reduction is very simple. Thus the formulas

$$a \vee b \vee c \tag{12}$$

$$a.b.c \tag{13}$$

which are written as ternary operations, can be reduced by means of formulas (2b and 3b paragraph 8) [the associative laws —L.A.O] to the corresponding binary operations. [...] It is different with the exclusive ‘or’. Although this operation is associative (it is even commutative and distributive) and therefore the ternary formula

$$a \underline{\vee} b \underline{\vee} c \tag{14}$$

has a meaning expressible as $(a \underline{\vee} b) \underline{\vee} c$, or as $a \underline{\vee} (b \underline{\vee} c)$, the meaning of (14) does not correspond to the meaning of the binary exclusive ‘or’, since (14) is true if all three propositions are true. In other words, (14) does not express the meaning: one and only one of the three propositions is true ...

(Reichenbach, 1947, 45)

A simple truth-table for a disjunction with three members will make the point clear. Suppose that the sentence in (4a) were to be interpreted as the formula in (4b), were ‘ $\underline{\vee}$ ’ stands for exclusive disjunction — a function that takes *two* propositions *A* and *B* and returns a proposition *C* that is true in worlds where exactly one of *A* or *B* is true.

- (4) a. Sandy is reading *Moby Dick*, *Huckleberry Finn* or *Treasure Island*.
- b. $M \underline{\vee} (H \underline{\vee} T)$

Consider the truth-table in (5):

(5)

M	H	T	$M \vee (H \vee T)$
1	1	1	1
1	1	0	0
1	0	1	0
1	0	0	1
0	1	1	0
0	1	0	1
0	0	1	1
0	0	0	0

We can identify the rows in the table with types of possible worlds: the first row represents a world where Sandy is reading *Moby Dick*, *Huckleberry Finn*, and *Treasure Island*; the second represents a world where Sandy is reading *Moby Dick* and *Huckleberry Finn*, but not *Treasure Island*, and so on. The sentence in (4a) is predicted to be true in any world where exactly one of the three atomic disjuncts is true, but it is also predicted to be true in a world where *all* three atomic disjuncts are true. If Sandy is reading *Huckleberry Finn* and *Treasure Island* in a world w , the proposition formed by applying exclusive disjunction to the proposition that Sandy is reading *Huckleberry Finn* and the proposition that Sandy is reading *Treasure Island* ($H \vee T$) will be false in w . If we now apply exclusive disjunction to that proposition and the proposition that Sandy is reading *Moby Dick* ($M \vee (H \vee T)$), we end up with a proposition that is true in a world w if and only if exactly one of the two disjuncts (one of which is not atomic) is true. We have just seen that the proposition that Sandy is reading exactly one of *Huckleberry Finn* or *Treasure Island* is false in a world w where she is reading the two books. If w is a world where Sandy is reading *Moby Dick*, exactly one of the two terms of the disjunction in (4b) will be true in w .

One could think that if we found an independent way to rule out the case where *all* atomic disjuncts are true, the resulting truth-conditions will be exactly what we want. But,

in fact, a disjunction of n -members ($n \geq 2$) is predicted to be true if and only if the total number of all true atomic disjuncts is odd.³ These truth-conditions are not attested. Take the following variation on the dialogue we started the chapter with:

- (6) a. Mom: “What is Sandy reading?”
b. Dad: “ (She is reading) *Moby Dick*, *Huckleberry Finn*, *Treasure Island*, or *Life on the Mississippi*.”

From Dad’s answer, Mom is not likely to conclude that Sandy is reading either exactly one or else exactly three of those books: she is likely to understand Dad as claiming that Sandy is reading *exactly one* of the four books. To get the correct truth-conditions out of a binary exclusive disjunction we would need to find a principled way to exclude worlds where the total number of true atomic disjuncts is odd and greater than one.

The Reichenbach-McCawley puzzle shows that an exclusive connective that states that exactly one of all atomic disjuncts is true, as *or* does, must have access to all atomic disjuncts. If *or* is to be translated by an exclusive connective, it should not be a binary one. To quote McCawley’s conclusion:

... if ‘ \vee ’ is to be one of the connectives of a logical system and if its logical properties are to match those of apparent ‘exclusive’ uses of *or* in English, it cannot be a two-term conjunction: it will have to be allowed to conjoin any number of propositions at a time, from two on up.

(McCawley, 1981, 78)

The exclusive component of *or* is usually captured by appealing to a scalar implicature (Horn, 1972; Gazdar, 1979).⁴ We will see next, however, that a variant of the Reichenbach-McCawley problem is known to arise when computing the implicature for disjunctions with more than two atomic disjuncts.

³McCawley (1981, 153-154) and Jennings (1994, 6-7) present the proof, which is reproduced in appendix A on page 208.

⁴See Gazdar 1977, Pelletier 1977, Gazdar 1979, and Horn 1989 for the classical arguments to treat *or* as inclusive disjunction.

3.3 The McCawley-Simons puzzle

Horn (1972) first exploited the idea that the exclusive interpretation of *or* can be derived as a conversational implicature by appealing to Grice's maxim of quantity.⁵

Just as (7a) entails (7b), so too (8a) entails (8b):

- (7) a. $\forall xFx$ (e.g. All the boys left)
- b. $\exists xFx$ (e.g. Some of the boys left.)
- (8) a. $P \ \& \ Q$ (e.g. John left and Bill left)
- b. $P \vee Q$ (e.g. John left or Bill left.)

But just as a speaker by uttering (7b) IMPLICATES that nothing stronger, including (7a) holds (so far as he is aware), a speaker of good faith will only utter (8b) if he does not KNOW that (8a) holds. Informally, *some* is entailed by and implicates the negation of *all*; *or* is entailed by, and implicates the negation of, *and*.

(Horn, 1972, 78-79)

If a cooperative speaker utters a sentence *S*, it can be assumed that she is not in a position to utter any stronger sentence *S'* that would have been as relevant as *S*. Take the case of (7b) and (8b).⁶ The substitution of *all* for *some* in (7b) determines a sentence (7a) that a speaker who utters (7b) could have uttered to make an equally relevant and stronger statement. Likewise, the substitution of *and* for *or* in (8b) determines a sentence (8a) that a speaker who utters (8b) could have used to make an equally relevant and stronger statement. *All* and *some*, and *and* and *or* are assumed to be part of a so-called 'Horn-scale'.

- (9) a. ⟨or, and⟩
- b. ⟨some, . . . , all⟩

⁵Its formulation is in (i) below.

- (i) (a) Make your contribution as informative as is required (for the current purposes of the exchange).
- (b) Do not make your contribution more informative than is required. (Grice 1989, 26)

The principle was formulated almost at the same time by Robert Fogelin as in (ii):

- (ii) Make the strongest possible claim that you can legitimately defend. (Fogelin 1967, 20)

⁶I have changed the numbering of the examples. The examples are numbered 2.45 and 2.46 in the original.

Horn-scales are used to determine for a sentence S a set of equally relevant but stronger sentences that the speaker could have uttered instead of S — what I will call, from now on, the *scalar competitors* of S . Uttering a sentence S can then trigger, based on the maxim of quantity, the implicature that the speaker is not in a position to utter any of its scalar competitors. A speaker who utters (8b) and believes that its scalar competitor in (8a) is true is not a cooperative speaker: in a situation where uttering (8b) is relevant, the claim in (8a) would presumably be equally relevant, but (8a) is more informative (logically stronger) than (8b). From the fact that a speaker utters (8b) and not (8a) we can then safely conclude that she is not convinced of the truth of (8a) — as in (10a), where ‘ $\mathcal{K}(\phi)$ ’ stands for ‘the speaker believes that ϕ ’.⁷ By assuming, furthermore, that the speaker is not agnostic about the scalar competitor of (8b) we can conclude that the speaker takes (8a) to be false (10b).⁸

- (10) a. $\neg\mathcal{K}(P \ \& \ Q)$
 b. $\mathcal{K}\neg(P \ \& \ Q)$

To capture the exclusive component of a simple disjunction with two atomic members of the form of (8a), we only need to assume that (the speaker believes that) its corresponding scalar competitor (8b) is false.

The problem arises when we look at disjunctions with more than two atomic disjuncts.⁹ Consider again the sentence in (11a), which we will assume to be truth-conditionally equivalent to the propositional logic formula in (11b).

- (11) a. Dad: “Sandy is reading *Moby Dick*, *Huckleberry Finn*, or *Treasure Island*.”
 b. $(M \vee H) \vee T$

⁷Usually, Hintikka’s epistemic logic is assumed (Hintikka, 1962). See the discussion of the scalar approach in chapter 4.

⁸The need to jump from (10a) to (10b) has been pointed out, among others, by Groenendijk and Stokhof (1984), Levinson (1983, 135), Horn (1989, 543) and Soames (1982, 455-456).

⁹The problem was hinted at by McCawley in an exercise in the second edition of his textbook (McCawley, 1993, 324). It was more recently addressed in Lee 1995, Lee 1996, and Simons 1998. From there, the puzzle has been discussed in Schwarz 2000, Fox 2003, Merin 2003, Chierchia 2004, Sauerland 2004, and Fox 2004.

From assuming that (11b) is true, we merely learn that we are in a world in which Sandy is reading at least one of *Moby Dick*, *Huckleberry Finn* and *Treasure Island*. We want to derive the conclusion that (as far as Dad knows) we are in a world where Sandy is reading exactly one of those three books.

To derive the exclusive component of the sentence in (11a) as a scalar implicature, we first need to determine what the scalar competitors of (11a) are. Appealing to stronger, equally relevant counterparts of (11a) that can be obtained by simply replacing any occurrence of *or* by *and* does not help. Take, for instance, the claim in (12a) below.

- (12) a. Dad: “Sandy is reading *Moby Dick*, (and) *Huckleberry Finn*, and *Treasure Island*.”
b. (M & H) & T

The claim that Sandy is reading all three books is an equally relevant and more informative claim that Dad could have made, but by concluding that the sentence in (12a) is false, we merely eliminate the possibility that Sandy is reading all three books. It is still possible that she is reading two of them. We do not get the required strengthening.

There are other claims stronger than (11b) that can be obtained by replacing *and* with *or*, and which I will represent with the following propositional logic formulae:

- (13) a. (M & H) \vee T
b. (M \vee H) & T

The formula in (13a) is true in any world w in which Sandy is reading both *Moby Dick* and *Huckleberry Finn*, and also in any world w in which she is reading *Treasure Island*. Suppose we assume that (the speaker believes that) it is false. By taking (13a) to be false, we strengthen the main assertion by assuming that any world w in which Sandy is reading *Moby Dick* and also *Huckleberry Finn* is incompatible with what the speaker believes, and that so is any world in which Sandy is reading *Treasure Island*, as illustrated in the truth-table below. These are not the truth-conditions that we want: a world where Sandy is

reading *Treasure Island* and no other book should be compatible with what the speaker knows.

(14)

M	H	T	$(M \vee H) \vee T$	$\neg[(M \& H) \vee T]$
1	1	1	1	0
1	1	0	1	0
1	0	1	1	0
1	0	0	1	1
0	1	1	1	0
0	1	0	1	1
0	0	1	1	0
0	0	0	0	0

The truth-table in (15) below shows that by assuming that the formula in (13b) is false, we do not exclude the possibility of Sandy reading both *Moby Dick* and *Huckleberry Finn*.

(15)

M	H	T	$(M \vee H) \vee T$	$\neg[(M \vee H) \& T]$
1	1	1	1	0
1	1	0	1	1
1	0	1	1	0
1	0	0	1	1
0	1	1	1	0
0	1	0	1	1
0	0	1	1	1
0	0	0	0	1

We could get the desired strengthening by assuming that all propositions in (16) are false. The claim that Sandy is reading at least one of the three books, together with the

assumption that all propositions in (16) are false, conveys that Sandy is reading at most one of the three books, as the truth-table in (17) shows.

- (16) a. M & H
 b. H & T
 c. M & T

(17)

M	H	T	$(M \vee H) \vee T$	$\neg(M \& H)$	$\neg(M \& T)$	$\neg(H \& T)$
1	1	1	1	0	0	0
1	1	0	1	0	1	1
1	0	1	1	1	0	1
1	0	0	1	1	1	1
0	1	1	1	1	1	0
0	1	0	1	1	1	1
0	0	1	1	1	1	1
0	0	0	0	1	1	1

Sauerland 2004 presents an algorithm for the computation of scalar competitors that delivers for any disjunction, among other competitors, all its atomic disjuncts and their conjunctions. The propositions in (16) are a subset of the scalar competitors that the algorithm delivers for the sentence in (11b). In the next two sections we will see that adopting the Sauerland algorithm allows for the derivation of the exclusive component of disjunctions like (11b).

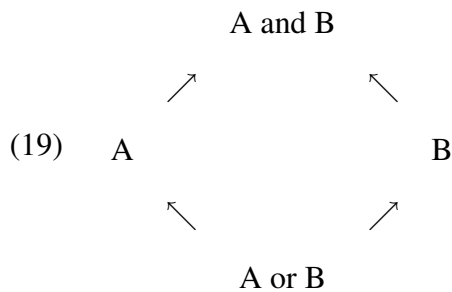
3.4 The Sauerland algorithm

We have assumed that *or* forms a Horn scale with *and*, as in (18a). The sentence in (18b) is the only competitor of (18c) determined by the scale in (18a).

- (18) a. ⟨or, and⟩

- b. Sandy is reading *Moby Dick* and *Huckleberry Finn*.
- c. Sandy is reading *Moby Dick* or *Huckleberry Finn*.

Based on the computation of the scalar implicatures of sentences containing more than one scalar item, Sauerland argues that the scale to which *or* belongs is not the one that we have been taking for granted. He argues that each term of the disjunction must be part of a partially ordered, diamond-shaped scale, as in (19). The conjunction of two sentences *A* and *B* asymmetrically entails both *A* and *B*, and both *A* and *B* asymmetrically entail their disjunction *A or B*, so uttering *or* should make salient not only the corresponding sentence with *and*, but also each individual disjunct on its own. A closely related claim has been made in Lee 1995 and Lee 1996.



The diamond-shaped scale determines that the sentences in (21) are the scalar competitors of the sentence in (20).

- (20) Sandy is reading *Moby Dick* or she is reading *Huckleberry Finn*.
- (21)
- a. Sandy is reading *Moby Dick*.
 - b. Sandy is reading *Huckleberry Finn*.
 - c. Sandy is reading *Moby Dick* and *Huckleberry Finn*.

But what kind of a scale is this diamond-shaped scale? The type of scales introduced by Horn 1972 are scales of lexical items. This is not. In fact, as Sauerland himself points out, this is not a scale, to begin with, but a *scale schema*, which can be instantiated by any pair of sentences. That — Sauerland himself points out — creates the following problem:

take any pair of sentences A , B such that A does not entail A and B . The ones in (22) will do.

- (22) a. Sandy read *Moby Dick*.
 b. Mount Everest is the tallest mountain on Earth.

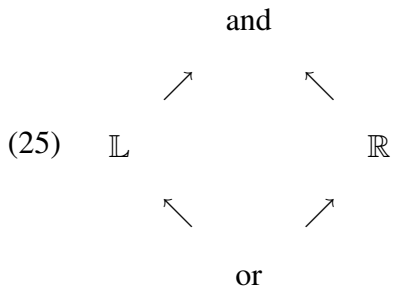
We cannot assume that the conjunction of (22a) and (22b) is a scalar competitor of (22a). An utterance of (22a) does not seem to trigger the implicature in (23a) (which would entail that the speaker is certain that Mount Everest is not the tallest mountain on Earth).

- (23) a. $\mathcal{K} \neg$ (Sandy read *Moby Dick* and Mount Everest is the tallest mountain on Earth)
 b. $\mathcal{K} \neg$ (Mount Everest is the tallest mountain on Earth)

To get out of this problem, Sauerland puts forth the following hypothesis: the scale of *or* is, after all, a scale of lexical items, but some of the items in the scale are not pronounced. The standard Boolean operators *and* and *or* form a scale with two silent binary connectives: \mathbb{L} and \mathbb{R} , defined as in (24) below:

- (24) Where $\llbracket A \rrbracket, \llbracket B \rrbracket \in D_{\langle s,t \rangle}$,
 a. $\llbracket A \mathbb{L} B \rrbracket = \llbracket A \rrbracket$
 b. $\llbracket A \mathbb{R} B \rrbracket = \llbracket B \rrbracket$

Once we posit the existence of \mathbb{L} and \mathbb{R} , the scale ends up being a partially ordered scale of lexical items:



For a disjunction with two atomic disjuncts, like the one in (26a) below, this scale determines the four scalar competitors in (27), which are obtained by replacing *or* with its scale mates. Their meanings are displayed, together with their entailment relations in figure 3.1 on page 68 (the direction of entailment is from top to bottom).¹⁰

(26) a. Sandy is reading *Moby Dick* or she is reading *Huckleberry Finn*.

b. LF: [M or H]

(27) Scalar competitors:

a. [M and H]

b. [M \mathbb{L} H]

c. [M \mathbb{R} H]

d. [M or H]

Let us now consider the case of a disjunction with three atomic disjuncts, like the one in (28a) below:

(28) a. Sandy is reading *Moby Dick*, or (she is reading) *Huckleberry Finn*, or (she is reading) *Treasure Island*

¹⁰In the discussion of the Sauerland algorithm, LFs will be abbreviated: (i-a), for instance, is an abbreviation of the disjunction of the sentence in (ii-a) and the sentence in (ii-b), (i-b) abbreviates an LF in which those sentences are coordinated by *and*, and (i-c) one in which they are coordinated by \mathbb{L} .

(i) (a) [M or H]

(b) [M and H]

(c) [M \mathbb{L} H]

(ii) (a) Sandy is reading *Moby Dick*.

(b) Sandy is reading *Huckleberry Finn*.

To talk about the denotation of these LFs, I will use propositional logic notation. The meanings of the LFs in (i) are listed in (iii) below, where ‘M’ stands for the proposition that Sandy is reading *Moby Dick*, and ‘H’ for the proposition that Sandy is reading *Huckleberry Finn*.

(iii) (a) $M \vee H$

(b) $M \& H$

(c) M

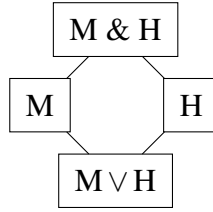


Figure 3.1. The meaning of the Sauerland competitors of *Sandy is reading Moby Dick or Huckleberry Finn*.

b. LF: $[[M \text{ or } H] \text{ or } T]$

Sauerland proposes that the scalar competitors of a sentence containing a scalar item s under the scope of another scalar item s' are determined by computing the cross-product of the scales to which both s and s' belong. In the case of (28b), computing the cross-product of two diamond-shaped scales for *or* yields a set containing the sixteen pairs of scalar items below.

$$(29) \left\{ \begin{array}{l} \langle \text{or}, \text{or} \rangle, \quad \langle \text{and}, \text{or} \rangle, \quad \langle \mathbb{L}, \text{or} \rangle, \quad \langle \mathbb{R}, \text{or} \rangle, \\ \langle \text{or}, \text{and} \rangle, \quad \langle \text{and}, \text{and} \rangle, \quad \langle \mathbb{L}, \text{and} \rangle, \quad \langle \mathbb{R}, \text{and} \rangle, \\ \langle \text{or}, \mathbb{L} \rangle, \quad \langle \text{and}, \mathbb{L} \rangle, \quad \langle \mathbb{L}, \mathbb{L} \rangle, \quad \langle \mathbb{R}, \mathbb{L} \rangle, \\ \langle \text{or}, \mathbb{R} \rangle, \quad \langle \text{and}, \mathbb{R} \rangle, \quad \langle \mathbb{L}, \mathbb{R} \rangle, \quad \langle \mathbb{R}, \mathbb{R} \rangle \end{array} \right\}$$

Each pair uniquely determines a competing sentence, which results from substituting the two occurrences of *or* in (28b) with the elements of the pair. The procedure generates for the sentence in (28b) the sixteen sentences in (30-33).

(30) a. $[[M \text{ or } H] \text{ or } T]$

b. $[[M \text{ or } H] \text{ and } T]$

c. $[[M \text{ or } H] \mathbb{L} T]$

$$(\llbracket [M \text{ or } H] \mathbb{L} T \rrbracket = M \vee H)$$

d. $[[M \text{ or } H] \mathbb{R} T]$

$$(\llbracket [M \text{ or } H] \mathbb{R} T \rrbracket = T)$$

(31) a. $[[M \text{ and } H] \text{ or } T]$

- b. $[[M \text{ and } H] \text{ and } T]$
- c. $[[M \text{ and } H] \text{ L } T]$ $([[M \text{ and } H] \text{ L } T] = M \& H)$
- d. $[[M \text{ and } H] \text{ R } T]$ $([[M \text{ and } H] \text{ R } T] = T)$
- (32) a. $[[M \text{ L } H] \text{ or } T]$ $([[M \text{ L } H] \text{ or } T] = M \vee T)$
- b. $[[M \text{ L } H] \text{ and } T]$ $([[M \text{ L } H] \text{ and } T] = M \& T)$
- c. $[[M \text{ L } H] \text{ L } T]$ $([[M \text{ L } H] \text{ L } T] = M)$
- d. $[[M \text{ L } H] \text{ R } T]$ $([[M \text{ L } H] \text{ R } T] = T)$
- (33) a. $[[M \text{ R } H] \text{ or } T]$ $([[M \text{ R } H] \text{ or } T] = H \vee T)$
- b. $[[M \text{ R } H] \text{ and } T]$ $([[M \text{ R } H] \text{ and } T] = H \& T)$
- c. $[[M \text{ R } H] \text{ L } T]$ $([[M \text{ R } H] \text{ L } T] = H)$
- d. $[[M \text{ R } H] \text{ R } T]$ $([[M \text{ R } H] \text{ R } T] = T)$

These sixteen competitors are associated with thirteen different meanings. Figure 3.2 on page 70 shows eleven of them (the propositions expressed by the competitors in (30b) and (31a) are omitted for clarity). Every individual disjunct is now a competitor for the whole disjunction, and so are all the conjunctions of the individual disjuncts.

The Sauerland algorithm determines for any disjunction a set of scalar competitors which are all at least as strong as the disjunction itself, but we cannot assume that *all* the stronger Sauerland competitors to a certain disjunction are false. Consider for instance the sentence in (20), repeated below as (34a).

- (34) a. Sandy is reading *Moby Dick* or *Huckleberry Finn*.
- b. $M \vee H$

The meanings associated with its Sauerland competitors are listed in figure 3.1 on page 68. The disjunction in (34a) expresses the proposition at the bottom of figure 3.1. All other propositions in figure 3.1 are stronger than the proposition expressed by (34a). If the sentence in (34a) is true, however, we cannot assume that they are all false, because,

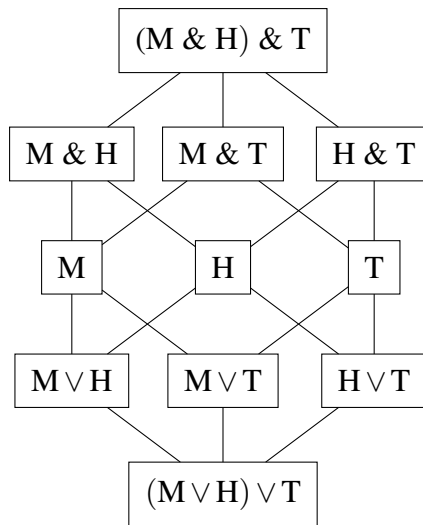


Figure 3.2. A subset of the meanings of the Sauerland competitors of the sentence in (28a).

under the standard analysis, the sentence in (34a) is true if and only if at least one of those stronger competitors is.

We cannot strengthen a disjunction by assuming that *all* its Sauerland competitors are false, then. There is no world in which the proposition expressed by a disjunction S is true and all the Sauerland competitors of S are false. For any disjunction S , the set of propositions containing the proposition expressed by S and the negation of all its Sauerland competitors is an inconsistent set of propositions.¹¹

Inconsistent sets of propositions figure prominently in the definition of conditional necessity in a premise semantics (Veltman, 1976; Kratzer, 1977, 1979). In a premise semantics, modal statements are evaluated with respect to sets of propositions. Evaluating the conditional in (35), for instance, involves considering the set of propositions that contains the propositions capturing what the Cambridge parking regulations provide in the world of evaluation together with the proposition that Sandy parks in front of her house during the

¹¹A set of propositions \mathcal{A} is consistent if and only if there is a world w such that all propositions of \mathcal{A} are true in w . \mathcal{A} is inconsistent otherwise.

street cleaning time. In the actual world, the Cambridge parking regulations provide that nobody park in front of Sandy’s house during the street cleaning period, and, so, the set of propositions with respect to which the modal is evaluated is inconsistent.

- (35) In view of the Cambridge parking regulations, if she parks in front of her house during the street cleaning time, Sandy must pay a fine.

The definition of conditional necessity in a premise semantics involves considering what follows from all maximal consistent subsets of the relevant premise set.¹² A conditional of the form of (35) is true in a world w if and only if the proposition that Sandy pays a fine follows from every maximal consistent subset of the set of propositions containing all the propositions capturing what the Cambridge parking regulations provide in w and the proposition that Sandy parks in front of her house during street cleaning time.

Fox (2006) points out that considering all maximal consistent subsets of the set of negated Sauerland competitors of a disjunction allows for the derivation of the exclusive component of disjunctions. Let us see why.

3.5 Innocent exclusion

Consider again the sentence in (34a), repeated in (36a) below:

- (36) a. Sandy is reading *Moby Dick* or she is reading *Huckleberry Finn*.
 b. $\llbracket(36a)\rrbracket = M \vee H$

¹²A proposition follows from a set of propositions \mathcal{A} if and only if p is true in all worlds where all the members of \mathcal{A} are true. A subset \mathcal{C} of a set of propositions \mathcal{A} is a maximal consistent subset of \mathcal{A} if and only if the following conditions hold:

- (i) \mathcal{C} is not the empty set
- (ii) \mathcal{C} is consistent
- (iii) For any proposition $p \in \mathcal{A}$, if $p \notin \mathcal{C}$, then $\mathcal{C} \cup \{p\}$ is inconsistent. (Kratzer, 1979, 125)

The set \mathcal{N} in (37) contains the negation of all the competitors of (36a) generated by the Sauerland algorithm.

$$(37) \quad \mathcal{N} = \{\neg(\mathbf{M} \vee \mathbf{H}), \neg\mathbf{M}, \neg\mathbf{H}, \neg(\mathbf{M} \ \& \ \mathbf{H})\}$$

When we add to \mathcal{N} the proposition expressed by the disjunction in (36a) we get an inconsistent set of propositions:

$$(38) \quad \mathcal{N} \cup \{\mathbf{M} \vee \mathbf{H}\} = \{\mathbf{M} \vee \mathbf{H}, \neg(\mathbf{M} \vee \mathbf{H}), \neg\mathbf{M}, \neg\mathbf{H}, \neg(\mathbf{M} \ \& \ \mathbf{H})\}$$

There are two maximal consistent subsets of the set in (38) that contain the proposition expressed by the disjunction in (36a): the ones in (39) below.

$$(39) \quad \begin{array}{l} \text{a. } \{\mathbf{M} \vee \mathbf{H}, \neg\mathbf{M}, \neg(\mathbf{M} \ \& \ \mathbf{H})\} \\ \text{b. } \{\mathbf{M} \vee \mathbf{H}, \neg\mathbf{H}, \neg(\mathbf{M} \ \& \ \mathbf{H})\} \end{array}$$

Two propositions follow from both sets in (39): the proposition expressed by the disjunction in (36a), and the proposition that Sandy is not reading both *Moby Dick* and *Huckleberry Finn*. Together with its ordinary meaning in (40a), we can associate the disjunction in (36a) with the strengthened meaning in (40b), which conveys its exclusive component.¹³

$$(40) \quad \begin{array}{l} \text{a. } \llbracket(36a)\rrbracket = \mathbf{M} \vee \mathbf{H} \\ \text{b. } \llbracket(36a)\rrbracket^+ = (\mathbf{M} \vee \mathbf{H}) \ \& \ \neg(\mathbf{M} \ \& \ \mathbf{H}) \end{array}$$

The strengthened meaning in (40b) is obtained by assuming that all the propositions that follow from both sets in (39) are true.

The same procedure captures the exclusive component of disjunctions with more than two atomic disjuncts. Consider, for instance, the sentence in (28a), repeated in (41a) below.

$$(41) \quad \text{a. } \text{Sandy is reading } \textit{Moby Dick}, \text{ or (she is reading) } \textit{Huckleberry Finn}, \text{ or (she is reading) } \textit{Treasure Island}.$$

¹³Notation: $\llbracket\alpha\rrbracket$ is the ordinary meaning of an expression α , and $\llbracket\alpha\rrbracket^+$ is its strengthened meaning.

b. $(M \vee H) \vee T$

We have seen that the Sauerland algorithm generates sixteen competitors for this sentence. Some of those competitors have the same meaning. There are thirteen different meanings in total. We will consider now the set \mathcal{N} containing the negation of those meanings.

$$(42) \quad \mathcal{N} = \left\{ \begin{array}{l} \neg((M \& H) \& T), \\ \neg((M \vee H) \& T), \neg((M \& H) \vee T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ \neg M, \neg H, \neg T, \\ \neg(M \vee H), \neg(M \vee T), \neg(H \vee T), \\ \neg((M \vee H) \vee T) \end{array} \right\}$$

Just as before, adding to this set the proposition expressed by the disjunction yields an inconsistent set of propositions, as illustrated below.

$$(43) \quad \mathcal{N} \cup \{(M \vee H) \vee T\} = \left\{ \begin{array}{l} \neg((M \& H) \& T), \\ \neg((M \vee H) \& T), \neg((M \& H) \vee T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ \neg M, \neg H, \neg T, \\ \neg(M \vee H), \neg(M \vee T), \neg(H \vee T), \\ \neg((M \vee H) \vee T), \\ (M \vee H) \vee T \end{array} \right\}$$

There are three maximal consistents of the set in (43) that include the proposition expressed by the disjunction:

$$(44) \quad \text{a. } \mathcal{N}_1 = \left\{ \begin{array}{l} \neg((M \& H) \& T), \\ \neg((M \vee H) \& T), \neg((M \& H) \vee T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ \neg H, \neg T, \\ \neg(H \vee T), \\ (M \vee H) \vee T \end{array} \right\}$$

$$\begin{array}{l}
\text{b. } \mathcal{N}_2 = \left\{ \begin{array}{l} \neg((M \& H) \& T), \\ \neg((M \vee H) \& T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ \neg H, \neg M, \\ \neg(M \vee H), \\ (M \vee H) \vee T \end{array} \right\} \\
\text{c. } \mathcal{N}_3 = \left\{ \begin{array}{l} \neg((M \& H) \& T), \neg((M \& H) \vee T) \\ \neg((M \vee H) \& T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ \neg M, \neg T, \\ \neg(M \vee T), \\ (M \vee H) \vee T \end{array} \right\}
\end{array}$$

The intersection of these three consistent sets, in (45), determines the strengthened meaning of the disjunction.

$$(45) \quad \bigcap \{ \mathcal{N}_1, \mathcal{N}_2, \mathcal{N}_3 \} = \left\{ \begin{array}{l} \neg((M \& H) \& T), \neg((M \vee H) \& T), \\ \neg(M \& H), \neg(M \& T), \neg(H \& T), \\ (M \vee H) \vee T \end{array} \right\}$$

Together with its ordinary meaning, the disjunction in (41a) can be strengthened by assuming that all the proposition in the set in (45) are true. The resulting proposition is true in any world w in which Sandy is reading at most one of the three books.

$$\begin{array}{l}
(46) \quad \text{a. } \llbracket (41a) \rrbracket = (M \vee H) \vee T \\
\quad \text{b. } \llbracket (41a) \rrbracket^+ = ((M \vee H) \vee T) \& \neg(M \& H) \& \neg(M \& T) \& \neg(H \& T)
\end{array}$$

Fox (2006) first called attention to this strengthening procedure. In his terminology, which I will adopt from now on, the propositions in all the maximal consistent sets con-

taining the proposition expressed by the disjunction and as many negated Sauerland competitors as consistency permits are said to be ‘innocently excludable’.¹⁴

$$(47) \quad \text{For any proposition } p \text{ and set of propositions } \mathcal{A}, \mathcal{E}(p, \mathcal{A}) \text{ (the set of innocently excludable competitors to } p \text{ in } \mathcal{A}) = \\ \bigcap \{ \mathcal{A}' \subseteq \mathcal{A} \mid \mathcal{A}' \text{ is a maximal set in } \mathcal{A} \text{ such that } \mathcal{A}'^* \cup \{p\} \text{ is consistent} \}$$

(Fox, 2006, 26)

To strengthen a disjunction, Fox (2006) assumes that a silent exhaustivity operator projects in the syntax. Its effect, in the semantics, is to say that the proposition expressed by the sentence under its scope is true and all its innocently excludable Sauerland competitors are false.

$$(48) \quad \llbracket \text{Exh} \rrbracket (\mathcal{A}_{\langle s,t \rangle, t})(p)(w) \Leftrightarrow p(w) \ \& \ \forall q [q \in \mathcal{E}(p, \mathcal{A}) \rightarrow \neg q(w)] \quad \text{(Fox, 2006, 26)}$$

3.6 No disjunct should be ignored

The Sauerland algorithm solves the McCawley-Simons puzzle, together with the mechanics of innocent exclusion, by making every disjunct visible in the pragmatics: the Sauerland algorithm makes sure that all atomic disjuncts (and their conjunctions) are among the scalar competitors of a disjunction; the mechanics of innocent exclusion negates as many Sauerland competitors as possible under the assumption that any atomic disjunct could be true. It seems that the McCawley-Simons problem can be solved without having to move beyond the textbook semantics of *or*, then.

However, this section shows that, precisely because it assumes the textbook semantics for *or*, the innocent exclusion mechanism still allows for the exclusion of some atomic disjuncts. And that, as we will see next, predicts counterintuitive strengthenings. To solve the McCawley-Simons puzzle, no individual disjunct should be innocently excludable.

¹⁴I follow Fox’s notation: $\mathcal{A}^* = \{\neg p \mid p \in \mathcal{A}\}$.

To see what the problem is, consider, for instance, the sentence in (49) below:

(49) Sandy is reading *Moby Dick*, *Huckleberry Finn*, or both.

The Sauerland mechanism assumes the standard analysis of disjunction. A plausible assumption to make is that the sentence in (49) is truth-conditionally equivalent to the propositional logic formula in (50).

(50) $(M \vee H) \vee (M \& H)$

The propositional logic formula in (50) is, on its turn, logically equivalent to the one in (51a), which is assumed to capture the truth-conditions of the sentence in (51b).

(51) a. $MD \vee HF$

b. Sandy read *Moby Dick* or *Huckleberry Finn*.

The mechanism associates with the sentence in (51b) the exclusivity implicature that the speaker knows that Sandy didn't read both books, but, because the standard analysis of *or* is assumed, and (51a) is logically equivalent to (50), the system wrongly associates the sentence in (49) with that same implicature. Let me illustrate why.

The sentence in (49) contains three scalar items. That means that the Sauerland algorithm generates sixty-four scalar competitors, resulting from computing the cross-product of three scales with four operators each. There are only four meanings associated with those candidates, the ones listed below:¹⁵

(52) a. $M \vee H$

b. $M \& H$

c. M

d. H

¹⁵The list of competitors is given in appendix B on page 210.

These meanings correspond to the meanings of the competitors of a simple disjunction with two atomic members (as shown in fig. 3.1 on page 68). For the innocent exclusion procedure, then, the disjunction in (50) is indistinguishable from the disjunction in (51b). Adding the meaning of the sentence in (49) to the set containing the negation of each of these meanings results, again, in an inconsistent set:

$$(53) \quad \{(M \vee H) \vee (M \& H), \neg(M \vee H), \neg M, \neg H, \neg(M \& H)\}$$

As we saw before in the case of a disjunction with two atomic disjuncts, there are two maximal consistent subsets of this set that contain the meaning of the sentence in (49):

$$(54) \quad \begin{array}{l} \text{a. } \{M \vee H, \neg M, \neg(M \& H)\} \\ \text{b. } \{M \vee H, \neg H, \neg(M \& H)\} \end{array}$$

That means that, as in the case of a simple disjunction with two atomic disjuncts, the proposition that Sandy is reading both *Moby Dick* and *Huckleberry Finn* is innocently excludable. The sentence in (49) is predicted to be true if and only if Sandy is reading at most one of the two books, thus ignoring what one of its atomic disjuncts convey.

$$(55) \quad \begin{array}{l} \text{a. } \llbracket(49)\rrbracket = M \vee H \\ \text{b. } \llbracket(49)\rrbracket^+ = (M \vee H) \& \neg(M \& H) \end{array}$$

The same problem arises with similar examples in which one of the disjuncts is truth-conditionally equivalent to the whole disjunction. Take the example in (56a), for instance.¹⁶

$$(56) \quad \begin{array}{l} \text{a. } \text{Sandy ate two or three bagels.} \\ \text{b. } \text{LF: } \llbracket[\text{Sandy ate two bagels}] \text{ or } [\text{Sandy ate three bagels}]\rrbracket \end{array}$$

We will assume the standard analysis of numerals: the first disjunct in (56b) is assumed to be true in a world w if and only if Sandy ate at least two bagels, and the second is assumed to

¹⁶Thanks to Angelika Kratzer for pointing out the importance of examples like (56a).

be true if and only if Sandy ate at least three. Because the first disjunct is stronger than the second, the whole disjunction is equivalent to the first disjunct: given the standard analysis of *or*, the sentence in (56a) denotes the proposition that Sandy ate at least two bagels.

$$(57) \quad \left\{ w \mid \left| \begin{array}{c} \{x \mid \mathbf{bagel}_w(x)\} \\ \cap \\ \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\} \\ \cup \\ \{x \mid \mathbf{bagel}_w(x)\} \\ \cap \\ \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\} \end{array} \right| \geq 2 \right\} = \left\{ w \mid \left| \begin{array}{c} \{x \mid \mathbf{bagel}_w(x)\} \\ \cap \\ \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\} \end{array} \right| \geq 2 \right\}$$

The Sauerland algorithm generates two distinct meanings, which correspond to the meaning of each of the disjuncts.

$$(58) \quad \begin{array}{l} \text{a. } \{w \mid |\{x \mid \mathbf{bagel}_w(x)\} \cap \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\}| \geq 2\} \\ \text{b. } \{w \mid |\{x \mid \mathbf{bagel}_w(x)\} \cap \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\}| \geq 3\} \end{array}$$

Given that (58a) is the meaning of the disjunction in (56a), we can only innocently exclude the proposition in (58b). The predicted strengthening of the sentence in (56a) conveys that Sandy ate exactly two bagels, thus ignoring what the second disjunct conveys.

$$(59) \quad \llbracket (56a) \rrbracket^+ = (58a) - (58b) = \{w \mid |\{x \mid \mathbf{bagel}_w(x)\} \cap \{x \mid \mathbf{eat}_w(\mathbf{s}, x)\}| = 2\}$$

3.7 Two open issues

There are two issues that need to be addressed: we have just encountered the first — to solve the McCawley-Simons puzzle, we need to make sure that the innocent exclusion mechanism makes no atomic disjunct innocently excludable; the second issue concerns the way the scalar competitors are generated.

So far, we have assumed that the atomic disjuncts are made visible in the pragmatics via the Sauerland algorithm. The visibility of the disjuncts depends on the assumption that

or forms a lexical scale with two silent operators (\mathbb{L} and \mathbb{R}). But this assumption still needs to be justified. To quote Sauerland himself:

Evidently, the adoption of $[\mathbb{L}$ and $\mathbb{R}]$ is more of a technical trick than a real solution for the problem just discussed. However, the intuition underlying it, that the use of the word *or* drives the computation of scalar implicatures, also underlies Horn’s quantitative scales and seems sound. Therefore I hope future research will show that the apparent clumsiness here is due to my technical execution, not the idea.

(Sauerland, 2004, 18)

To the extent that there is an alternative way to make the atomic disjuncts (and their conjunctions) visible in the pragmatics, \mathbb{L} and \mathbb{R} become superfluous.

The next section shows that if an alternative semantics for *or* is adopted, the type of scalar competitors generated by the Sauerland mechanism can be generated by making reference to the set of propositional alternatives that disjunctions denote. A natural extension of the mechanics of innocent exclusion, which assumes that disjunctions denote sets of propositions, solves the problem that we encountered in section 3.6.

3.8 Innocent exclusion in an alternative semantics

We will start by adopting an alternative semantics of the type discussed in the introduction, where expressions are mapped to *sets* of semantic objects. We will assume, as we did in the previous chapter, that *or* gathers the denotation of its disjuncts in a set.

(60) *The Or Rule*

$$\text{Where } \llbracket \mathbf{B} \rrbracket, \llbracket \mathbf{C} \rrbracket \subseteq \mathbf{D}_\tau, \left[\left[\begin{array}{c} \mathbf{A} \\ \swarrow \quad \downarrow \quad \searrow \\ \mathbf{B} \quad \text{or} \quad \mathbf{C} \end{array} \right] \right] \subseteq \mathbf{D}_\tau = \llbracket \mathbf{B} \rrbracket \cup \llbracket \mathbf{C} \rrbracket$$

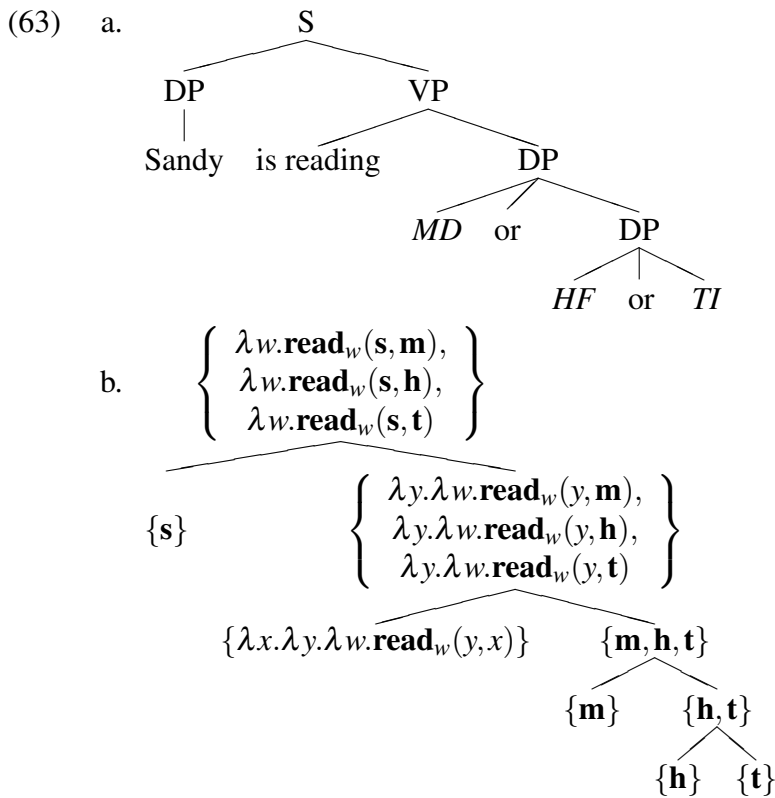
Consider an unembedded disjunction with three atomic disjuncts, like the one in (28a), repeated below as (61).

(61) Sandy is reading *Moby Dick*, *Huckleberry Finn*, or *Treasure Island*.

Under the standard analysis of *or*, the denotation of this sentence is the proposition that is true in any world w in which Sandy is reading at least one of the three books.

$$(62) \quad \lambda w.(\mathbf{read}_w(\mathbf{s}, \mathbf{m}) \vee \mathbf{read}_w(\mathbf{s}, \mathbf{h})) \vee \mathbf{read}_w(\mathbf{s}, \mathbf{t})$$

In an alternative semantics, the disjunction in (61) denotes a set containing three propositions. We will assume that in (61) we have a DP disjunction, as in (63), and that the individual alternatives introduced by *or* grow by means of several applications of the Hamblin rule, as illustrated in (63b) below. The denotation of the sentence in (61) is the set containing the proposition that Sandy is reading *Moby Dick*, the proposition that Sandy is reading *Huckleberry Finn*, and the proposition that Sandy is reading *Treasure Island*.¹⁷



The Sauerland mechanism generates the competitors of the sentence in (61) syntactically, by considering substitutions of the scalar items that it contains. If disjunctions denote sets of propositions, however, the competitors that the innocent exclusion procedure needs can be generated by making reference to their denotations exclusively.

¹⁷The assumption that we have a disjunction of DPs in (61) is not essential for our purposes: in the type of semantics I am assuming, the sentence in (61) would denote the same set of propositions if it were analyzed as an elliptical disjunction of sentences or VPs.

3.8.1 Generating the competitors

If disjunctions denote sets of propositions, we can mimic the effects of the Sauerland algorithm without resorting to the \mathbb{L} and \mathbb{R} operators by mapping a set of propositional alternatives \mathcal{A} into the set containing, for any non-empty subset \mathcal{B} of \mathcal{A} , the proposition that is true in a world w if and only if all the members of \mathcal{B} are true in w .

(64) For any sentence S ,

$$\llbracket S \rrbracket_{\text{ALT}, \cap} = \{p \mid \exists \mathcal{B} [\mathcal{B} \in \wp(\llbracket S \rrbracket) \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cap \cdot \mathcal{B}]\}$$

The function $\llbracket \cdot \rrbracket_{\text{ALT}, \cap}$ maps the sentence in (63), for instance, to the set in (65), which I will call ‘the set of conjunctive competitors’ of (63).

$$(65) \quad \llbracket (63) \rrbracket_{\text{ALT}, \cap} = \left\{ \begin{array}{c} \text{M, H, T,} \\ \text{M \& H, H \& T, M \& T,} \\ \text{M \& H \& T} \end{array} \right\}$$

We can capture the exclusive component of the disjunction in (63) with the help of this set of conjunctive competitors by appealing to the mechanics of innocent exclusion. Since unembedded disjunctions are assumed to denote sets of propositions, we need to adjust the definition of innocent exclusion accordingly.¹⁸

3.8.2 Innocent exclusion

The innocent exclusion procedure tries to find out which of the competitors of a disjunction S can be negated under the assumption that any of the disjuncts might turn out to be true. Keeping close to the definition of conditional necessity in premise semantics, we will adopt the following definition of innocent exclusion:

(66) *Innocent exclusion*

The negation of a proposition p in the set of competitors of a sentence S ($\llbracket S \rrbracket_{\text{ALT}, \cap}$)

¹⁸I am indebted to Angelika Kratzer for pointing out to me how innocent exclusion can be defined while assuming that unembedded disjunctions denote sets of propositions.

is innocent if and only if, for each $q \in \llbracket S \rrbracket$, every way of adding to q as many negations of propositions in $\llbracket S \rrbracket_{ALT, \cap}$ as consistency allows reaches a point where the resulting set implies $\neg p$.

Let us see how this definition works for the case of the disjunction in (63). The sentence in (63), repeated in (67a) below, denotes the set of propositions in (67b). Its set of competitors is in (67c).

(67) a. Sandy is reading *Moby Dick*, *Huckleberry Finn*, or *Treasure Island*.

b. $\llbracket (67a) \rrbracket = \{M, H, T\}$

c. $\llbracket (67a) \rrbracket_{ALT, \cap} = \left\{ \begin{array}{c} M, H, T, \\ M \& H, H \& T, M \& T, \\ M \& H \& T \end{array} \right\}$

There are three ways of adding to one member of the set in (67b) as many negations of propositions in the set in (67c) as consistency permits. They are represented by the sets \mathcal{N}_1 - \mathcal{N}_3 in (68) below

(68) a. $\mathcal{N}_1 = \left\{ \begin{array}{c} M, \neg H, \neg T, \\ \neg(M \& H), \neg(H \& T), \neg(M \& T), \\ \neg(M \& H \& T) \end{array} \right\}$

b. $\mathcal{N}_2 = \left\{ \begin{array}{c} \neg M, H, \neg T, \\ \neg(M \& H), \neg(H \& T), \neg(M \& T), \\ \neg(M \& H \& T) \end{array} \right\}$

c. $\mathcal{N}_3 = \left\{ \begin{array}{c} \neg M, \neg H, T, \\ \neg(M \& H), \neg(H \& T), \neg(M \& T), \\ \neg(M \& H \& T) \end{array} \right\}$

The set of innocently excludable competitors of the disjunction in (67a) is the intersection of the sets in (68):

$$(69) \quad \bigcap \{ \mathcal{N}_1, \mathcal{N}_2, \mathcal{N}_3 \} = \left\{ \begin{array}{l} \neg(\mathbf{M} \ \& \ \mathbf{H}), \neg(\mathbf{H} \ \& \ \mathbf{T}), \neg(\mathbf{M} \ \& \ \mathbf{T}), \\ \neg(\mathbf{M} \ \& \ \mathbf{H} \ \& \ \mathbf{T}) \end{array} \right\}$$

We can now define the strengthened meaning of the disjunction in (63), as Fox (2006) proposes, by resorting to the innocently excludable conjunctive competitors. The strengthened meaning of (63) is the proposition that is true in a world w if and only if some proposition in its ordinary denotation is true in w , but none of the propositions in (69) is.

$$(70) \quad \llbracket (63) \rrbracket^+ = \lambda w. \exists p [p \in \llbracket (63) \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in (69) \rightarrow \neg q(w)]]$$

In general,

(71) For any disjunction S ,

where $\heartsuit(\llbracket S \rrbracket_{\text{ALT}, \cap})$ is the set of innocent excludable propositions in $\llbracket S \rrbracket_{\text{ALT}, \cap}$

$$\llbracket S \rrbracket^+ = \lambda w. \exists p [p \in \llbracket S \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \heartsuit(\llbracket S \rrbracket_{\text{ALT}, \cap}) \rightarrow \neg q(w)]]$$

If we assume an alternative semantics for *or*, we can replicate the results of the strengthening algorithm presented in Fox 2006 without having to rely on the Sauerland algorithm, and the syntactic connectives \mathbb{L} and \mathbb{R} . Because we are now assuming that disjunctions denote sets of propositions, and because each atomic disjunct is now considered when defining the innocently excludable competitors to a disjunction, the problem discussed in section 3.6 does not arise. To see why, let us consider the following two disjunctions:

(72) a. Sandy is reading *Moby Dick* or *Huckleberry Finn*.

b. Sandy is reading *Moby Dick*, *Huckleberry Finn*, or both.

Under the standard analysis, the disjunctions in (72a) and (72b) denote the same object (the proposition that is true in a world w if and only if Sandy is reading at least one of the two books).

$$(73) \quad \llbracket (72a) \rrbracket = \llbracket (72b) \rrbracket = \mathbf{M} \vee \mathbf{H}$$

Under the alternative semantics analysis, the disjunctions in (72a) and (72b) denote different objects. The disjunction in (72a) denotes a set containing two propositions (the proposition that Sandy is reading *Moby Dick*, and the proposition that Sandy is reading *Huckleberry Finn*), and the disjunction in (72b) denotes a set containing three propositions (the proposition that Sandy is reading *Moby Dick*, the proposition that Sandy is reading *Huckleberry Finn*, and the proposition that Sandy is reading both books).

- (74) a. $\llbracket(72a)\rrbracket = \{M, H\}$
 b. $\llbracket(72b)\rrbracket = \{M, H, M \& H\}$

The set of competitors generated by the function $\llbracket\cdot\rrbracket_{ALT, \cap}$ is the same for both disjunctions:

- (75) $\llbracket(72a)\rrbracket_{ALT, \cap} = \llbracket(72b)\rrbracket_{ALT, \cap} = \{M, H, M \& H\}$

But because the disjunctions denote different sets of propositions, the set of innocently excludable competitors is different. Take the disjunction in (72a). There are two ways of adding to each member of its denotation as many negated competitors as consistency allows. The proposition that Sandy is not reading both *Moby Dick* and *Huckleberry Finn* follows from each of them, and, so, it is innocently excludable.

- (76) a. $\{M, \neg H, \neg(M \& H)\}$
 b. $\{H, \neg M, \neg(M \& H)\}$

Consider now the disjunction in (72b). Because the disjunction denotes a set containing three propositions, we need to consider three ways of adding as many negated competitors as consistency allows. They are represented by the sets below:

- (77) a. $\{M, \neg H, \neg(M \& H)\}$
 b. $\{H, \neg M, \neg(M \& H)\}$
 c. $\{M \& H\}$

The proposition that Sandy is not reading both *Moby Dick* and *Huckleberry Finn* does not follow from every set in (77). It is not innocently excludable then.

To conclude, let us consider the example in (56a), repeated as (78) below.

(78) Sandy ate two or three bagels.

We have seen in section 3.6 that, under the standard analysis of *or* and numerals, the disjunction in (78) denotes the proposition that Sandy ate at least two bagels. Under the alternative semantics analysis, it denotes the set of propositions containing the proposition that Sandy ate at least two bagels and the proposition that Sandy ate at least three.¹⁹

(79) { that Sandy ate at least two bagels, that Sandy ate at least three bagels }

The set in (79) is also the set of competitors of the disjunction.

(80) $\llbracket(78)\rrbracket_{\text{ALT}, \cap} = (79)$

The proposition that Sandy ate at least two bagels is consistent with the proposition that Sandy didn't eat at least three. The proposition that Sandy ate at least three bagels entails the proposition that Sandy ate at least two. There are then two ways of adding to every proposition in (79) as many negated competitors as consistency permits, as represented by the sets below:

(81) a. { that Sandy ate at least two bagels, that Sandy didn't eat at least three }
b. { that Sandy ate at least three bagels }

None of the propositions in (79) is in both sets. None of the disjuncts is innocently excludable, then.

¹⁹I use *that* clauses, informally, as names of propositions.

3.9 Summary

In this chapter we have seen that the interpretation mechanism needs to have access to all atomic disjuncts and their conjunctions to derive the exclusive component of disjunctions with more than two atomic disjuncts.

The Sauerland syntactic algorithm makes sure that all atomic disjuncts and their conjunctions are among the scalar competitors to any disjunction. Together with Fox's innocent exclusion mechanism, it allows for the derivation of the exclusive component of disjunctions with more than two atomic disjuncts as an implicature, without having to abandon the standard analysis of *or*.

We have gone through two problems for this approach. First, the Sauerland algorithm assumes that *or* forms a lexical scale with two unpronounced lexical operators, for which we have no independent evidence. Second, because the textbook semantics for *or* is assumed, the innocent exclusion mechanism allows for the exclusion of some atomic disjuncts, which leads to the wrong strengthenings.

We have seen, to conclude, that if an alternative semantics for *or* is assumed, Fox's strengthening algorithm can be extended while circumventing both problems.

The strengthening algorithm that I presented will play an important role in capturing the interpretation of disjunctions under the scope of modals, which is the topic of next chapter.

CHAPTER 4

DISJUNCTION AND MODALS

4.1 Overview

This chapter deals with the interpretation of disjunctions under the scope of modals. A central concern will be the interpretation of sentences like the one in (1) below:

- (1) Mom, to Dad: “Sandy may have cake, ice cream, or an apple.”

In a situation where Mom knows what Sandy may and may not have for dessert, the utterance in (1) conveys that Sandy has three permitted dessert options: she may have cake, she may have ice cream, and she may have an apple. However, as we have seen in the introduction, the standard analysis of *or* fails to capture this. Under standard assumptions, *may* requires that the proposition that it operates over contain at least one permitted world. If *may* operates in (1) over the union of the set of worlds where Sandy has cake, the set of worlds where she has ice cream, and the set of worlds where she has an apple — as the standard analysis of *or* maintains — the sentence in (1) is predicted to be true in a world w as long as there are permitted worlds in w of *at least one* of the three types. Nothing in the semantics delivers the requirement that there be permitted worlds of *all three* types (what I will call, following Kratzer and Shimoyama 2002 ‘the distribution requirement’). The problem is illustrated in section 4.2.

If the standard semantics for *or*, together with the standard semantics for modals, does not deliver the distribution requirement, what does? Section 4.3 examines three answers that have been explored in the recent semantic literature. The first type of answer, which I survey in section 4.4, moves beyond the standard semantics of *or*, modals, or both, and

assumes that the distribution requirement is truth-conditional (Zimmerman, 2001; Aloni, 2003; Geurts, 2005; Simons, 2005); the second, presented in section 4.5, derives the distribution requirement from the presuppositional behavior of disjunctions (Vainikka, 1987); and the third, presented in section 4.6, derives it as a conversational implicature (Kratzer and Shimoyama, 2002; Alonso-Ovalle, 2005; Schulz, 2004, 2005; Aloni and van Rooij, to appear; Fox, 2006). I show that neither the first nor the second type of analysis makes the right predictions for downward entailing environments, where the distribution requirement is absent, and that the third does.

The rest of the chapter is devoted to the derivation of the distribution requirement as an implicature. Sections 4.6 - 4.8 discuss the problems that the derivation of the distribution requirement as a scalar implicature faces, and how the mechanics of innocent exclusion (Fox, 2006) introduced in chapter 3 can solve them. Section 4.9 shows that if the scalar competitors are generated by the Sauerland algorithm, the innocent exclusion procedure can ignore some atomic disjuncts, which leads to the wrong strengthenings, as we have seen in chapter 3. I then show in section 4.10 that if an alternative semantics for *or* is adopted, the distribution requirement is derivable as a domain widening implicature (Kratzer and Shimoyama, 2002). Section 4.11 provides a strengthening algorithm that derives the distribution requirement by computing an implicature of domain widening on top of the exclusive component generated by an innocent exclusion mechanism of the type presented in chapter 3.

4.2 The von Wright-Kamp puzzle

4.2.1 The distribution requirement

In the introduction we have established that, in a context where Mom knows who may have what, the sentence in (2) conveys that Sandy has three permitted dessert options: she may have this cake, she may have that ice cream, and she may have that apple. Each disjunct conveys a permitted dessert option. For reasons that will become clear in the next

subsection, I will refer to this meaning component as ‘the distribution requirement’ (a term that I borrow from Kratzer and Shimoyama 2002).¹

(2) Mom, to Dad: “Sandy may have this cake, that ice cream, or that apple.”

The dialogue in (3) illustrates that sentences in which *or* is under the scope of *must* can also convey the distribution requirement.

(3) a. Dad, to Leonor and Sandy: “We have to clean some bedrooms, cook dinner and mow the lawn.”

b. Dad, to Sandy: “You must cook dinner or clean your bedroom.”

Every month Dad, Sandy and Leonor spend a full Sunday doing home chores. Dad decides what to do and who must do what. Nobody is required to do anything unless Dad explicitly says so. The dialogue in (3) illustrates what happened last Sunday. What has Sandy learned about her home chores obligations from the utterance in (3b)? At least two things: (i) that not doing any of those two chores is not permitted, and (ii) that she is permitted to do either chore: she may cook dinner and she may clean her bedroom. Each disjunct represents a permitted option.

4.2.2 The von Wright-Kamp puzzle

The problem is that the standard semantics of modals, when taken together with the standard semantics for *or*, does not deliver the distribution requirement (von Wright, 1968; Kamp, 1973, 1978). Let us see why.

According to the standard semantics for modals, *may* requires the proposition that it combines with (which, following von Fintel (2006), I will call its ‘prejacent’) to be consistent with the set of worlds that are permitted in the world of evaluation. *Must* requires that its prejacent be entailed by the set of permitted worlds.

¹In the context discussed in the introduction, Mom utters the sentence in (2) to inform Dad of what Sandy is permitted to have.

(4) Where $\llbracket \alpha \rrbracket$ is a proposition and \mathcal{D}_w the set of permitted worlds at w ,

$$\text{a. } \left[\begin{array}{c} \oplus \\ \diagup \quad \diagdown \\ \text{may} \quad \alpha \end{array} \right] = \lambda w. \exists w' [w' \in \mathcal{D}_w \ \& \ \llbracket \alpha \rrbracket(w')]$$

$$\text{b. } \left[\begin{array}{c} \oplus \\ \diagup \quad \diagdown \\ \text{must} \quad \alpha \end{array} \right] = \lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow \llbracket \alpha \rrbracket(w')]$$

Take now the sentences at issue:

- (5) a. Sandy may have this cake, that ice cream, or that apple.
 b. Sandy must cook dinner, or clean her bedroom.

What are the propositions that *may* and *must* operate over in these examples? According to the standard analysis of *or*, *may* operates over the proposition in (6) (the union of the proposition that Sandy has this cake, the proposition that Sandy has that ice cream, and the proposition that she has that apple).

$\llbracket \text{Sandy has this cake} \rrbracket$

∪

(6) $\llbracket \text{Sandy has that ice cream} \rrbracket$

∪

$\llbracket \text{Sandy has that apple} \rrbracket$

Must operates over the proposition in (7) (the union of the proposition that Sandy cooks dinner and the proposition that she cleans her bedroom).²

(7) $\llbracket \text{Sandy cooks dinner} \rrbracket \cup \llbracket \text{Sandy cleans her bedroom} \rrbracket$

Given the standard semantics for modals and *or*, the sentence in (5a) is predicted to be true if and only if the proposition in (6) contains at least one permitted world.

²We are assuming a simple version of the standard analysis, according to which *or* operates over propositions, but *or* does not seem to disjoin propositional constituents in our examples: we seem to have a DP disjunction and a VP-disjunction. To interpret DP and VP disjunctions, we need to assume a cross-categorial version of the standard analysis — those that are not familiar with that analysis can consult appendix C to see how it works.

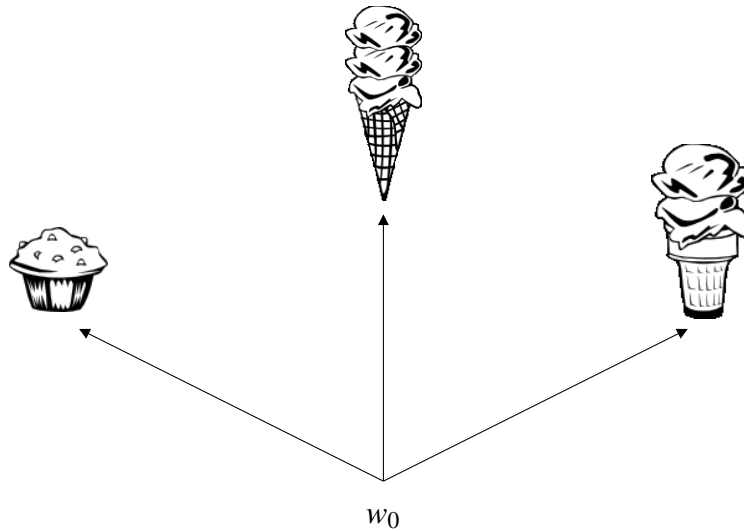


Figure 4.1. A world where Sandy is permitted to have ice cream and is permitted to have a muffin.

As we have seen in the introduction, these truth-conditions are too weak, because they do not convey that Sandy has three permitted dessert options. To see why, consider the situation depicted in figure 4.1. The illustration in figure 4.1 depicts a situation where there are only three types of permitted worlds: there are permitted worlds where Sandy has a two-scoop ice cream cone, there are permitted worlds where Sandy has a three-scoop ice cream cone, and there are permitted worlds where Sandy has a muffin. Those are Sandy's only permitted dessert options: she is not permitted to have this cake, and she is not permitted to have that apple either. In that situation it is true that the proposition in (6) contains some permitted worlds. The proposition in (6) contains all worlds where Sandy has ice cream. Some of those are permitted in the situation depicted in figure 4.1. The sentence in (5a) can then be true in a situation in which Sandy is not permitted to have this cake or that apple, contrary to our intuitions.

Consider now the sentence in (5b). According to the standard semantics of *or* and *must*, the sentence in (5b) is predicted to be true in a world w if and only if all permitted worlds are worlds in the proposition in (7).

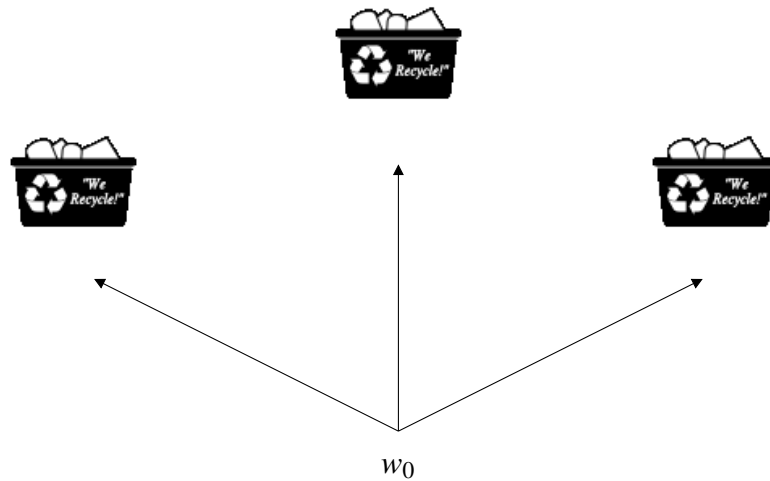


Figure 4.2. A world where Sandy must clean her bedroom.

These truth-conditions are also too weak. To see why, consider the situation depicted in figure 4.2. In the situation depicted in figure 4.2 the only permitted worlds are worlds where Sandy cleans her bedroom. None of the permitted worlds are worlds where Sandy cooks dinner. In that situation, the sentence in (5b) is intuitively false. It is predicted to be true, though: all permitted worlds in the situation depicted in figure 4.2 are worlds in the proposition in (7). Yet notice that in the situation in figure 4.2 Sandy is not allowed to cook dinner. The distribution requirement is not derived. Nothing makes sure that cleaning her bedroom and cooking dinner are both permitted.

To capture the natural interpretation of sentences like (5a) and (5b) — which I will call from now on ‘von Wright-Kamp sentences’ — in contexts like the ones we have considered — where the speakers know who may do what — their standard truth-conditions should be strengthened: we want (5a) and (5b) to convey that *each* individual disjunct is permitted. The only type of situations we want to consider are the ones depicted in figures 4.3 (page 93) and 4.4 (page 94).

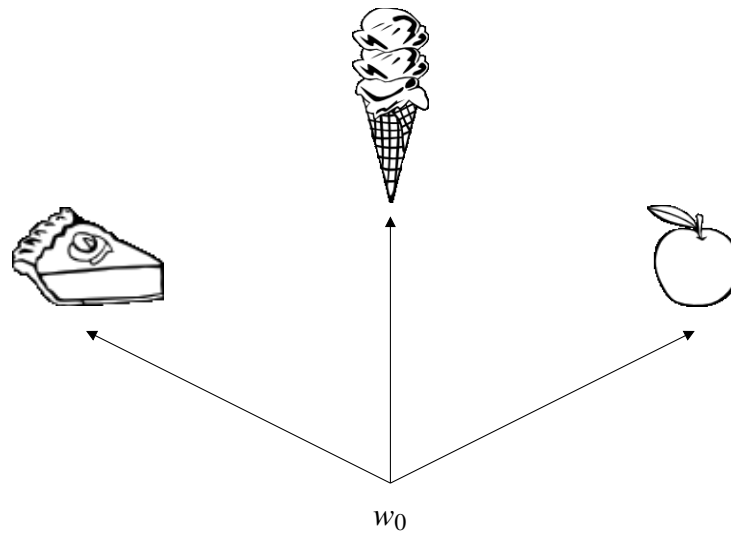


Figure 4.3. A world where Sandy has three types of permitted dessert options.

4.2.3 The epistemic distribution requirement

In the two scenarios we have considered so far the speakers presumably knew what Sandy may or may not do, but the very same sentences they uttered can be uttered by speakers who do not. Suppose, for instance, that Mom tells Dad what everybody may or may not have for dessert. She wants to leave before dinner and wants to leave Dad in charge of giving Sandy and Renée dessert. In this specific occasion, she uttered the sentence below:

(8) Mom, to Dad: “Sandy may have this cake, and Renée may have that ice cream.”

Four hours pass by. It’s dinner time. Dad forgets about what Mom has told him. Sandy asks him what she may have for dessert. Dad tries to report what Mom had told him and answers with the sentence in (9):

(9) Dad, to Sandy: “You may have this cake, or that ice cream — I don’t remember which.”

The same type of scenario can be constructed for the case with *must*. Suppose Dad leaves before Sunday and tells Mom what Sandy and Renée must do.

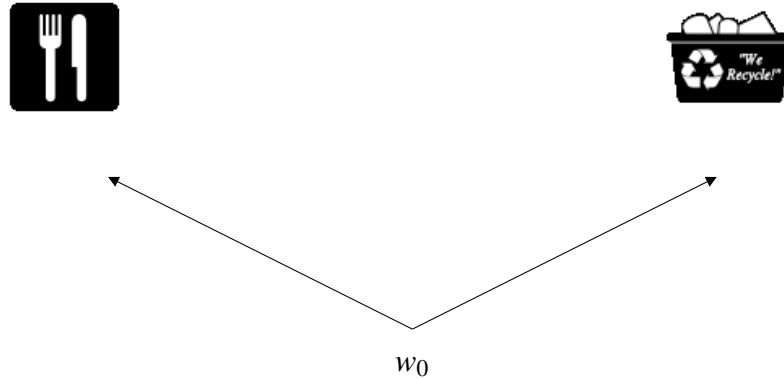


Figure 4.4. A world where Sandy is allowed to cook dinner and is also allowed to clean her bedroom.

(10) Dad to Mom: “Sandy must clean her bedroom, and Renée must cook dinner.”

When the time comes to tell Sandy and Leonor what they must do, Mom forgets who is required to do what. Sandy asks her what she must do. Mom gives the sentence in (11) as an answer:

(11) Mom, to Sandy: “You must clean your bedroom or cook dinner — I forgot which.”

The sentences do not convey the distribution requirement now. Not in the form we are entertaining. Take the sentence in (9). It conveys that, according to what the Dad knows, Sandy might be allowed to eat this ice cream and she might be allowed to eat that cake. The illustration in figure 4.5 on page 95 depicts the situation: the arrows leaving from w_0 point to the epistemic options: the types of worlds that, according to what Dad knows, could be the actual world.³ The arrows departing from the two types of epistemic options point to the types of worlds that are permitted in those worlds. We are not requiring that the

³Notation: I use capital \mathscr{W} with a subscript to indicate that I intend to refer to *types* of worlds, rather than particular worlds.

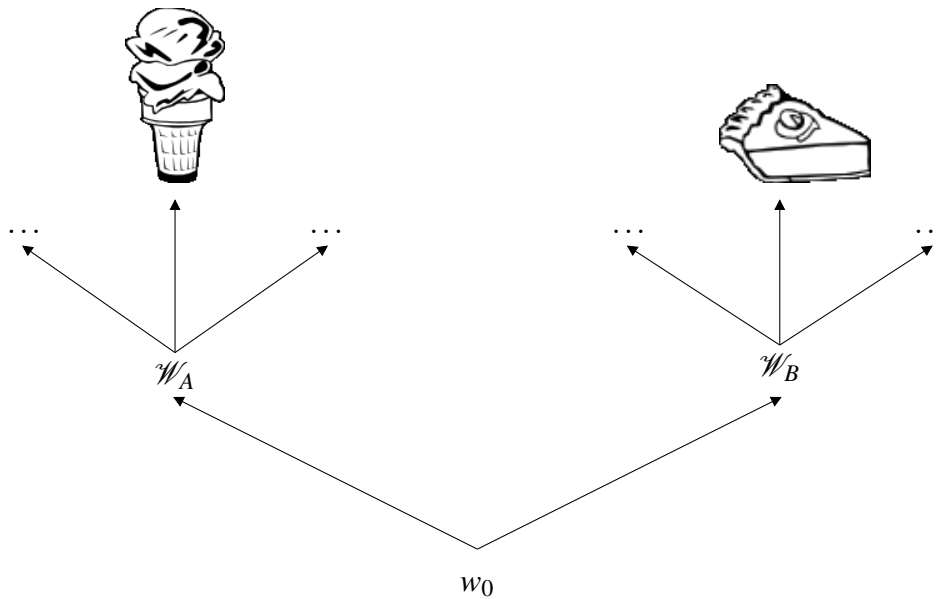


Figure 4.5. *Sandy may have this ice cream or that cake — I don't know which.*

permitted worlds at w_0 include worlds where Sandy eats this ice cream as well as worlds where she eats that cake. We are requiring that among the epistemic options there be worlds where Sandy is allowed to eat this ice cream and also worlds where she is allowed to eat that cake.

Likewise for the sentence in (11). In the scenario that we have considered, the sentence conveys that, according to what Mom knows, it might be true that Sandy must clean her room and it might also be true that she must cook dinner. The situation is illustrated in figure 4.6 on page 96. The arrows leaving from w_0 point to the epistemic options: the types of worlds that, according to what Mom knows, could be the actual world. The arrows departing from the two types of epistemic options point to the types of worlds that are permitted in those worlds. In the first type of epistemically accessible world, Sandy is required to cook dinner. In the second type, she is required to clean her bedroom. We are not requiring that the permitted worlds at w_0 include worlds where Sandy cleans her bedroom as well as worlds where she cooks dinner. We are rather requiring that the epistemic alternatives

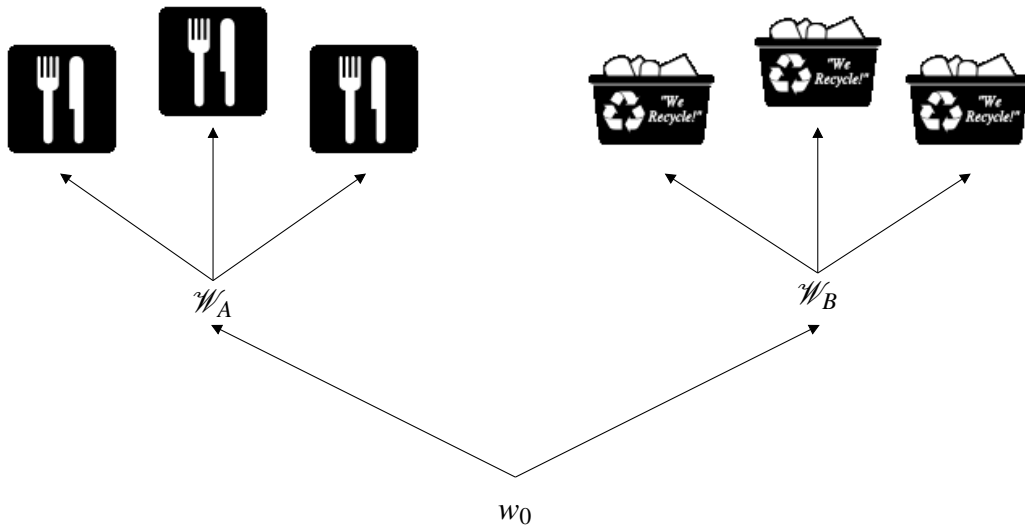


Figure 4.6. *Sandy must clean her bedroom or cook dinner — I don't know which.*

include worlds where Sandy is required to clean her bedroom and worlds where she is required to cook dinner.

Let me give these readings a name. When necessary, I will speak of the *deontic* (distributive) reading to refer to the reading of the sentences at stake under which each disjunct is required to be true in at least one permitted world, and I will speak of the *epistemic* (distributive) reading to refer to the reading of the sentences that express the ignorance of the speaker as to which option is allowed or required. We will not be concerned in this chapter, for the most part, with the epistemic reading.

4.3 What conveys the distribution requirement?

The standard analysis of *or*, together with the standard analysis of modals, predicts very weak truth-conditions for von Wright-Kamp sentences. The *may* examples are predicted to be true as long as there are some permitted worlds in the disjunction the modal operates over, and the *must* examples are predicted to be true if the proposition expressed by one of

the disjuncts contains no permitted worlds. If the semantics does not deliver the distribution requirement, what does?

There have been a number of proposals in the recent literature. I sort them in *three* major families, depending on whether they take the distribution requirement to be semantic (either part of the truth-conditional component proper or derived as a presupposition) or pragmatic.

Analysis 1 builds the distribution requirement into the truth-conditions. Since the standard semantics does not deliver the distribution requirement, the analysis proposes a non standard semantics (for *or* (Zimmerman, 2001; Geurts, 2005) or for both modals and *or* (Aloni, 2003; Simons, 2005)) that does.

Analysis 2 (Vainikka, 1987) derives the distribution requirement from the presupposition projection behavior of disjunctions. Other than the presupposition that *each* disjunct be compatible with the local context (the set of worlds compatible with the common ground knowledge, in the case of unembedded disjunctions, or the relevant set of accessible worlds, in the case of disjunctions embedded under modals) the semantics of *or* and modals are standard.

In sections 4.4.3 and 4.5.2, I show that Analyses 1 and 2 predict the wrong truth-conditions in downward entailing environments, and I take the observation that the distribution requirement seems absent in those environments as a reliable sign that it must be a conversational implicature.

Analysis 3 derives the distribution requirement as a conversational implicature (Kratzer and Shimoyama, 2002; Alonso-Ovalle, 2004; Schulz, 2004, 2005; Fox, 2006).⁴ The proposal presented in Fox 2006 sticks to a standard semantics for both *or* and modals, but

⁴I would like to thank Katrin Schulz for sharing unpublished versions of her work with me. I have familiarized myself with Schulz's work only recently. Due to time constraints, I cannot include the kind of thorough review of her work that I would have liked to include. The reader is referred to Schulz 2004, Schulz 2005 and Aloni and van Rooij to appear. As far as I understand her analysis, it is committed to the authoritative principle that Zimmerman's analysis (reviewed below) advocates. To the extent that this is so, what I say about Zimmerman's analysis extends to her analysis as well.

assumes that the pragmatic component can see each atomic disjunct in combination with the modal via the Sauerland algorithm. As we have seen in chapter 3, assuming the Sauerland algorithm and the standard semantics for *or* allows the pragmatics to ignore some disjuncts. I will conclude by showing that if an alternative semantics for *or* is adopted, the distribution requirement can be derived as an implicature of domain widening (Kratzer and Shimoyama, 2002).

I start by considering Analysis 1.

4.4 Is the distribution requirement truth-conditional?

Analysis 1 comprises a whole family of proposals that import the distribution requirement into the truth-conditions of von Wright-Kamp sentences. All of them derive the distribution requirement associated with the *may* cases, but only the proposals presented in Geurts 2005 and Simons 2005 derive the distribution requirement associated with the *must* cases.

In section 4.4.1 I go through the analyses of the *may* cases presented in Zimmerman 2001, Geurts 2005, Aloni 2003 and Simons 2005: they all propose that the *may* varieties of the von Wright-Kamp sentences assert that every individual disjunct is permitted, and propose a novel semantics for *or* or modals to derive these truth-conditions. In section 4.4.2 I present the analyses of the *must* cases in Geurts 2005 and Simons 2005. I conclude by showing in section 4.4.3 that Analysis 1 makes the wrong predictions in downward entailing environments.

4.4.1 The *may* cases: all disjuncts are permitted

Consider the sentence in (12):

(12) Sandy may have this ice cream, that cake, or that apple.

Analysis 1 assumes that the sentence in (12) asserts that the proposition that Sandy has this cake, the proposition that she has that ice cream, and the proposition that she has that apple all contain permitted worlds:

$$(13) \quad \llbracket(12)\rrbracket = \lambda w. \forall p \in \left\{ \begin{array}{l} \llbracket\text{Sandy has this cake}\rrbracket, \\ \llbracket\text{Sandy has that ice cream}\rrbracket, \\ \llbracket\text{Sandy has that apple}\rrbracket \end{array} \right\} \llbracket\text{may}\rrbracket(p)(w)$$

The different varieties of Analysis 1 differ on how they get to the truth-conditions in (13). The analysis presented in Zimmerman 2001, and its extension in Geurts 2005, propose a novel semantics for unembedded disjunctions. The analyses presented in Aloni 2003 and Simons 2005, propose a novel semantics for both disjunctions and modals. I will go through the proposals next.

4.4.1.1 A novel semantics for unembedded disjunctions

Zimmerman (2001) proposes a novel analysis of clausal disjunctions. Unembedded clausal disjunctions without overt modals, like the one in (14a), are interpreted as *lists* of epistemic possibilities, where lists are understood as conjunctions of epistemic possibilities (together with a closure condition): the sentence in (14a) is taken to assert that, according to what the speaker knows, Sandy might have eaten this ice cream and she might have eaten that cake and that there is no other contextually relevant possibility as to what Sandy ate. Ignoring the closure condition, the content of the sentence in (14a) can be represented as in (14b), where ‘ ∇ ’ stands for epistemic possibility:⁵

- (14) a. Sandy ate this ice cream or she ate that cake.
 b. $\llbracket(14a)\rrbracket(w) = 1 \Leftrightarrow \nabla(\llbracket\text{Sandy has this cake}\rrbracket) \ \& \ \nabla(\llbracket\text{Sandy has that ice cream}\rrbracket)$

A von Wright-Kamp sentence, like the one in (15a), is also understood as a list of epistemic possibilities. We are dealing now with a list of doubly modalized statements: the sentence in (15a) is assumed to assert that it might be that Sandy may eat this cake and that it might be that she may eat that ice cream (and that there is no other contextually relevant

⁵Zimmerman (2001) shows that capturing formally the content of the closure condition proves difficult. The reader is referred to section 2.3 of Zimmerman 2001 for a discussion of the issues involved. I will ignore the closure component in what follows.

dessert option that the speaker deems possible that Sandy may have). Ignoring again the closure condition, the content of the sentence can be represented as in (15b), where ‘ \diamond ’ stands for deontic possibility:

- (15) a. Sandy may have this cake or she may have that ice cream.
- b. $\llbracket(15a)\rrbracket(w) = 1 \Leftrightarrow \left[\begin{array}{c} \nabla(\diamond(\llbracket\text{Sandy has this cake}\rrbracket)) \\ \& \\ \nabla(\diamond(\llbracket\text{Sandy has that ice cream}\rrbracket)) \end{array} \right]$

These truth-conditions capture one of the readings of the sentence in (15a), which can in fact be used by a speaker who knows that Sandy is permitted to have one of the two dessert options (this ice cream or that cake), but does not know which one. This reading was discussed in section 4.2.3, where we considered sentences like (15a) in contexts where the speaker didn’t know what the permitted options were.

To get from the truth-conditions in (15a) to the ones we are assuming (that it is permitted that Sandy has this cake and is also permitted that Sandy has that ice cream), Zimmerman makes an assumption about the type of epistemic modality invoked. He assumes that a sentence like the one in (15a) conveys that Sandy has two permitted dessert options whenever listeners assume that the speaker is an authority on what is permitted —whenever she knows perfectly well what the permitted options are. If the speaker is an authority on what is permitted (if the speaker knows that a certain proposition p is permitted if and only if p is in fact permitted and she knows that p is not permitted if and only if p is not permitted), then if she deems it possible that Sandy may have this cake, Sandy may indeed have this cake, and, likewise, if she deems it possible that Sandy may have that ice cream, Sandy may indeed have that ice cream. Let’s see why.

How is this authoritative knowledge defined? Zimmerman assumes that the speaker is an authority on a certain property P in a context c if and only if the speaker in c knows the extension of P in c (Zimmerman, 2001, 285). Deontic modals are taken to express a property of propositions: a proposition p is in the extension of the modal operator ‘ \diamond ’ in a

world w if and only if p is compatible with the set of worlds that are permitted in w . The speaker is an authority on what is permitted in a context c if and only for every proposition p she knows whether p is compatible with what is permitted in the world of the context c . More formally:⁶

(16) A speaker is an authority on \diamond in c if and only if

$$\forall w' \in \mathcal{E}_{s,w_c} \forall p \in D_{\langle s,t \rangle} [w' \in \diamond(p) \leftrightarrow w_c \in \diamond(p)]$$

From the assumption that the speaker is an authority on what is permitted, it follows that if the speaker takes it possible that Sandy may have this cake, she in fact knows that Sandy may have this cake. To convince ourselves that this is indeed the case, suppose that the speaker is an authority on what is permitted. Now assume that she takes it possible that Sandy may have this cake, but does not know it — suppose that there is at least one world epistemically accessible for the speaker where it is true that Sandy may have this cake (call it w^*), and that there is at least one epistemically accessible world where it is false that Sandy may have this cake (call it w^{**}). Either Sandy may have this cake in w_c or not. Suppose she does. Then, in virtue of the authority principle, there should not be an epistemically accessible world where Sandy may not have this cake, contradicting the assumption that w^{**} is one such world. Suppose that Sandy may not have this cake in w_c . Then, in virtue of the authority principle, there should not be a world where she may have this cake, contradicting the assumption that w^* is one such world.

Now take the sentence in (15a). Suppose the sentence were uttered in the scenario we started the chapter with. We can assume that Mom knows perfectly well what Sandy may and may not have. We can therefore assume that the epistemic modality involved is authoritative. But then the truth-conditions of the sentence under discussion are the ones

⁶Notation: for any world w , context c , and speaker s , $\mathcal{E}_{s,w}$ is the set of worlds epistemically accessible for s in w ; w_c is the world of context c .

we are after: the sentence conveys that the speaker knows that Sandy may have this cake and that she knows that Sandy may have that ice cream.

We have seen that the von Wright-Kamp sentences we are analyzing are ambiguous between a *deontic* and an *epistemic* reading. Zimmerman's approach captures the ambiguity in a straightforward manner: whenever it is possible to assume that the epistemic modality involved is authoritative, we get the deontic reading; when a non-authoritative epistemic modality is involved, we get the epistemic reading. The derivation of the distribution requirement is tied to the assumption that the epistemic modality invoked is authoritative. Yet the assumption that the speaker's infallible knowledge about who can do what is a necessary condition for the distribution of the disjuncts seems to me a bit strong. Zimmerman himself briefly considers in a footnote the sentence in (17):

- (17) I know absolutely nothing about the rules for Mr. X's moves, except this: He can take a bus or a boat at this stage of the game. (Zimmerman, 2001, fn. 46)

The sentence is to be understood with respect to a scenario discussed in the paper, where a set of people are playing a board game that requires finding out about Mr. X's whereabouts. In (17), the speaker acknowledges that she is not an authority about the rules of the game, which determine which transportation Mr. X may and may not take at any stage of the game and, yet, the von Wright-Kamp sentence seems to convey that (according to the rules of the game) Mr. X can take a bus and he can also take a boat.

Although Zimmerman's analysis concerns unembedded disjunctions, we can consider similar cases where the relevant von Wright-Kamp sentences are embedded under attitude verbs. Consider for instance what happens at Ms. Green's. Ms. Green is Sandy's favorite teacher. She throws a party every two weeks for her students. But the truth is that at Ms. Green's, dessert is not great. Nobody can choose what to have. Well, nobody except for the best student of the week, that is, who is always granted the right to choose which dessert (usually custard or apple pie) to have. Somebody, knowing that Sandy has been working

hard, asks Ms. Green's husband whether Sandy will get to choose what dessert to have and, since he has also seen her work hard, he answers in a pompous tone:

(18) I suspect that Sandy may have custard or pie (whichever she wants) but I might be wrong.

He could have also uttered the sentence below:

(19) I suppose that Sandy may have custard or pie (as she wishes) but I am not sure yet.

Or simply:

(20) I believe that Sandy may have custard or pie (as she wishes) but I am not a hundred percent sure.

Or suppose I know it is Leonor, and not Sandy, who got the prize, I can then add:

(21) Ms. Green's husband wrongly believes that Sandy may have custard or pie.

Or maybe I just want to know and decide to ask Ms. Green's husband:

(22) Me, to Ms. Green's husband: "I want to know whether Sandy may have custard or pie — as she wishes — or not."

What is going on in these cases? Do we really have to assume that the speaker is an authority on who can borrow what? I would like to say that one could make a case that what Mr. Green is not sure about (or suspects or believes) is whether Sandy has being granted the right to have custard and also the right to have pie or not. And if that is the case, we have to think about whether the authoritative knowledge is really a necessary condition for the distribution of the disjuncts. True: in the cases where the speaker is granting permission, it is safe to assume that she know what the deontic options are, but we can't take that for granted the moment we *describe* somebody's rights.

Geurts (2005) presents a follow-up on Zimmerman's theory that dispenses with the assumption that the modality involved is authoritative knowledge. As in Zimmerman 2001,

disjunctions are analyzed as conjunctions of modal statements. Unlike in Zimmerman 2001, however, the modals are not restricted to epistemic possibility modals. The sentence at stake is analyzed as a conjunction of *deontic* possibilities (with the relevant closure condition). Ignoring the closure condition, the sentence in (15a), repeated below in (23a), is analyzed as in (23b):⁷

(23) a. Sandy may have this cake or she may have that ice cream.

$$\text{b. } \llbracket (23a) \rrbracket(w) = 1 \Leftrightarrow \left[\begin{array}{c} \diamond(\llbracket \text{Sandy has this cake} \rrbracket) \\ \& \\ \diamond(\llbracket \text{Sandy has that ice cream} \rrbracket) \end{array} \right]$$

Assuming that von Wright-Kamp sentences do not invoke authoritative knowledge when they license the deontic distributive requirement does not account for the cases in (18-22). In the sentences in (18-22), the corresponding von Wright-Kamp sentences are embedded, but Zimmerman's proposal focus on unembedded disjunctions. The issue of how to treat within his framework cases where von Wright-Kamp are embedded remains open. We need to know more about the compositional implementation of the analysis.

4.4.1.2 A novel analysis for both *or* and modals

Unlike the proposals in Zimmerman 2001 and Geurts 2005, the ones presented in Aloni 2003 and Simons 2005 get to the meaning of (24a) in (24b) in a fully compositional way.

(24) a. Sandy may have this ice cream, that cake, or that apple.

$$\text{b. } \llbracket (24a) \rrbracket = \lambda w. \forall p \in \left\{ \begin{array}{l} \llbracket \text{Sandy has this cake} \rrbracket, \\ \llbracket \text{Sandy has that ice cream} \rrbracket, \\ \llbracket \text{Sandy has that apple} \rrbracket \end{array} \right\} \llbracket \text{may} \rrbracket(p)(w)$$

⁷The main innovation in the system presented in Geurts (2005) has to do with a constraint on the domains modals can range over. The constraint allows him to derive the distribution requirement for the *must* cases. Since it does not play an important role in the possibility cases, I omit it for the time being. It will be discussed in section 4.4.2.

These truth-conditions involve three meaning components: (i) a domain of propositions, (ii) a universal quantifier that ranges over them, and (iii) a modal component. If the paraphrase is to be taken seriously, something has to be said about where these meaning components come from. Both the analysis in Aloni 2003 and the one in Simons 2005 tease apart the universal force from the setting up of the domain of quantification. They both propose that *or* has nothing to do with the universal force: its only role is to set up the domain of propositional alternatives.

For the case of (24a), the barebones of both analyses go as follows: (i) disjunction contributes only a set of propositional alternatives (containing the proposition that Sandy eats this cake, the proposition that she eats that ice cream and the proposition that she eats that apple), and (ii) at the relevant level of interpretation, *may* takes this set of propositions as its argument and yields a proposition that is true if and only if *all* of the propositions in the argument set are permitted. The analyses differ in their technical setup, which I discuss next.

Let us first talk about how *or* ends up setting a domain of propositional alternatives in the analysis presented in Aloni 2003. Aloni assumes that disjunctions can be translated in two different ways. Consider, for instance, the unembedded disjunction in (25): it can be translated by the formula in (25a) or by the formula in (25b).⁸

(25) Sandy has this cake or she has that ice cream.

$$\begin{array}{l}
 \text{a. } \exists p \left[\begin{array}{c} \vee p \wedge \left(\begin{array}{c} p = \lambda w. \mathbf{have}_w(\mathbf{s}, \mathbf{c}) \\ \vee \\ p = \lambda w. \mathbf{have}_w(\mathbf{s}, \mathbf{i}) \end{array} \right) \end{array} \right] \\
 \text{b. } \exists p \left[\vee p \wedge (p = \lambda w. \mathbf{have}_w(\mathbf{s}, \mathbf{c}) \vee \mathbf{have}_w(\mathbf{s}, \mathbf{i})) \right]
 \end{array}$$

The formulae in (25a) and (25b) are logically equivalent: they are both true in a world w if and only if w is a world where Sandy eats cake or one where she eats ice cream.

⁸Notation: Aloni uses a language with propositional variables, the ‘ \vee ’ operator is interpreted as follows: let A be an expression denoting a proposition, $\llbracket \vee A \rrbracket^{w,g} = 1$ iff $w \in \llbracket A \rrbracket^{w,g}$.

Aloni presents an innovative semantics that makes use of propositional alternatives. In the semantics that she presents formulae introduce propositional alternatives, and the formulae in (25a) and (25b), although they are equivalent, introduce a different set of propositional alternatives: the formula in (25a) introduces the set containing the proposition that Sandy eats cake and the proposition that she eats ice cream, and the formula in (25b) introduces the singleton containing the proposition that is true in a world w if and only if at least one of those two propositions is true in w .

How do formulae introduce propositional alternatives into the semantics? The set of propositional alternatives introduced by a formula is defined in terms of the set of possible values for an existentially quantified variable. Aloni defines recursively a function $([\cdot]_{M,g})$ which maps formulae to sets of pairs $\langle s, w \rangle$ consisting of a sequence of semantic objects s and a possible world. Here's her definition:

- (26)
1. $[P(t_1 \dots t_n)]_{M,g} = \{ \langle \langle \rangle, w \rangle \mid \langle \llbracket t_1 \rrbracket_{M,w,g}, \dots, \llbracket t_n \rrbracket_{M,w,g} \rangle \in \llbracket P \rrbracket_{M,w,g} \}$
 2. $[t_1 = t_2]_{M,g} = \{ \langle \langle \rangle, w \rangle \mid \llbracket t_1 \rrbracket_{M,w,g} = \llbracket t_2 \rrbracket_{M,w,g} \}$
 3. $[\neg \phi]_{M,g} = \{ \langle \langle \rangle, w \rangle \mid \neg \exists s : \langle s, w \rangle \in [\phi]_{M,g} \}$
 4. $[\exists x \phi]_{M,g} = \{ \langle ds, w \rangle \mid \langle s, w \rangle \in [\phi]_{M,g[x/d]} \}$
 5. $[\phi \wedge \psi]_{M,g} = \{ \langle s_1 s_2, w \rangle \mid \langle s_2, w \rangle \in [\phi]_{M,g} \ \& \ \langle s_1, w \rangle \in [\psi]_{M,g} \}$

(Aloni, 2003, 5)

This function maps the formulae in (25a) and (25b) into sets of pairs consisting of a proposition and a world where that proposition is true. The formula in (25a) is mapped into a set containing pairs of the form of the ones in (27a-i) and (27a-ii), where the proposition that Sandy has this cake is paired with a world w where that proposition is true, and so is the proposition that Sandy has that ice cream. The formula in (25b) is mapped to a set containing pairs of the form of the one in (27b), where the proposition that is true in a world w if and only if Sandy eats cake in w or she eats ice cream in w is associated with a world where it is true.

- (27) a. i. $\langle \lambda w.\mathbf{have}_w(\mathbf{s}, \mathbf{c}), w \rangle$
 ii. $\langle \lambda w.\mathbf{have}_w(\mathbf{s}, \mathbf{i}), w \rangle$
 b. $\langle \lambda w.\mathbf{have}_w(\mathbf{s}, \mathbf{c}) \vee \mathbf{have}_w(\mathbf{s}, \mathbf{i}), w \rangle$

On the basis of these sets of pairs, the set of propositional alternatives is defined as the set containing the sets of worlds that are paired with the same sequence of semantic objects (in our case, with the same proposition).⁹

$$(28) \quad \text{ALT}(\phi)_{M,g} = \{ \{w \mid \langle s, w \rangle \in [\phi]_{M,g} \} \mid s \in D^{n(\phi)} \} \quad (\text{Aloni, 2003, 5})$$

In the case of the formula in (25a), the function $\text{ALT}(\cdot)_{M,g}$ yields the set containing the proposition that Sandy has this cake and the proposition that she has that ice cream. And that is the object that *may* operates over, thus making sure that the modal has access to each individual disjunct.

Consider, as an illustration, the case in (29).

- (29) Sandy may have this cake, or that ice cream.

The sentence in (29) can be translated as in (30) below:

$$(30) \quad \diamond \left(\exists p \left[\vee p \wedge \left(\begin{array}{c} p = \lambda w.\mathbf{have}_w(\mathbf{s}, \mathbf{c}) \\ \vee \\ p = \lambda w.\mathbf{have}_w(\mathbf{s}, \mathbf{i}) \end{array} \right) \right] \right)$$

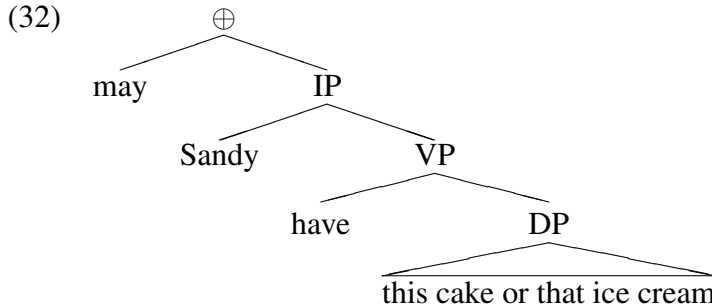
Aloni proposes that in this case *may* quantifies over the alternatives introduced by the formula in its scope. *May* simply says that all of the alternatives introduced by the formula in its scope are permitted. The function $[\cdot]_{M,g}$ maps the formula in (30) to the set of pairs of the form ‘ $\langle \langle \rangle, w \rangle$ ’, where ‘ $\langle \rangle$ ’ is the sequence of objects that contains no object, and w is a world where all the alternatives introduced by the formula under the scope of the deontic modal are permitted. By applying the definition of the propositional alternatives introduced

⁹ $n(\phi)$ gives the length of s and is equivalent to the number of existential quantifiers in a given formula.

by a formula to this set of pairs, we get for (31) the set containing the proposition that is true in a world w if and only if all propositions in the set of propositional alternatives introduced by the disjunction are permitted in w . According to (30), Sandy is permitted to have this cake, and she is also permitted to have that ice cream.¹⁰

$$(31) \quad [\diamond\phi]_{M,g} = \{ \langle \langle \rangle, w \rangle \mid \forall \alpha \in \text{ALT}(\phi)_{M,g} : \exists w' \in \mathcal{D}_w : w' \in \alpha \} \quad (\text{Aloni, 2003, 7})$$

The analysis presented in Simons 2005 posits the same division of labor: disjunctions introduce sets of alternatives and modals operate over them. The technicalities are different, though. Simons (2005) assumes that *or* introduces sets of semantic objects in the derivation. Take the sentence at issue. We assume that its interpretable structure is as in (32) below:



The only role of *or* is to collect the denotation of the objects it operates over in a set. In the case at hand, *or* collects in a set two individuals: this cake and that ice cream.

$$(33) \quad \llbracket \text{DP} \rrbracket = \{ \mathbf{c}, \mathbf{i} \}$$

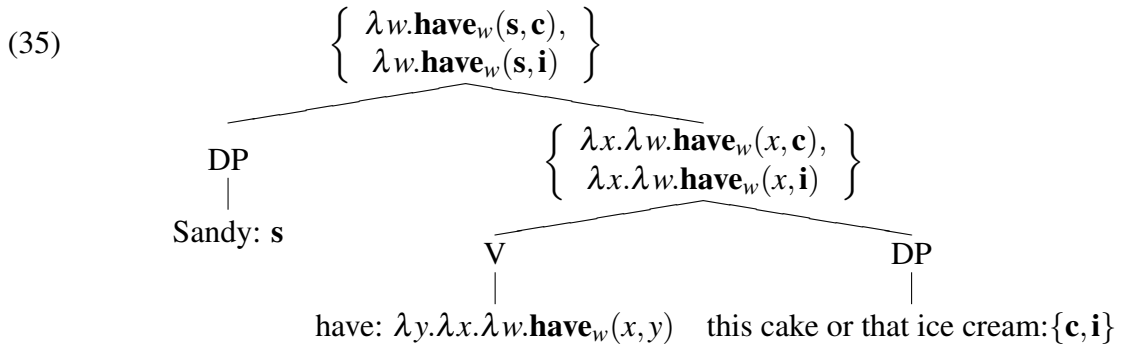
The individual alternatives keep growing by successive instances of a pointwise functional application rule up until the point when they alternatives grow propositional. Since Simons does not resort to an alternative semantics, she cannot resort to the Hamblin rule (not every constituent denotes a set of objects). She adopts the following set of functional application rules instead:

¹⁰As usual, \mathcal{D}_w is the set of deontically accessible worlds in w .

(34) *Rule of Independent Composition*

1. Let α be a branching node with daughters β and γ , where $\llbracket \beta \rrbracket \in D_{\langle b,a \rangle}$ and $\llbracket \gamma \rrbracket \subseteq D_b$.
Then $\llbracket \alpha \rrbracket = \{a : \exists g \in \llbracket \gamma \rrbracket : \llbracket \beta \rrbracket(g) = a\}$
2. Let α be a branching node with daughters β and γ , where $\llbracket \beta \rrbracket \subseteq D_{\langle b,a \rangle}$ and $\llbracket \gamma \rrbracket \in D_b$.
Then $\llbracket \alpha \rrbracket = \{a : \exists b \in \llbracket \beta \rrbracket : b(\llbracket \gamma \rrbracket) = a\}$
3. Let α be a branching node with daughters β and γ , where $\llbracket \beta \rrbracket \subseteq D_{\langle b,a \rangle}$ and $\llbracket \gamma \rrbracket \subseteq D_b$.
Then $\llbracket \alpha \rrbracket = \{a : \exists g \in \llbracket \gamma \rrbracket \exists b \in \llbracket \beta \rrbracket : b(g) = a\}$ (Simons, 2005, 289)

The familiar process by which the alternatives grow propositional is illustrated in (35) below:



We end up again with the required set of propositional alternatives. What is responsible for the universal quantification? Now *may* operates over the set of propositions above. It makes sure that every proposition in that set is permitted. This is implemented as a constraint on the domain of permitted worlds. The truth conditions for the result of applying *may* to a set of propositions, in (36), which make use of the notion of a *supercovers* in (37), require the set of deontically accessible worlds to contain a *subset* X such that every proposition in the set that *may* operates over is true in some world in X , and every world w in X is characterized by at least one of those propositions. All propositions in the set *may* operates over must be permitted.

(36) Where $\mathcal{A} \subseteq D_{\langle s,t \rangle}$ and \mathfrak{D}_w is the set of permitted worlds at w ,
 $\llbracket \text{may} \rrbracket(\mathcal{A})(w) \Leftrightarrow \exists X \subseteq \mathfrak{D}_w \ \& \ \mathcal{A}$ is a supercover of X

(37) A set of propositions SC is a supercover of a set of worlds S iff:

1. Every member of SC contains some member of S.
2. Every member of S belongs to some member of SC.

If SC is a supercover of S, then $\cup \text{SC} \supseteq S$.

4.4.2 The *must* cases

Let's now consider what happens with the *must* cases. Recall the example we used above:

(38) Sandy must clean her bedroom, or cook dinner.

We want to derive the distribution requirement: the requirement that there must be permitted worlds where Sandy cleans her bedroom and permitted worlds where she cooks dinner, but we can't simply apply the strategy pursued to derive the distribution requirement for the possibility cases. The sentence in (39a) was analyzed as in (39b):

(39) a. Sandy may have this cake or that ice cream.

$$\text{b. } \llbracket (39\text{a}) \rrbracket = \lambda w. \forall p \in \left\{ \begin{array}{l} \llbracket \text{Sandy has this cake} \rrbracket, \\ \llbracket \text{Sandy has that ice cream} \rrbracket \end{array} \right\} \llbracket \text{may} \rrbracket(p)(w)$$

The parallel analysis for the *must* cases is wrong. We cannot analyze (38) as in (40) below, because the sentence in (38) does not entail that Sandy is required to clean her bedroom and that she is also required to cook dinner.

$$(40) \llbracket (38) \rrbracket = \lambda w. \forall p \in \left\{ \begin{array}{l} \llbracket \text{Sandy cleans her bedroom} \rrbracket, \\ \llbracket \text{Sandy cooks dinner} \rrbracket, \end{array} \right\} \llbracket \text{must} \rrbracket(p)(w)$$

Of all the varieties of Analysis 1 that we are examining, only the ones in Geurts 2005 and Simons 2005 provide an analysis for the *must* cases.¹¹

¹¹Zimmerman (2001) acknowledges that his analysis does not extend to the *must* cases. The analysis in Aloni 2003 makes the wrong predictions for the *must* cases. To derive the distribution of *any* the way she

Geurts (2005) presents a very ingenious extension of Zimmerman’s system. Under Geurts’ proposal, the *must* (clausal) cases *can* be analyzed as conjunctions of *must* statements without them implying that both disjuncts are necessary. Here’s how.

Geurts analyzes the clausal variant of the example in (38) (repeated in (41a) below) as a conjunction of two necessity statements. To avoid the entailment that Sandy is required to clean her bedroom and is also required to cook dinner, he assumes a constraint on the domain of quantification of the conjoined modals. The domains of the necessity modals are required to be disjoint and to exhaust together the space of deontic possibilities:¹²

- (41) a. Sandy must clean her bedroom or she must cook dinner.
 b. $\Box_{\mathcal{D}_1}(\lambda w.\mathbf{clean}_w(s, \mathbf{the-bedroom-of-s})) \ \& \ \Box_{\mathcal{D}_2}(\lambda w.\mathbf{cook-dinner}_w(s))$
 where $\mathcal{D}_1 \cup \mathcal{D}_2 = \mathcal{D}_w$ and $\mathcal{D}_1 \cap \mathcal{D}_2 = \emptyset$

What do we get, then? We get the effect of partitioning the set of permitted worlds into two cells: one containing worlds where Sandy cleans her bedroom, and the other worlds where she cooks dinner. It is not true that Sandy cleans her bedroom in all permitted worlds and it is not true that she cooks dinner in all permitted worlds either, but it is true that in all permitted worlds she does one of the two and it is true that there are permitted worlds where she cleans her bedroom and permitted worlds where she cooks dinner too.

Geurts’ analysis raises the issue of whether there is independent evidence for this restriction on the domain of quantification of *must*. We cannot assume, for instance, for the conjunctive counterpart of (41a) in (42a) that the domain of quantification is partitioned in the same way, because, if it were, the sentence in (42a) would not convey that Sandy is

wants, she needs to assume that *must* existentially quantifies over the set of alternatives it operates over. It simply says that at least one of those alternatives is true in all permitted worlds. Take the example in (38). It is predicted to be true if and only if at least one of these is true: that Sandy is required to clean her bedroom or that she is required to cook dinner. Nothing requires that she be allowed to clean her bedroom and that she be allowed to cook dinner.

¹²Notation: the subscripts in the necessity operators are meant to indicate the domain of quantification.

under the obligation of cleaning her bedroom *and* under the obligation of cooking dinner; but, what exactly prevents the required partitioning from applying here?

- (42) a. Sandy must clean her bedroom and she must cook dinner.
 b. $\Box_{\mathcal{D}_1}(\lambda w.\mathbf{clean}_w(s, \mathbf{the-bedroom-of-s})) \ \& \ \Box_{\mathcal{D}_2}(\lambda w.\mathbf{cook-dinner}_w(s))$
 where $\mathcal{D}_1 \cup \mathcal{D}_2 = \mathcal{D}_w$ and $\mathcal{D}_1 \cap \mathcal{D}_2 = \emptyset$

Simons 2005 builds the distribution requirement into her semantic rule for the combination of *must* and the set of propositional alternatives it operates over. Once *must* is applied to the set of propositions that it operates over, it requires that all the propositions be permitted and that in all permitted worlds at least one of them is true.

- (43) Where $\mathcal{A} \subseteq D_{\langle s,t \rangle}$ and \mathcal{D}_w is the set of permitted worlds at w ,
 $\llbracket \mathbf{must} \rrbracket(\mathcal{A})(w) \Leftrightarrow \mathcal{A}$ is a supercover of \mathcal{D}_w

- (44) A set of propositions SC is a supercover of a set of worlds S iff:
1. Every member of SC contains some member of S.
 2. Every member of S belongs to some member of SC.

If SC is a supercover of S, then $\cup SC \supseteq S$.

Nothing blocks the possibility that all propositions be true in all worlds. To avoid that possibility, Simons assumes that the notion of supercover can be strengthened by assuming the condition that all propositions p must be true in at least one world in which all propositions other than p are false.

- (45) A set of propositions SC is an *enhanced* supercover of a set of worlds S iff:
1. Every member of SC contains some member of S.
 2. Every member of S belongs to some member of SC.
 3. $\forall p \in SC \exists w \in S \forall p' [(p' \neq p) \rightarrow (w' \notin p')]$ (Simons, 2005, 308)

Simons' requirement is weaker than Geurts': Geurts requires the disjuncts to be mutually exclusive, while Simons simply requires that there be permitted world where exactly one of the propositions is true.

4.4.3 The distribution requirement is not truth-conditional

Analysis 1 imports the distribution requirement into the truth-conditions, then, but is there any evidence that the distribution requirement is in fact truth-conditional?

Kratzer and Shimoyama (2002) derive the distribution requirement associated with existential free choice items as a conversational implicature. Simons (2005) comments on their proposal as follows:

The truth conditions I have offered differ from theirs [the truth conditions that Kratzer and Shimoyama (2002) assume for sentences containing existential free choice items under the scope of deontic modals — L.A.O] in incorporating the distribution requirement. This, in essence, is the function of the supercover condition. The inclusion of the supercover condition expresses the idea that when a modal (or other operator) takes a non-singleton set as argument, the operator in some sense interacts with each member of the argument set. The truth conditions of the sentence are thus sensitive to the membership of the set. This is what seems to be the case for sentences containing *or* coordinations. If Kratzer and Shimoyama are correct about the status of the distribution requirement with respect to free choice sentences, then an interesting difference emerges between these two cases. An obvious next step is to investigate further the claims about the status of the distribution requirement; but this I cannot undertake here.

(Simons, 2005, 278-279)

I take up the challenge and undertake that investigation here. The conclusion that will be reached is that there is no interesting difference between the status of distribution requirement triggered by the existential free choice items investigated in Kratzer and Shimoyama 2002 and disjunction: the distribution requirement associated with *or* does not seem to be part of the truth-conditions either.

Consider a variant of the scenario we started this chapter with. It's dinner time again. Mom, Dad, Sandy and Leonor are at the table. There is, again, cake, ice cream, *crème*

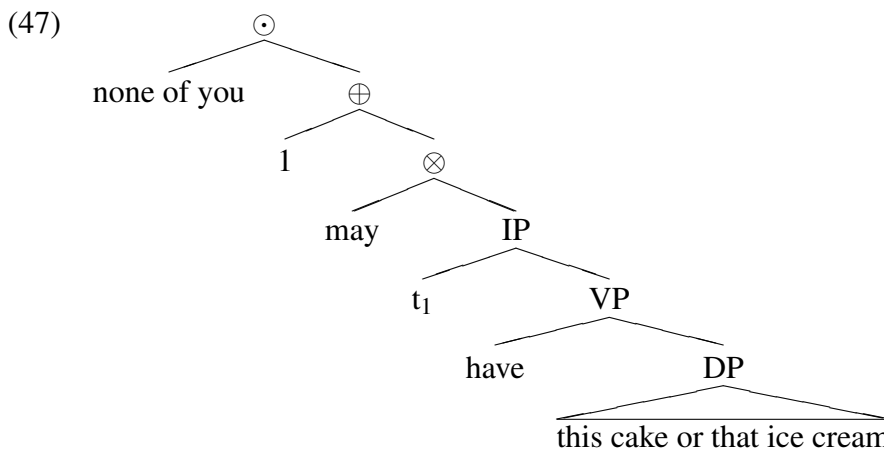
caramel and one apple for dessert, and, again, nobody can have anything unless Mom has explicitly said so and nobody disobeys Mom.

In this particular occasion, Mom ruled as follows:

(46) Mom, to Sandy and Leonor: “None of you may have this cake or that ice cream.”

Given what Mom has said, if Sandy were to have either this cake or that ice cream, she would be disobedient (and the same, of course, goes for Leonor). But Analysis 1 fails to capture this.

Let’s see why. Suppose the relevant LF for (46) were the one below, where the quantifier in subject position is interpreted above the scope of *may*:



We assume, standardly, that the trace in the specifier position of the IP is interpreted as a variable. What’s the denotation of the IP? Under the two compositional accounts of Analysis 1, the denotation of the IP has to be a set of propositions (because that is the object that *may* operates over). In the version in Simons 2005 the disjunction of DPs in object position introduces a set of individuals: the set containing this cake and that ice cream.

$$(48) \quad \left[\left[\begin{array}{c} \text{DP} \\ \hline \text{this cake or that ice cream} \end{array} \right] \right] = \{c, i\}$$

The set grows in the familiar way up until the point where the alternatives become propositional:

$$(49) \quad \left\{ \begin{array}{l} \lambda w. \mathbf{have}_w(x, \mathbf{c}), \\ \lambda w. \mathbf{have}_w(x, \mathbf{i}) \end{array} \right\}$$

$$\begin{array}{c} \text{DP} \\ | \\ x \end{array} \quad \left\{ \begin{array}{l} \lambda x. \lambda w. \mathbf{have}_w(x, \mathbf{c}), \\ \lambda x. \lambda w. \mathbf{have}_w(x, \mathbf{i}) \end{array} \right\}$$

$$\begin{array}{c} \text{V} \\ | \\ \lambda y. \lambda x. \lambda w. \mathbf{have}_w(x, y) \end{array} \quad \begin{array}{c} \text{DP} \\ | \\ \{\mathbf{c}, \mathbf{i}\} \end{array}$$

Now *may* combines with this set and returns the proposition that is true in a world w if and only if all propositions in the set are permitted, as illustrated below:

$$(50) \quad \lambda w. \forall p \in \left\{ \begin{array}{l} \lambda w'. \mathbf{has}_{w'}(x, \mathbf{this-cake}), \\ \lambda w'. \mathbf{has}_{w'}(x, \mathbf{that-ice-cream}) \end{array} \right\} \exists w'' [w'' \in \mathcal{D}_w \ \& \ p(w'')]$$

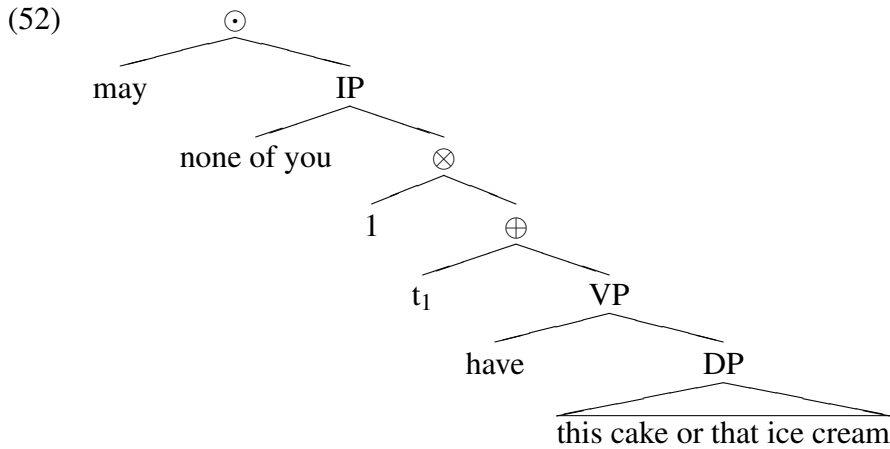
The denotation of the node labelled as ‘ \oplus ’ is the property that results from abstracting over the free variable:

$$(51) \quad \lambda x. \lambda w. \forall p \in \left\{ \begin{array}{l} \lambda w'. \mathbf{has}_{w'}(x, \mathbf{this-cake}), \\ \lambda w'. \mathbf{has}_{w'}(x, \mathbf{that-ice-cream}) \end{array} \right\} \exists w'' [w'' \in \mathcal{D}_w \ \& \ p(w'')]$$

This is the property that the quantifier takes as its argument. The sentence is predicted to be true if and only if for no child x *both* the proposition that x has this cake and the proposition that x has ice cream are permitted.

These truth-conditions do not capture the intuition according to which, given what Mom wants, if, say, Sandy were to have this cake, she would be disobedient. Take, for instance a situation where both Sandy and Leonor are allowed to have this cake (but not that ice cream). The sentence is predicted to be true: none of the girls have both the right to eat ice cream and the right to eat cake. Or take a situation where Sandy may have ice cream (but not cake) and Sandy may have cake (but not ice cream). The sentence would be also wrongly predicted to be true. And the same goes for a situation where one of the girls is permitted to have cake and is also permitted to have ice cream and the other is permitted to have only of the two dessert options, or a situation where one of the girls is permitted to have cake and is also permitted to have ice cream, but the other is permitted to have none of these dessert options. These truth-conditions are wrong.

Interpreting the negative quantifier under the modal does not help. For suppose we were to interpret the structure below, instead, in which *may* scopes over the quantifier:



The denotation of the constituent labeled ‘ \oplus ’ is the set containing the proposition that (the value of) x has this cake and the proposition that (the value of) x has that ice cream. What is the denotation of the node above it? Simons 2005 does not offer any rule for abstraction when one of the constituents is a set of semantic objects. Let’s assume the following rule:

(53) *Predicate Abstraction*

Where i is an index and $\llbracket \beta \rrbracket \subseteq D_\sigma$,

$$\left[\left[\begin{array}{c} \alpha \\ \wedge \\ i \quad \beta \end{array} \right] \right] = \{ f \in D_{\langle e, \sigma \rangle} \mid \forall d \in D_e (f(d) \in \llbracket \beta \rrbracket^{g(d/i)}) \}$$

(Kratzer and Shimoyama, 2002, 8)

The result of applying the abstraction rule to the set of propositional alternatives denoted by the IP is the set of properties below:

$$(54) \quad \llbracket \otimes \rrbracket = \left\{ \begin{array}{l} \lambda x. \lambda w. \mathbf{have}_w(x, \mathbf{this-cake}), \\ \lambda x. \lambda w. \mathbf{have}_w(x, \mathbf{that-ice-cream}) \end{array} \right\}$$

The quantifier can now apply pointwise to return the set of propositions containing the proposition that no children has this cake and the proposition that no children has that ice cream:

$$(55) \quad \llbracket \text{IP} \rrbracket = \left\{ \begin{array}{l} \lambda w. \neg \exists x [\mathbf{child}_w(x) \ \& \ \mathbf{have}_w(x, \mathbf{this-cake})], \\ \lambda w. \neg \exists x [\mathbf{child}_w(x) \ \& \ \mathbf{have}_w(x, \mathbf{that-ice-cream})] \end{array} \right\}$$

This is now the set of propositions over which *may* operates, returning the proposition that is true in a world w if and only if there are permitted worlds in w where the proposition that no child has this cake is true and there are also permitted worlds in w where the proposition that no child has that ice cream is true.

$$(56) \quad \llbracket \odot \rrbracket = \lambda w. \forall p \in \left\{ \begin{array}{l} \lambda w'. \neg \exists x [\mathbf{child}_{w'}(x) \ \& \ \mathbf{have}_{w'}(x, \mathbf{this-c})], \\ \lambda w'. \neg \exists x [\mathbf{child}_{w'}(x) \ \& \ \mathbf{have}_{w'}(x, \mathbf{that-i-c})] \end{array} \right\} \exists w'' [w'' \in \mathcal{D}_w \ \& \ p(w'')]$$

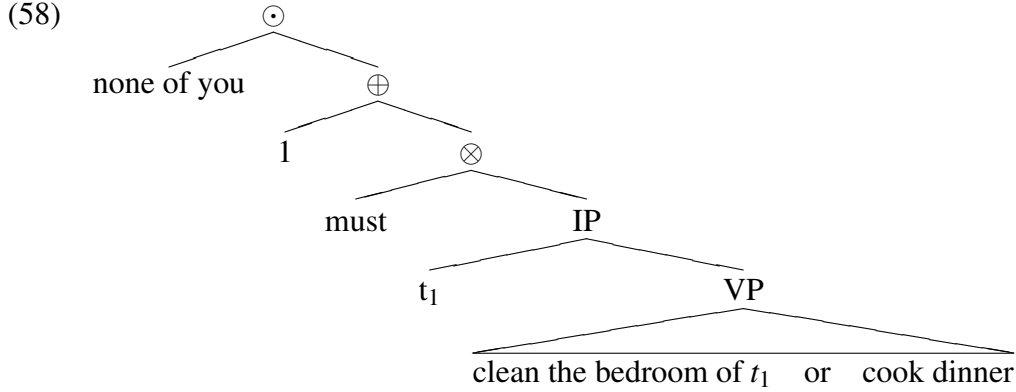
The resulting truth-conditions are too weak: the sentence is predicted to be true in a world w if and only if in w it is permitted that no child have this cake and it is also permitted that no child have that ice cream. That is wrong. If these truth-conditions were right, the sentence would be true if both Sandy and Leonor were allowed to have ice cream (but not cake) or if they were allowed to have both. That goes against the intuitions that we have noticed before.

We can construct a similar argument for the *must* cases. Consider again the second scenario. Dad tells Leonor and Sandy what they are required to do. This time he goes like this:

(57) Dad, to Sandy and Leonor: “None of you must clean the bedroom or cook dinner.”

Given what Dad wants, Sandy is not required to clean her bedroom — nor to cook dinner. And the same goes for Leonor. But consider what the compositional implementation of Analysis 1 predicts.

Suppose that the relevant LF were the one below:



We can assume that the quantifier takes the property in (59) as its argument and claims that it is true of none of the children.

(59) $\llbracket \oplus \rrbracket =$

$$\lambda x. \lambda w. \left(\forall p \in \left\{ \begin{array}{l} \lambda w'. \mathbf{clean}_{w'}(x, x'\mathbf{s-bedroom}), \\ \lambda w'. \mathbf{cook-dinner}_{w'}(x) \end{array} \right\} \exists w'' [w'' \in \mathcal{D}_w \ \& \ p(w'')] \right) \& \left(\forall w' \in \mathcal{D}_w [\mathbf{clean}_{w'}(x, x'\mathbf{s-bedroom}) \vee \mathbf{cook-dinner}_{w'}(x)] \right)$$

Now think about the truth-conditions we get. Consider a situation where both Sandy and Leonor are required to cook dinner and neither of them is allowed to clean her bedroom. We have determined that intuitively, the sentence would be false in such a situation, but it is predicted to be true: neither child is allowed to clean her bedroom and is also allowed to cook dinner.

Analysis 1 fails to deliver the right truth-conditions in downward entailing environments. The next section introduces Analysis 2. We will see that it also makes the wrong predictions in these environments.

4.5 Is the distribution requirement presuppositional?

In order to derive the distribution requirement, the interpretation mechanism has to see the modal together with each disjunct. We have already seen that this is not possible under the standard analysis. Analysis 1 moved beyond the standard analysis of disjunction to make

the disjuncts visible. Analysis 2 is more conservative than Analysis 1 and sticks to the standard analysis of both *or* and *modals*. How does it manage to let the modal see each disjunct on its own? By making each disjunct visible on its own in the pragmatics. To the best of my knowledge, Vainikka 1987 is the only version of Analysis 2 in the literature. I review her proposal next.

4.5.1 Each disjunct updates the context on its own

To understand Analysis 2, we first need to understand the presupposition projection behavior of disjunctions. In order to do so, we will need to introduce a dynamic framework.

Assertions are made in context, and their content sometimes depends on the context in which they are made; but assertions also modify the context (Stalnaker, 1978). We will take contexts to be informational states, modelled as sets of worlds: the set of worlds consistent with what is common ground knowledge at any point in a conversation. Assertions are proposals to add information to what is common ground knowledge: they eliminate worlds from the contexts — all those worlds that are incompatible with the content of what is asserted. They can be viewed as functions from contexts to contexts: *context-change potentials*.

Sentences (or, rather, their Logical Forms, as we will assume) will be associated with context change potentials. We start by defining the context change potential of a sentence that does not contain any logical operator (for our purposes, a sentence that does not contain negation, modals, conjunction or disjunction).¹³

(60) If \mathcal{C} is a context and ϕ an atomic sentence, then

1. If defined, $\mathcal{C} + \phi = \{w \in \mathcal{C} \mid \llbracket \phi \rrbracket(w) = 1\}$
2. $\mathcal{C} + \phi$ is defined iff there is at least a world $w \in \mathcal{C}$ where ϕ is true.

¹³Notation: I use ‘+’ in infix notation for the context update operation.

the other. Take, for instance, the cases in (62a-62b). Neither (62a) or (62b) presupposes that Jane has siblings, although the sentence in (61a) does. In both cases the presupposition that Jane is not an only child is inconsistent with the other disjunct.

- (62) a. Either Jane is an only child, or she dislikes her siblings. (Simons, 1998, 113)
 b. Either Jane dislikes her siblings, or she is an only child. (Simons, 1998, 113)

The same blocking effect is attested when both disjuncts are presuppositional and their presuppositions are inconsistent with each other. The sentence in (63a) presupposes that George told the truth. The sentence in (63b) that he lied. Their disjunction, in (63c), does not carry either presupposition:¹⁵

- (63) a. George regrets telling the truth.
 b. George has discovered that he inadvertently lied. (Simons, 1998, 114)
 c. Either George regrets telling the truth, or he has discovered that he inadvertently lied. (Simons, 1998, 114)

Simons (1998) shows that this presupposition projection pattern can be easily explained by assuming that each disjunct imposes its own presuppositional requirements on the context independently of the other. She assumes the following context change potential for disjunctions:

- (64) 1. If defined, $\mathcal{C} + (\phi \text{ or } \psi) = (\mathcal{C} + \phi) \cup (\mathcal{C} + \psi)$
 2. $\mathcal{C} + (\phi \text{ or } \psi)$ is defined iff both $\mathcal{C} + \phi$ and $\mathcal{C} + \psi$ are defined.

Let's go through the previous cases and see what this context change potential definition predicts. Take the first case:

- (65) a. Jane dislikes her siblings.

¹⁵Assuming that we are talking about the same action.

b. Either Jane has no interesting family stories or she dislikes her siblings.

(Simons, 1998, 150)

The sentence in (65a) presupposes that Jane has siblings, as illustrated below:

- (66) 1. If defined, $\mathcal{C} + (65a) = \{w \in \mathcal{C} \mid \text{Jane dislikes her siblings in } w\}$
2. $\mathcal{C} + (65a)$ is defined iff in all worlds in \mathcal{C} Jane has siblings.

According to the context change potential definition in (64), the context change potential of (65b) will be defined only for contexts in all whose worlds Jane has siblings. The whole disjunction is predicted to inherit the presupposition of (65a). The prediction matches the intuition that the sentence in (65b) presupposes that Jane has siblings, and that is a welcome result.

- (67) a. Jane is an only child.
b. She dislikes her siblings.
c. Either Jane is an only child or she dislikes her siblings. (Simons, 1998, 113)

Let's consider now the second case. According to the context change potential definition in (64), the context change potential of (67c) will be defined only for contexts \mathcal{C} that entail that Jane has siblings, since the context change potential of the sentence in (67b) will only be defined for those contexts.

Now take a context \mathcal{C}_1 that contains worlds where Jane is an only child and worlds where she is not, and apply the context change potential of (67c) to it:

$$(68) \quad \mathcal{C}_1 + (67c) = (\mathcal{C}_1 + (67a)) \cup (\mathcal{C}_1 + (67b))$$

The context change potential of (67c) is *not* defined for \mathcal{C}_1 . For the context change potential of (67c) to be defined, the context change potential of *both* disjuncts need to be defined. The operation $\mathcal{C}_1 + (67a)$ is defined, since, by assumption, there is at least one world in \mathcal{C}_1 in which Jane is an only child; but the operation $\mathcal{C}_1 + (67b)$ is not, because for $\mathcal{C}_1 + (67b)$ to be defined, all worlds in \mathcal{C}_1 must be worlds where Jane has siblings. This is *not* a

welcome result, because the sentence in (67c) can be uttered felicitously in a context that is compatible with Jane having siblings and also with her being an only child.

Accommodating the presupposition that Jane is an only child does not help. For suppose that we update \mathcal{C}_1 with the proposition that Jane has siblings to get a context \mathcal{C}_2 that entails that Jane has siblings, as illustrated below:

$$(69) \quad \mathcal{C}_1 \cap \{w \mid \text{Jane has siblings in } w\} = \mathcal{C}_2$$

Let's now suppose that we are to apply the context change potential of (67c) to \mathcal{C}_2 , instead of \mathcal{C}_1 :

$$(70) \quad \mathcal{C}_2 + (67c) = (\mathcal{C}_2 + (67a)) \cup (\mathcal{C}_2 + (67b))$$

Now the operation $\mathcal{C}_2 + (67b)$ is defined, but $\mathcal{C}_2 + (67a)$ is not, because there is no world in \mathcal{C}_2 where Jane is an only child. This means that $\mathcal{C}_2 + (67c)$ is undefined, given the definedness conditions for disjunctions that we are assuming.

Simons points out that once we assume that each disjunct updates the context on its own, a second accommodation possibility becomes available. The presupposition that Jane has siblings can be accommodated *locally*: we can let (67a) update \mathcal{C}_1 and (67b) update \mathcal{C}_2 , as illustrated below:

$$(71) \quad \mathcal{C}_1 + (67c) = (\mathcal{C}_1 + (67a)) \cup ((\mathcal{C}_1 + (\text{Jane has siblings})) + (67b))$$

The presuppositions of both (67a) and (67b) are now satisfied: the sentence in (67c) can be felicitously uttered in a context like \mathcal{C}_1 , as long as the presupposition that Jane has siblings is accommodated locally, and the resulting context is predicted to contain worlds where Jane is an only child and worlds where Jane has siblings and dislikes them, which seems to be right.

Simons shows, then, that by assuming that unembedded disjunctions are associated with the *parallel* context change potential in (72), the presupposition projection behavior of unembedded disjunctions can be explained.

- (72) 1. If defined, $\mathcal{C} + (\phi \text{ or } \psi) = (\mathcal{C} + \phi) \cup (\mathcal{C} + \psi)$
 2. $\mathcal{C} + (\phi \text{ or } \psi)$ is defined iff both $\mathcal{C} + \phi$ and $\mathcal{C} + \psi$ are defined.

More than a decade before, Vainikka (1987) proposed to derive the distribution requirement by assuming this type of parallel context change potential for disjunctions embedded under *may* or *must*. I present her proposal next.

4.5.1.2 Vainikka (1987) on the distribution requirement

The first step is to consider the context change potentials of atomic sentences embedded under *may* and *must*, like the ones below:

- (73) a. Sandy may eat this ice cream.
 b. LF: may (Sandy eat this ice cream)

- (74) a. Sandy must clean her bedroom.
 b. LF: must (Sandy clean her bedroom)

Take the standard semantics for *may* and *must* again:

- (75) Where $\llbracket \alpha \rrbracket$ is a proposition and \mathfrak{D}_w the set of permitted worlds at w ,

$$\begin{array}{l} \text{a. } \left[\begin{array}{c} \oplus \\ \diagup \quad \diagdown \\ \text{may} \quad \alpha \end{array} \right] = \lambda w. \exists w' [w' \in \mathfrak{D}_w \ \& \ \llbracket \alpha \rrbracket(w')] \\ \text{b. } \left[\begin{array}{c} \oplus \\ \diagup \quad \diagdown \\ \text{must} \quad \alpha \end{array} \right] = \lambda w. \forall w' [w' \in \mathfrak{D}_w \rightarrow \llbracket \alpha \rrbracket(w')] \end{array}$$

May simply says that the proposition that it operates over is compatible with the set of permitted worlds in the world of evaluation. *Must* says that the proposition it operates over is true in all permitted worlds in the world of evaluation. Here's a straightforward dynamification of this standard semantics:¹⁶

¹⁶Vainikka attributes the type of context change potential for possibility modals illustrated in (76) to Heim (1985) (Vainikka, 1987, 157)— although Vainikka is not explicit about the definedness conditions. I have not seen Heim 1985. A published version of that material (Heim, 1992), does not discuss the context change potentials of possibility modals. For the context change potential of intensional operators with universal force, see Heim 1992.

- (76) 1. If defined, $\mathcal{C} + \text{may}(\phi) = \{w \in \mathcal{C} \mid \mathcal{D}_w + \phi \neq \emptyset\}$
 2. $\mathcal{C} + \text{may}(\phi)$ is defined iff for some $w \in \mathcal{C}$, $\mathcal{D}_w + \phi \neq \emptyset$
- (77) 1. If defined, $\mathcal{C} + \text{must}(\phi) = \{w \in \mathcal{C} \mid \mathcal{D}_w + \phi = \mathcal{D}_w\}$
 2. $\mathcal{C} + \text{must}(\phi)$ is defined iff for some $w \in \mathcal{C}$, $\mathcal{D}_w + \phi = \mathcal{D}_w$

Consider the LF in (73b). Its context change potential is defined for those contexts \mathcal{C} that contain at least one world in which Sandy may have this ice cream. For any such context \mathcal{C} , the operation yields as output a context \mathcal{C}' in all whose worlds Sandy may eat ice cream.

Now take the LF in (74b). The context change potential of the LF in (74b) is defined only for those contexts \mathcal{C} that contain at least one world in which Sandy must clean her bedroom. For any context \mathcal{C} for which it is defined, the context change potential of (74b) yields a context \mathcal{C}' in all whose worlds Sandy must clean her bedroom.

Vainikka (1987) shows that once we adopt a parallel context change potential (of the type that Simons (1998) argues for) together with these context change potentials for *may* and *must*, the distribution requirement for both the *may* and *must* varieties of von Wright-Kamp sentences can be derived. To see how, let's consider the examples below:

- (78) a. Sandy may eat this ice cream or that cake.
 b. LF: may (Sandy may eat this ice cream or Sandy may eat that cake)
- (79) a. Sandy must clean her bedroom or cook dinner.
 b. LF: must (Sandy clean her bedroom or Sandy cooks dinner)

The LF in (78b) is associated with the context change potential in (80) below:

$$(80) \quad \mathcal{C} + (78b) = \left\{ w \in \mathcal{C} \mid \mathcal{D}_w + \left(\begin{array}{c} \text{Sandy eat this ice cream} \\ \text{or} \\ \text{Sandy eat that cake} \end{array} \right) \neq \emptyset \right\}$$

Vainikka assumes that disjunctions are associated with the *parallel* context change potential in (81). We have seen that the presupposition projection behavior of unembedded disjunctions provides support to this assumption (Simons, 1998).

- (81) 1. If defined, $\mathcal{C} + (\phi \text{ or } \psi) = \mathcal{C} + \phi \cup \mathcal{C} + \psi$.
2. $\mathcal{C} + (\phi \text{ or } \psi)$ is defined iff *both* $\mathcal{C} + \phi$ and $\mathcal{C} + \psi$ are defined.

(Vainikka, 1987, 161)

The context change potential in (80), then, is assumed to be equivalent to the one in (82) below.

$$(82) \quad \mathcal{C} + (78b) = \left\{ w \in \mathcal{C} \mid \left(\begin{array}{c} \mathcal{D}_w + \text{Sandy eat this ice cream} \\ \cup \\ \mathcal{D}_w + \text{Sandy eat that cake} \end{array} \right) \neq \emptyset \right\}$$

I will assume that the context change potential in (82) is defined if and only if there is at least one world $w \in \mathcal{C}$ such that when the disjunction operation is performed over the set of worlds that are deontically accessible from w , the result is not the empty set:

$$(83) \quad \mathcal{C} + (78b) \text{ is defined iff for some } w \in \mathcal{C}, \left(\begin{array}{c} \mathcal{D}_w + \text{Sandy eat this ice cream} \\ \cup \\ \mathcal{D}_w + \text{Sandy eat that cake} \end{array} \right) \neq \emptyset$$

The definedness conditions associated with the context change potentials of disjunctions become important once we assume context change potentials like the one in (81). Vainikka (based on a suggestion by Kratzer (Vainikka, 1987, 161)), notes that when the definedness condition of the disjunction operation is taken into account, the context change potential in (82) captures the distribution requirement. What does the operation in (82) do? For any context \mathcal{C} for which the operation is defined, it returns the set of worlds w in \mathcal{C} for which the disjunction operation, when applied to the set of worlds w' that are deontically accessible from w , does not yield the empty set. The disjunction operation is assumed to be defined for any set of worlds $\mathcal{D}_{w'}$ if and only if every disjunct is compatible with $\mathcal{D}_{w'}$. For

a world w to be in the output of the context change potential in (82), it has to be the case that the set of worlds w' that are deontically accessible from w contains for every disjunct p at least one world where p is true. That means that the context change potential in (82) will yield as output a context \mathcal{C}' in all whose worlds Sandy may have this ice cream and she may also have that cake. Every disjunct is permitted. The distribution requirement is derived.

An important feature of Analysis 2 is that, unlike Analysis 1, it extends in a straightforward way to the *must* cases. The LF in (84b) is associated with the context change potential in (85) below:

(84) a. Sandy must clean her bedroom or cook dinner.

b. LF: must (Sandy clean her bedroom or Sandy cook dinner)

$$(85) \quad \mathcal{C} + (84b) = \left\{ w \in \mathcal{C} \mid \left(\begin{array}{c} \mathfrak{D}_w + \text{Sandy cleans her bedroom} \\ \cup \\ \mathfrak{D}_w + \text{Sandy cooks dinner} \end{array} \right) = \mathfrak{D}_w \right\}$$

Given the definition of the disjunction operation that we are assuming, a world w will be in the context \mathcal{C}' that results from applying the context change potential in (85) to a context \mathcal{C} if and only if the set of worlds w' that are deontically accessible from w contains at least one world where Sandy cleans her bedroom and at least one world where Sandy cooks dinner. In all worlds in the resulting context, then, Sandy is allowed to clean her bedroom and she is also allowed to cook dinner. The distribution requirement is derived.

Analysis 2, then, covers both the *may* and *must* cases the same way, by resorting to an independently motivated assumption about the context change potential of disjunctions. It goes wrong, however, in exactly the same cases where Analysis 1 does.

4.5.2 Negation is a problem

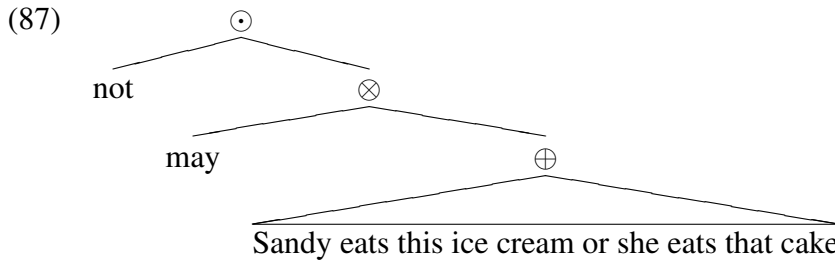
Let us convince ourselves that Analysis 2 goes wrong in downward entailing environments.

Suppose that Mom were to utter the sentence below:

(86) Mom, to Dad: “Sandy is not allowed to eat this ice cream or that cake.”

Given what Mom wants, Sandy is not allowed to eat this ice cream, and she is not allowed to eat that cake, either.

To capture that intuition, the context change potential of the LF of the sentence in (86) should eliminate from any context \mathcal{C} those worlds w where Sandy is permitted to eat this ice cream, and also those worlds where she is permitted to eat that cake. That is not what we get, though. To see why, let’s assume that the LF of the sentence in (86) is the one in (87) below, where negation scopes *may*, which, on its turn, scopes over *or*.



What is the context change potential of this LF? The standard context change potential for negation is the one below:

- (88) a. If defined, $\mathcal{C} + \text{not}(\phi) = \mathcal{C} - (\mathcal{C} + \phi)$
 b. $\mathcal{C} + \text{not}(\phi)$ is defined iff $\mathcal{C} + \phi$ is.

The context change potential of the LF in (87) looks as below, then:

(89) If defined, $\mathcal{C} + (87) =$

$$\mathcal{C} - \left(\mathcal{C} + \text{may}(\text{Sandy eat this ice cream or she eats that cake}) \right) =$$

$$\mathcal{C} - \left\{ w \in \mathcal{C} \mid \left(\begin{array}{c} \mathcal{D}_w + \text{Sandy eat this ice cream} \\ \cup \\ \mathcal{D}_w + \text{Sandy eat that cake} \end{array} \right) \neq \emptyset \right\}$$

Take a context \mathcal{C} for which this context change potential is defined. The operation in (89) subtracts from \mathcal{C} the worlds in the context that the operation in (90) yields as output:

(90) $\mathcal{C} + \text{may}(\text{Sandy eat this ice cream or she eats that cake})$

We have already seen that when defined, the operation in (90) yields a context \mathcal{C}' that contains worlds w where Sandy is permitted to eat this ice cream *and* is also permitted to eat that cake. That means that the context change potential in (89) eliminates from \mathcal{C} all those worlds where Sandy has *both* rights, but keeps any world in \mathcal{C} where Sandy has only one of the two rights. And that is not what we want: we have said that after (86) is uttered, it becomes common knowledge that Sandy is not allowed to eat this ice cream and that she is not allowed to eat that cake either: no world where she has one of those rights should remain in the context set.

4.5.3 Conclusion

Analysis 2 is more conservative than Analysis 1. It sticks to a standard semantic analysis of *or* and modals. Other than that, it resorts to a strategy that is *very* similar to the strategy Analysis 1 entertains: it makes all disjuncts visible (in this case to the context change operation) and it *forces* them all to be permitted. It is not surprising to learn that it goes wrong where Analysis 1 does.

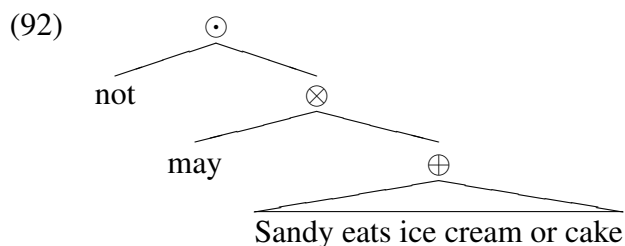
Let us consider now Analysis 3.

4.6 The distribution requirement behaves like a quantity implicature

Sections 4.4 and 4.5 show that the distribution requirement is absent in downward entailing environments. To see why, consider the sentence in (91):

(91) Sandy may not eat ice cream or cake.

Suppose its LF were the one below, and suppose that *or* were interpreted according to the standard analysis.



The denotation of the disjunction would be the union of the proposition that Sandy eats ice cream and the proposition that she eats cake:

$$(93) \quad \llbracket \oplus \rrbracket = \{w \mid \text{Sandy eats ice cream in } w\} \cup \{w \mid \text{Sandy eats cake in } w\}$$

May operates over the proposition in (93) and returns the proposition that is true in a world w if and only if there are worlds in the proposition in (93) that are permitted in w . Negation operates over that proposition and returns the proposition that is true in a world w if and only if the proposition in (93) does not contain any world that is permitted in w . These are in fact the perceived truth-conditions. If the distribution requirement is not part of the truth-conditions, we get exactly what we want in downward entailing environments.

If the distribution requirement were a quantity implicature, its absence in downward entailing contexts would be hardly surprising. Being unnoticeable in downward entailing environments is in fact the hallmark of quantity-based implicatures (Gazdar, 1979; Horn, 1989). Take, as an illustration, the standard neogricean derivation of the exclusive component of disjunctions in positive environments that we went through in the previous chapter.

The sentence in (94a) is naturally heard as saying that Sandy borrowed exactly one of the two books, but the textbook analysis of *or* has it that (94a) can describe a scenario where Sandy borrowed both books — under the textbook analysis, the sentence in (94a) denotes the proposition in (94b), which contains all worlds where Sandy borrowed *Moby Dick* and all worlds where she borrowed *Huckleberry Finn* and, therefore, includes the worlds where she borrowed both.

(94) a. Sandy borrowed *Moby Dick* or *Huckleberry Finn*.

$$\{w \mid \text{Sandy borrowed } \textit{Moby Dick} \text{ in } w\}$$

b.

∪

$$\{w \mid \text{Sandy borrowed } \textit{Huckleberry Finn} \text{ in } w\}$$

A famous argument — presented in Pelletier 1977 and Gazdar 1979 — shows that the exclusive component of (94a) (that Sandy borrowed at most one of the two books) cannot

be part of its truth-conditional content. For suppose (94a) were to denote the proposition in (95) (the set of worlds where Sandy borrowed exactly one of the two books).

$$(95) \left(\begin{array}{c} \{w \mid \text{Sandy borrowed } MD \text{ in } w\} \\ \cup \\ \{w \mid \text{Sandy borrowed } HF \text{ in } w\} \end{array} \right) - \{w \mid \text{Sandy borrowed } MD \text{ and } HF \text{ in } w\}$$

Then the sentence in (96) would denote the proposition that is true in a world w if and only if w is *not* in the set in (95). A world where Sandy borrowed both books will not be in the set in (95) and, so, the sentence is predicted to be true if Sandy borrowed both books.

(96) Sandy didn't borrow *Moby Dick* or *Huckleberry Finn*.

In a world where Sandy borrowed both books, however, the sentence in (96) is intuitively taken to be false. There seems to be no trace of the exclusive component under negation.

If the exclusive component is not part of the truth-conditions, where do we get it from? The neogricean take on the exclusive component of *or* derives it as a quantity implicature, as we saw in the previous chapter. In a sentence that contains no other logical operators, like (94a), substituting *or* with *and* leaves us with an equally relevant claim that is stronger.

(97) Sandy borrowed *Moby Dick* and *Huckleberry Finn*.

Assuming that the speaker believes that (98) is true allows us to capture the perceived exclusive interpretation.¹⁷

(98) It is false that Sandy borrowed *Moby Dick* and *Huckleberry Finn*.

An impressive achievement of this reasoning is that it gives us a sound reason for why the exclusive component disappears under negation. Negation reverses the direction of entailment and, so, the quantity implicatures that are usually drawn in positive environments are absent in negative environments. Take the sentence in (96), repeated below as (99):

¹⁷Grice doesn't talk about the exclusive interpretation of *or*, only about the non truth-functional aspects of its interpretation. As far as I know, it was Horn (1972) the first to make the connection, spelled out in more detail in Gazdar 1979

(99) Sandy didn't borrow *Moby Dick* or *Huckleberry Finn*.

Given the textbook analysis of *or*, the sentence in (99) is true if Sandy didn't borrow either book. Now take a variant of (96) in which *and* is used, instead of *or*:

(100) Sandy didn't borrow *Moby Dick* and *Huckleberry Finn*.

The claim made by (100) is now *weaker* than the claim made by (96) and, therefore, the chain of reasoning that led to the exclusive component of *or* does not apply here.

Consider now the parallelism with the case of the von Wright-Kamp sentences. According to the standard analysis of *or* and modals, the sentence in (101a) claims that at least one of the propositions in the set in (101b) is true.

- (101) a. Sandy may borrow *Moby Dick* or *Huckleberry Finn*.
b. $\left\{ \begin{array}{l} \text{that Sandy may borrow } \textit{Moby Dick}, \\ \text{that Sandy may borrow } \textit{Huckleberry Finn} \end{array} \right\}$

Intuitively, however, the sentence in (101a) makes the stronger claim that *all* the propositions in (101b) are permitted. We have seen that if the distribution requirement is built into the semantics, we predict the wrong truth-conditions in downward entailing environments. If there were a way to derive the strengthening by appealing to a quantity implicature, the behavior of the distribution requirement under negation would be completely expected. Analysis 3 enters the scene.

In what follows, I am going to explore what it takes to defend the hypothesis that the distribution requirement is a conversational implicature. Section 4.7 goes through the predictions of the algorithm for the computation of scalar implicatures presented in Sauerland 2004. This will highlight the main challenges for the scalar approach: we will see that it derives the distribution requirement associated with the *must* cases, but not with the *may* cases, because the negation of all scalar competitors of a *must* von Wright-Kamp sentence is consistent with its content, but the negation of all scalar competitors of a *may* von Wright-Kamp sentence isn't. Then, in section 4.8, we will see that the innocent exclusion

mechanism presented in chapter 3 can derive the distribution requirement associated with the *may* cases if it applies recursively, as Fox (2006) shows. Section 4.9 ends the discussion of the scalar approach by showing that the recursion of the innocent exclusion mechanism inherits the problem that we pointed out in the chapter 3 in connection with unembedded disjunctions.

4.7 The standard scalar approach does not derive the distribution requirement

Together with the *may* sentence in (101a), repeated below as (102a), we will consider the *must* sentence in (103a):¹⁸

- (102) a. Sandy may borrow *Moby Dick* or *Huckleberry Finn*.
b. LF: [may [M or H]]
- (103) a. Sandy must borrow *Moby Dick* or *Huckleberry Finn*.
b. LF: [must [M or H]]

We are interested in deriving from either (102a) or (103a) both (104a) and (104b) as quantity implicatures.

- (104) a. Sandy may borrow *Moby Dick*.
b. Sandy may borrow *Huckleberry Finn*.

What do we get by applying the standard quantity implicature reasoning to the sentences in (102a) and (103a)? First we need to determine what are the scalar competitors associated with (102a) and (103a). The sentences in (102a) and (103a) contain two scalar

¹⁸I use the same abbreviations of LFs that I used in chapter 3 (see footnote 10). When discussing LFs, ‘M’ stands for the sentence ‘Sandy borrows *Moby Dick*’. When discussing meanings, I will adopt modal logic notation. ‘M’, when talking about meanings, stands for the proposition that Sandy borrows *Moby Dick*. ‘ \diamond M’ stands for the proposition that Sandy is permitted to borrow *Moby Dick*, and ‘ \square M’ for the proposition that she is required to do so.

items, one in the scope of each other: a modal (*may* or *must*) and *or*. We have seen in chapter 3 that Sauerland 2004 presents an algorithm to derive the relevant alternatives in cases like this. The basic idea is that the scalar competitors associated with a sentence containing a scalar item s in the scope of another scalar item s' are determined by computing the cross-product of the scales to which both s and s' belong.

The possibility modal *may* forms a Horn scale with *must*. Given the standard semantics of modals, the sentence in (105b) asymmetrically entails the one in (105a): the sentence in (105a) is true if there is at least one permitted world in which Sandy borrows *Moby Dick*, and (105b) is true if Sandy borrows *Moby Dick* in *all* permitted worlds. Given that, by assuming that speakers make the strongest possible relevant claims, from an utterance of (105a) it is possible to conclude that the speaker is not in a position to defend the sentence in (105b).

- (105) a. Sandy may borrow *Moby Dick*.
 b. Sandy must borrow *Moby Dick*.
 c. $\neg \mathcal{H}(\text{Sandy must borrow } \textit{Moby Dick})$.

We have seen that the Sauerland algorithm assumes that *or* forms a partially ordered scale with *and*, and the two silent connectives \mathbb{L} and \mathbb{R} . For the computation of the scalar competitors, we can take scales to be sets of lexical items. The cross-product of the two sets in (106a) (the set of ordered pairs in (106b)) determines for the sentences in (102a) and (103a) the eight scalar competitors in (107-108).

- (106) a. i. {may, must}
 ii. {or, \mathbb{L} , \mathbb{R} , and}
 b. $\left\{ \begin{array}{ll} \langle \text{may, and} \rangle, & \langle \text{must, and} \rangle, \\ \langle \text{may, } \mathbb{L} \rangle, & \langle \text{must, } \mathbb{L} \rangle, \\ \langle \text{may, } \mathbb{R} \rangle, & \langle \text{must, } \mathbb{R} \rangle, \\ \langle \text{may, or} \rangle, & \langle \text{must, or} \rangle \end{array} \right\}$

- (107) a. may [M and H] $(\llbracket \text{may [M and H]} \rrbracket = \diamond(M \& H))$
 b. may [M \mathbb{L} H] $(\llbracket \text{may [M } \mathbb{L} \text{ H]} \rrbracket = \diamond M)$
 c. may [M \mathbb{R} H] $(\llbracket \text{may [M } \mathbb{R} \text{ H]} \rrbracket = \diamond H)$
 d. may [M or H] $(\llbracket \text{may [M or H]} \rrbracket = \diamond(M \vee H))$
- (108) a. must [M and H] $(\llbracket \text{must [M and H]} \rrbracket = \square(M \& H))$
 b. must [M \mathbb{L} H] $(\llbracket \text{must [M } \mathbb{L} \text{ H]} \rrbracket = \square M)$
 c. must [M \mathbb{R} H] $(\llbracket \text{must [M } \mathbb{R} \text{ H]} \rrbracket = \square H)$
 d. must [M or H] $(\llbracket \text{must [M or H]} \rrbracket = \square(M \vee H))$

The algorithm presented in Sauerland 2004 generates quantity implicatures with the help of these scalar competitors. For any of the sentences in (102a-103a), the scalar competitors ϕ in (107-108) that asymmetrically entail them generate the implicature that it is false that the speaker believes that ϕ . Sauerland follows Gazdar in adopting Hintikka's epistemic logic (Hintikka, 1962) in the formalization of the derivation of quantity implicatures. We will follow him in using ' $\mathcal{K}(\phi)$ ' to translate 'the speaker believes that ϕ '.¹⁹ These implicatures are called *primary*.

By assuming that the speaker is well informed about any of the stronger competitors ϕ (that she knows for any of the stronger competitors ϕ whether they in fact are true or false) the *primary* implicatures of the form ' $\neg\mathcal{K}(\phi)$ ' (conveying that the speaker is not certain about the truth of ϕ) are strengthened to get *secondary* implicatures of the form ' $\mathcal{K}\neg(\phi)$ ' (which convey that the speaker is certain that ϕ is false). This move amounts to assuming Zimmerman's authoritative knowledge, as discussed in section 4.4.1.1: we assume that the speaker is an authority on the stronger scalar competitors (whenever any of the negations of

¹⁹Following Gazdar (1979), we will ignore for the most part the differences between knowledge and belief, since nothing of what is at stake seems to hinge on whether the relevant modality is knowledge or belief, although we will discuss the consequences of assuming full introspective power (which does not obtain for knowledge in Hintikka's logic) for the derivation of the distribution requirement with epistemic modals.

the stronger competitors is compatible with what the speaker knows, then it is implied by what the speaker knows).

Why do we get from the primary to the secondary implicatures by assuming that the relevant knowledge is authoritative? Take any implicature of the form ‘ $\neg\mathcal{K}(\phi)$.’ It says that ϕ is not true in *all* worlds compatible with what the speaker believes. That can be true if ϕ is true in none of those worlds, but it can also be true if ϕ is true in some, but not all of those worlds (in which case, according to what the speaker knows, it might be true that ϕ and it might also be true that ϕ is false). If the speaker is well informed about whether ϕ is true or not, either ϕ is true in *all* her epistemic alternatives or in *none* of them. Since the implicature eliminates the possibility that ϕ be true in *all* those worlds, it must be false in all of them.

In this system the primary implicatures are strengthened to get the corresponding secondary implicatures, unless the strengthening results in a claim that contradicts the assertion or creates an inconsistent set of implicatures.

4.7.1 The *must* cases are derived

Let us see what the system predicts for the sentence in (103a), repeated below as (109a).

- (109) a. Sandy must borrow *Moby Dick* or *Huckleberry Finn*.
b. LF: [must [M or H]]

We will assume a classic semantics for (109a), according to which the sentence in (109a) says that the proposition that Sandy borrows at least one of the two books is true in all deontically accessible worlds.

- (110) Assertion: $\Box(M \vee H)$

The proposition in (110) is compatible with the proposition that Sandy borrows *Huckleberry Finn* being false in all permitted worlds. That is the possibility that we want to avoid: we want to strengthen the claim in (110) by assuming that there are permitted worlds where

Sandy borrows *Moby Dick*, and that there are permitted worlds where Sandy borrows *Huckleberry Finn*.

(111) Desired strengthening: $\Diamond M \ \& \ \Diamond H$

From the assertion of (109a), via the assumption that speakers should only make claims that they are ready to support, we get the quality implicature that the speaker knows that Sandy is under the obligation of borrowing at least one of the two books:

(112) Quality: $\mathcal{K}(\Box(M \vee H))$

Consider now the scalar competitors in (107-108). Only the ones in (113) are stronger than the claim in (110).

- (113) a. must [M and H]
 b. must [M \mathbb{L} H]
 c. must [M \mathbb{R} H]

These competitors trigger the primary implicatures in (114) below:

- (114) a. $\neg \mathcal{K}(\Box(M \ \& \ H))$
 b. $\neg \mathcal{K}(\Box M)$
 c. $\neg \mathcal{K}(\Box H)$

All these three implicatures can be strengthened to get the secondary implicatures in (115), because the set containing all secondary implicatures in (115) is consistent, and the set containing all these secondary implicatures and the proposition in (110) is also consistent.

(115) Quantity Implicatures:

- a. $\mathcal{K} \neg(\Box(M \ \& \ H))$
 b. $\mathcal{K} \neg(\Box M)$
 c. $\mathcal{K} \neg(\Box H)$

The quality implicature conveys that the speaker knows that in all permitted worlds Sandy borrows at least one of the two books. The implicature in (115a) conveys that the speaker knows that she doesn't have to borrow both books. The implicature in (115b) conveys that she is not under the obligation of borrowing *Moby Dick*, and the implicature in (115c) conveys that she is not under the obligation of borrowing *Huckleberry Finn*. The quality implicature, together with the quantity implicatures in (115b) and (115c) derive the distribution requirement: they entail that the speaker knows that Sandy is allowed to borrow *Moby Dick* and that she knows that Sandy is allowed to borrow *Huckleberry Finn*. Here's the proof:

1. Assume: $\mathcal{K}(\Box(M \vee H))$ (Via the maxim of quality)
2. Assume: $\mathcal{K}\neg(\Box M)$ (Via the maxim of quantity and the Sauerland algorithm)
3. Assume: $\mathcal{K}\neg(\Box H)$ (Via the maxim of quantity and the Sauerland algorithm)
4. Assume: $\neg\mathcal{K}(\Diamond M)$ (*Reductio* assumption)
5. Given the assumption in 4, there must be at least one world compatible with what the speaker believes — let's call it w^* — in none of whose deontically accessible worlds w' Sandy borrows *Moby Dick*.
6. Given the assumption in 1, w^* must be a world in all of whose deontically accessible worlds w' Sandy borrows at least one of the two books (*Moby Dick* or *Huckleberry Finn*).
7. Since Sandy doesn't borrow *Moby Dick* in any world w' deontically accessible from w^* , it must be the case that Sandy borrows *Huckleberry Finn* in every world w' deontically accessible from w^* .
8. But the conclusion in 7 that Sandy is under the obligation of borrowing *Huckleberry Finn* in w^* contradicts the assumption in 3 that Sandy is required to borrow *Huck-*

leberry Finn in none of the worlds compatible with what the speaker believes. The *reductio* assumption must then be false.

We can prove likewise that the quality implicature, together with the quantity implicatures in (115b) and (115c) entails that the speaker knows that Sandy may borrow *Huckleberry Finn*. The distribution requirement is derived, then.

4.7.2 The *may* cases are not derived

The reasoning, however, does not extend to the cases with possibility modals. To see why, let's start with the familiar sentence in (116):

(116) Sandy may borrow *Moby Dick*, or *Huckleberry Finn*.

We assume again a standard semantics for both *or* and *may*, according to which the sentence in (116) is true in a world w if and only if the proposition that Sandy borrows *at least one* of the two books is true in *at least one* of the worlds that are permitted in w .

(117) Assertion: $\diamond(M \vee H)$

The claim in (117) is compatible with Sandy only having the right to borrow *Moby Dick*. We want to avoid that possibility and capture the intuition that (116) conveys that Sandy has the right to borrow *Moby Dick* and also the right to borrow *Huckleberry Finn*.

(118) Desired strengthening: $\diamond M \ \& \ \diamond H$

From the assertion of (116), via the assumption that speakers should only make claims that they are ready to support, we get the implicature that the speaker knows that Sandy has *at least one* of the two rights.

(119) Quality: $\mathcal{K}(\diamond(M \vee H))$

The scalar competitors associated with the sentence in (116) that we are getting by computing the cross-product of the *may* and *or* scales are the same as before. I list their meanings below:

- (120) a. $\diamond(M \& H)$
 b. $\diamond M$
 c. $\diamond H$
 d. (Claim:) $\diamond(M \vee H)$
 e. $\square(M \& H)$
 f. $\square M$
 g. $\square H$
 h. $\square(M \vee H)$

The scalar competitors in (120a-120c) and (120e-120h) are all stronger than the original assertion and, so, we predict the following primary implicatures:

- (121) a. $\neg \mathcal{H}(\diamond(M \& H))$
 b. $\neg \mathcal{H}(\diamond M)$
 c. $\neg \mathcal{H}(\diamond H)$
 d. $\neg \mathcal{H}(\square(M \& H))$
 e. $\neg \mathcal{H}(\square M)$
 f. $\neg \mathcal{H}(\square H)$
 g. $\neg \mathcal{H}(\square(M \vee H))$

Let's take the competitors with *must*. The implicatures in (121d) to (121g) can be strengthened to get the following secondary implicatures:

- (122) a. $\mathcal{H}\neg(\square(M \& H))$
 b. $\mathcal{H}\neg(\square(M))$
 c. $\mathcal{H}\neg(\square(H))$
 d. $\mathcal{H}\neg(\square(H \vee M))$

We derive that the speaker knows that Sandy is not required to borrow *both* books, that she knows that Sandy is not required to borrow *Moby Dick*, that she knows that Sandy is not required to borrow *Huckleberry Finn* either, and that she knows that Sandy is allowed not to borrow both books. These implicatures do not deliver the distribution requirement yet. The implicatures in (122), together with the assertion, do not exclude a situation where Sandy has only the right to borrow *Moby Dick* (as long as she is not under the obligation of doing so), but not the right to borrow *Huckleberry Finn*.

What happens with the alternatives with *may*? Do they derive the distribution requirement? The primary implicatures with *may* do not exclude a situation where Sandy has the right to borrow only one of the books. Take the primary implicature in (121a). All it says is that the speaker does not know that Sandy is permitted to borrow both books. That is compatible with her knowing that Sandy may only borrow one of them. The implicatures in (121b) and (121c) together say that the speaker is not certain that Sandy may borrow *Moby Dick* and that she is not certain that Sandy may borrow *Huckleberry Finn*. But that is still consistent with the speaker knowing that Sandy may only borrow one of the two books. And it is not possible to strengthen *all* these primary implicatures while being consistent with the assertion and the rest of primary implicatures.

The implicature in (121a) can be strengthened to get the secondary implicature in (123):

(123) $\mathcal{K} \neg(\diamond(M \ \& \ H))$

This implicature rules out the possibility of the speaker knowing that Sandy has the right to borrow both books. That is consistent with the rest of the primary implicatures, but it does not rule out the possibility of Sandy having the right to borrow only one of the books. And neither (121b) nor (121c) can be strengthened while keeping consistency with the rest of the primary implicatures and the content of the assertion. Suppose, for instance, that we strengthen the primary implicature in (121b) to the secondary implicature below:

(124) $\mathcal{K}(\neg \diamond M)$

The strengthened implicature, together with the quality implicature in (125a), would entail that the speaker knows that Sandy is allowed to borrow *Huckleberry Finn* (125b).

- (125) a. Quality: $\mathcal{K}(\diamond(M \vee H))$
 b. $\mathcal{K}(\diamond H)$

But (125b) contradicts the primary implicature that the speaker does not believe that Sandy is allowed to borrow *Huckleberry Finn*. By reasoning likewise, we can conclude that (121c) can't be strengthened either. The scalar reasoning falls short of deriving the desired strengthening, then.

There is one more issue that should be discussed in connection with applying Sauerland's system to the strengthening of von Wright-Kamp sentences. As we have previously discussed when going through Zimmerman 2001 in section 4.4.1.1, in a situation where the speaker knows perfectly well what the permitted options are, we can assume that if a speaker deems it possible that ϕ is permitted, then she knows that ϕ is permitted. But suppose now that we assume that the type of epistemic modality involved in these examples is authoritative. The primary implicatures in (121b) and (121c), repeated below as (126a) and (126b), convey that, according to what the speaker knows, it might be that Sandy may not borrow *Moby Dick* and it might be that she may not borrow *Huckleberry Finn*. If the type of epistemic modality involved is authoritative, we must conclude that the speaker *knows* that Sandy may not borrow *Moby Dick* and she *knows* that Sandy may not borrow *Huckleberry Finn*. Unfortunately, this conclusion contradicts the quality implicature that the speaker knows that Sandy may borrow at least one of the two books.

- (126) a. $\neg \mathcal{K}(\diamond M)$
 b. $\neg \mathcal{K}(\diamond H)$

If the type of epistemic modality involved is authoritative, then, the system generates implicatures that contradict the assertion. It is unclear what would block the assumption

that the type of epistemic modality involved in this reasoning is authoritative knowledge in permission granting contexts when the distribution requirement is conveyed.

The issue becomes especially relevant in connection with epistemic modals, which also trigger the distribution requirement, and for which something like the authoritative knowledge assumption seems to be unavoidable. If the speaker is taken to be an authority on what is or is not compatible with what she believes, Sauerland's system generates implicatures that are incompatible with the assertion.²⁰

To see what the problem is, let us start by considering the example in (127). Suppose we don't know which book Sandy borrowed from the school's library. We ask somebody else. She doesn't know, either, but, judging from the books that are missing, she answers by uttering (127).

(127) Sandy might have borrowed *Moby Dick* or *Huckleberry Finn*.

Let's assume again that *or* receives its standard analysis and that what the sentence in (127) says is that the proposition that Sandy borrowed *at least* one of the books is true in *at least one* of the worlds that, according to what the speaker believes, might be the actual world.²¹

(128) Assertion: $\nabla(M \vee H)$

A familiar problem arises: an utterance of (127) gives us reasons to conclude that both sentences in (129) are true.

- (129) a. Sandy might have borrowed *Moby Dick*.
b. Sandy might have borrowed *Huckleberry Finn*.

Yet the predicted truth-conditions for (127) are compatible with the speaker deeming it possible that Sandy borrowed *Moby Dick*, but not that she borrowed *Huckleberry Finn*. We need to strengthen the assertion so that it entails the truth of the sentences in (129).

²⁰I became aware of the following problem via some class notes by Irene Heim on this topic (Heim, 2005). I rely on them in what follows

²¹' ∇ ' stands for epistemic possibility, as before.

We start by defining the relevant scalar competitors by computing the cross-product of the scale of *might* and *or* (\mathcal{K} stands for speaker oriented epistemic necessity, as before, and ∇ stands for epistemic possibility).

(130) a. $\nabla(M \& H)$

b. $\nabla(M \vee H)$

c. ∇M

d. ∇H

(131) a. $\mathcal{K}(M \& H)$

b. $\mathcal{K}(M \vee H)$

c. $\mathcal{K}M$

d. $\mathcal{K}H$

We now apply Sauerland's mechanism to generate a set of primary implicatures of the form $\neg\mathcal{K}\phi$ (conveying that the speaker is not certain about ϕ) by selecting the scalar competitors ϕ that are stronger than the original assertion. We get the following primary implicatures:

(132) a. $\neg\mathcal{K}(\nabla(M \& H))$

b. $\neg\mathcal{K}(\mathcal{K}(M \vee H))$

c. $\neg\mathcal{K}(\mathcal{K}(M \& H))$

d. $\neg\mathcal{K}(\nabla M)$

e. $\neg\mathcal{K}(\nabla H)$

f. $\neg\mathcal{K}(\mathcal{K}M)$

g. $\neg\mathcal{K}(\mathcal{K}H)$

Which of these implicatures can be strengthened? To answer the question we have to think a bit about what are the properties of the epistemic modality involved. What are the

assumptions about the speaker's beliefs? One safe assumption to make is that the speaker is competent about her own epistemic state: that she doesn't have mistaken beliefs about her beliefs and that she is not agnostic about her beliefs either.²²

(133) Speaker's competence about her beliefs:

1. She doesn't have mistaken beliefs about her beliefs:

(a) $\mathcal{K}(\mathcal{K}\phi) \rightarrow \mathcal{K}\phi$ (If she believes that she believes something, she believes it).

(b) $\mathcal{K}(\neg\mathcal{K}\phi) \rightarrow \neg\mathcal{K}\phi$ (If she believes that she doesn't believe something, she doesn't really believe it).

2. She is not agnostic about her beliefs:

(a) $\mathcal{K}\phi \rightarrow \mathcal{K}(\mathcal{K}\phi)$ (If she believes something, she believes that she believes it).

(b) $\neg\mathcal{K}\phi \rightarrow \mathcal{K}(\neg\mathcal{K}\phi)$ (If she doesn't believe something, she believes that she doesn't believe it)

Now take the implicatures in (132d) and (132e), repeated below as (134a) and (134b):

(134) a. $\neg\mathcal{K}(\nabla M)$

b. $\neg\mathcal{K}(\nabla H)$

The claim in (134a) can be true (i) either because the speaker has not made up his mind about whether Sandy might have borrowed *Moby Dick*, or (ii) because she in fact believes that it is not possible that Sandy borrowed *Moby Dick*. We assume that the speaker has no doubts about her beliefs, and, so the claim in (134a) can only be true because she believes that it is not possible that Sandy borrowed *Moby Dick*. Likewise for (134b). We can then

²²As Heim points out in her class notes, we can't make these assumptions if the relevant epistemic notion is knowledge, rather than belief. The different introspective properties are discussed in Hintikka (1962).

conclude that the speaker believes that it is not possible that Sandy borrowed *Moby Dick* and that it is not possible that she borrowed *Huckleberry Finn* either. But from the assertion, together with the presumption that the speaker believes what she is talking about, we can conclude that the speaker knows that it is possible that Sandy borrowed at least one of the two books. We hit a contradiction.

- (135) a. Assertion: $\nabla(M \vee H)$
 b. Quality: $\mathcal{K}(\nabla(M \vee H))$

The assertion and the scalar implicatures send contradictory information. Should the implicatures not be computed here? If so, we are left with no way to strengthen the claim in the necessary way. Should they be computed? Then the disjunction should not be usable, contrary to what happens.

4.7.3 Summary and overview

In section 4.6 we learned that the distribution requirement looks like a quantity implicature. Deriving the distribution requirement as a conversational implicature involves reasoning about why a specific claim was chosen over a set of scalar competitors. The scalar approach generates the competitors of von Wright-Kamp sentences by computing the cross-product of the Sauerland scale and the standard Horn-scale for modals. It assumes that the reason why the asserted claim was chosen over the competitors is to avoid making a false claim — the speaker is assumed not to have enough evidence to assert any of the competitors. The analysis delivers the distribution requirement for the *must* cases by assuming that (the speaker believes that) the stronger competitors generated by the Sauerland algorithm are all false: the formula in (136), together with the conjunction of the negated competitors in (137a-137c) entails that each disjunct is permitted.

(136) $\Box(A \vee B)$

(137) a. $\neg\Box A$

- b. $\neg\Box B$
- c. $\neg\Box(A \& B)$

The reasoning, however, does not extend to the possibility cases, because the set containing the proposition in (138) and the negation of *all* propositions in (139a-139c) is inconsistent.

(138) $\Diamond(A \vee B)$

- (139) a. $\Diamond A$
- b. $\Diamond B$
- c. $\Diamond(A \& B)$

We have encountered a similar situation when discussing unembedded disjunctions in chapter 3, where we noted that the negation of all the scalar competitors associated by the Sauerland algorithm with an unembedded disjunction is inconsistent with the content of the disjunction. The innocent exclusion mechanism presented in Fox 2006 allowed for the strengthening of unembedded disjunctions via the negation of a subset of the scalar competitors, thus avoiding getting a contradiction. We will see next that the innocent exclusion mechanism can solve the problem here too, and deliver the distribution requirement of *may* sentences, if it is assumed to apply recursively, as Fox (2006) proposes.

4.8 Recursive innocent exclusion

As we have seen before, the Sauerland algorithm delivers for a *may* von Wright-Kamp sentence like (140a) the scalar competitors in (141) and (142).

- (140) a. Sandy may have ice cream or cake.
- b. LF: may [Sandy have ice cream or cake]
- (141) a. may [I or C]
- b. may [I \perp C]
- c. may [I \mathbb{R} C]

- d. may [I and C]
- (142)
- a. must [I or C]
 - b. must [I \perp C]
 - c. must [I \mathbb{R} C]
 - d. must [I and C]

In what follows, we will ignore the competitors in (142).

Under the standard analysis of *or* and *may*, all the competitors in (141), except for (141a), are stronger than the sentence in (140a). We have seen that we cannot assume that they are *all* false — that would contradict the content of (140a), but we can assume that some of them are. There are, in fact, two ways of negating as many of the competitors in (141) as possible while being consistent with (140a): we can assume that both (141b) and (141d) are false, or that both (141c) and (141d) are.

- (143)
- a. may [I \perp C]
 - b. may [I and C]
- (144)
- a. may [I \mathbb{R} C]
 - b. may [I and C]

Each of these strengthenings entails that one of the competitors is true: assuming that both sentences in (143) are false (and that (140a) is true) entails that Sandy may have cake; and assuming that both sentences (144) are false entails that Sandy may have ice cream.

The strengthening procedure presented in Fox 2006 assumes that as many of the competitors generated by the Sauerland mechanism are false as possible while (i) being consistent with the assertion, and (ii) avoiding the entailment that a certain competitor is true. The algorithm looks at all the sets containing as many negated Sauerland competitors as possible while being consistent with the assertion. The original von Wright-Kamp sentence is strengthened by taking the negated competitors that are in *all* those sets. Those competitors are said to be innocently excluded, as we saw in chapter 3. The definition of the set of

innocently excludable competitors to a certain proposition p in a set of propositions \mathcal{A} is repeated in (145) below.²³

- (145) For any proposition p and set of propositions \mathcal{A} , $\mathcal{E}(p, \mathcal{A})$ (the set of innocently excludable competitors to p in \mathcal{A}) =
 $\bigcap \{ \mathcal{A}' \subseteq \mathcal{A} \mid \mathcal{A}' \text{ is a maximal set in } \mathcal{A} \text{ such that } \mathcal{A}'^* \cup \{p\} \text{ is consistent} \}$
(Fox, 2006, 26)

The negation of the competitor in (141d) is innocent. But strengthening the claim in (140a) by assuming the negation of the competitor in (141d) does not deliver the distribution requirement: in a situation in which Sandy is allowed to have ice cream, but not cake, the claim in (140a) is true, and (141d) is false. The innocent exclusion mechanism does not by itself solve the problem. Interestingly, however, Fox (2006) shows that the distribution requirement associated with the *may* sentences can be captured if the innocent exclusion mechanism is assumed to apply recursively.

Fox (2006) assumes that a silent exhaustivity operator is assumed to project in the syntax. The operator claims that the sentence under its scope is true, but all its innocently excludable scalar competitors are false:

- (146) $\llbracket \text{Exh} \rrbracket (\mathcal{A}_{\langle s,t \rangle}) (p)(w) \Leftrightarrow p(w) \ \& \ \forall q [q \in \mathcal{E}(p, \mathcal{A}) \rightarrow \neg q(w)]$ (Fox, 2006, 26)

The sentence in (147a) is assumed to be ambiguous. It can be associated with the syntactic representation in (147b) or the one in (147c).²⁴ The LF in (147b) denotes the proposition that is true in a world w if and only if Sandy is permitted at least one of these two things in w : having cake or having ice cream. The LF in (147c) denotes the proposition that is true in a world w if and only if the proposition expressed by the LF in (147b) is

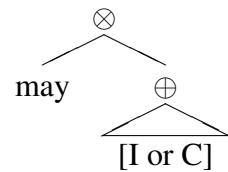
²³Notation: $\mathcal{A}^* = \{ \neg p \mid p \in \mathcal{A} \}$

²⁴Notation: ‘I or C’ stands for ‘Sandy has ice cream or cake’. I represent the first argument of the exhaustivity operator as a subscript. It is assumed to denote the set containing the propositions expressed by the Sauerland generated competitors to the constituent under the immediate scope of the exhaustivity operator.

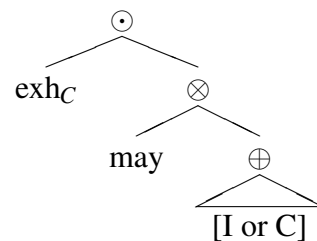
true in w and all the innocently excludable competitors to the proposition expressed by the sentence under the immediate scope of the exhaustivity operator are false in w . In the case at hand, only the proposition expressed by the competitor in (141d) is innocently excludable. The proposition expressed by the LF in (147c) is true in a world w if and only if in w Sandy is allowed to have *at most one* of the two desserts options under discussion.

(147) a. Sandy may have ice cream or cake.

b. LF₁:

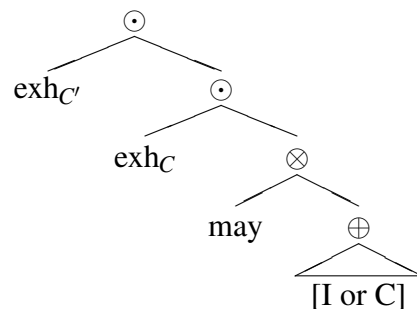


c. LF₂:



Now consider what happens when we interpret the LF in (148), in which a second exhaustivity operator takes scope over the LF in (147c). The LF in (148) expresses a proposition that entails that Sandy is allowed to eat ice cream and that she is also allowed to eat cake (although she is not allowed to eat both ice cream and cake). Let us see why this is so.

(148) LF₃:



To interpret the LF in (148) we need to determine the competitors to the LF constituent under the immediate scope of the exhaustivity operator. The Sauerland algorithm delivers the set in (149).

$$(149) \quad C' = \left\{ \begin{array}{ll} \text{exh}_C \text{ may}[\text{I or C}], & \text{exh}_C \text{ must}[\text{I or C}], \\ \text{exh}_C \text{ may}[\text{I } \perp \text{ C}], & \text{exh}_C \text{ must}[\text{I } \perp \text{ C}], \\ \text{exh}_C \text{ may}[\text{I } \Re \text{ C}], & \text{exh}_C \text{ must}[\text{I } \Re \text{ C}], \\ \text{exh}_C \text{ may}[\text{I and C}], & \text{exh}_C \text{ must}[\text{I and C}] \end{array} \right\}$$

We will ignore, as before, all the competitors containing *must*.

Given the definition of the exhaustivity operator, the LF in (148) denotes a proposition that is true in a world w if and only if the proposition expressed by the LF in (147c) is true in w and all the competitors in the set in (149) that are innocently excludable given the proposition expressed by the LF in (147c) are false in w .

In (150) we have the denotation of the *may* competitors in the set in (149). There is one maximal set of negated competitors that is compatible with the proposition expressed by the LF in (147c): the set containing the negation of the competitors in (150b-150d). The proposition expressed by the LF in (148) is then true in a world w if and only if Sandy is allowed to eat ice cream (but not cake) in w and she is also allowed to eat cake (but not ice cream) in w . The distribution requirement is captured.

- (150) a. $\llbracket \text{exh}_C \text{ may} [\text{I or C}] \rrbracket = \diamond(\text{I } \vee \text{ C}) \ \& \ \neg \diamond(\text{I } \& \ \text{C})$
b. $\llbracket \text{exh}_C \text{ may} [\text{I } \perp \text{ C}] \rrbracket = \diamond \text{I} \ \& \ \neg \diamond \text{C}$
c. $\llbracket \text{exh}_C \text{ may} [\text{I } \Re \text{ C}] \rrbracket = \diamond \text{C} \ \& \ \neg \diamond \text{I}$
d. $\llbracket \text{exh}_C \text{ may} [\text{I and C}] \rrbracket = \diamond(\text{I } \& \ \text{C})$

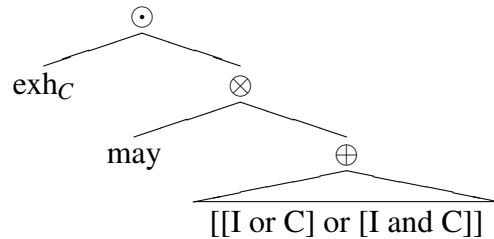
4.9 No disjunct should be ignored

Resorting to the recursion of the innocent exclusion mechanism solves the inconsistency problem and delivers the distribution requirement associated with the *may* cases, but it faces the problem that we encountered in chapter 3: the system still allows for the exclusion of disjuncts which should nevertheless be visible to the interpretation mechanism. Consider, for instance, the sentence in (151) below:

(151) Sandy may have ice cream, cake, or both.

Uttered by a speaker who knows perfectly well what Sandy may and may not have for dessert, the sentence in (151) naturally conveys that Sandy may have both ice cream and cake. The innocent exclusion mechanism fails to predict so. To see why, consider the LF in (152) below:

(152) LF₂:



To compute the meaning of the LF in (152), we first need to compute the Sauerland competitors to the LF constituent under the immediate scope of the exhaustivity operator. There are four scalar items: *may*, two instances of *or*, and *and*. The Sauerland algorithm generates 2×4^3 syntactic objects. Ignoring again the *must* competitors, we end up with 64 syntactic objects, which correspond to only four logically distinct meanings, the ones listed below:²⁵

- (153) a. $\diamond(I \vee C)$
 b. $\diamond I$
 c. $\diamond C$
 d. $\diamond(I \& C)$

These meanings correspond to the ones that we obtain for the competitors of a von Wright-Kamp sentence with only one *or*, like the one we analyzed in the previous section (ignoring, again, the *must* competitors).

Under the standard analysis, the LF-constituent under the immediate scope of the exhaustivity operator denotes the meaning in (153a). We can only innocently exclude the

²⁵The reader is referred to appendix B. By assuming that the competitors listed in the appendix are under the scope of *may*, we obtain the *may* competitors to the sentence at stake.

proposition in (153d). But that means that the first layer of exhaustification already excludes the possibility that Sandy be allowed to have both ice cream and cake.

As we have seen in chapter 3, it is not difficult to generate similar examples for which the system, as is, innocently excludes one of the disjuncts, which should nevertheless remain visible to the interpretation mechanism. Consider for instance the sentence in (154):²⁶

(154) Dad, to Sandy: “You may have two or three scoops of ice cream.”

Uttered by a speaker who knows how much ice cream Sandy may have, the sentence in (154) conveys that Sandy may have three scoops of ice cream. The innocent exclusion mechanism, however, ignores that possibility. Assuming the standard analysis of numerals, under which ‘two scoops of ice cream’ means ‘at least two scoops of ice cream’, we will find among the competitors to the sentence in (154), the propositions expressed by the sentences below:

- (155) a. Sandy may have at least two scoops of ice cream.
b. Sandy may have at least three scoops of ice cream.
c. Sandy may have at least four scoops of ice cream.
d. Sandy may have at least five scoops of ice cream.
e. ...

All these propositions, except for the one expressed by the sentence in (155a), can be innocently excluded while being consistent with the claim in (154) (that Sandy has the right to do at least one of these two things: eating at least two scoops of ice cream, or eating at least three scoops of ice cream). The first application of the innocent exclusion mechanism conveys that Sandy is allowed to have exactly two scoops of ice cream. Excluding atomic disjuncts does not seem to be innocent, then.

²⁶Thanks to Angelika Kratzer for suggesting to me this type of example.

Section 4.11 will present a different strengthening algorithm. In the next section we will see that if an alternative semantics for *or* is assumed, the distribution requirement can be derived as a domain widening implicature. This domain widening implicature will be computed on top of the strengthened meanings delivered by the innocent exclusion algorithm presented in chapter 3. As we have seen there, adopting an alternative semantics for *or* makes it possible to define innocent exclusion in such a way that no atomic disjunct is excluded. And because an alternative semantics is assumed, the competitors of von Wright-Kamp sentences can be defined with respect to the propositional alternatives that *or* introduces into the semantic derivation. There is therefore no need to resort to the sentential connectives \mathbb{L} and \mathbb{R} . Since the competitors are defined with respect to set of propositional alternatives, the algorithm can apply to cases where the distribution requirement is triggered by free choice indefinites, if they are also assumed to introduce propositional alternatives in the semantic derivation (Kratzer and Shimoyama, 2002).

4.10 *Or* and the implicatures of domain widening

4.10.1 A classic semantics for von Wright-Kamp sentences

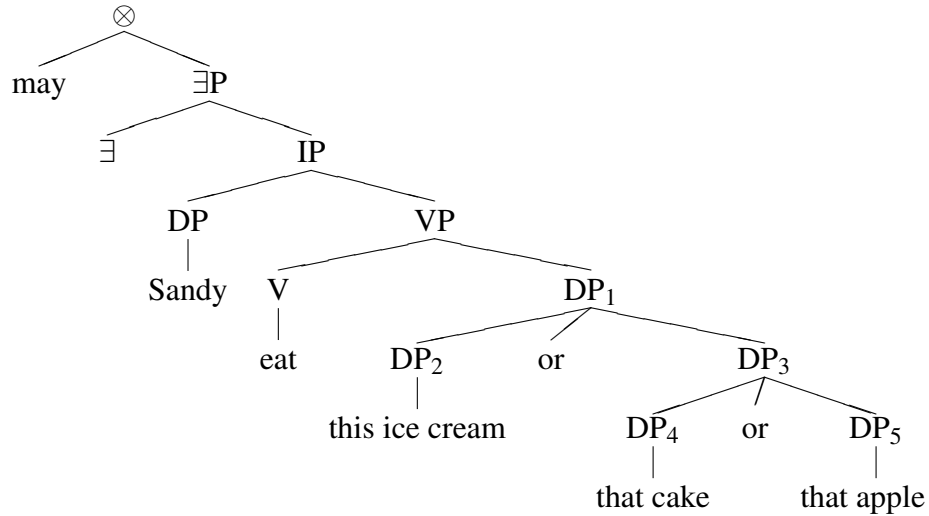
Let us start by laying out some assumptions about the interpretation of von Wright-Kamp sentences in an alternative semantics. Consider, for instance, the one in (156):

(156) Sandy may eat this ice cream, that cake, or that apple.

I will assume that the relevant interpretable structure is the one in (157) below, where an operation of Existential Closure is triggered under the scope of modals (Heim, 1982).²⁷

²⁷The structure internal to the disjunction is immaterial for the semantics.

(157)



We will adopt, as in the previous chapters, an alternative semantics for disjunctions. The denotation of DP_1 is the set of individuals containing this ice cream, that cake, and that apple.

(158) $\llbracket DP_1 \rrbracket = \{\mathbf{i}, \mathbf{c}, \mathbf{a}\}$

This set of alternatives combines with the denotation of the verb via the Hamblin rule in (159).

(159) Where $\llbracket \alpha \rrbracket \subseteq D_{\langle \sigma, \tau \rangle}$ and $\llbracket \beta \rrbracket \subseteq D_\sigma$,

$$\llbracket \alpha(\beta) \rrbracket = \{c \in D_\tau \mid \exists a \in \llbracket \alpha \rrbracket \exists b \in \llbracket \beta \rrbracket (c = a(b))\} \quad (\text{Hamblin, 1973})$$

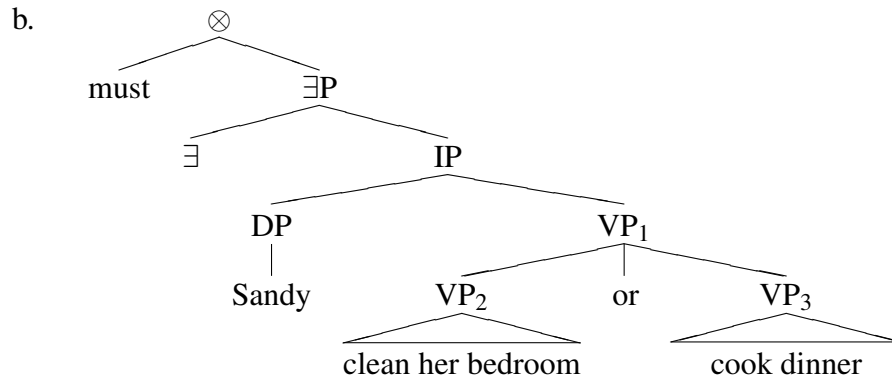
The denotation of the VP combines with the denotation of the subject via the Hamblin rule too. The denotation of the IP is the set of propositional alternatives containing the proposition that Sandy eats this ice cream, the proposition that Sandy eats that cake, and the proposition that Sandy eats that apple. The process by means of which the individual alternatives introduced by *or* turn into propositional alternatives is illustrated in (160) below:

that Existential Closure operates over in (161) is true in some world that is permitted in w . Nothing yet assures that *all* the propositions in that set are permitted.

(163) Sandy may eat this ice cream, that cake, or that apple.

We will make exactly the same assumptions for the *must* cases. Take the familiar sentence in (164a) below, for which we will assume the LF in (164b):

(164) a. Sandy must clean her bedroom or cook dinner.



Must combines via the Hamblin rule with the output of Existential Closure. It returns the singleton containing the proposition that is true in a world w if and only if in all worlds deontically accessible from w at least one of the propositional alternatives in the domain of Existential Closure is true:

$$(165) \quad \begin{aligned} \text{a. } \llbracket \exists P \rrbracket &= \left\{ \lambda w. \exists p \left[p \in \left\{ \begin{array}{l} \lambda w. \mathbf{clean}_w(\mathbf{s}, \mathbf{the-bedroom-of-s}), \\ \lambda w. \mathbf{cook-dinner}_w(\mathbf{s}) \end{array} \right\} \& p(w) \right] \right\} \\ \text{b. } \llbracket \mathbf{must} \rrbracket &= \{ \lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow \llbracket \exists P \rrbracket(w')] \} \end{aligned}$$

The sentence in (164a) also receives the same truth-conditions that it receives under the standard analysis of *or*. It would be predicted to be true, for example, if one of the propositional alternatives is true in none of the permitted worlds — it would be true, for instance, if Sandy were required to clean her bedroom, but were not allowed to cook dinner. Nothing yet assures that *all* propositions introduced by *or* are true in some permitted world.

A question arises: if we get the same truth-conditions as in the standard semantics, why, then, even bother adopting an alternative semantics for *or*? The answer, in short, is this: because an alternative semantics for *or* preserves the semantic identity of the disjuncts.

Although Existential Closure destroys the semantic identity of the disjuncts, and the modals cannot see each individual disjunct in the semantics, we now have an object that retains the semantic identity of the disjuncts: the set of alternatives that Existential Closure ranges over. That property can be exploited to make the disjuncts visible to the modal in the pragmatics. We can now contrast, for example, the claim made by using a particular set of alternatives with competing claims that would have resulted from using other domains, in particular smaller ones, which would have led to stronger claims. For any von Wright-Kamp sentence, a set of competitors can be generated by considering alternative domains for Existential Closure to range over: all the subsets of the domain introduced by *or* (down to the singletons that contain each atomic disjunct).

Since, under this setup, the only role of disjunctions is to set up a specific domain of quantification, the reason to choose the asserted claim over the competitors need not be limited to avoiding making a false claim. I show in the next section that the distribution requirement can be derived as an implicature associated with the widening of a domain of quantification. The distribution requirement for the possibility cases can be derived on the assumption that the reason for using the specific domain that was in fact used is to signal that no competing subdomain is to be excluded: the claims resulting from substituting the domain that was used with any of the subdomains are all true.

4.10.2 Reasoning about domain widening

Under the scalar approach, the assumption that *or* forms a linguistic scale with *and*, \mathbb{L} , and \mathbb{R} , brought the relevant competitors into play. Under the present setup, *or* cannot be part of a linguistic scale, simply because there is no *or* in the semantics — we only have an alternative forming operation; an external item, the Existential Closure operator, is

responsible for the existential force traditionally associated with *or*. Let's think about the role of *or* under the alternative semantics setup we are assuming.

In the particular syntactic configuration of von Wright-Kamp sentences, the role of the propositional alternatives introduced by *or* is to set up a particular domain of quantification for the Existential Closure operator to range over. Using a certain disjunction now means choosing a particular domain for the Existential Closure operator. Using a disjunction with three terms means choosing a domain containing *three* propositional alternatives. Using a disjunction with two, choosing a domain containing *two* propositional alternatives. Using no disjunction at all means choosing a singleton for Existential Closure to range over. Adding disjuncts — using a disjunction, to begin with — amounts to widening the domain of Existential Closure, as illustrated below:

- (166) a. $\llbracket \text{may } \exists (\text{Sandy eats this ice cream}) \rrbracket =$
 $\{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \{\lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i})\} \ \& \ p(w')]\}$
- b. $\llbracket \text{may } \exists (\text{Sandy eats this ice cream or that cake}) \rrbracket =$
 $\{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left\{ \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}) \end{array} \right\} \ \& \ p(w')]\}$
- c. $\llbracket \text{may } \exists (\text{Sandy eats this ice cream or that cake or that apple}) \rrbracket =$
 $\{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left\{ \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')]\}$

By using a certain disjunction, the speaker signals that she is using a particular set of alternatives. Using any of its subsets would have meant making a stronger (but equally relevant) claim, because Existential Closure is upward entailing — if the proposition in (166a) is true, so will be the ones in (166b) and (166c); but not the other way around. There must then be a reason why the speaker is using a certain disjunction, instead of a shorter version of that disjunction (or just any of the disjuncts alone).

Why did the speaker not use any of the subdomains of the domain of propositional alternatives that she in fact used, then? One possible reason to widen the domain of Existential Closure is to avoid making a false claim (Kratzer and Shimoyama, 2002).

Consider, for instance, the sentence in (167a):

(167) a. Sandy must clean her bedroom or cook dinner.

b. LF: must \exists (Sandy cleans her bedroom)

c. $\llbracket \text{must } \exists (\text{Sandy cleans her bedroom or cooks dinner}) \rrbracket =$

$$\{\lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow \exists p [p \in \left\{ \begin{array}{l} \lambda w. \mathbf{clean}_w(\mathbf{s}, \mathbf{the-bedroom-of-s}), \\ \lambda w. \mathbf{cook-dinner}_w(\mathbf{s}) \end{array} \right\} \& p(w')]]\}$$

The speaker could be using the domain in (167c), which contains two propositional alternatives, because she knows that using any of its subdomains instead would have meant making a false claim. We can conclude that the speaker knows that the propositions in (168a-168b) are false.

(168) a. $\llbracket \text{must } \exists (\text{Sandy eats her bedroom}) \rrbracket =$

$$\{\lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow \mathbf{clean}_{w'}(\mathbf{s}, \mathbf{the-bedroom-of-s})]\}$$

b. $\llbracket \text{must } \exists (\text{Sandy eats her bedroom}) \rrbracket =$

$$\{\lambda w. \forall w' [w' \in \mathcal{D}_w \rightarrow \mathbf{cook-dinner}_{w'}(\mathbf{s})]\}$$

We replicate the results of the scalar approach for the *must* cases. If it is false that in all permitted worlds Sandy cleans her bedroom, and it is also false that in all permitted worlds she cooks dinner, but it is true that in all permitted worlds she does at least one of the two chores, it must be true that in some of the permitted worlds she cleans her bedroom and that in some of the permitted worlds she cooks dinner, as we have seen in section 4.7.1.

This justification for domain widening, however, does not extend to the *may* cases, for the reasons that the reader will be familiar with from the discussion in section 4.7.2. Consider the sentence in (169a), which expresses the proposition in (169b).

(169) a. Sandy may eat this ice cream, that cake, or that apple.

$$\text{b. } \{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left. \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')]\}$$

Consider now the propositions that result from using any of the subdomains of the set of propositional alternatives that Existential Closure operates over in (169b), which are listed below.

$$\begin{aligned} (170) \quad \text{a. } & \{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left. \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}) \end{array} \right\} \ \& \ p(w')]\} \\ \text{b. } & \{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left. \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')]\} \\ \text{c. } & \{\lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left. \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')]\} \\ \text{d. } & \{\lambda w. \exists w' [w' \in \mathcal{D}_w \ \& \ \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{i})]\} \\ \text{e. } & \{\lambda w. \exists w' [w' \in \mathcal{D}_w \ \& \ \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{c})]\} \\ \text{f. } & \{\lambda w. \exists w' [w' \in \mathcal{D}_w \ \& \ \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{a})]\} \end{aligned}$$

We cannot assume that the speaker believes all these propositions to be false. If the speaker believes that all propositions in (170) are false, she must believe that the proposition in (169b) is also false. The proposition in (169b) entails that at least one of the propositions in (170) is true. The negation of all propositions in (170) is inconsistent with the proposition in (169b). We cannot assume that the reason why the domain of propositional alternatives in (169b) was used, instead of any of the subdomains in (170) is to avoid making a false claim.

Kratzer and Shimoyama (2002) propose a novel reason to justify widening the domain of an existential quantifier. Consider again the familiar dessert time scenario:

- (171) a. Dad, to Mom: “For dessert, we have cake, ice cream, and *crème caramel*.”
b. Mom, to Leonor: “You may eat *crème caramel*.”

c. Mom, to Sandy: “You may eat this ice cream, that cake, or that apple.”

The scenario makes sure that the domain of dessert options is known. Upon hearing (171b), Leonor concluded that she may not have ice cream — remember that, given the rules, had Mom wanted Leonor to have ice cream, she would have surely said so. Now consider her utterance in (171c). Mom chose this time a bigger domain for Existential Closure, one containing three propositions. She could have chosen a smaller domain and uttered any of the stronger sentences in (172a-172f).

(172) a. Sandy may eat this ice cream.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats this ice cream}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ p \in \{ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}) \} \ \& \ p(w')] \} \end{aligned}$$

b. Sandy may eat that cake.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats that cake}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ p \in \{ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}) \} \ \& \ p(w')] \} \end{aligned}$$

c. Sandy may eat that apple.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats that apple}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ p \in \{ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \} \ \& \ p(w')] \} \end{aligned}$$

d. Sandy may eat this ice cream, or that cake.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats that this ice cream or that cake}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ \exists p \in \left\{ \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}) \end{array} \right\} \ \& \ p(w')] \} \end{aligned}$$

e. Sandy may eat this ice cream, or that apple.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats that this ice cream or that apple}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ p \in \left\{ \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')] \} \end{aligned}$$

f. Sandy may eat ice cream, or that cake.

$$\begin{aligned} & \llbracket \text{may } \exists (\text{Sandy eats that this ice cream or that cake}) \rrbracket = \\ & \{ \lambda w. \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \left\{ \begin{array}{l} \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{c}) \end{array} \right\} \ \& \ p(w')] \} \end{aligned}$$

We can wonder, in the way familiar from the derivation of quantity implicatures, why she didn't do so. Given what Leonor has concluded, uttering (172a) could have led Sandy to conclude that she is not allowed to have cake or that she is not allowed to have that apple. By widening the domain of Existential Closure, Mom signals that the exhaustivity inference that (172b) or (172c) is false is to be avoided. We conclude from (171c) that if (172a) is true, then so are (172b) and (172c). By parity of reasoning, we can conclude that if (172b) is true, then so are (172a) and (172c) and that if (172c) is true, then so are (172a) and (172c). Likewise for any of the other competitors.²⁹

$$(173) \quad (171c) \ +> \ (\llbracket (172a) \rrbracket \Leftrightarrow \llbracket (172b) \rrbracket \Leftrightarrow \llbracket (172c) \rrbracket \Leftrightarrow \llbracket (172d) \rrbracket \Leftrightarrow \llbracket (172e) \rrbracket \Leftrightarrow \llbracket (172f) \rrbracket)$$

One reason to justify the introduction of the alternatives is to signal that no subdomain is to be privileged to the exclusion of the others. We will refer to this reason, following Kratzer (2005) as 'No Privilege'. The claim in (169b), together with the No Privilege implicature entails that Sandy has the right to have this ice cream, that she has the right to have that cake, and that she has the right to have that apple.

Two questions arise. First, if all Mom wanted to convey is that Sandy has the right to have this ice cream, the right to have that cake, and the right to have that apple, why didn't she utter one of the sentences in (174), instead of the one in (171c)?

- (174) a. Mom, to Sandy: "You may have this ice cream, you may have that cake, and you may have that apple."
 b. Mom, to Sandy: "You may have this ice cream, that cake, and that apple."

²⁹Notation: the symbol '+>' stands for 'con conversationally implicates' (Levinson, 2001).

The second question has to do with unembedded disjunctions, like the one in (175).

(175) Sandy ate this ice cream or that cake.

Let's assume that the sentence is to be analyzed as in (176) below.

$$(176) \quad \{\lambda w. \exists p [p \in \left\{ \begin{array}{l} \lambda w'. \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{i}), \\ \lambda w'. \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{c}) \end{array} \right\} \& p(w)]\}$$

By running the No Privilege reasoning, we conclude that if one of the propositions in the domain of Existential Closure is true in w , so will be the other. Together with the claim that at least one of them is true in w , this entails that *both* propositions are true. We then predict that the sentence in (175) could be strengthened to mean that Sandy had this ice cream and that she had that cake too. The reading, though, is unattested.³⁰

Both questions are answered once we assume, as I will do in the next section, that No Privilege only works in interaction with the exclusivization of the propositional alternatives that *or* introduces.

In the next section, where I lay out the details of the strengthening algorithm, I assume, with Fox (2006), that, for the sentence in (171c) the strengthening algorithm first requires that there be no permitted world where Sandy has more than one of those three dessert options.³¹ If that is the case, there is a reason for Mom not to utter any of the sentences in (174). By uttering (171c), Mom conveys that Sandy has all three rights and that she doesn't have the right to eat more than one dessert. None of the sentences in (174) convey that Sandy can only eat one dessert.

Likewise, the strengthening algorithm requires for (175) that at most one of the propositions that Existential Closure ranges over be true. That means that No Privilege cannot be run. For assume that the sentence in (175) were to be analyzed as in (176):

³⁰This objection has been presented in Aloni and van Rooij (to appear) and Fox 2006.

³¹For the importance of assuming that the alternatives involved in the distribution requirement are exhaustive, see Menéndez-Benito 2005 and Kratzer 2005.

$$(177) \quad \{\lambda w. \exists p [p \in \left\{ \begin{array}{l} \lambda w'. \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{i}) \ \& \ \neg \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{c}), \\ \lambda w'. \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{c}) \ \& \ \neg \mathbf{eat}_{w'}(\mathbf{s}, \mathbf{i}), \end{array} \right\} \ \& \ p(w)]\}$$

The result of running the No Privilege reasoning has it that either all of the propositions in the domain of Existential Closure are true or else that none are. That, together with the claim that at least one of them is true, derives a contradiction. If at least one of them is true in a world w , *at most one* of them will be.

If it were true that Sandy ate both this ice cream and that cake, there would be no reason for a well-informed speaker not to have uttered the sentence in (178). However, if either of the sentences in (174) were true, there would still be a reason not to utter them: none of them would generate the implicature that Sandy is not allowed to eat more than one dessert, like the sentence in (171c) does, as I will assume in the next section.

(178) Sandy ate this ice cream and that cake.

4.10.3 Negation

Negation posed a problem for both Analysis 1 and Analysis 2, because they imported the distribution requirement into the truth-conditions. The semantics we are relying on is truth-conditionally equivalent to the standard analysis of *or* and modals, and it makes the correct predictions in downward entailing environments. Take, as an illustration, the possibility case:

(179) Sandy may not eat this ice cream, that cake, or that apple.

Under the present setup, the sentence claims that none of the following propositions is permitted: that Sandy has this cake, that she has that ice cream, and that she has that apple.

$$(180) \quad \{\lambda w. \neg \exists w' \exists p [w' \in \mathfrak{D}_w \ \& \ p \in \left\{ \begin{array}{l} \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \mathbf{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \ \& \ p(w')]\}$$

The proposition in the set in (180) entails any proposition of the form in (181) (where \mathcal{D} ranges over the proper (non-empty) subsets of the domain of Existential Closure in (180)).

$$(181) \quad \{\lambda w. \neg \exists w' \exists p [w' \in \mathcal{D}_w \ \& \ p \in \mathcal{D} \ \& \ p(w')]\}$$

If none of the propositional alternatives in the largest domain are permitted, it must follow that none of the propositional alternatives in the smaller domains are permitted either. We cannot assume, therefore, that the speaker knows that all the claims of the form in (181) are false. That would contradict the main claim. If all the competing domains are false, then Sandy may eat this ice cream, she may eat that cake, and she may eat that apple, which contradicts the assumption that she may not have any of those dessert options. But we can safely assume that the speaker takes all the competing claims to be true. The No Privilege implicature, if run at all, goes unnoticed.

4.10.4 How does domain comparison work?

We have just seen that the distribution requirement can be derived as an implicature of domain widening. Kratzer and Shimoyama (2002) first showed how to derive the distribution requirement associated with the German indefinite *irgendein* as a domain widening implicature. They derive the distribution requirement associated with the German indefinite *irgendein* as an implicature triggered by the fact that *irgendein* indefinites (but not *ein* indefinites) explicitly convey that their domain of quantification is as wide as it can possibly be. The case of *or* is slightly different from the case of indefinites like *irgendein*, because there does not seem to be a competition between lexical items. We then need to know how the alternative domains enter the pragmatics reasoning.

Domain widening can only be seen by comparing domains. In the case at hand, the relevant domains to be compared are all the non-empty proper subsets of the domain introduced by *or*: the antiexhaustivity implicature that delivers the distribution requirement is based on the observation that none of those smaller domains were chosen. But for domain comparison to take place — for all those alternative domains to be entertained —

the semantic identity of the disjuncts must be preserved. Existential Closure destroys the semantic identity of the disjuncts, though. How does domain comparison take place, then? What is the grammar of domain widening?

In what follows, I present a mechanism that computes the Kratzer and Shimoyama-style domain widening implicature recursively, following very recent work on the grammar of domain widening (Chierchia, 2005). In the proposal I present, I embed a mechanism of innocent exclusion that, as in the system presented in Fox 2006, exclusifies the propositional alternatives introduced by *or*, but, unlike the system presented in Fox 2006, does not ignore any of the individual disjuncts and can be extended in a straightforward way to derive the distribution requirement associated with existential free choice indefinites (Kratzer and Shimoyama, 2002; Chierchia, 2005).

4.11 Domain comparison, *or*, and recursive pragmatics

We will follow the spirit of the recursive pragmatics presented in Chierchia 2005, which computes, together with the usual, ordinary meanings, their strengthened counterparts, determined with the help of certain alternatives, which I will call, as before, *competitors* — to avoid any confusion with the propositional alternatives introduced by *or* into the semantic derivation. The system allows for importing the strengthened meanings into the ordinary meanings, and that will allow us to account for cases where the distribution requirement seems to enter the truth-conditional content of embedded sentences (as first noticed in Kamp 1978).³²

There are three main components to the system. First, we will continue to assume a Hamblin semantics that maps any expression α of type σ to a subset of D_σ , which we will call ‘the ordinary meaning of α ’ ($\llbracket \alpha \rrbracket$). Second, two functions are defined: $\llbracket \cdot \rrbracket_{ALT, \cup}$ (the function generating what I will call the ‘subdomain competitors’) and $\llbracket \cdot \rrbracket_{ALT, \cap}$ (the func-

³²I am indebted to thank Angelika Kratzer for her insightful advice about the material covered in this section. All errors, however, are mine.

tion generating what I will call the ‘conjunctive competitors’). These functions introduce the competitors, on the basis of which strengthened meanings are computed. I will assume, for ease of exposition, that *or* is the only item that activates competitors. The first function allows comparison with shorter disjunctions (smaller subdomains of alternatives); while the second allows comparison with conjunctive or universal alternatives. Third, together with ordinary meanings, the system computes, for any sentence, two strengthened meanings. A first strengthened meaning ($\llbracket S \rrbracket^+$) is obtained by assuming that all competitors in $\llbracket S \rrbracket_{ALT, \cap}$ are false, if that is consistent with the ordinary meaning of *S*, or, otherwise, that all the innocent excludable competitors are false. The second strengthened meaning ($\llbracket S \rrbracket^{++}$) is obtained by assuming that no subdomain in $\llbracket S \rrbracket_{ALT, \cup}$ is privileged: either all the subdomain competitors are true, or they are all false. This factors in No Privilege. Computing the No Privilege implicature on top of the exclusivity implicature delivers the distribution requirement.

4.11.1 Ordinary meanings

Nothing changes with respect to the computation of ordinary meanings. The lexical entries of proper names, verbs, modals, and Existential Closure, look like before.

- (182) a. i. $\llbracket \text{Sandy} \rrbracket = \{\mathbf{s}\}$
 ii. $\llbracket \text{this ice cream} \rrbracket = \{\mathbf{i}\}$
 iii. $\llbracket \text{that cake} \rrbracket = \{\mathbf{c}\}$
 iv. $\llbracket \text{that apple} \rrbracket = \{\mathbf{a}\}$
 b. $\llbracket \text{eat} \rrbracket = \{\lambda x. \lambda y. \lambda w. \mathbf{eat}_w(y, x)\}$
 c. i. $\llbracket \text{may} \rrbracket = \{\lambda p. \lambda w. \exists w' [w' \in \mathfrak{D}_w \ \& \ p(w')]\}$
 ii. $\llbracket \text{must} \rrbracket = \{\lambda p. \lambda w. \forall w' [w' \in \mathfrak{D}_w \rightarrow p(w')]\}$
 d. Where $\llbracket A \rrbracket \subseteq D_{\langle s, t \rangle}$, $\llbracket \exists A \rrbracket = \{\lambda w. \exists p [p \in \llbracket A \rrbracket \ \& \ p(w)]\}$

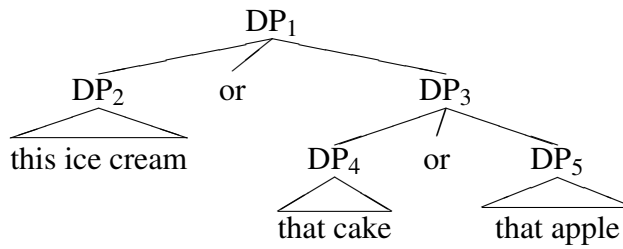
We will continue to assume that *or* simply collects the denotation of its disjuncts in a set.

(183) *The Or Rule*

$$\text{Where } \llbracket B \rrbracket, \llbracket C \rrbracket \subseteq D_\tau, \left[\left[\begin{array}{c} A \\ \swarrow \quad \downarrow \quad \searrow \\ B \quad \text{or} \quad C \end{array} \right] \right] \subseteq D_\tau = \llbracket B \rrbracket \cup \llbracket C \rrbracket$$

As illustration, in what follows, we will use the DP-disjunction in (184a). The internal structure of the disjunction is immaterial for our purposes.

(184) a.



b. $\llbracket DP_1 \rrbracket = \llbracket DP_2 \rrbracket \cup \llbracket DP_3 \rrbracket = \{\mathbf{i}\} \cup \{\mathbf{c}, \mathbf{a}\}$

We will continue to assume the Hamblin rule for functional application, as well:

(185) Where $\llbracket A \rrbracket \subseteq D_{\langle \sigma, \tau \rangle}$ and $\llbracket B \rrbracket \subseteq D_\sigma$,

$$\llbracket A(B) \rrbracket = \{c \in D_\tau \mid \exists a \in \llbracket A \rrbracket \exists b \in \llbracket B \rrbracket (c = a(b))\} \quad (\text{Hamblin, 1973})$$

4.11.2 Determining the competitors

We now turn to the definition of the functions $\llbracket \cdot \rrbracket_{ALT, \cup}$ and $\llbracket \cdot \rrbracket_{ALT, \cap}$, which are meant to model the activation of the competitors for the purpose of strengthening ordinary meanings.

In the case of proper names, verbs, modals, and *or*, the functions introducing the competitors $\llbracket \cdot \rrbracket_{ALT, \cup}$ and $\llbracket \cdot \rrbracket_{ALT, \cap}$ and the ordinary interpretation function $\llbracket \cdot \rrbracket$ yield the same values. This is a simplification for ease of exposition: since I am ignoring scalar implicatures, I will ignore the fact that modals are scalar items.

(186) a. $\llbracket \text{Sandy} \rrbracket_{ALT, \cup} = \llbracket \text{Sandy} \rrbracket_{ALT, \cap} = \{\mathbf{s}\}$

b. $\llbracket \text{this ice cream} \rrbracket_{ALT, \cup} = \llbracket \text{this ice cream} \rrbracket_{ALT, \cap} = \{\mathbf{i}\}$

c. $\llbracket \text{eat} \rrbracket_{ALT, \cup} = \llbracket \text{eat} \rrbracket_{ALT, \cap} = \{\lambda x. \lambda y. \lambda w. \mathbf{eat}_w(y, x)\}$

- d. i. $\llbracket \text{may} \rrbracket_{\text{ALT},\cup} = \llbracket \text{may} \rrbracket_{\text{ALT},\cap} = \{\lambda p.\lambda w.\exists w'[w' \in \mathcal{D}_w \ \& \ p(w')]\}$
 ii. $\llbracket \text{must} \rrbracket_{\text{ALT},\cup} = \llbracket \text{must} \rrbracket_{\text{ALT},\cap} = \{\lambda p.\lambda w.\forall w'[w' \in \mathcal{D}_w \rightarrow p(w')]\}$
- e. i. $\left[\begin{array}{c} \text{A} \\ \swarrow \quad \downarrow \quad \searrow \\ \text{B} \quad \text{or} \quad \text{C} \end{array} \right]_{\text{ALT},\cup} = \llbracket \text{B} \rrbracket_{\text{ALT},\cup} \cup \llbracket \text{C} \rrbracket_{\text{ALT},\cup}$
 ii. $\left[\begin{array}{c} \text{A} \\ \swarrow \quad \downarrow \quad \searrow \\ \text{B} \quad \text{or} \quad \text{C} \end{array} \right]_{\text{ALT},\cap} = \llbracket \text{B} \rrbracket_{\text{ALT},\cap} \cup \llbracket \text{C} \rrbracket_{\text{ALT},\cap}$

The important part is the definition of the competitors activated by Existential Closure. The problem we are facing is that Existential Closure destroys the semantic identity of the disjuncts and to derive the distribution requirement we need to make visible all the subdomains of the domain of quantification set up by *or*. We define the subdomain competitors introduced by a branching node immediately dominating the Existential Closure operator and a constituent denoting a set of alternatives \mathcal{A} as the set containing the propositions that result from applying Existential Closure to all the non-empty subsets of \mathcal{A} :

$$(187) \quad \text{Where } \llbracket \text{A} \rrbracket \subseteq D_{\langle s,t \rangle}, \left[\begin{array}{c} \exists \text{P} \\ \swarrow \quad \downarrow \\ \exists \quad \text{A} \end{array} \right]_{\text{ALT},\cup} = \{p \mid \exists \mathcal{B} \subseteq \llbracket \text{A} \rrbracket \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cup \mathcal{B}\}$$

The ‘conjunctive-competitors’ introduced by a branching node immediately dominating Existential Closure and a set of propositional alternatives \mathcal{A} are the members of the set containing for each set of propositional alternatives \mathcal{B} that is a non-empty subset of \mathcal{A} the proposition that is true in a world w if and only if *all* members of \mathcal{B} are true in w .

$$(188) \quad \text{Where } \llbracket \text{A} \rrbracket \subseteq D_{\langle s,t \rangle}, \left[\begin{array}{c} \exists \text{P} \\ \swarrow \quad \downarrow \\ \exists \quad \text{A} \end{array} \right]_{\text{ALT},\cap} = \{p \mid \exists \mathcal{B} \subseteq \llbracket \text{A} \rrbracket \ \& \ \mathcal{B} \neq \emptyset \ \& \ p = \cap \mathcal{B}\}$$

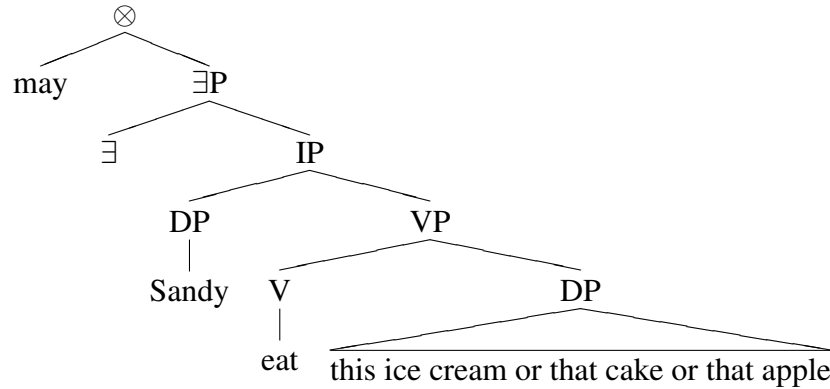
We will assume the Hamblin rule for the computation of other non-terminal nodes:

- (189) a. Where $\llbracket \text{A} \rrbracket_{\text{ALT},\cup} \subseteq D_{\langle \sigma,\tau \rangle}$ and $\llbracket \text{B} \rrbracket_{\text{ALT},\cup} \subseteq D_{\sigma}$,
 $\llbracket \text{A}(\text{B}) \rrbracket_{\text{ALT},\cup} = \{c \in D_{\tau} \mid \exists a \in \llbracket \text{A} \rrbracket_{\text{ALT},\cup} \exists b \in \llbracket \text{B} \rrbracket_{\text{ALT},\cup} (c = a(b))\}$
- b. Where $\llbracket \text{A} \rrbracket_{\text{ALT},\cap} \subseteq D_{\langle \sigma,\tau \rangle}$ and $\llbracket \text{B} \rrbracket_{\text{ALT},\cap} \subseteq D_{\sigma}$,
 $\llbracket \text{A}(\text{B}) \rrbracket_{\text{ALT},\cap} = \{c \in D_{\tau} \mid \exists a \in \llbracket \text{A} \rrbracket_{\text{ALT},\cap} \exists b \in \llbracket \text{B} \rrbracket_{\text{ALT},\cap} (c = a(b))\}$

Let me illustrate how these functions define a set of competitors for the familiar von Wright-Kamp *may* example in (190a):

(190) a. Sandy may eat this ice cream, that cake, or that apple.

b. LF:



Disjunction introduces, just as in the case of ordinary meanings, a set of alternatives, which keep expanding by successive applications of the Hamblin rule. Both functions map the IP below Existential Closure to the set containing the proposition that Sandy eats this ice cream, the proposition that she eats that cake, and the proposition that she eats that apple.

$$(191) \quad \llbracket \text{IP} \rrbracket_{\text{ALT}, \cap} = \llbracket \text{IP} \rrbracket_{\text{ALT}, \cup} = \left\{ \begin{array}{l} \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{i}), \\ \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\}$$

The most important difference between the ordinary meanings and the alternative activating function concerns the interpretation of Existential Closure. The ordinary meaning of the node that immediately dominates the IP is the singleton containing the proposition that is true in a world w if and only if at least one of the propositional alternatives in (191) is true in w .

$$(192) \quad \llbracket \exists \text{P} \rrbracket = \left\{ \lambda w. \exists p [p \in \left\{ \begin{array}{l} \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{i-c}), \\ \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{c}), \\ \lambda w. \text{eat}_w(\mathbf{s}, \mathbf{a}) \end{array} \right\} \& p(w)] \right\}$$

This contrasts with the value of the functions defining the competitors. For ease of exposition, I will use the following notation: ‘I’ will stand for the proposition that Sandy eats this ice cream, ‘C’ will stand for the proposition that Sandy eats that cake, and ‘A’ for the proposition that Sandy eats that apple. ‘ $C \cup I \cup A$ ’ stands for the proposition that is true in a world w if and only if at least one of those three propositions is true in w , and ‘ $C \cap I \cap A$ ’ for the proposition that is true in a world w if and only if all three propositions are true in w . The set of subdomain competitors generated for the constituent immediately dominating the Existential Closure operator is in (193a). Those correspond to disjunctions of shorter or equal length than the asserted. The set of conjunctive competitors is in (193b).

$$(193) \quad \begin{array}{l} \text{a. } \llbracket \exists P \rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} I, C, A, \\ I \cup C, C \cup A, I \cup A, \\ I \cup C \cup A \end{array} \right\} \\ \text{b. } \llbracket \exists P \rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} I, C, A, \\ I \cap C, C \cap A, I \cap A, \\ I \cap C \cap A \end{array} \right\} \end{array}$$

The modal combines now with these sets of propositional alternatives via the Hamblin rule to generate the competitors below:

$$(194) \quad \begin{array}{l} \text{a. } \llbracket \otimes \rrbracket_{ALT, \cup} = \llbracket \text{may} \rrbracket_{ALT, \cup}(\llbracket \exists P \rrbracket_{ALT, \cup}) = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(I \cup C), \diamond(C \cup A), \diamond(I \cup A) \\ \diamond(I \cup C \cup A) \end{array} \right\} \\ \text{b. } \llbracket \otimes \rrbracket_{ALT, \cap} = \llbracket \text{may} \rrbracket_{ALT, \cap}(\llbracket \exists P \rrbracket_{ALT, \cap}) = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(I \cap C), \diamond(C \cap A), \diamond(I \cap A), \\ \diamond(I \cap C \cap A) \end{array} \right\} \end{array}$$

The subdomain competitors are all stronger than the proposition in the ordinary meaning of the sentence — with the exception of the proposition in the ordinary meaning of the sentence itself, of course. All the conjunctive competitors are stronger than the ordinary meaning of the sentence. Since the singletons containing each individual disjunct enter the

derivation, the modal can see each individual disjunct on its own. We now have the required competitors to run the No Privilege implicature and strengthen the ordinary meaning of the sentence.

4.11.3 Strengthened meanings

Together with the sentence in (190a), repeated below as (195a), we will consider the sentence in (196a). Their ordinary meanings are given in (195b) and (196b). The sets containing their conjunctive competitors are given in (195c) and (196c), and the sets containing their subdomain competitors are given in (195d) and (196d).

(195) a. Sandy may eat this ice cream, that cake, or that apple.

b. $\llbracket(195a)\rrbracket = \{\diamond(I \cup C \cup A)\}$

c. $\llbracket(195a)\rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(I \cap C), \diamond(I \cap A), \diamond(C \cap A), \\ \diamond(I \cap C \cap A) \end{array} \right\}$

d. $\llbracket(195a)\rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(I \cup C), \diamond(I \cup A), \diamond(C \cup A), \\ \diamond(I \cup C \cup A) \end{array} \right\}$

(196) a. Sandy must eat this ice cream, that cake, or that apple.

b. $\llbracket(196a)\rrbracket = \{\square(I \cup C \cup A)\}$

c. $\llbracket(196a)\rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} \square I, \square C, \square A, \\ \square(I \cap C), \square(I \cap A), \square(C \cap A), \\ \square(I \cap C \cap A) \end{array} \right\}$

d. $\llbracket(196a)\rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} \square I, \square C, \square A, \\ \square(I \cup C), \square(I \cup A), \square(C \cup A), \\ \square(I \cup C \cup A) \end{array} \right\}$

For any sentence S, two strengthened meanings are defined. The first, which I will refer to as ‘meaning plus’ ($\llbracket \cdot \rrbracket^+$) is obtained by excluding conjunctive competitors. In the case

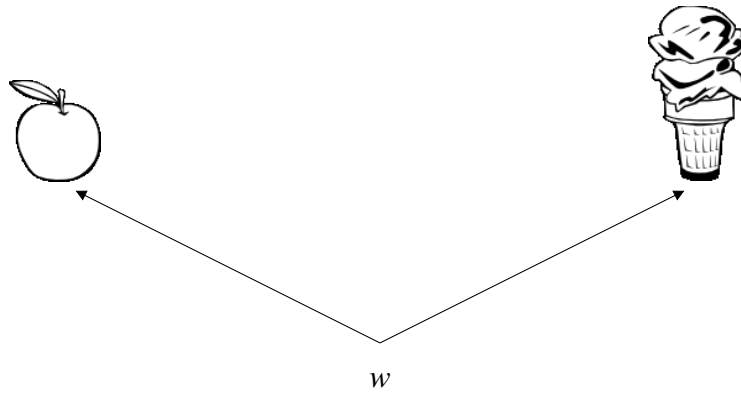


Figure 4.7. A world where Sandy is permitted to have that apple and is permitted to have that ice cream.

of the sentence in (196a), the set containing its ordinary meaning and the negation of all its conjunctive competitors (in (197) below) is a consistent set of propositions. Consider, for instance the situation depicted in figure 4.7 on page 174. As before, the arrows departing from the world w at the bottom of the picture are the only types of permitted worlds in w . We have two of them: in the first type of permitted world Sandy eats that apple (but neither this ice cream or that cake), in the second type of permitted world Sandy eats that ice cream (but neither that cake or that apple). All the propositions in the set in (197) are true in w .

$$(197) \left\{ \begin{array}{l} \neg\Box I, \neg\Box C, \neg\Box A, \\ \neg\Box(I \cap C), \neg\Box(I \cap A), \neg\Box(C \cap A), \\ \neg\Box(I \cap C \cap A), \\ \Box(I \cup C \cup A) \end{array} \right\}$$

We will assume that the first strengthened meaning of the sentence in (196a) is the proposition that is true in a world w if and only if the proposition in its ordinary meaning is true in w and all its conjunctive counterparts are false in w . This strengthening, as figure 4.7 shows, does not license the distribution requirement yet.

$$(198) \quad \llbracket (196a) \rrbracket^+ = \lambda w. \exists p [p \in \llbracket (196a) \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \llbracket (196a) \rrbracket_{ALT, \cap} \rightarrow \neg q(w)]]$$

The situation is different in the case of (195a). The set containing the proposition in the ordinary meaning of (195a) and the negation of all its conjunctive competitors is inconsistent, because the negation of *all* its conjunctive competitors entails that the proposition in the ordinary meaning of (195a) is false. To strengthen the meaning of (195a) by negating its conjunctive competitors, we will resort to the mechanics of innocent exclusion.

In chapter 3 we saw that the innocent exclusion procedure needs to make sure that no atomic disjunct is excluded. Here's the definition of innocent exclusion that we used in chapter 3:

(199) *Innocent exclusion*

The negation of a proposition p in the set of competitors of a sentence S ($\llbracket S \rrbracket_{ALT,\cap}$) is innocent if and only if, for each $q \in \llbracket S \rrbracket$, every way of adding to q as many negations of propositions in $\llbracket S \rrbracket_{ALT,\cap}$ as consistency allows reaches a point where the resulting set implies $\neg p$.

The ordinary meaning of the von Wright-Kamp sentences that we are discussing contains only one proposition, because the alternatives introduced by *or* are caught by the Existential Closure operator under the scope of the modals. That means that the definition of innocent exclusion above will allow for the exclusion of some atomic disjuncts. To see why, consider, for instance, the example below in (200) below:

(200) Sandy may eat this ice cream, that apple, or both.

Its ordinary meaning is the singleton in (201a). Its conjunctive competitors are listed in (201b).

(201) a. $\llbracket (200) \rrbracket = \{\diamond(I \cup A \cup (I \cap A))\}$

b. $\llbracket (200) \rrbracket_{ALT,\cap} = \{\diamond I, \diamond A, \diamond(I \cap A)\}$

There are two ways of adding to the proposition in the set in (201a) as many negated conjunctive competitors as consistency permits. The sets in (202) illustrate them.

- (202) a. $\{\diamond(I \cup A \cup (I \cap A)), \neg \diamond I, \neg \diamond(I \cap A)\}$
 b. $\{\diamond(I \cup A \cup (I \cap A)), \neg \diamond A, \neg \diamond(I \cap A)\}$

That means that the negation of the proposition that Sandy may have both this ice cream and that apple is innocent. That proposition is generated by combining one of the atomic disjuncts with the modal. To account for the distribution requirement of sentences like (200), no such proposition should be excluded. To avoid this situation, we need to be sure that the system keeps track of the propositional alternatives introduced by *or*. The innocent exclusion mechanism will make reference to the subdomain competitors:

- (203) *Innocent exclusion* (Second version)

The negation of a proposition p in the set of competitors of a sentence S ($\llbracket S \rrbracket_{ALT, \cap}$) is innocent if and only if, for each $q \in \llbracket S \rrbracket_{ALT, \cup}$, every way of adding to $\{q\} \cup \llbracket S \rrbracket$ as many negations of propositions in $\llbracket S \rrbracket_{ALT, \cap}$ as consistency allows reaches a point where the resulting set implies $\neg p$.

The subdomain competitors of the sentence in (200) are listed below:

- (204) $\llbracket (200) \rrbracket_{ALT, \cup} = \{\diamond I, \diamond A, \diamond(I \cap A), \diamond(I \cup A), \diamond(I \cup A \cup (I \cap A))\}$

The proposition that Sandy is allowed to eat both desserts is among the subdomain competitors. That makes sure that it is not innocently excludable. We need to consider now the six sets in (205) below. The set in (205c) does not imply that Sandys is not allowed to eat both this ice cream and that apple. None of the conjunctive competitors is innocently excludable.

- (205) a. $\{\diamond(I \cup A \cup (I \cap A)), \diamond I, \neg \diamond A, \neg \diamond(I \cap A)\}$
 b. $\{\diamond(I \cup A \cup (I \cap A)), \diamond A, \neg \diamond I, \neg \diamond(I \cap A)\}$
 c. $\{\diamond(I \cup A \cup (I \cap A)), \diamond(I \cap A)\}$
 d. i. $\{\diamond(I \cup A \cup (I \cap A)), \diamond(I \cup A), \neg \diamond I, \neg \diamond(I \cap A)\}$
 ii. $\{\diamond(I \cup A \cup (I \cap A)), \diamond(I \cup A), \neg \diamond A, \neg \diamond(I \cap A)\}$

Let us consider again the sentence in (195a), repeated below as (206a). Its conjunctive competitors are listed again in (206c), and its subdomain competitors are listed in (206d).

(206) a. Sandy may eat this ice cream, that cake, or that apple.

b. $\llbracket(206a)\rrbracket = \{\diamond(IUC \cup A)\}$

c. $\llbracket(206a)\rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(I \cap C), \diamond(I \cap A), \diamond(C \cap A), \\ \diamond(I \cap C \cap A) \end{array} \right\}$

d. $\llbracket(206a)\rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} \diamond I, \diamond C, \diamond A, \\ \diamond(IUC), \diamond(IUA), \diamond(CUA), \\ \diamond(IUC \cup A) \end{array} \right\}$

To determine which conjunctive competitors can be innocently excluded, we consider every way of adding to the proposition in (196a) and one of its subdomain competitors as many negated conjunctive competitors as consistency allows, as illustrated by the sets below:

(207) a. i. $\left\{ \begin{array}{l} \diamond(IUC \cup A), \diamond I, \\ \neg \diamond C, \neg \diamond A, \\ \neg \diamond(I \cap C), \neg \diamond(C \cap A), \neg \diamond(I \cap A), \\ \neg \diamond(I \cap C \cap A) \end{array} \right\}$

ii. $\left\{ \begin{array}{l} \diamond(IUC \cup A), \diamond C, \\ \neg \diamond I, \neg \diamond A, \\ \neg \diamond(I \cap C), \neg \diamond(C \cap A), \neg \diamond(I \cap A), \\ \neg \diamond(I \cap C \cap A) \end{array} \right\}$

iii. $\left\{ \begin{array}{l} \diamond(IUC \cup A), \diamond A, \\ \neg \diamond I, \neg \diamond C, \\ \neg \diamond(I \cap C), \neg \diamond(C \cap A), \neg \diamond(I \cap A), \\ \neg \diamond(I \cap C \cap A) \end{array} \right\}$

b. i. $\{\diamond(IUC \cup A), \diamond(IUC)\} \cup ((207a-i) - \{\diamond I\})$

ii. $\{\diamond(IUC \cup A), \diamond(IUC)\} \cup ((207a-ii) - \{\diamond C\})$

- c. i. $\{\diamond(IUC \cup A), \diamond(IUA)\} \cup ((207a-i) - \{\diamond I\})$
ii. $\{\diamond(IUC \cup A), \diamond(IUA)\} \cup ((207a-iii) - \{\diamond A\})$
- d. i. $\{\diamond(IUC \cup A), \diamond(C \cup A)\} \cup ((207a-ii) - \{\diamond C\})$
ii. $\{\diamond(IUC \cup A), \diamond(C \cup A)\} \cup ((207a-iii) - \{\diamond A\})$
- e. i. $\{\diamond(IUC \cup A)\} \cup ((207a-i) - \{\diamond I\})$
ii. $\{\diamond(IUC \cup A)\} \cup ((207a-ii) - \{\diamond C\})$
iii. $\{\diamond(IUC \cup A)\} \cup ((207a-iii) - \{\diamond A\})$

The set of innocently excludable competitors in (206c) is determined by subtracting the ordinary meaning of the sentence in (196a) from the intersection of all these sets.³³

$$(208) \quad \heartsuit(\llbracket(206a)\rrbracket_{ALT,\cap}) = \cap \left\{ \begin{array}{l} (207a-i), (207a-ii), \\ (207a-iii), (207b-i), \\ (207b-ii), (207c-i), \\ (207c-ii), (207d-i), \\ (207d-ii), (207e-i) \\ (207e-ii), (207e-iii) \end{array} \right\} - \{\diamond(IUC \cup A)\} = \left\{ \begin{array}{l} \neg\diamond(I \cap C), \\ \neg\diamond(C \cap A), \\ \neg\diamond(I \cap A), \\ \neg\diamond(I \cap C \cap A) \end{array} \right\}$$

The first strengthening of a von Wright-Kamp *may* sentence excludes all the innocently excludable conjunctive competitors. We get a proposition that is true in a world w if and only if Sandy is allowed to eat at most one of the three desserts. The distribution requirement is not delivered yet: the proposition in (209) is true in the type of world depicted in figure 4.7 on page 174, in which Sandy is not permitted to have cake.

$$(209) \quad \llbracket(206a)\rrbracket^+ = \lambda w. \exists p[p \in \llbracket(206a)\rrbracket \ \& \ p(w) \ \& \ \forall q[q \in \heartsuit(\llbracket(206a)\rrbracket_{ALT,\cap}) \rightarrow \neg q(w)]]$$

The first strengthening excludes *all* conjunctive competitors, if that is consistent with the ordinary meaning, otherwise, it excludes *all* conjunctive competitors whose negation is

³³I follow the notation that I used in chapter 3: for any sentence S , $\heartsuit(\llbracket S \rrbracket_{ALT,\cap})$ is the set of propositions in $\llbracket S \rrbracket_{ALT,\cap}$ whose negation is innocent.

innocent. The innocent exclusion mechanism applies to make the best out of an inconsistent set of propositions.

- (210) a. If $\llbracket S \rrbracket \cup \{\neg p \mid p \in \llbracket S \rrbracket_{ALT, \cap}\}$ is consistent,

$$\llbracket S \rrbracket^+ = \lambda w. \exists p [p \in \llbracket S \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \llbracket S \rrbracket_{ALT, \cap} \rightarrow \neg q(w)]]$$
- b. Otherwise,

$$\llbracket S \rrbracket^+ = \lambda w. \exists p [p \in \llbracket S \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \heartsuit(\llbracket S \rrbracket_{ALT, \cap}) \rightarrow \neg q(w)]]$$

The second strengthening imports the No Privilege implicature, which requires that either all the subdomain competitors are true or none of them are.

$$(211) \quad \llbracket S \rrbracket^{++} = \lambda w. \llbracket S \rrbracket^+(w) \ \& \ \forall q \forall r \left[\begin{array}{c} \left(\begin{array}{c} q \in (\llbracket S \rrbracket_{ALT, \cup} - \llbracket S \rrbracket) \\ \& \\ r \in (\llbracket S \rrbracket_{ALT, \cup} - \llbracket S \rrbracket) \end{array} \right) \rightarrow (q(w) \leftrightarrow r(w)) \end{array} \right]$$

Consider the sentence in (206a) again. Its second strengthened meaning conveys that Sandy is allowed to eat this ice cream, that she is allowed to eat that cake, that she is also allowed to eat that apple, and that she is allowed to eat at most one of the desserts. We can now see why the strengthened meaning of (206a) differs from the ordinary meanings of the sentences in (212a-213a) below: the second strengthening of the meaning of the sentence in (206a) conveys that Sandy does not have more than one dessert in any permitted world, but neither of the sentences in (212a-213a) does.

- (212) a. Sandy may eat this ice cream, she may eat that cake, and she may eat that apple.
b. $\llbracket (212a) \rrbracket = \{\diamond I \cap \diamond C \cap \diamond A\}$
- (213) a. Sandy may eat this ice cream, that cake, and that apple.
b. $\llbracket (213a) \rrbracket = \{\diamond (I \cap C \cap A)\}$

Consider now the sentence in (196a), repeated in (214a) below, together with its conjunctive and subdomain competitors.

- (214) a. Sandy must eat this ice cream, that cake, or that apple.

$$\begin{aligned}
\text{b. } \llbracket(214\text{a})\rrbracket &= \{\Box(I \cup C \cup A)\} \\
\text{c. } \llbracket(214\text{a})\rrbracket_{\text{ALT}, \cap} &= \left\{ \begin{array}{l} \Box I, \Box C, \Box A, \\ \Box(I \cap C), \Box(I \cap A), \Box(C \cap A), \\ \Box(I \cap C \cap A) \end{array} \right\} \\
\text{d. } \llbracket(214\text{a})\rrbracket_{\text{ALT}, \cup} &= \left\{ \begin{array}{l} \Box I, \Box C, \Box A, \\ \Box(I \cup C), \Box(I \cup A), \Box(C \cup A), \\ \Box(I \cup C \cup A) \end{array} \right\}
\end{aligned}$$

The set containing the proposition in (214b) and all the negations of conjunctive competitors is consistent. Consider, for instance, again, the world w and the accessibility relation depicted in figure 4.7 on page 174. The proposition in (214b) is true in w : in all permitted worlds Sandy eats at least one of the desserts at issue. All propositions in (214c) are false. It is not true that in all permitted worlds Sandy eats cake, it is not true that in all permitted worlds she eats ice cream, and it is not true that in all permitted world she eats an apple, either. It is also false that in all permitted worlds she eats more than one of the desserts. We therefore get, as the first strengthened meaning, the proposition that is true in a world w if and only if the proposition in (214b) is true in w and all propositions in (214c) are false in w .

$$(215) \quad \llbracket(214\text{a})\rrbracket^+ = \lambda w. \exists p [p \in \llbracket(214\text{a})\rrbracket(w) \ \& \ p(w) \ \& \ \forall q [q \in \llbracket(214\text{a})\rrbracket_{\text{ALT}, \cap} \rightarrow \neg q(w)]]$$

This strengthened meaning does not convey the distribution requirement yet, as the situation depicted in fig. 4.7 on page 174 shows, but the second strengthened meaning in (216), which we get by importing the No Privilege implicature, does.

$$(216) \quad \llbracket(214\text{a})\rrbracket^{++} = \lambda w. \llbracket(214\text{a})\rrbracket^+(w) \ \& \ \forall q \forall r \left[\left(\begin{array}{l} q \in (\llbracket(214\text{a})\rrbracket_{\text{ALT}, \cup} - \llbracket(214\text{a})\rrbracket) \\ \& \\ r \in (\llbracket(214\text{a})\rrbracket_{\text{ALT}, \cup} - \llbracket(214\text{a})\rrbracket) \end{array} \right) \rightarrow \left(\begin{array}{l} q(w) \\ \leftrightarrow \\ r(w) \end{array} \right) \right]$$

Here's the proof:

1. Assume that the proposition in (216) is true in a world w . That means that the proposition in (215) is true in w .
2. Since the proposition in (215) is true in w , we can conclude:
 - (a) that the proposition in the set in (214b) is true in w , and
 - (b) that all subdomain competitors are false in w (since the proposition in (215) entails that some of them are ($\Box I, \Box C$ and $\Box A$)).
3. Assume, now, that Sandy is not allowed to eat ice cream in w .
4. The assumption that Sandy is not allowed to eat ice cream in w , together with the assumption that the proposition in the set in (214b) is true in w implies that one of the subdomain competitors ($\Box(C \cup A)$) is true, contrary to what we have assumed in (2b).

Let us consider now the negated counterparts of the von Wright-Kamp sentences that we have discussed so far, which I list in (217a-218a) below, together with their conjunctive and subdomain counterparts.

(217) a. Sandy may not eat this ice cream, that cake, or that apple.

b. $\llbracket(217a)\rrbracket = \{\neg\Diamond(I \cup C \cup A)\}$

c. $\llbracket(217a)\rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} \neg\Diamond I, \neg\Diamond C, \neg\Diamond A, \\ \neg\Diamond(I \cap C), \neg\Diamond(I \cap A), \neg\Diamond(C \cap A), \\ \neg\Diamond(I \cap C \cap A) \end{array} \right\}$

d. $\llbracket(217a)\rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} \neg\Diamond I, \neg\Diamond C, \neg\Diamond A, \\ \neg\Diamond(I \cup C), \neg\Diamond(I \cup A), \neg\Diamond(C \cup A), \\ \neg\Diamond(I \cup C \cup A) \end{array} \right\}$

(218) a. Sandy does not have to eat this ice cream, that cake, or that apple.

b. $\llbracket(218a)\rrbracket = \{\neg\Box(I \cup C \cup A)\}$

$$\begin{array}{l}
\text{c. } \llbracket (218a) \rrbracket_{ALT, \cap} = \left\{ \begin{array}{l} \neg \Box I, \neg \Box C, \neg \Box A, \\ \neg \Box (I \cap C), \neg \Box (I \cap A), \neg \Box (C \cap A), \\ \neg \Box (I \cap C \cap A) \end{array} \right\} \\
\text{d. } \llbracket (218a) \rrbracket_{ALT, \cup} = \left\{ \begin{array}{l} \neg \Box I, \neg \Box C, \neg \Box A, \\ \neg \Box (I \cup C), \neg \Box (I \cup A), \neg \Box (C \cup A), \\ \neg \Box (I \cup C \cup A) \end{array} \right\}
\end{array}$$

Let us consider the first strengthening. The proposition in the ordinary meaning of either sentence entails all its conjunctive competitors. Assuming that all the competitors are false is, therefore, inconsistent with the ordinary meanings. What about innocent exclusion? The proposition in the ordinary meaning of the sentence in (217a) entails all its conjunctive and subdomain competitors. For any subdomain competitor p , no negation of a conjunctive competitor can be added to the set $\{p\} \cup \{\neg \Diamond (I \cup C \cup A)\}$ while keeping consistency. There is no conjunctive competitor whose negation is innocent, then. That means that the first strengthening ($\llbracket (217a) \rrbracket^+$) does not result in a proposition that is stronger than the proposition in the ordinary meaning of the sentence. The proposition in (219) is true in exactly those worlds where the proposition in the ordinary meaning is true.

$$(219) \quad \llbracket (217a) \rrbracket^+ = \lambda w. \exists p [p \in \llbracket (217a) \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \emptyset \rightarrow \neg q(w)]]$$

We can conclude the same for the sentence in (218a). The proposition in the ordinary meaning of (218a) is inconsistent with the negation of all its conjunctive competitors. For any proposition p in the set of subdomain competitors of (218a), $\{p\} \cup \{\neg \Box (I \cup C \cup A)\}$ is consistent, but the addition of any negated conjunctive competitor leads to an inconsistent set of propositions. There are no innocently excludable competitors, then.

Assuming that either all or none of the subdomain competitors is true fails to strengthen the meanings of these sentences, since the proposition in their ordinary meanings already entails that all their subdomain competitors are true.

Before concluding this section, I would like to point out an advantage of this setup: the system presented here allows for importing the strengthened meanings into the truth conditions and, therefore, can in principle account for the cases where the distribution requirement seems to enter the meaning of embedded sentences.

4.11.4 Implicature *freezing*

Kamp (1978) entertained the possibility of deriving the distribution requirement as an implicature, but called attention to an example, which I reproduce in (220) below, where a von Wright-Kamp sentence is embedded and seems to contribute the distribution requirement to the meaning of the embedding construction.

(220) Usually you may only take an apple. So if you may take an apple or take a pear, you should bloody well be pleased. (Kamp, 1978, 279)

The antecedent of the conditional in (220) above is considering a scenario where the addressee has both the right to take an apple and the right to take a pear and, so, the distribution requirement seems to be part of the truth-conditional meaning of the *if*-clause.

In section 4.4.1.1 we encountered some examples where a von Wright-Kamp sentence is embedded under a propositional attitude verb. I repeat them below:

- (221)
- a. I suspect that Sandy may have custard or pie (whichever she wants) but I might be wrong.
 - b. I suppose that Sandy may have custard or pie (as she wishes) but I am not sure yet.
 - c. I believe that Sandy may have custard or pie (as she wishes) but I am not a hundred percent sure.
 - d. Ms. Green's husband wrongly believes that Sandy may have custard or pie.

Together with those, we also considered a case where the von Wright-Kamp sentence is an embedded interrogative:

(222) Me, to Ms. Green's husband: "I want to know whether Sandy may have custard or pie — as she wishes — or not."

In the cases in (221), the distribution requirement seems to be part of what the speaker suspects or believes, or part of what Ms. Greens wrongly believes, and so, it also seems to be part of the conventional meaning of the embedded sentence. Likewise, according to what (222) says, what I want to know is whether Sandy has both the right to have custard and the right to have pie.

The behavior of the distribution requirement in the conditional in (220) puzzled Kamp, who suggested that, if the distribution requirement is to be derived as an implicature, the pragmatic component must then include some mechanism that imports implicatures into conventional meanings:

One ... cannot escape the impression that in certain cases, such as in particular that of [(220)], an implicature which the sentence typically carries when used by itself, becomes conventionally attached to that sentence in such a way that it may contribute to the interpretation of compounds in which the first sentence is so embedded that it becomes inaccessible as input to the conversational component of the theory in the usual way. We might contemplate adding to the pragmatic component of our theory a principle that makes this intuition precise — although how such a principle should be stated I am unable to say.

(Kamp, 1978, 280)

Almost thirty years after Kamp's suggestion, we have learned how to state such a principle. The observation that many implicatures seem to enter the truth-conditions of the sentences with which they are associated has become commonplace. The reader is referred to Levinson 2001 for an inventory of the so-called 'intrusive implicatures'.³⁴ The type of recursive pragmatics presented in Chierchia 2004 and Chierchia 2005 allows precisely for importing implicatures into the truth-conditions. To account for the cases where implicatures seem to 'intrude' into embedded meanings, Chierchia (2005, 18) resorts to a syntactic operator that projects at LF and imports strengthened meanings into the ordinary meanings:

³⁴See also the discussion in Recanati (2003).

$$(223) \quad \left[\left[\begin{array}{c} \circ \\ \sigma \quad \text{IP} \end{array} \right] \right] = \llbracket \text{IP} \rrbracket^{++}$$

By projecting Chierchia’s sigma operator in the relevant places (under the scope of *if* or the propositional attitude verbs), we can derive the interpretation of Kamp’s conditional and the cases in (221) and (222). An important question arises, though: when and where does the sigma operator project? Can it project freely? If not, under which conditions? Answering that question goes well beyond my goal in this section: I only wanted to show how the No Privilege reasoning can be imported in a system that allows for the computation of strengthened meanings in tandem with the computation of ordinary meanings.³⁵

4.11.5 Summary

In this section I provided an interpretative mechanism that computes meanings strengthened via the No Privilege (domain widening) implicature. Each individual alternative introduced by disjunction is made visible to the modal in the pragmatics despite the intervening Existential Closure operator in the semantics.

4.12 The epistemic cases

In section 4.2.3 we have seen that the von Wright-Kamp sentences are ambiguous between what I called the *deontic distributive reading* and the *epistemic distributive reading*.

So far, we have derived the deontic distributive reading by appealing to an implicature of domain widening. For the deontic distributive reading to be derived, the alternatives

³⁵One interesting observation is that the distribution requirement can be imported into the constructions we have been examining quite freely, in contrast to what happens when we embed a von Wright-Kamp sentence under negation where the distribution requirement can only be imported when *or* receives a pitch accent, especially in cases of denials, the so-called *metalinguistic* cases Horn (1985), as illustrated below:

- (i) (a) Dad: “Sandy may eat this ice cream OR that cake.”
- (b) Mom: “ No! That’s not quite right! She may not eat this ice cream OR that cake: she may only have that cake!”

Fox (2006) also makes this observation.

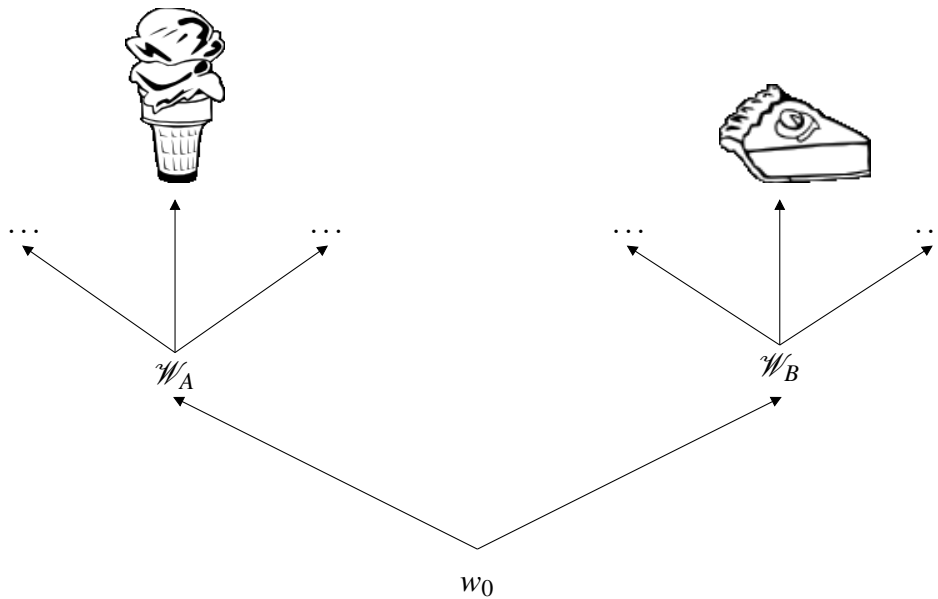


Figure 4.8. *Sandy may have this ice cream or that cake — I don't know which*

introduced by *or* must be caught by the Existential Closure operator triggered under the scope of modals. What is the configuration that gives rise to the epistemic reading?

Take the *may* example. I contend that what is at issue in these examples is the distribution of the propositional alternatives in the set in (224) (the proposition that Sandy may eat this ice cream and the proposition that Sandy may eat that cake) over the space of epistemic options:

$$(224) \quad \{\diamond I, \diamond C\}$$

The epistemic reading requires that the set of worlds compatible with what Dad believes contain worlds where Sandy may have this ice cream and worlds where Sandy may have that cake, as illustrated in figure 4.5, repeated here as figure 4.8.

Likewise for the *must* case. The epistemic reading involves the distribution of the propositional alternatives below (the proposition that Sandy must clean her bedroom and

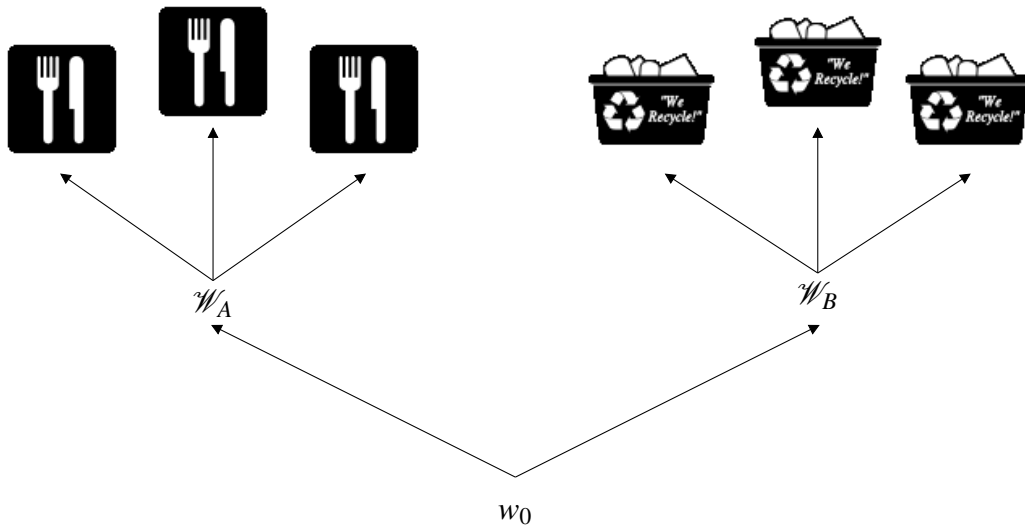


Figure 4.9. *Sandy must clean her bedroom or cook dinner — I don't know which.*

the proposition that she must cook dinner) over the space of worlds compatible with what the speaker knows.³⁶

(225) $\{\Box C, \Box D\}$

The epistemic reading requires that the set of worlds compatible with what Mom believes contain worlds where Sandy must clean her bedroom, and worlds where she must cook dinner, as illustrated in figure 4.6, repeated as figure 4.9 on page 187.

Two questions arise: (i) how do we get these propositional alternatives and, (ii) how do they get distributed over the worlds compatible with what the speaker believes.

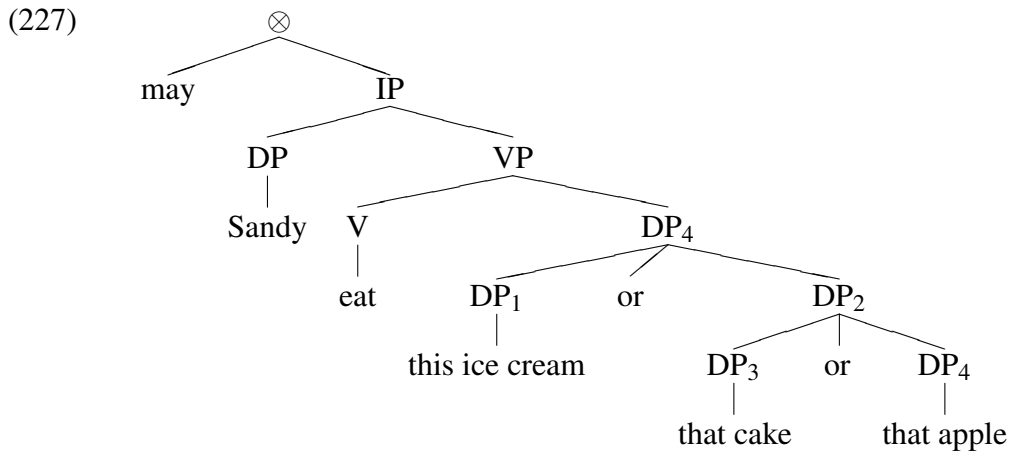
The answer to the first question that I want to entertain is this: if Existential Closure does not intervene between the set of propositional alternatives generated by *or* and the modal applies directly to it, the Hamblin rule gives us all we need to get the desired alter-

³⁶Notation: ' $\Box C$ ' stands for the proposition that Sandy must clean her bedroom and ' $\Box D$ ' stands for the proposition that Sandy must cook dinner.

natives. Take, as an illustration, the *may* example that we have been examining throughout the chapter.

(226) Sandy may have this ice cream, that cake, or that apple.

Suppose now that its LF does not involve the Existential Closure that we have been assuming is triggered under the immediate scope of modals:



The alternatives introduced by *or* expand by successive applications of the Hamblin rule up until the point when they get propositional. The denotation of the IP is the set containing the proposition that Sandy eats this ice cream, the proposition that she eats that cake, and the proposition that she eats that apple:

(228) $\llbracket \text{IP} \rrbracket = \{I, C, A\}$

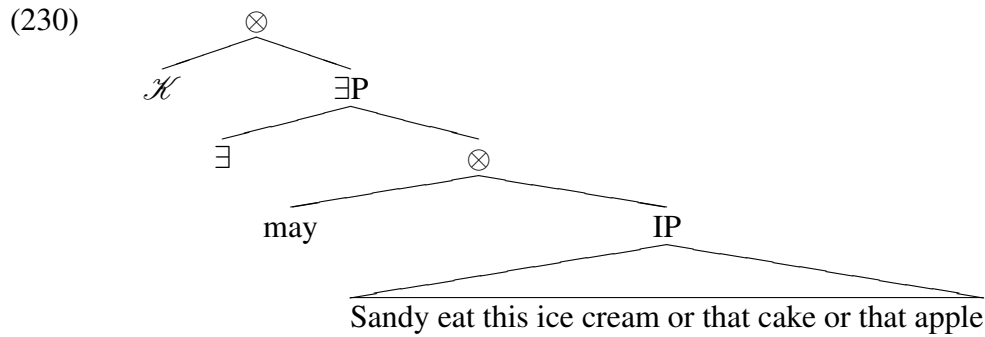
The denotation of the modal is (the singleton containing) a function from propositions to propositions. To derive the deontic distributive reading we assumed that Existential Closure mapped the set of propositional alternatives into a set containing just one proposition, but given the denotation in (229a), the modal can directly combine with the set of propositional alternatives via the Hamblin rule. The result is the set containing the proposition that Sandy is allowed to eat this ice cream, the proposition that Sandy is allowed to eat that cake, and the proposition that she is allowed to eat that apple. This is the set we need.

(229) a. $\llbracket \text{may} \rrbracket = \{\lambda p_{\langle s,t \rangle} . \lambda w . \exists w' [w' \in \mathfrak{D}_w \ \& \ p(w')]\}$

b. $[[\otimes]] = \{\diamond I, \diamond C, \diamond A\}$

I will make the same assumptions for the *must* cases.

The answer to the second question (how are those alternatives distributed over the space of epistemic possibilities) is the answer to the question of what happens with the sets of propositional alternatives that are not caught by the Existential Closure operator under the scope of modals. I will assume that those propositional alternatives are caught by the Existential Closure operator triggered under the scope of an implicit epistemic operator. The LF of the sentence in (226) that derives the epistemic reading, then, looks like the one below:³⁷



The proposal, then, is that von Wright-Kamp sentences are ambiguous: the deontic distribution requirement is associated with the LF where Existential Closure is triggered under the scope of the deontic modals and the epistemic distribution requirement is tied to the LF where Existential Closure is triggered under the scope of an implicit epistemic modal.

Let us now see what the strengthening algorithm predicts for this type of LF.

(231) a. $[[230]] = \{\mathcal{H}(\diamond I \cup \diamond C \cup \diamond A)\}$

b. $[[230]]_{ALT, \cap} = \left\{ \begin{array}{l} \mathcal{H}(\diamond I), \mathcal{H}(\diamond C), \mathcal{H}(\diamond A), \\ \mathcal{H}(\diamond I \cap \diamond C), \mathcal{H}(\diamond I \cap \diamond A), \mathcal{H}(\diamond C \cap \diamond A), \\ \mathcal{H}(\diamond I \cap \diamond C \cap \diamond A) \end{array} \right\}$

³⁷As before, ‘ \mathcal{H} ’ stands for a necessity doxastic operator.

$$c. \llbracket (230) \rrbracket_{ALT,U} = \left\{ \begin{array}{c} \mathcal{H}(\diamond I), \mathcal{H}(\diamond C), \mathcal{H}(\diamond A), \\ \mathcal{H}(\diamond I \cup \diamond C), \mathcal{H}(\diamond I \cup \diamond A), \mathcal{H}(\diamond C \cup \diamond A), \\ \mathcal{H}(\diamond I \cup \diamond C \cup \diamond A) \end{array} \right\}$$

The negation of all conjunctive competitors is compatible with the proposition in the set in (231a). The first strengthening yields a proposition that is true in a world w if and only if the proposition in the set in (231a) is true in w and none of the conjunctive competitors are true in w .

$$(232) \quad \llbracket (230) \rrbracket^+ = \lambda w. \exists p [p \in \llbracket (230) \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \llbracket (230) \rrbracket_{ALT,\cap} \rightarrow \neg q(w)]]$$

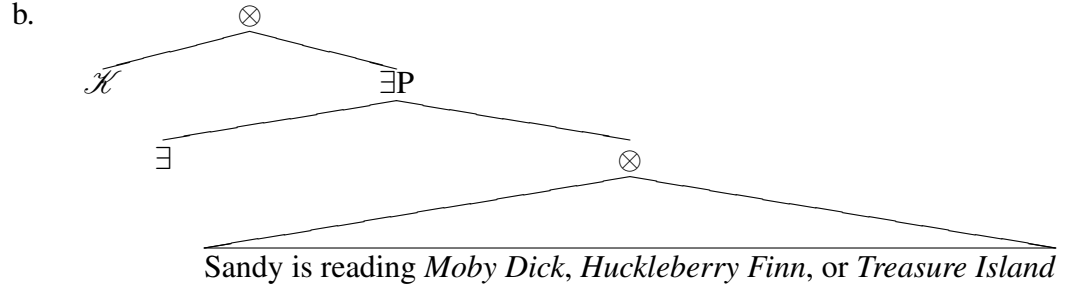
The proposition in (232) does not derive the distribution requirement yet: it is true in a world w in which the speaker believes, for instance, that Sandy is not allowed to eat ice cream. The possibility is ruled out by the second strengthening:

$$(233) \quad \llbracket (230) \rrbracket^{++} = \lambda w. \llbracket (230) \rrbracket^+(w) \ \& \ \forall q \forall r \left[\left(\begin{array}{c} q \in (\llbracket (230) \rrbracket_{ALT,U} - \llbracket (230) \rrbracket) \\ \& \\ r \in (\llbracket (230) \rrbracket_{ALT,U} - \llbracket (230) \rrbracket) \end{array} \right) \rightarrow \left(\begin{array}{c} q(w) \\ \leftrightarrow \\ r(w) \end{array} \right) \right]$$

The second strengthening adds the requirement that all subdomain competitors have the same truth value. Given the first strengthening, this amounts to assuming that they are all false, and this assumption delivers the epistemic distribution requirement. The reasoning will be familiar to the reader. Suppose that the speaker is convinced that Sandy is not allowed to eat this ice cream. That assumption, given the ordinary meaning, entails that one of the competitors ($\mathcal{H}(\diamond C \cup \diamond A)$) is true, while another ($\mathcal{H}(\diamond I)$) is false. And that's what No Privilege rules out. The epistemic distribution requirement is derived.

We can make the same assumptions for unembedded disjunctions. Consider, for instance the sentence in (234a), together with its conjunctive and subdomain competitors.

$$(234) \quad a. \text{ Sandy is reading } \textit{Moby Dick}, \textit{Huckleberry Finn}, \text{ or } \textit{Treasure Island}.$$



c. $\llbracket (234a) \rrbracket = \{ \mathcal{K}(\mathbf{M} \cup \mathbf{H} \cup \mathbf{T}) \}$

d. $\llbracket (234a) \rrbracket_{\text{ALT}, \cap} = \left\{ \begin{array}{l} \mathcal{K}(\mathbf{M}), \mathcal{K}(\mathbf{H}), \mathcal{K}(\mathbf{T}), \\ \mathcal{K}(\mathbf{M} \cap \mathbf{H}), \mathcal{K}(\mathbf{M} \cap \mathbf{T}), \mathcal{K}(\mathbf{H} \cap \mathbf{T}), \\ \mathcal{K}(\mathbf{M} \cap \mathbf{H} \cap \mathbf{T}) \end{array} \right\}$

e. $\llbracket (234a) \rrbracket_{\text{ALT}, \cup} = \left\{ \begin{array}{l} \mathcal{K}(\mathbf{M}), \mathcal{K}(\mathbf{H}), \mathcal{K}(\mathbf{T}), \\ \mathcal{K}(\mathbf{M} \cup \mathbf{H}), \mathcal{K}(\mathbf{M} \cup \mathbf{T}), \mathcal{K}(\mathbf{H} \cup \mathbf{T}), \\ \mathcal{K}(\mathbf{M} \cup \mathbf{H} \cup \mathbf{T}) \end{array} \right\}$

The first strengthening yields the proposition that is true in a world w if and only if the proposition in (234c) is true in w and all the conjunctive competitors are false in w . That rules out the possibility that the speaker is convinced that Sandy is reading more than one of the two books.

$$(235) \quad \llbracket (234a) \rrbracket^+ = \lambda w. \exists p [p \in \llbracket (234a) \rrbracket \ \& \ p(w) \ \& \ \forall q [q \in \llbracket (234a) \rrbracket_{\text{ALT}, \cap} \rightarrow \neg q(w)]]$$

Just as before, the distribution requirement is not licensed yet. This proposition can be true in a world w in which the speaker is convinced that Sandy is not reading *Moby Dick*. Once the No Privilege implicature is imported, that possibility, as before, is excluded. For the proposition in (236) to be true, the speaker must deem it possible that Sandy is reading *Moby Dick*, it must also be possible, according to what she knows, that Sandy is reading *Huckleberry Finn*, and it must also be possible that she is reading *Treasure Island*. We have already given the proof many times before: if the speaker is convinced that Sandy is not reading *Moby Dick*, given the ordinary meaning of the sentence, one of the subdomain competitors ($\mathcal{K}(\mathbf{H} \cup \mathbf{T})$) must be true. The epistemic distribution requirement is derived.

$$(236) \quad \llbracket (234a) \rrbracket^{++} = \lambda w. \llbracket (234a) \rrbracket^+(w) \ \& \ \forall q \forall r \left[\left(\begin{array}{c} q \in (\llbracket (234a) \rrbracket_{ALT, \cup} - \llbracket (234a) \rrbracket) \\ \& \\ r \in (\llbracket (234a) \rrbracket_{ALT, \cup} - \llbracket (234a) \rrbracket) \end{array} \right) \rightarrow \left(\begin{array}{c} q(w) \\ \leftrightarrow \\ r(w) \end{array} \right) \right]$$

For the proposition in (236) to be true in a world w , the speaker should not be convinced of the fact that Sandy is reading more than one book. This condition is consistent with the speaker deeming it possible that she is. Bu the truth-conditions could be strengthened further by assuming, for any competitor of the form $\mathcal{K}(\phi)$, the implicature that the speaker is convinced that ϕ is false ($\mathcal{K}\neg(\phi)$), as long as that is consistent with the proposition in (236).

We have already seen that none of the implicatures in (237a) are consistent with the proposition in (236) (assuming that, say, the speaker is convinced that Sandy is not reading *Moby Dick*, entails that some, but not all subdomain competitors are false). For the same reason, none of the implicatures are consistent with the proposition in (236) either (assuming that the speaker knows that Sandy is reading neither *Moby Dick*, nor *Huckleberry Finn* would entail that some, but not all subdomain competitors are false). The implicatures in (237c), however, are all consistent with the proposition in (237a).

- (237) a. $\{\mathcal{K}(\neg M), \mathcal{K}(\neg H), \mathcal{K}(\neg T)\}$
 b. $\{\mathcal{K}(\neg(M \cup H)), \mathcal{K}(\neg(M \cup T)), \mathcal{K}(\neg(H \cup T))\}$
 c. $\{\mathcal{K}(\neg(M \cap H)), \mathcal{K}(\neg(M \cap T)), \mathcal{K}(\neg(H \cap T))\}$

4.13 Chapter summary and concluding remarks

Let's sum up. We have seen that the distribution requirement is absent in downward entailing environments. That, we have concluded, suggests that it is not part of the truth-conditional content of von Wright-Kamp sentences. We have also seen that if an alternative semantics for *or* is assumed, the distribution requirement can be derived as an implicature of domain widening. A strengthening algorithm was presented that derives the distribution

requirement by computing Kratzer and Shimoyama's No Privilege implicature on top of an exclusivity implicature. In the derivation of the distribution requirement, it was important for the system to keep track of the alternatives introduced by each individual disjunct.

I conclude this chapter with a caveat. In the discussion of the derivation of the distribution requirement I intentionally left out a set of cases in which *or* conjoins full clauses with repeated occurrences of a modal, as illustrated in (238) below. I will refer to them as 'the two modals variety' of the von Wright-Kamp sentences.

- (238) a. Mom, to Dad: "Sandy may have this cake, she may have that ice cream, or she may have that apple."
b. Dad, to Mom: "Sandy must clean her bedroom or she must cook dinner."

It is usually noted that the two modals variety of the von Wright-Kamp cases also triggers the distribution requirement (Legrand, 1975; Zimmerman, 2001; Geurts, 2005; Simons, 2005): (238a) can convey that Sandy has three permitted dessert options, and (238b) that she has both the right to clean her bedroom and the right to cook dinner.

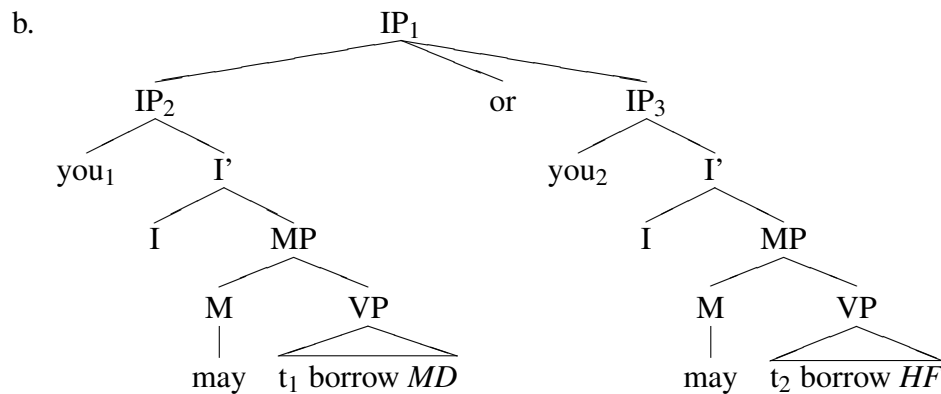
The derivation of the distribution requirement that I have entertained crucially assumes that a modal scopes over the set of propositional alternatives introduced by *or* (and that the alternatives are caught by an Existential Closure operator under its scope). The proposal does not extend to cases like (238a) or (238b) where no deontic modal seemingly scopes over the whole disjunction.

Simons (2005) offers an explicit way to deal with *both* the clausal and non-clausal cases by assuming that at LF the two modals cases do not differ from the varieties of von Wright-Kamp sentences that we examined in this chapter. In section 4.4.3 I showed that Simons' analysis relies on importing the distribution requirement into the truth-conditions, and that, therefore, the analysis makes the wrong predictions in downward-entailing contexts. But Simons' syntactic assumptions could, in principle, be imported into the framework that I assumed in this chapter to allow for the derivation of the distribution requirement associated with the sentences in (238).

To conclude this chapter, I would like to show why I think that resorting to Simons' syntactic machinery is not the right strategy to account for the distribution requirement of the two modals cases.

The proposal, in a nutshell, is this: Simons assumes that the surface structure of (242a) is as in (239b) below:

(239) a. Sandy may borrow *Moby Dick* or she may borrow *Huckleberry Finn*.

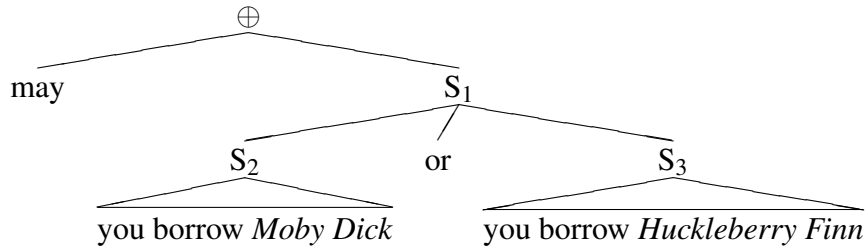


Three processes take place in the mapping to LF: (i) the subjects reconstruct back to their VPs, (ii) the modals disappear from the disjuncts, and (iii) only one of them ends up in a position where it scopes over the whole disjunction. Simons assumes that an operation of Across the Board movement is responsible for (ii) and (iii): the modals that we see at surface structure must be traces of one interpretable modal which, at LF, scopes over the disjunction.

The strategy of relying on interpretable structures containing one and only one modal is not new. Legrand (1975, 171) discusses a similar proposal. She credits it to Jerrold Sadock (personal communication to Legrand). Sadock proposed that the interpretable structure of (240a) (its deep structure, in the terminology of those days) is exactly as the modern version has it: it contains one and only one modal, which scopes over the disjunction of two non-modal propositions.

(240) a. You may borrow *Moby Dick* or you may borrow *Huckleberry Finn*.

b. Deep Structure:



The surface structure is derived by means of a transformation rule (in (241)), which copies the modal in two positions.

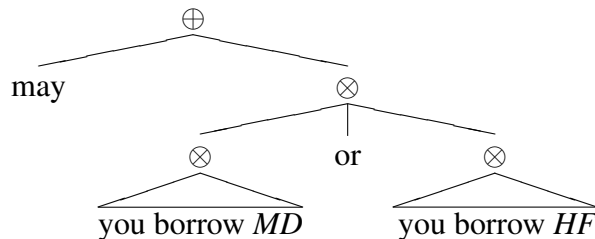
(241) Transformation:

May/Can	S ₁	OR	S ₂	⇒
1	2	3	4	
1	2	3	1 4	

The LF of the sentence in (242a) is, then as in (242b): it contains only one modal, which scopes over the disjunction, each of whose terms is a propositional constituent.

(242) a. You may borrow *Moby Dick* or you may borrow *Huckleberry Finn*.

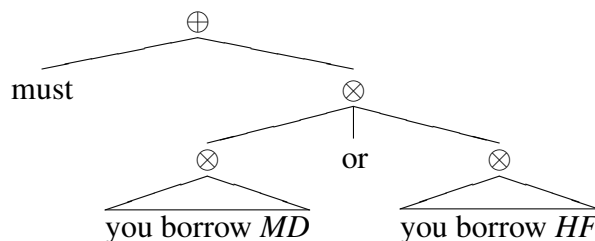
b. LF:



The same type of structure must be available for other types of possibility modals and for necessity modals too.

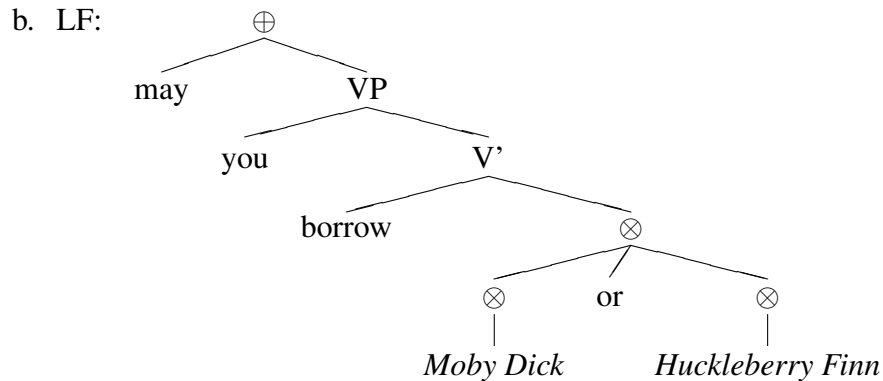
(243) a. You must borrow *Moby Dick* or you must borrow *Huckleberry Finn*.

b. LF:

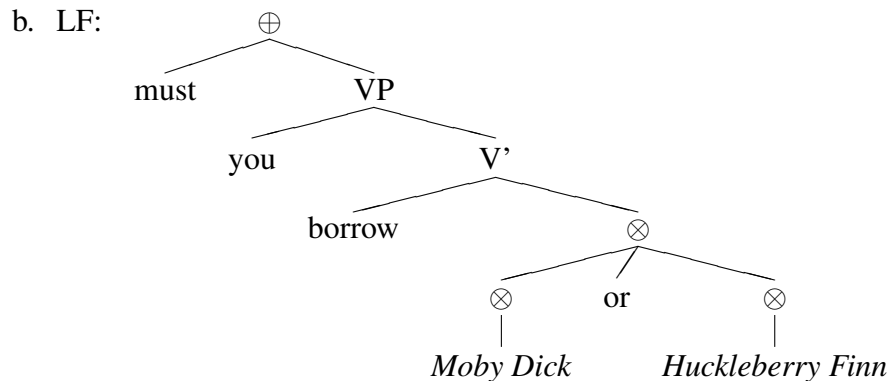


Under our assumptions, the LFs in (242b) and (243b) would receive the same interpretation as the LFs of the non-clausal cases in (244a) and (245a) below, if we assume that, in both cases an operation of Existential Closure is triggered at LF under the immediate scope of the modals.

(244) a. You may borrow *Moby Dick* or *Huckleberry Finn*.



(245) a. You must borrow *Moby Dick* or *Huckleberry Finn*.



Given the alternative semantics for *or*, the disjunction in the non-clausal cases denotes the set containing the individual denoted by each disjunct. The individual-level alternatives keep expanding. By two instances of the Hamblin rule, the VP in the LFs below denotes the set of propositions containing the proposition that Sandy borrows *Moby Dick* and the proposition that Sandy borrows *Huckleberry Finn*. The modal operates over one and the same semantic object in the clausal and non-clausal cases. The sentences are predicted to be semantically equivalent, and the reader can verify that they would generate the same conjunctive and subdomain competitors.

Without getting into the evaluation of the syntactic assumptions that Simons makes, I can see two problems for the adoption of Simons' syntactic assumptions within the framework that I presented in this chapter.

First, for her analysis to derive the distribution requirement, the two disjuncts must share the same type of modal. The analysis does not extend — as Simons herself acknowledges — to cases where *or* conjoins two clauses with different modals, since different modals cannot be pronounced traces of one and the same interpreted head. It is not difficult to find examples where the distribution requirement is triggered by clausal disjunctions whose terms contain a different possibility modal each. A sampler of naturally occurring examples follows:

(246) There are no changing facilities in Rehoboth; see Beach Rules. There are outdoor rinse-off showers along the boardwalk in Rehoboth. You may use these or you can also shower and change at most state park beaches and at the Tower Road facilities, just south of Dewey beach on Route One.

<http://www.rehoboth.com/faq.asp>

(247) You may email us or you can reach the Business License office at 949 644-3141.

www.city.newport-beach.ca.us/revenue/faqs.htm

(248) You can pay by online check from our subscribe page, you may use paypal or you can email contact@mammothnews.net for more billing options.

www.mammothnews.net/faqs.htm

(249) You may work alone or you can find other people doing the same thing and form a group.

projects.edtech.sandi.net/miramesa/vernalpools/

(250) You may represent yourself, or you can be represented by an attorney, certified public accountant, or individual enrolled to practice before the IRS.

www.unclefed.com/TaxHelpArchives/2001/TaxTips/taxtip02-71.html

The second problem that I see is this: the One Modal Analysis assumes that the clausal von Wright-Kamp sentences we are looking at contain only one interpreted modal. That must then mean that there is only one modal that can be restricted by the usual grammatical means. Yet, I think it is possible to find cases where each modal is restricted by a different *if*-clause and the distribution requirement is still licensed. Take, for instance, the case in (251) below:

(251) Mom, to Sandy: “You may watch T.V for an hour, if you finish *Moby Dick*, or you may go to the movies, if you solve three math problems.”

Once Mom utters (251), worlds where Sandy watches T.V. for an hour are permitted, but only if they are also worlds where she finishes *Moby Dick*. Similarly, worlds where Sandy goes to the movies are also permitted, but only as long as they are worlds where she solves three math problems. Each *if*-clause seems to restrict a different type of permitted world in just the way expected if they were restricting a different modal.

Or take the example below:

(252) Mom, to Sandy: “You must clean your bedroom, if your clothes are on the floor, or you must mow the lawn, if your bedroom is clean.”

After Mom utters the sentence in (252), worlds where Sandy’s toys are on the floor and she cleans her bedroom are permitted, and so are worlds where her bedroom is clean and she mows the lawn. Each *if*-clause seems to act on its own, restricting the permitted worlds in which Sandy cleans the bedroom and the permitted worlds in which Sandy mows the lawn.

And the same happens with epistemic modals, as the dialogue below illustrates:

(253) a. Dad, to Mom: “Where is Sandy?”
b. Mom, to Dad: “Sandy might be in her bedroom, if her cat is not in the living room, or she might be in the living room, if the TV is on.”

It seems that each *if*-clause restricts a different modal, yet the One Modal Analysis assumes there is only one modal to be restricted.

The strengthening algorithm that I presented falls short of deriving the distribution requirement of the two modals cases. Something else should be said about them, but that goes beyond the goals of this chapter, where I only wanted to show that, for the derivation of the distribution requirement, it is important for the interpretation system to have access to the alternatives introduced by each individual disjunct.

CHAPTER 5

CONCLUSIONS AND AGENDA

This dissertation has investigated the interpretation of counterfactuals with disjunctive antecedents, unembedded disjunctions, and disjunctions under the scope of modals. We have seen that capturing the natural interpretation of these constructions proves to be challenging if the standard analysis of disjunction, under which *or* is the Boolean join, is assumed.

The reason why the standard analysis fails to capture the natural interpretation of these constructions is the same in all three cases: to capture the natural interpretation of these constructions the interpretation system needs to have access to the atomic propositions that *or* operates over. In the case of counterfactuals with disjunctive antecedents, the semantics needs to select the closest worlds from each of the propositions that *or* operates over. To derive the exclusive interpretation of unembedded disjunctions as a scalar implicature, the pragmatic system needs to count each atomic disjunct, and the conjunction of any pair of atomic disjuncts, among the scalar competitors of disjunctions. To capture the distribution requirement, the interpretation system needs to entertain representations where the modal combines with each atomic disjunct.

In all three cases we have seen that a Hamblin-style analysis can avoid the problems that the standard analysis runs into. In the case of disjunctive counterfactuals, we have seen that if a Hamblin analysis is adopted, and conditionals are analyzed as correlative constructions, their natural interpretation is expected — the counterfactuals are predicted to claim that the consequent holds in the worlds in each disjunct that come closest to the world of evaluation. In the case of unembedded disjunctions, assuming a Hamblin-style analysis allowed us to define the scalar competitors of disjunctions by making reference

only to the semantic value of disjunctions. It also allowed us to define innocent exclusion in such a way that the negation of no individual disjunct counted as innocent. Finally, in the case of disjunctions under the scope of modals, assuming a Hamblin-style analysis allowed for the generation of the subdomain competitors of disjunctions, and, therefore, for the derivation of the distribution requirement as an implicature of domain widening.

The components of the analysis of disjunction that we have entertained in this dissertation have many antecedents in the semantics literature. We have assumed, for instance, that *or* has no quantificational force of its own. The only role of *or* is to set up a domain of quantification for other external operators to range over: the universal quantifier built into the semantics of correlatives — in the cases that we studied in chapter 2 — or the Existential Closure operator — in the cases studied in chapter 4. This is reminiscent of the Lewis-Kratzer analysis of conditionals, which claims that there is no *if...then* connective in the semantics (Lewis, 1975; Kratzer, 1991, 1986) — *if*-clauses are analyzed as grammatical devices that restrict the domain of quantification of different operators. The assumption that *or* has no quantificational force of its own was first made in recent times in Rooth and Partee 1982. And the idea that disjunctions introduce sets of propositional alternatives has been entertained in several frameworks before. In chapter 4, I mentioned the proposals presented in Aloni 2003 and Simons 2005, where the assumption is most explicitly defended, but the idea that, somehow, disjunctions contribute sets of alternatives can be found, under many guises, in other works: Jennings 1994 puts forth quite explicitly the idea that disjunctions can be treated as providing lists of syntactic objects, and Simons 1998 found important connections between the pragmatics of disjunctions and the semantics of questions.

I would like to conclude by mentioning that the Hamblin semantics that I advocated in this dissertation lends itself to investigating an important cross-linguistic property of disjunctions that remains mostly ignored in the semantics literature: in language after lan-

guage, *or* is a polarity item that associates with propositional operators (Moravcsik, 1971; Haspelmath, to appear).

Consider, for instance, the case of questions. In English, questions containing a disjunction are known to be ambiguous between an alternative question reading (under which each disjunct provides a possible answer to the question) and a yes/no question reading (under which the possible answers to the question are that at least one of the disjuncts is true or that none are). Intonation disambiguates.¹

- (1) a. A: “Did Sandy read *Moby Dick*, or *Huckleberry Finn*?”
- b. Possible answers under the alternative question reading:
 - i. B: “(She read) *Moby Dick*.”
 - ii. B: “(She read) *Huckleberry Finn*.”
- c. Possible answers under the yes/no question reading:
 - i. B: “Yes.” (= she read at least one of them.)
 - ii. B: “No.” (= she didn’t read either.)

Several languages are known to mark the distinction by having a special *or* for the alternative question reading — which I will call, following Haspelmath (to appear) ‘interrogative disjunction’. Finnish (Vainikka, 1987), Mandarin Chinese (Li and Thompson, 1981), (Hualde and de Urbina, 2003), and Kannada (Amritavalli, 2003) — a Dravidian language — are among them.²

In Mandarin Chinese, *hàishi* is restricted to questions, where it seems to invariably express an alternative question, as in the examples below:³

¹See Bolinger 1978 for reasons to distinguish the two types of questions, and Bartels 1997 (chapter 4) for the intonation facts.

²Moravcsik (1971, 34) adds to this list Latin (*aut* vs. *an*), Lithuanian (*arba* vs. *ař*), Vietnamese (*houac* vs. *hay*), Amharic (*wayəm* vs. *wayis*), Syrian Arabic, Buriat (*ygi* vs. *ali*), Gothic, and Yoruba (*tàbi* vs. *abí*).

³In what follows, I stick to whatever glossing conventions were used in the sources I quote.

(2) a. nǐ yào wǒ bāng nǐ hàishi yào zìjǐ zuò?

you want I help you or want self do

‘Do you want me to help you, or do you want to do it yourself?’

(Li and Thompson, 1981, 653)

b. nǐ mài bàozhǐ hàishi kāi jìchéngchē?

you sell newspaper or drive taxi

‘Do you sell newspapers, or do you drive taxis?’

(Li and Thompson, 1981, 532)

This contrasts with *huòshi*, *huòzhě*, and *huòzheshì*, which deliver yes/no question readings.

(3) wǒmen zài zhèli chī huòzhe chī fàndiàn dōu xíng

we at here eat or eat restaurant all OK

‘We can either eat here or eat out?’

(Li and Thompson, 1981, 532)

In Basque, we find a similar contrast between *edo* and *ala*. *Ala* is restricted to questions, where it forces an alternative question reading. Whereas the question in (4) is reported to be a yes/no question, the ones in (5) and (6) are alternative questions (Saltarelli, 1988, 84).⁴

(4) Te-a edo kafe-a nahi d-u-zu?

Tea-SING.ABS or coffee-SING.ABS want 3.ABS-(PRS)-AUX2-2SE

‘Do you want tea or coffee?’

(Saltarelli, 1988, 84)

(5) mendi-ra joan-go z-a-ra ala etxe-an

mountain-s.ALL go-FUT 2.ABS-PRS-AUXL or house-s.LOC stay-FUT

⁴Although *edo* doesn’t force an alternative question reading, it seems to be compatible with it, according to the description in Hualde and de Urbina (2003, 849), supported by the following example:

(i) Nora joan nahi duzu, zinemara ala/edo antzerkira?

where go want AUX cinema.to or theatre.to

‘Where do you want to go, to the cinema or to the theatre?’

‘Will you go to the mountains or will you stay at home?’ (Saltarelli, 1988, 85)

- (6) bihar ala etzi etorri-ko d-i-r-en jaki-n nahi
tomorrow or day.after come-FUT 3A-PRS-AUXL-COMP know-PRF want
n-u-ke

1S.ERGATIVE(-PST-3.ABSOLUTIVE)AUX2-POTENTIAL

‘I would like to know if they will come tomorrow or the day after’.

(Saltarelli, 1988, 85)

Finnish is another well-known example. It has two varieties of disjunction that contrast the same way: *tai* and *vai*. *Vai* is an interrogative disjunction: both in matrix (7) and embedded (8) questions, it expresses an alternative question.

- (7) Mattiko näki sinut vai Maija?

Matti-Q see-IMP-(3SG) you-ACC or Maija

‘Did Matti see you or was it Maija?’ (Sulkala and Karjalainen, 1992, 11)

- (8) Hän kysyi Matti vai Maijako tulee

s/he ask-IMPF-(3SG) Matti or Maija-Q come-3SG

‘S/he asked whether it was Matti or Maija who was coming.’

(Sulkala and Karjalainen, 1992, 33)

Vai, which is not restricted to questions, contrasts with *tai* in that it expresses a yes/no question, as the following contrast from Vainikka 1987 illustrates:

- (9) a. Otakko kahvia vai teetä?

you-take-? coffee or tea

‘Do you want coffee, or tea?’ (Vainikka, 1987, 164)

- b. Kahvia / Teetä

coffee / tea

‘Coffee. / Tea.’

- (10) a. Otatko kahvia tai teetä?
 you-take-? coffee or tea
 ‘Do you want (some) coffee or tea?’ (Vainikka, 1987, 164)
- b. Otan. / En.
 yes / no
 ‘Yes. / No.’

Amritavalli (2003) describes a slightly more complex situation in Kannada. Kannada has two disjunctive forms: *illa* —a morpheme homophonous with sentential negation — and *-oo*. The two forms contrast sharply when connecting clauses. A disjunction of two clauses with *-oo* can only be read as an alternative question, be it a matrix question (11) or an embedded question (12).⁵

- (11) avanu bar-utt-aan-oo, naavu hoog-utt-iiv-oo
 he come-NONPST-AGR-oo we go-NONPST-AGR-oo
 ‘Does he come, or do we go?’ / ‘Will he come, or will we go?’ (but not ‘Either he comes or we go’) (Amritavalli, 2003, 3)

- (12) avanu bar-utt-aan-oo, naavu hoog-utt-iiv-oo pro gottilla
 he come-NONPST-AGR-oo we go-NONPST-AGR-oo know-not

⁵The contrast between *illa* and *-oo* disappears when we look at disjunctions of constituents smaller than clauses, where only *-oo* is possible.

- (i) bekk-oo naay-oo
 cat oo dog oo
 ‘cat or dog’ (Amritavalli, 2003, 2)
- (ii) doDDa bekki-g-oo chikka naayi-g-oo
 big cat-DAT-oo small dog-DAT-oo
 ‘for/to a big cat or a small dog’ (Amritavalli, 2003, 2)
- (iii) ada-ra meel-oo ida-ra keLag-oo
 that-GEN top-oo this-GEN under-oo
 ‘from on top of that or from under this’ (Amritavalli, 2003, 3)

‘One does not know whether he comes or we go.’/‘One does not know whether he will come or we will go’.

(Amritavalli, 2003, 3)

A disjunction of two clauses with *illa*, however, can only be read as a declarative clause, as in the example below:

- (13) *prati shanivaara illa avanu bar-utt-aane, illa naavu hoog-utt-iivi*
 every Saturday or he come-NONPST-AGR or we hoog-NONPST-AGR
 ‘(Every Saturday) either he comes, or we go.’
- (Amritavalli, 2003, 3)

In Spanish, *o...o* is not compatible with an alternative question: it is either ruled out (when disjoining sentences) or marginally acceptable (when disjoining DPs) as a yes/no question.

- (14) a. *¿Lo dijo Irma o lo dijo César?*
 it said Irma or it said César
 ‘Did Irma say that, or César?’
- (Camacho, 1999, 2685)
- b. **¿O lo dijo Irma o lo dijo César?*

- (15) *¿Quieres ir o al cine o al teatro?*
 want to go or to the movies or to the theater
 ‘Do you want to want to go either to the movies or to the theater?’
- (Jiménez-Juliá, 1986, 170)

There is then an intimate connection between certain varieties of disjunctions and alternative questions.

We find a completely parallel interaction with negation. There are varieties of coordinators that behave as disjunctions that are obligatorily in the scope of negation, like English *neither...nor* — what Haspelmath (to appear) calls ‘negative contrastive coordinators’. Spanish *ni...ni* is an example at hand. Turkish *ne...ne* is another (Payne, 1985).

- (16) a. *No bebí ni té ni café.*
 not saw *ni* tea *ni* coffee

‘I drank neither tea nor coffee.’

b. bu sabah ne cay ne kahve icdim.

this morning neither tea nor coffee drank

‘This morning I drank neither coffee nor tea.’

(Payne, 1985, 41)

And there are known varieties of disjunction that obligatorily scope out of negations. Hungarian *vagy* is a case at hand (Szabolcsi, 2002).

(17) Nem csukt-uk be az ajtó-t vagy az ablak-ot.

not closed-1pl in the door or the window-acc

‘Either we didn’t close the door or we didn’t close the window.’ (Szabolcsi, 2002)

Not: ‘We didn’t close the door or the window.’

These dependencies with a number of propositional operators are also characteristic of indefinites (Haspelmath, 1997), for which a Hamblin semantics have been proposed (Kratzer and Shimoyama, 2002).

If the Hamblin semantics for *or* that I have advocated is on the right track, and the only role of disjunctions is to introduce propositional alternatives into the semantic derivation, an intimate relation between propositional operators and the disjunctions that they can take as arguments is probably to be expected. But the ultimate nature of the connection between *or* and the propositional operators that it seems to depend on still remains to be explored. A research agenda presents itself.

APPENDIX A

BINARY EXCLUSIVE DISJUNCTION AND THE EXCLUSIVE COMPONENT OF *OR*

For the sake of completeness, I want to include here the proof by mathematical induction that if *or* is binary exclusive disjunction, a disjunction with n atomic disjuncts is true if and only if the total number of true atomic disjuncts is odd.

1. *Base of induction.* An exclusive disjunction of two atomic disjuncts is true iff exactly one of the two disjuncts is true. So it is true iff the total number of its true atomic disjuncts is odd.
2. *Hypothesis of induction.* Let us assume that for any $m \geq 2$, an exclusive disjunction of m atomic disjuncts is true iff the total number of its true atomic disjuncts is odd.
3. We now show that for any $n > m$, an exclusive disjunction of n atomic members is true iff the total number of its true atomic disjuncts is odd.

(a) \Rightarrow Take any disjunction $\mathcal{D}_1 \vee \mathcal{D}_2$ with n number of *atomic* disjuncts. Assume it is true. Then either \mathcal{D}_1 is true and \mathcal{D}_2 is false or \mathcal{D}_2 is true and \mathcal{D}_1 is false.

- i. Assume \mathcal{D}_1 is true and \mathcal{D}_2 is false. Call o the number of atomic disjuncts in \mathcal{D}_1 . The number of atomic disjuncts in \mathcal{D}_2 will be $n - o$. Since both o and $n - o$ are less than n , by the hypothesis of induction both \mathcal{D}_1 and \mathcal{D}_2 will be true iff the total number of their true atomic disjuncts is odd. That means that the number of true atomic disjuncts in \mathcal{D}_1 is odd and the number of true atomic disjuncts in \mathcal{D}_2 is even. But then since an odd number added to

an even number yields an odd number, the number of true atomic disjuncts in $\mathcal{D}_1 \vee \mathcal{D}_2$ is odd.

ii. Assume \mathcal{D}_1 is false and \mathcal{D}_2 is true. By parallel reasoning we conclude that the total number of true atomic disjuncts in \mathcal{D}_1 is even and that the total number of true atomic disjuncts in \mathcal{D}_2 is odd. The number of true atomic disjuncts in $\mathcal{D}_1 \vee \mathcal{D}_2$ is then odd.

(b) \Leftarrow Assume that the total number of true atomic disjuncts in $\mathcal{D}_1 \vee \mathcal{D}_2$ is odd. Then either the total number of true atomic disjuncts in \mathcal{D}_1 is odd and the total number of true atomic disjuncts in \mathcal{D}_2 is even or viceversa — if both were odd or both were even, the total number of true atomic disjuncts in $\mathcal{D}_1 \vee \mathcal{D}_2$ would be even.

i. If the total number of true atomic disjuncts in \mathcal{D}_1 is odd, then, by the hypothesis of induction, \mathcal{D}_1 will be true. If the total number of true atomic disjuncts in \mathcal{D}_2 is even, then, by the hypothesis of induction, \mathcal{D}_2 will be false. So then $\mathcal{D}_1 \vee \mathcal{D}_2$ will be true.

ii. If the total number of true atomic disjuncts in \mathcal{D}_1 is even, then, by the hypothesis of induction, \mathcal{D}_1 will be false. If the total number of true atomic disjuncts in \mathcal{D}_2 is odd, then, by the hypothesis of induction, \mathcal{D}_2 will be true. But then $\mathcal{D}_1 \vee \mathcal{D}_2$ will be true.

APPENDIX B

THE SAUERLAND COMPETITORS OF A DISJUNCTION WITH THREE ATOMIC DISJUNCTS

Figure B.1 below lists the sixty-four scalar competitors that the Sauerland algorithm generates for the sentence in (1).

(1) Sandy is reading *Moby Dick*, *Huckleberry Finn*, or both.

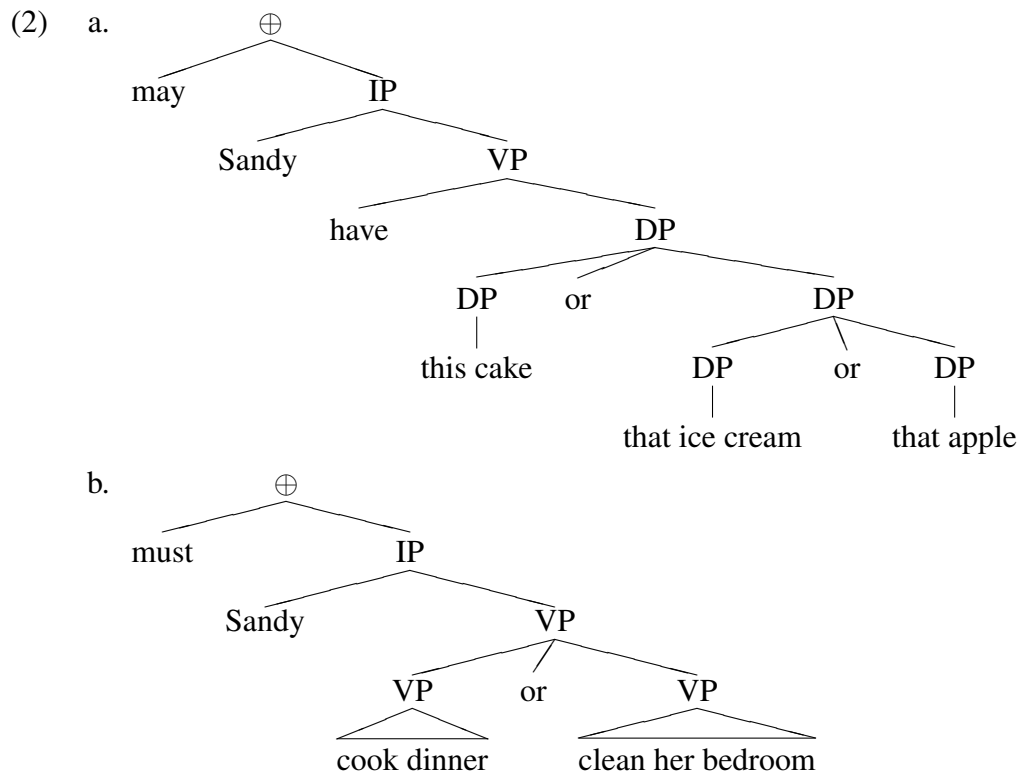
[M or H] or [M and H] (= M or H)	[M and H] or [M and H] (= M and H)	[M L H] or [M and H] (= M)	[M R H] or [M and H] (= H)
[M or H] or [M or H] (= M or H)	[M and H] or [M or H] (= M or H)	[M L H] or [M or H] (= M or H)	[M R H] or [M or H] (= M or H)
[M or H] or [M L H] (= M or H)	[M and H] or [M L H] (= M)	[M L H] or [M L H] (= M)	[M R H] or [M L H] (= M or H)
[M or H] or [M R H] (= M or H)	[M and H] or [M R H] (= H)	[M L H] or [M R H] (= M or H)	[M R H] or [M R H] (= H)
[M or H] and [M and H] (= M or H)	[M and H] and [M and H] (= M and H)	[M L H] and [M and H] (= M and H)	[M R H] and [M and H] (= M and H)
[M or H] and [M or H] (= M or H)	[M and H] and [M or H] (= M and H)	[M L H] and [M or H] (= M)	[M R H] and [M or H] (= H)
[M or H] and [M L H] (= M)	[M and H] and [M L H] (= M and H)	[M L H] and [M L H] (= M)	[M R H] and [M L H] (= M and H)
[M or H] and [M R H] (= H)	[M and H] and [M R H] (= M and H)	[M L H] and [M R H] (= M and H)	[M R H] and [M R H] (= H)
[M or H] L [M and H] (= M or H)	[M and H] L [M and H] (= M and H)	[M L H] L [M and H] (= M)	[M R H] L [M and H] (= H)
[M or H] L [M or H] (= M or H)	[M and H] L [M or H] (= M and H)	[M L H] L [M or H] (= M)	[M R H] L [M or H] (= H)
[M or H] L [M L H] (= M or H)	[M and H] L [M L H] (= M and H)	[M L H] L [M L H] (= M)	[M R H] L [M L H] (= H)
[M or H] L [M R H] (= M or H)	[M and H] L [M R H] (= M and H)	[M L H] L [M R H] (= M)	[M R H] L [M R H] (= H)
[M or H] R [M and H] (= M and H)	[M and H] R [M and H] (= M and H)	[M L H] R [M and H] (= M and H)	[M R H] R [M and H] (= M and H)
[M or H] R [M or H] (= M or H)	[M and H] R [M or H] (= M or H)	[M L H] R [M or H] (= M or H)	[M R H] R [M or H] (= M or H)
[M or H] R [M L H] (= M)	[M and H] R [M L H] (= M)	[M L H] R [M L H] (= M)	[M R H] R [M L H] (= M)
[M or H] R [M R H] (= H)	[M and H] R [M R H] (= H)	[M L H] R [M R H] (= H)	[M R H] R [M R H] (= H)

Figure B.1. The Sauerland competitors of the sentence in (1).

APPENDIX C

CROSS-CATEGORIAL *OR*

Let us assume that the sentences in (5a) and (5b) (chapter 4) involve a DP and a VP disjunction. I will assume that both *may* and *must* are raising predicates, that their surface structure subjects are not their own arguments and reconstruct back under their scope at LF, as in (2).¹



¹The issue of whether all modals are in fact raising predicates has been debated in the syntactic literature, where certain types of deontic modals have been claimed to be control predicates. The reader is referred to Bhatt 1998 and Wurmbrand 1999 for an overview of the debate and a defense of the claim that modals are raising predicates. In any event, we only need to assume that at LF modals operate over propositional constituents.

In this LFs, *or* does not operate over sentences. We will assume a definition of the union operation (the boolean join) that applies to all types with a boolean domain, or ‘conjoinable types’ (the ones ‘ending in *t*’) (Geach, 1970; Gazdar, 1980; Partee and Rooth, 1983; Keenan and Faltz, 1985).

(3) *Conjoinable types*

- a. *t* is a conjoinable type
- b. if τ is a conjoinable type, $\langle \sigma, \tau \rangle$ is a conjoinable type, for any σ .

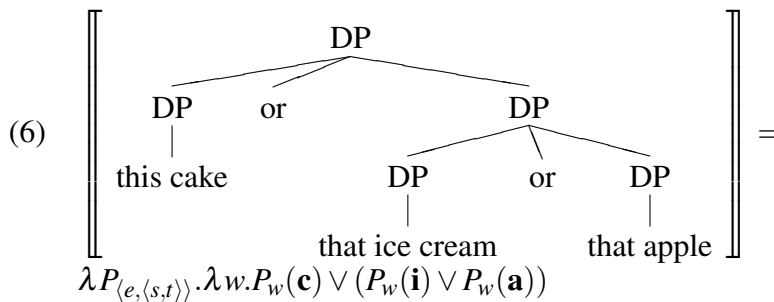
In the domain of truth-values the join is the familiar inclusive disjunction of propositional logic: a function that maps two truth values into the True if and only if at least one of them is the True (and to the False otherwise). For functional types, the join is defined as in (4b):

- (4) For any α, β of conjoinable type τ , $[\alpha \text{ or } \beta] = [\alpha] \sqcup [\beta]$
- a. for $T_1, T_2 \in D_t$, $T_1 \sqcup T_2 = T_1 \vee T_2$ (= 1 iff $T_1 = 1$ or $T_2 = 1$)
 - b. for $f_1, f_2 \in D_{\langle \sigma, \tau \rangle}$, $f_1 \sqcup f_2 = \lambda s_{\sigma}. f_1(s) \sqcup f_2(s)$

The DPs in (2) are analyzed as generalized quantifiers:²

- (5) a. $[\text{this cake}] = \lambda P_{\langle e, \langle s, t \rangle \rangle}. P_w(\mathbf{c})$
 b. $[\text{that ice cream}] = \lambda P_{\langle e, \langle s, t \rangle \rangle}. P_w(\mathbf{i})$
 c. $[\text{that apple}] = \lambda P_{\langle e, \langle s, t \rangle \rangle}. P_w(\mathbf{a})$

They are of a conjoinable type. The denotation of the disjunction is their join:

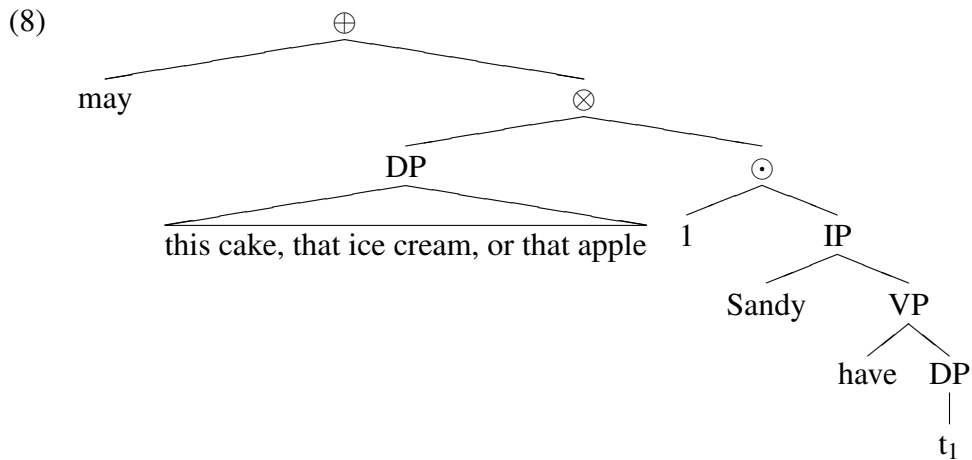


²I use an extensional typed language with world variables. The worlds arguments are subscripts.

The object DP is a generalized quantifier, then. It is interpreted as any other quantifier in object position: its denotation is applied to the property in (7).

$$(7) \quad \llbracket [1 \text{ [Sandy have } t_1]] \rrbracket = \lambda x. \lambda w. \mathbf{have}_w(\mathbf{s}, x)$$

The property in (7) can be obtained, as in the Heim and Kratzer (1998) system, by moving the object and interpreting its index as a lambda abstractor operating over the trace left by the object. The interpretable structure, then, really looks as below:



The result of applying (6) to (7) is the proposition defined by the expression in (9): the characteristic function of the union of the set of worlds where Sandy has this cake, the set of worlds where she has that ice cream, and the set of worlds where she has that apple.

$$(9) \quad \lambda w. \mathbf{have}_w(\mathbf{s}, \mathbf{c}) \vee (\mathbf{have}_w(\mathbf{s}, \mathbf{i}) \vee \mathbf{have}_w(\mathbf{s}, \mathbf{a}))$$

Similarly, the VP-disjunction in (2b) is interpreted as the join of two properties:

- (10) a. $\llbracket [VP \text{ clean her bedroom}] \rrbracket = \lambda x. \lambda w. \mathbf{clean}_w(x, x\text{'s-bedroom})$
 b. $\llbracket [VP \text{ cook dinner}] \rrbracket = \lambda x. \lambda w. \mathbf{cook-dinner}_w(x)$
 c. $\llbracket [VP [VP \text{ clean her bedroom}] \text{ or } [VP \text{ cook dinner}]] \rrbracket =$
 $\lambda x. \lambda w. \mathbf{clean}_w(x, x\text{'s-bedroom}) \vee \mathbf{cook-dinner}_w(x)$

Applied to the denotation of the subject, (10c) returns the characteristic function of the union of the set of worlds where Sandy cleans her bedroom and the set of worlds where she cooks dinner.

(11) $\llbracket [_{VP} [_{VP} \text{clean her bedroom}] \text{ or } [_{VP} \text{cook dinner}]] \rrbracket (\llbracket \text{Sandy} \rrbracket) =$
 $\lambda w. \mathbf{clean}_w(\mathbf{s}, \mathbf{s}'\mathbf{s} \mathbf{bedroom}) \vee \mathbf{cook-dinner}_w(\mathbf{s})$

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