UNIVERSITY OF CALIFORNIA

Los Angeles

Plurality and Possibility

A dissertation submitted in partial satisfaction

of the requirements for the degree
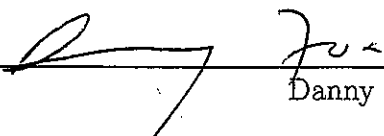
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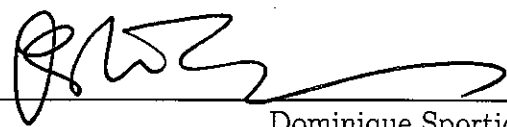
by

Nathan Winter Klinedinst

2007

The dissertation of Nathan Winter Klinedinst is approved.
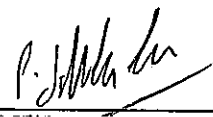
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University of California, Los Angeles

2007

to modern moonlight

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ACKNOWLEDGMENTS

Any useful idea or piece of scholarship contained herein owes ultimately to Philippe Schlenker, both for its utility, and for existing in the first place. Thanks to my other committee members for serving: to Danny Fox, for his interest in my work and generosity with his time, to Dominique Sportiche, for his encouragement and open-mindedness, and to Daniel Büring, for encouraging clarity and precision. My work has also profited both directly and indirectly from long distance collegial relationships with the following people, co-students all too briefly, but quickly friends: Valentine Hacquard, Daniel Rothschild, Jessica Rett, Benjamin Spector, and Emmanuel Chemla.

The bulk of the writing was completed in two months while living out of my car. For keeping me off the streets during some of this period, and sometimes even well-accommodated, I'd like to give special thanks to Laura Cunningham (and Jean-Pierre Plunier, and of course Paisley Strellis), Daniel Büring, and Gwynne Ridgway. Honorable mentions are also due to: some friend (?) of Paisley who lives behind Spaceland, Tyler and Selina (sp.?) and their estate in South Central, and the parking lot of the Silverlake Coffee Company. No thanks at all to Jen from Malo, or her other house guest, with the face-eating virus.

At bottom, this thesis – like my graduate studies – began less with an intellec-tual conviction than a personal one; to get unstuck of the fear to create something and be judged. I'm not sure whether I've budged more than a few typing fingers in completing it. I am sure that there would be nothing to show without the encouragement of my mother and father and the memory of my grandmother Helen, and my good fortune in being inspired through the friendship of the following men: Daniel Kopton, Calixto Hernandez, Richard Collins, Christopher Hoke, and Tory Fry. That my parents (and friends) always take so much pride

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and pleasure in my accomplishments has always been difficult for me to accept. Still it is of the greatest comfort to know that, because they do, my writing of this thesis cannot have been in vain.

VITA

1977   Born, Charlottesville, Virginia.

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ABSTRACT OF THE DISSERTATION

Plurality and Possibility

by

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This thesis develops a formal pragmatic solution to a long standing puzzle about the interpretation of disjunction in the scope of possibility modals, the 'puzzle of free choice permission'. The puzzle is roughly that *Alex may have beer or wine*, for example, conveys that Alex is allowed to have either, in direct conflict with what seems to be predicted by otherwise well-motivated semantic and pragmatic assumptions. The key innovation in the proposed solution is a semantic treatment of possibility modals as plural quantifiers (over possible worlds). Chapter 1 establishes that a parallel puzzle arises for disjunction in the scope of (distributive) plural existential quantifiers – *Some passengers got sick or had trouble breathing*, for example, conveys that there were passengers of both types, again contrary to apparently reasonable theoretical assumptions. This conjunctive meaning is argued to have a natural explanation as being due to embedded/local scalar implicatures triggered by distributivity and disjunction. The explanation generalizes trivially to free choice permission, given the innovation of a plural semantics for possibility modals. The latter is argued to be natural and harmless (if not independently motivated).

In Chapter 2, a formal account of embedded implicature, following Chierchia (2004), is introduced to implement the proposal sketched in Chapter 1. Chapter 3 considers implicatures of disjunction in existential quantifier **restrictions**. We present data and independent considerations about distributivity in quantifier restrictions which provides supporting evidence for the core aspect of the proposal in Chapters 1 and 2: that the free choice effect for disjunction under plural existentials (possibility modals) is due to implicatures triggered by distributivity. (The data and considerations have general implications for the theory of plural marking, which are explored in Chapter 3's final section). The fourth and final chapter extends the main innovations of the thesis -- modals as plurals, and the treatment of distributivity implicatures -- to account for another old puzzle about the interpretation of disjunction in the antecedent of (counterfactual) conditionals.

CHAPTER 1

Introduction

1 Introduction

Possibility modals with disjunctive complements often give rise to stronger meanings than expected under a standard semantics for modals and disjunction, roughly paraphrasable in terms of *con*junction; (1), for example, naturally conveys that stronger meaning (1a):

(1)   You may have beer or wine

      a.   can convey: 'You may have beer and you may have wine'

This 'puzzle of free choice permission' has spurred a wide array of revisions, often radical, to standard assumptions about disjunction, modality, the theory of scalar implicature, or some combination thereof. I observe that possibility modals pattern systematically with plural existential quantifiers, and against singulars, in allowing for such conjunctive strengthenings:

(2)   (The train was very stuffy,) Some passengers got sick or had trouble breathing

      a.   can convey: 'Some passengers got sick and some passengers had trouble breathing'

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(3)   (The train was very stuffy,) A/Some passenger got sick or had trouble
       breathing

       a.   can't convey: '≠Some passenger got sick and some passenger had
             trouble breathing'

This thesis explores the possibility that the data (1)-(3) are transparently
revealing: possibility modals pattern with *plural* existentials *because they are*.
This possibility makes available a natural and unified account of the pattern,
starting from the observation that in the individual and temporal domains, the
availability of conjunctive strengthenings for *or* in the scope of plural existentials
is crucially tied to distributivity. I propose that this is due to an 'embedded'
implicature calculated based on a distributive operator intervening between the
existential and the disjunction.[1] Entirely analogous implicatures, triggered by *or*
and distribution over the plurality of worlds introduced by the modal, yield a
parallel account of free choice permission.

In the remainder of this chapter I recount the analytical problems posed by
free choice permission (i.e. show *why* it is a puzzle in the first place), and establish
that entirely parallel problems arise for the analysis of conjunctive strengthenings
with plural existentials.[2] I then sketch the basic elements of the tandem solution
to be developed formally in Chapter 2. The solution requires few assumptions
about modals, the theory of implicature, or disjunction that are non-standard,

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[1]Some important notes about my use of the term *implicature* First, I use it interchangeably
with *scalar implicature*, somewhat misleadingly. Second, I use the terms purely **descriptively**,
to refer to aspects of (non-truth-conditional) meaning with particular, and familiar, properties
– e.g. cancelability, (overwhelming) tendency to disappear in downward entailing contexts. It
is important to keep this in mind, since they were originally introduced (by Grice, Horn) as
simultaneously descriptive *and* theoretical terms, meaning roughly 'the aspect of non-truth-
conditional meaning with such and such properties *derived* in such and such a way (as result
of reasoning based on principles of cooperative conversation, etc)'.

[2]I use the abbreviation *CSs* henceforth.

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or not independently motivated. The particular innovation that carries the bulk of the explanatory burden is the plural semantics for possibility modals.

I will absolutely not give a knockdown argument that possibility modals are plural quantifiers. However, given recent work which argues that the semantics of plurals and plural quantifiers is very weak (essentially number neutral, see §4.1), and given the nature of the domain of modal quantification, such an argument may be difficult to find, but unnecessary anyway. Nonetheless, several preliminary arguments are considered in §7. §7 also includes brief comments on two other important issues about free choice permission not focussed on in this thesis, and requiring further research (free choice effects with wide scope disjunctions, and with indefinites).

1.1   The old puzzle: free choice permission

Often when possibility modals have disjunctive complements, the information conveyed is stronger than what is expected given a standard interpretation for the modal, and a Boolean interpretation for disjunction. For example, it is natural to conclude more from (4) than (4a), its literal meaning under these assumptions, and most strikingly the stronger (4b):

(4)   You may have beer or wine.

    a. $\Diamond(B \lor W)$

    b. $\Diamond B \land \Diamond W$

While (4a) is strictly true if drinking beer isn't an option, so long as wine drinking is, it seems that the sentence conveys that *both* in fact are.[3] The same puzzle

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[3](4b) does not fully characterize the relevant reading, a point to which we return, though it serves to frame the basic puzzle.

crops up across modalities ((5a)-(5c) allow for identical strengthenings), though for historical reasons – it was first noticed in work on deontic logic – the cases most often discussed in the linguistics literature involve deontic modals, and it is often referred to as 'the puzzle of free choice permission'.[4]

(5) a. Jenny may/might be a doctor or a lawyer. (*epistemic*)

    b. Jenny might have been a doctor or a lawyer. (*metaphysical?*)

    c. Jenny can outsmart a doctor or a lawyer. (*ability*)

In each case, rather than (just) $\Diamond(D \vee L)$, the logically stronger $\Diamond D \wedge \Diamond L$ is naturally understood (with '$\Diamond$' expressing the respectively appropriate type of modality). That the same strengthening effect is observed across modalities casts doubt on the possibility that the effect with (4) is due solely to something special about *the act of* granting permission. This point is made more directly by the fact that the conjunctive strengthening is equally possible where the function of (4) is to report permission (*(according to this rulebook)... you may have beer or wine*), rather than grant it.

At the same time, there are good reasons to assume that the explanation for the puzzle is not that the standard truth conditions are (drastically) wrong, but rather that the strengthening is pragmatic in nature. In particular, the strengthened meaning bears all of the hallmarks of being due to *scalar implicatures*. Far from explaining away the puzzle, however, this observation deepens it; standard, central assumptions about scalar implicature predict precisely that such a strengthening should be *im*possible. Before turning to an elaboration of the latter two claims in §2, we show that the puzzle generalizes beyond the domain

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[4]We follow tradition in using deontic examples, and stick to the somewhat misleading terminology. Importantly though, the account outlined below and developed in Chapter 2 applies in full generality across modalities.

of possibility modals and into the domain of plural existential quantifiers, and sketch a unified solution which builds crucially on this observation.

1.2   The new puzzle: conjunctive strengthenings

Plural existential quantifiers, in both the individual and temporal domain, can give rise to conjunctive strengthenings for *or* in their scope, identical to those observed with possibility modals; singular existential quantifiers systematically cannot. The following, for example, are naturally understood as conveying the stronger (b) meanings rather than the predicted (a) meanings (again, the (a) meanings are too weak because they are consistent with one of the disjuncts being false under all values of the relevant variable (in the domain of the quantifier)):[5]

(6)   (The air in the train became extremely stuffy,) Some passengers got sick or had trouble breathing.

    a.   [∃X: Passengers(X)] (S(X) ∨ T(X))

    b.   [∃X: Passengers(X)] S(X) ∧ [∃X: Passengers(X)] T(X)

        (i)   'Some passengers got sick, and some passengers had trouble breathing.'

(7)   (His journey was trying,) Sometimes/at times John was sick or too tired , to continue.

    a.   [∃T] (J-sick at T ∨ J-too-tired at T)

    b.   [∃T] J-sick at T ∧ [∃T] J-too-tired at T

        (i)   'Sometimes John was sick, and sometimes he was too tired to

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[5]For example, in the case of (6), with it being false that some passengers got sick, i.e. being true that no passenger got sick. The (b) paraphrases given here are in fact not entirely correct, a point which is later addressed in full, but the difference is irrelevant for present purposes.

continue.'

Conjunctive strengthenings are impossible in their singular counterparts:

(8)   (The air in the train became extremely stuffy,) Some passenger/a passenger got sick or had trouble breathing.

    a. $[\exists x: P(x)] (S(x) \vee T(x))$

    b. #$[\exists x: P(x)] S(x) \wedge [\exists x: P(x)] T(x)$

        (i)   'Some passenger got sick, and some passenger had trouble breathing.'

(9)   (His journey was trying,) At some point/at least once John was sick or too tired to continue.

    a. $[\exists t] (\text{J-sick at } t \vee \text{J-too-tired at } t)$

    b. #$[\exists t] \text{J-sick at } t \wedge [\exists t] \text{J-too-tired at } t$

        (i)   'At some point John was sick, and at some point he was too tired to continue.'[6]

The strengthening phenomenon observed with plural existentials is on the face of it exactly the same as that observed with possibility modals. On top of the mystery these phenomena pose in and of themselves, is the fact that possibility modals do *not* pattern with singular existentials. This fact is not completely explained under many previous approaches to the conjunctive effect with possibility modals (as discussed in §5), and is prima facie surprising, since possibility modals are standardly taken to *be* singular existential quantifers (over possible worlds). In sum, we are faced with 3 problems: explaining (i) how conjunctive strengthen-

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[6]In the remainder of the chapter I focus attention on the examples with individual quantifiers, and ignore the temporal cases.

ings arise with possibility modals, (ii) how they arise with plural existentials, and (iii) why they don't with singular existentials in general. In the following section we show that (i) and (ii) present the same analytical puzzle: the strengthenings in both cases exhibit the hallmarks of being due to scalar implicatures – yet there is good reason to think that they cannot be. ((iii), on the other hand, is shown to follow directly from standard assumptions about scalar implicature). §3 then sketches our proposed answer to (i) and (ii), which resolves the apparent paradox in a way consistent with (iii).

2   The Implicature Paradox

As noted by Alonso-Ovalle (2005), conjunctive strengthenings for possibility modals have the hallmarks of strengthened meanings due to scalar implicatures: they (very strongly tend to) disappear in downward entailing contexts, and they can be cancelled (we return to the latter point below):

(10)   You may not have beer or wine.

The overwhelmingly natural reading is exactly the one that is expected under standard assumptions (and given the fact that negation always scopes over deontic modals): $\neg\Diamond(B \lor W)$, $=\neg\Diamond B \land \neg\Diamond W$ ('You may have neither beer nor wine'). The same point is not as easy to establish with plural existentals, since they generally resist appearing in DE contexts in which implicatures routinely disappear. It clearly holds for their negative polarity variants, however:

(11)   John doubts that any students drank beer or wine.

      a. $\neq$'John doubts this: some students drank beer, and some students

drank wine.'

For many people *some* can appear unproblematically in the scope of weakly downward entailing operators, (i.e. non-antiadditive operators) like *at most n people*, allowing the point to be established more directly:

(12)   At most three people sent some friends a card or a letter.

    a. $\neq$'At most three people are such that they sent some friends a card, and some friends a letter.'   [possibly a fourth sent some friends a card, but no friends a letter, or vice versa]

    b.   ='At most three people sent a card or a letter to some friends.' [entails: no more than three people sent cards to friends, and no more than three sent letters]

But the most basic considerations about scalar implicature seem to rule out the possibility of deriving CSs as such. From the following sentences a fairly robust empirical generalization, (16), emerges:

(13)   Alex drank beer or wine. *B(a)* $\vee$ *W(a)*

    a. $\rightsquigarrow$The speaker isn't certain that Alex drank beer, and isn't certain that Alex drank wine

(14)   Most students drank beer or wine. *[Most x: S(x)]: B(x)* $\vee$ *W(x)*

    a. $\rightsquigarrow$The speaker isn't certain that most students drank beer, and isn't certain that most students drank wine

(15)   Every student drank beer or wine. *[∀x: S(x)]: B(x)* $\vee$ *W(x)*

    a. $\rightsquigarrow$The speaker isn't certain that every student drank beer, and isn't

certain that every student drank wine

(16)   For any embedding X (possibly null), if *XA/XB* is more informative, *X(A ∨ B)* has among its implicatures that ¬KXA and ¬KXB (where *K* means 'the speaker knows/is certain that')

This generalization receives a straightforward explanation in classical Gricean pragmatics: if the speaker knew that XA/XB, saying so would have been more informative (and briefer, no less). So as long as knowing the truth of these more informative statements is relevant to the purposes of the conversation, and the speaker is assumed to be cooperative, a hearer is licensed to infer that the speaker wasn't in a position to assert XA/XB, i.e. doesn't know that XA/XB. As is often observed, these implicatures tend, as a matter of empirical fact, to strengthen to K¬XA/XB, where certain conditions are met. So for example (15) typically conveys in addition to its literal content that (the speaker knows that) not every student drank beer ($¬[∀x: S(x)]\ B(x)$), and that (the speaker knows that) not every student drank wine ($¬[∀x: S(x)]\ W(x)$) – which is to say, that there were both wine drinking and beer drinking students. Given this, it is not at all surprising that an entirely parallel pattern holds for necessity modals with disjunctive complements, since they are universals:

(17)   John must clean his room or take out the trash. [$\Box(C ∨ T)$]

     a.   ↝¬$\Box$C, ¬$\Box$T (=$\Diamond$¬C, $\Diamond$¬T)

So (17) in a way also comes to express 'free choice'; both the cleaning and the trash are implicated as being options for John to fulfill the obligation literally asserted ($\Box(C ∨ T)$) – an obligation which is strictly consistent with John having

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no true options (e.g. with room cleaning being required, and taking out the trash optional or forbidden). This strengthening is again straightforwardly captured under the classical Gricean system, to the extent the strengthening of ¬KXA to K¬XA can be explained, and also follows in the revised neo-Gricean framework of e.g. Sauerland (2004).

What is puzzling is that, in some cases, plural existentials and possibility modals scoping over disjunction do fit the generalization (16): they do have 'readings' on which implicatures in line with this generalization are attested (the rider 'I can't remember which' forces or reinforces these implicatures - call this the 'uncertainty reading'):

(18)   Some students drank beer or wine (I can't remember which).
         [∃X: Students(X)]: B(X) ∨ W(X)

   a.   ↝The speaker isn't certain that some students drank beer, and the speaker isn't certain that some students drank wine.

(19)   John may drink beer or wine (I can't remember which).
         ◇(B ∨ W)

   a.   ↝The speaker isn't certain that John may drink beer, and the speaker isn't certain that John may drink wine.

Singular exisentials are systematically consistent with it:

(20)   Someone drank beer or wine.
         [∃x] B(x) ∨ W(x)

   a.   ↝The speaker isn't certain that someone drank beer, and the speaker isn't certain the someone drank wine.

Parallel to the examples (13)-(17), the non-disjunctive counterpart statements to (18) and (19), *Some students drank beer/wine* and *John may drink beer/wine* are logically stronger, and so it's not surprising that we seem to get 'uncertainty' implicatures, entirely in line w/ the generalization (16). The problem is to explain why in many cases – in fact the bulk of them – we do get a strengthening to conjunction for such examples, in direct contradiction of (16). The uncertainty implicatures, which seem robust in general, directly contradict (the speaker believing) the conjunctive meaning: $\neg K \Diamond B$, for example, is obviously inconsistent with $K(\Diamond B \land \Diamond W)$.[7]

Putting the point more generally, general Gricean considerations lead one to expect that pragmatic reasoning on an assertion of $\Diamond(A \text{ or } B)$ should take into account the fact that the, simpler, stronger statements $\Diamond A$ and $\Diamond B$ could have been used instead (identically for *Some Ns A or B*). Consideration of parallel cases with other modals/quantifiers leads us to expect that that reasoning process works in a way that should rule out strengthening to conjunction. On the other hand, the conjunctive effect seems precisely to be due to scalar implicatures, as witnessed by its disappearance in DE contexts, and since (18) and (19) themselves plausibly involve cancelation of an implicature.

There are many logically possible approaches to resolving this apparent paradox, most of which have been explored in the literature. The account developed here resolves it by appeal to an assumption that seems to be required indepen-

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[7]In the case of plural existentials, the exact predictions of a theory that derives (16) (in the general case) depend on what the plural means. If the truth conditional contribution of *Some passengers got sick/had trouble breathing* is that *2 or more* passengers did, implicatures of $\neg K$(Some passengers got sick/had trouble breathing) are consistent with the speaker knowing/it being the case that exactly one student had beer, and exactly one wine. This is the wrong result in general, and in particular does not capture what is expressed by the conjunctively strengthened 'reading' (on which there may be and naturally are many passengers of each type). The problem is even more severe once a more realistic semantics is adopted for plural existentials (see below).

dently: that implicatures can sometimes be added in a local fashion, rather than being calculated globally. We illustrate and motivate this resolution in the following section, returning in §5 to a discussion of existing approaches.

3   Distributivity Implicatures

The key to understanding free choice permission lies in assimilating it to another puzzle, the fact that plural existentials allow for conjunctive strengthenings. The key to understanding the latter is the observation that *overtly distributive* plural existential quantification also does:

(21)   Some of the students each bought a car or a motorcycle.

    a.   [∃X: Students(X)] [∀x: x is-part-of X] C(x) ∨ M(x)

    b.   ⇝Some of the students (each) bought a car, and some of the students (each) bought a motorcycle.[8]

The conjunctive strengthening available for (21) is every bit as puzzling as it is in the case of plural existentials without overtly realized distributivity; under the generalization (16) we expect implicatures that the speaker doesn't know that the non-disjunctive statements *Some of the students (each) bought a car/motorcycle* are true, but this is precisely the opposite of what is attested.[9] It seems plausible that the effect is somehow tied to distributivity itself, since distributive/universal quantification gives rise to a similar one, as noted in the previous section:

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[8]Examples in the temporal domain are not as easy to construct, though probably for independent reasons. A plausible case is the following: *On each of several (special) occasions I drank beer or wine with dinner.* A conjunctively strengthened reading is available, and presumably the indefinite *several occasions* takes inverse scope over *each*. Less clear is that the quantification is over times, not situations, but either way the example is of interest.

[9]Here again the conjunctive strengthening can be defeated/fail to arise, vis. the possibility of adding the rider '... but I don't know which'.

(22)   Each of the students bought a car or a motorcycle.

    a.   [$\forall$x: x is-on-of-the-students] $C(x) \lor M(x)$

    b. $\rightsquigarrow$Some of the students (each) bought a car, and some of the students (each) bought a motorcycle.

The two cases are of course different; in (21) the distributive universal quantification is over some part of the students[10], and the implicature is (more properly) that *among those* students there are some car buyers and some motorcycle buyers. But unless there is a true specific use of the indefinite involved, this implicature amounts to exactly what is stated, and thus is identical to the implicature of (22), for the obvious reason that any part/subset of the students (containing both car buyers and motorcycle buyers) is a part of the the entirety of the students.

Given this similarity, it is possible to understand the conjunctive strengthening of (21) as owing to exactly the kind of implicature found with (22), but calculated at an *embedded* level, within the scope of the plural existential. Looking at the scope of *some of the students* in (21a), we have something which is essentially identical to (22): a universal quantifier with disjunctive scope. Adding the implicatures that such a configuration gives rise to when unembedded, but within the scope of the existential, gives exactly the conjunctive strengthening:

(23)   There is a plurality consisting of students such that: each student in it bought a car or a motorcycle, and some some students in it bought a car, and some students in it bought a motorcycle

    a.   i.e. 'Some of the students bought a car, and some of the students bought a motorcycle'

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[10]Proper part, given that (21) implicates that not all of the students (each) bought a car or a motorcycle.

Chapter 2 develops this basic idea implementing a formal variant of Chierchia (2004)'s theory of implicature which shares its defining property: implicatures are treated as 'grammaticalized', in the strong sense that they can be computed with respect to and added to the meanings of embedded constituents. We introduce here a highly simplified prelude to the system, in order to illustrate in slightly more detail how we derive the conjunctive strengthening (and free choice permission – see §4). Following nearly all of the work in modern formal pragmatics (including Chierchia), owing to Horn, we assume that it is a conventional property of certain words/sentences that they are compared to *particular* sets of alternatives – at the level of the sentence, a set of sentences that the speaker might (reasonbly) have used instead in order to convey his intended meaning (see Chapter 2, §1).[11] The system is modified from Chierchia in several crucial ways; one is that *XA* and *XB* are taken as alternatives to *X(A ∨ B)*, in addition to *X(A ∧ B)* (following e.g. Sauerland (2004)). This is a generalization of what is needed to account for the implicatures of universals over disjunction. An illustration:

(24)   a.   Let STRONG(α) stand for the implicature strengthened meaning of α: i.e. the meaning of the conjunction of α with the negations of its stronger alternatives.

        b.   Let STRONGERALTS($\forall$(A or B))={$\forall$A, $\forall$B, $\forall$(A and B)}

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[11]Once one begins stipulating alternatives, it is worth asking whether it is possible to directly derive conjunctive strengthenings via scalar implicatures, by simply stipulating appropriate ones. Schulz (2004) shows that it indeed is, given an appropriate algorithm for calculating implicatures; in the case of $\Diamond$(A or B) the crucial alternatives are $\Box\neg$A and $\Box\neg$B. Deriving their negations obviously yields free choice directly. I will not give a full discussion of how Schulz's proposal does this (while respecting (16) in general, and not deriving inappropriate implicatures otherwise). I assume that we want some reasonable constraints on alternatives. For example they should be things that might plausibly have been said instead in order to express the meaning that speaker intended to convey by his assertion. This is obviously not the case with Schulz's crucial alternatives, which moreover seem to be entirely ad hoc.

c. STRONG($\forall$x: A(x) $\lor$ B(x)) is thus equivalent to

(i)   [($\forall$x: A(x) $\lor$ B(x)) $\land$ ($\neg\forall$x: A(x)) $\land$ ($\neg\forall$x: B(x)) $\land$ ($\neg\forall$x: A(x) $\land$ B(x))]

(ii) =[($\forall$x: A(x) $\lor$ B(x)) $\land$ ($\exists$x: A(x) $\land$ $\neg$B(x)) $\land$ ($\exists$x: B(x) $\land$ $\neg$A(x))]

(21) (repeated) can now by given representation in (25a):

(25)   Some of the students each bought a car or a motorcycle.

a.   [$\exists$X: Students(X)] STRONG([$\forall$x: x is-part-of X] C(x) $\lor$ M(x))

b.   =[$\exists$X: Students(X)] ([$\forall$x: x is-part-of X] C(x) $\lor$ M(x)) $\land$ ($\neg$[$\forall$x: x is-part-of X] C(x)) $\land$ ($\neg$[$\forall$x: x is-part-of X] M(x)) $\land$ ($\neg$[$\forall$x: x is-part-of X] C(x) $\land$ M(x))

c.   =[$\exists$X: Students(X)] ([$\forall$x: x is-part-of X] C(x) $\lor$ M(x)) $\land$ ([$\exists$x: x is-part-of X] C(x) $\land$ $\neg$M(x)) $\land$ ([$\exists$x: x is-part-of X] M(x) $\land$ $\neg$C(x))

d.   'At least one of the students bought a car (but not a motorcycle), and at least one of the students bought a motorcycle (but not a car).'

For illustrative purposes there are two major simplifications made the actual theory of implicature developed in Chapter 2. First, allowing *XA* and *XB* as alternatives to *X(A or B)*, and computing implicatures with something like STRONG would be disastrous in the general case. Take the null embedding, i.e. a simple disjunction *(A or B*. It's predicted strong (implicature strengthened) meaning would be the contradiction – *(A or B) and $\neg$A and $\neg$B* –since both *A* and *B* are by assumption alternatives (and are logically stronger). The algorithm for computing/adding implictures assumed in Chapter 2 is in fact a minimally more

sophisticated one, following Sauerland (2004) and Fox (2006): roughly, the implicatures added to s will be the negations of the logically stronger alternatives a to s such that s *and* $\neg a$ does not entail any other alternative a'. This for example precludes the problematic implicatures of $\neg A$ and $\neg B$ in the case of A *or B* (but crucially not $\neg \forall A$ and $\neg \forall B$, in the case of $\forall$*(A or B)*). The second major simplification is that we abstract away from the question of how embedded implicatures are inherited by higher structures (implicature 'projection). (For example in (25), the question how the implicatures added in the scope of the existential will interact with further implicatures that can be added at the global level, triggered by *some*, and how they would behave if further embedded under various types of operators). A crucial property of Chierchia's system, discussed in Chapter 2, is that the way that implicatures are inherited is tightly controlled. This is what distinguishes it from a theory that explains away implicatures via positing lexical ambiguities, for example.

As indicated in the paraphrase (25d), the actual result is not quite equivalent to what we've been assuming as a paraphrase of the conjunctive strengthening – but fortunately so. One difference is that the strengthened meaning derived doesn't require that there be multiple motorcycle buyers or multiple car buyers – just one or more of each, in contrast with the paraphrase we've been working with, which used a plural existential: 'Some of the students (each) bought a car, and some of the students (each) bought a motorcycle'. This seems to be exactly what is wanted: if there are three students who made a vehicle purchase, one of a motorcycle, two of a car, there's nothing strange about using (21) – so long as there was no need to be more precise, of course. In the further degenerate case in which there was just one car buyer, and just one motorcycle buyer (among the students), the account predicts (25) to have exactly the status of the statement *Some students (each) bought a car*, in a context in which the speaker knows

that exactly two students did, and this seems to be correct. There is a general tendency, it seems, for plural existentials to suggest vagueness in number, or to be odd where the number of witnesses hovers at barely plural (i.e. 2).[12] There is probably a pragmatic explanation for this fact, but all that matters for present purposes is that the facts are no different whether or not conjunctive strengthening obtains.

A second difference is that the derived strengthened meaning strictly requires that there be at least one student who bought a motorcycle but *not* a car, and at least one who bought a car but *not* a motorcycle. Again, this is intuitively correct, and the facts are entirely parallel to the pure (unembedded) universal case ((22)), as predicted.

The claim that distributivity is crucial to the conjunctive strengthening of (21) is independent of the particular account just sketched. 'Embedded implicature' is in one sense a purely descriptive term, and as has been shown in other domains (Spector (2003), Sauerland (2004)), sometimes what the existence of embedded implicature shows us is that we didn't understand a particular (neo-) Gricean mechanism sufficiently, rather than that a (radically) non-Gricean approach is needed. Distributivity could be implicated in a number of ways (not involving embedded implicatures).[13] There is some independent evidence that it

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[12]This explains why the the plural paraphrase for the conjunctive strengthening that we've been using up until now seemed intuitively correct – we continue to use it since it is appropriate in all but exceptional cases.

[13]For example, here is a possible 'globalist'/neo-Gricean way of restating the proposal about conjunctive strengthenings sketched above. Suppose that global pragmatic reasoning for existentially quantified statements involves, rather than comparison to other existential statements, comparison to statements with different possible witnesses to it replacing the quantifer. The (relevant) competitors to *Some As B or C* would be {*a and b (and c...) B/C*: a and b are Bs/Cs}. Where *B/C* is distributive, the negation of each of these stronger competitors could be consistently derived (it's not the case that a and b are each B/C). This effectively yields an implicature that, whatever the witness to *Some As B or C* is, it includes both Bs and Cs, i.e. a strengthening to conjunction. An entirely parallel account could be given for free choice permission; see below. I leave an exploration of this possibility for the future.

is crucially involved, to be introduced in Chapter 3, though it is somewhat indirect. I of course assume in this thesis that embedded implicatures are real, in the sense that I develop an account of free choice permission that depends on a throroughly non-Gricean, grammatical, account of implicature (essentially Chierchia (2004)). I make this assumption without providing much novel argument for it – though I follow Chierchia, Sauerland (2005), and Geurts (2007) (among others). (However, to the extent that my account of conjunctive strengthenings and free choice permission fares better than its competitors, it itself gives an argument for the reality of embedded implicatures).

Given that distributivity is involved, the account in terms of embedded implicature developed for (21) extends straightforwardly to plural existential cases like (26) (we assume that the embedded implicature can be calculated just as well on a distributivity operator if it doesn't happen to be pronounced)[14]

(26) Some students wrote a poem or composed a song.

    a. $[\exists X: \text{Students}(X)]$ STRONG($[\forall x: x \text{ is-part-of } X]$ P(x) $\vee$ S(x))

    b. $=[\exists X: \text{Students}(X)]$ ($[\forall x: x \text{ is-part-of } X]$ P(x) $\vee$ S(x)) $\wedge$ ($\neg[\forall x: x \text{ is-part-of } X]$ P(x)) $\wedge$ ($\neg[\forall x: x \text{ is-part-of } X]$ S(x)) $\wedge$ ($\neg[\forall x: x \text{ is-part-of } X]$ P(x) $\wedge$ S(x))

    c. $=[\exists X: \text{Students}(X)]$ ($[\forall x: x \text{ is-part-of } X]$ P(x) $\vee$ S(x)) $\wedge$ ($[\exists x: x \text{ is-part-of } X]$ P(x) $\wedge$ $\neg$S(x)) $\wedge$ ($[\exists x: x \text{ is-part-of } X]$ P(x) $\wedge$ $\neg$S(x))

    d. 'At least one student wrote a poem (but not song), and at least one student composed a song (but not a poem).'

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[14]Evidence that non-overt operators can trigger implictatures like their overt counterparts can be found with existential readings for bare plurals, for example. *Alex saw girls from his section at the dance* implicates, just like *Alex saw some girls from his section at the dance*, that he didn't see every girl from his section.

It is somewhat difficult to test the claim that distributivity is crucial directly, since, as argued in the work of Roger Schwarzschild (e.g. Schwarzschild (1996)), the line between collectivity and distributivity is somewhat blurry. In particular he showed that even when a plural quantifier combines with a purely collective predicate, a kind of distributive reading arises – on which the collective predicate applying to sub-pluralities of pluralities in the range of the quantifier.

(27)   context: there are some salient groups of books

    a.   The books are stacked.

    b.   meaning: the salient groupings of the totality of books ('the books') form stacks. nb. that the totality of books are not stacked (together).

The means that even when we have a disjunction of collective predicates, in principle a distributive operator could appear to distribute to sub-pluralities, and give rise to a conjunctive meaning, a possibility which is in fact attested:

(28)   Some students gathered in the hall or on the common

    a. $\leadsto$ Some gathered in the hall, and some gathered on the common

The account crucially assumes the presence in the logical syntax of some mechanism that distinctly represents distributive readings (whether fully distributive or not), and that disjunction can fall within the (logical) scope of this mechanism of distributivity. Both assumptions are independently warranted. The first boils down to the assumption that distributive readings and collective readings are not special cases of one general reading. Schwarzschild (1996) is sometimes understood as having claimed that they are (e.g. in Kratzer (2007)), i.e. that

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putative collective/distributive ambiguities just correspond to different ways of a plural predication coming out true. But in fact he gave a theory (and arguments for such a theory) on which it is simply *possible* to collapse the two readings into one (see Sauerland (1998), who made the same observation); the theory in Schwarzschild (1996) allows for distributive readings to represented distinctly in the logical syntax. In any case, it can be directly established that collectivity and distributivity are not in general special cases of an all encompassing reading, and that, in particular, a distributive reading must be distinctly available. This can be shown by embedding a plural predication in a DE context, and observing that the collective/distributive ambiguity persists. In (29a), a distributive reading in particular must be available:

(29) a. The boys aren't heavy enough to tilt the seesaw (with Fat Matt on the other side)...

   b. so they have to get on together

   c. but if there were one more boy, then they would be

If there were not the possibility of distinctly representing a distributive reading for the predicate *be heavy enough...*, the continuation (29b) should be a contradiction (for the relevance of (29c), see below). A theory which lumps collective and distributive 'readings' for such a predicate together (e.g. Kratzer (2007)) predicts that (29a) is true iff: (i) Johnny and Susie were not individually heavy enough to tilt the seesaw, and (ii) together not heavy enough to. This is because it would have to interpret the VP/predicate (essentially) as follows:

(30) $[\![$be heavy enough to tilt the seesaw$]\!]=\lambda X.$ (i') $[\forall x\colon x\sqsubseteq X]$ x is heavy enough to tilt the seesaw $\vee$ (ii') X is (together) heavy enough to tilt the

$[\![(29a)]\!]=\neg[\![$be heavy enough to tilt the seesaw$]\!]([\![$Johnny and Susie$]\!])$, and thus (29a) is true iff (i) and (ii) are met.[15] Clearly (29a) should not entail (ii), at pain of predicting (29b) to be a contradiction. But the fact that (29c) is sensible shoes that (ii) *must*, under a 'lumping theory', be part of the truth conditions of (29a) – that ii′ must be part of the definition of the extension of the predicate). This is important because (ii) entails (i), meaning that the truth conditions for (29a) are equivalent to (i). A logically possible move for the lumping theory would thus be to claim that *be heavy enough to...* is inherently distributive; that (i′) defines its extension completely. (29c) shows that this is not a possible way out; a collective reading must also be available. Adding one more boy to the existing group certainly would not make it the case that *each* of the boys is individually heavy enough to tilt the seesaw.

The second assumption, that 'distributivity has scope', is evidenced by the fact that it interacts with quantificational elements (as often observed):

(31)   Some boys bought a car

The indefinite can be 'distributed over': there can be individuals purchases by boys of (obviously) distinct cars. This means that, no matter what ones theory of distributivity is (for example, if one wanted to account for it in terms of lexical operations of type shift, rather than with an operator), it must allow for distributivity to have (logical) scope. And this is minimally what is needed for our

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[15]We ignore the issue of 'homogeneity' effects (Schwarzschild (1994), since it does not affect the point. The meaning as given allows $\neg[\![$be heavy enough to tilt the seesaw$]\!]([\![$Johnny and Susie$]\!])$ to true if e.g. Johnny but not Susie was (alone) heavy enough. This presents an additional problem.

account to be tenable. We assume an operator based account for transparency.

It should now be apprent that we predict directly that strengthening to conjunction is unavailable for singular existentials (e.g. (8), *Some passenger got sick or had trouble breathing*): the strengthening depends crucially on fact that quanitifcation is distributive (and plural[16]). What about the 'uncertainty' implicatures that do arise with singulars ((20)) and in cases in which the conjunctive reading with plurals is (overtly) suspended/cancelled ((18))? We assume, following e.g. Fox (2006), that such implicatures are of a different nature than those generated by the (purely) formal/conventional system suggested above, and described in Chapter 2. In particular, we assume that they are posterior to the latter, the output of genuine Gricean reasoning; see Fox (2006) for motivation for this view (and, more basically, for appealing to something beyond (neo-) Gricean reasoning, and of a purely formal nature, to account for certain facts about implicatures).

We now turn to assimilating free choice permission to the more general case of conjunctive strengthening due to embedded distributivity implicatures.

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[16]Even if distributive operators can appear entirely freely and thus can appear (trivially) even with *singular* quantifications – the prediction would be unaffected. An illustration:

(i)　　Some student wrote a poem or composed a song.

　　a.　　$[\exists x: \text{student}(x)]$ STRONG($[\forall y: y \text{ is-part-of } x]\ P(y) \vee S(y)$)

Since 'x' ranges over atoms (individual students), the distribution is vacuous (this is because we assume that the 'part-of' relation is such that anything that bears it to an atom *is* that atom). Thus '$[\forall y: y \text{ is-part-of } x]\ P(y) \vee S(y)$' is equivalent to '$P(x) \vee S(x)$'. Assume as before that the alternatives to '$([\forall y: y \text{ is-part-of } x]\ P(y) \vee S(y))$' are (a) '$[\forall y: y \text{ is-part-of } x]\ P(y)$', (b) '$[\forall y: y \text{ is-part-of } x]\ S(y)$', and (c) '$[\forall y: y \text{ is-part-of } x]\ P(y) \wedge S(y)$'. Because 'x' ranges over atoms, the only alternative which is such that the conjunction of its negation with '$P(x) \vee S(x)$' entails no other alternative is (c); i.e. 'STRONG($[\forall y: y \text{ is-part-of } x]\ P(y) \vee S(y)$)' will be '$(P(x) \vee S(x)) \wedge \neg(P(x) \wedge S(x))$', as desired.

4 Plurality and Possibility

Taking possibility modals to express plural existential quantification over possible worlds, an account of free choice permission can be given which is entirely parallel to that sketched in the last section.

The only further assumption required is one that is already completely standard: intensions are taken to be functions from *atomic* entities (possible worlds) to extensions. Distribution is therefore at least possible in the scope of possibility modals, since they quantify over pluralities, and a simple modal statement like *John may have beer or wine* can be translated with a distributive operator, as follows:[17]

(32) $[\exists W: Acc_D(W)] \; [\forall w: w \text{ is-part-of } W] \; B(w) \lor W(w)$

'Acc_D' is to be understood distributively, i.e. as holding of pluralities of worlds each of which are deontically accessible (to the evaluation world).[18] (32) is exactly parallel in structure to the non-modal cases analyzed in the previous section, and the account applies in turn. Calculating an (embedded) distributivity implicature

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[17]"Possible" since in §4.1 we assume a weak, 'one or more' semantics for plurals, which means that a distributive operator is not *required*, for semantic reasons, to mediate between an intension and a possibility modal qua plural existential. All that is needed for our purposes is an assumption that one *can* be present. There is in principle a prediction that, if there isn't •
one, free choice should not arise. This is difficult to test independently.

[18]Lurking behind this terminological point is an important question. Given the use of pluralities of possible worlds, and distribution over them, we can fairly ask whether there are natural language expressions/structures whose meanings are collective predicates of pluralities of worlds (and what exactly this would mean). This interesting question is largely independent of the proposal, as long as the disjunctive complements of possibility modals that allow for conjunctive strengthening *can* have as meanings functions defined on atomic worlds. We have no reason to think that they can't. Importantly, though, in the absence of a readily identifiable clausal complement for ◇ which expresses a collective predicate of worlds, the claim that distributivity is a necessary condition for conjunctive strengthening is not testable in the modal domain. Of course, if there simply are no such expressions, the question of testing it doesn't even arise, for it then becomes equivalent to the claim that possibility modals are plural existentials.

derives the crucial facts of free choice permission:

(33) a. $[\exists W: \mathrm{Acc}_D(W)]$ STRONG$([\forall w:\ w\ \text{is-part-of}\ W]\ B(w) \vee W(w))$

  b. $=[\exists W: \mathrm{Acc}_D(W)]\ ([\forall w:\ w\ \text{is-part-of}\ W]\ B(w) \vee W(w)) \wedge (\neg[\forall w:\ w\ \text{is-part-of}\ W]\ B(w)) \wedge (\neg[\forall w:\ w\ \text{is-part-of}\ W]\ W(w)) \wedge (\neg[\forall w:\ w\ \text{is-part-of}\ W]\ B(w) \wedge W(w))$

  c. $=[\exists W: \mathrm{Acc}_D(W)]\ ([\forall w:\ w\ \text{is-part-of}\ W]\ B(w) \vee W(w)) \wedge ([\exists w:\ w\ \text{is-part-of}\ W]\ B(w) \wedge \neg W(w)) \wedge ([\exists w:\ w\ \text{is-part-of}\ W]\ B(w) \wedge \neg W(w))$

  d. 'There is a plurality of worlds consistent with the rules which includes at least one world in which John drinks beer but not wine, and at least one world in which he drinks wine but not beer'

A more colloquial paraphrase: (1) John's options include the following: drinking beer (but not drinking wine), and (2) drinking wine (but not drinking beer). Notice that it also follows from the strengthened meaning (33a) that John is not **required** to drink both – which seems to be empirically correct. There is however a further implicature that *John may have beer or wine* often carries, which remains to be derived; that John is not allowed to have both $(\neg \Diamond(B \wedge W))$. To derive this requires an explanation of how implicatures of embedded sentences are 'projected'/'inherited' in complex structures. We introduce Chierchia's account of projection in Chapter 2, modifying it in crucial ways in order to derive the remaining implicature.

4.1 Negation and Plurality

An obvious feature of the standard semantics for possibility modals is that it trivially captures the logical equivalence of *not possible A* and *necessarily not A* (if there does not exist an (accessible) world in which A holds, then in all

accessible worlds A does does hold). Interestingly, this equivalence is exactly what is expected on the assumption that possibility modals are in fact plural existentials, despite a possible impression to the contrary. (Doesn't 'there is not a plurality of worlds in which P' just mean that there are less than two – and not necessarily that there are none (that in all worlds not P)?) The crucial observation is that plurals behave systematically like singulars in downward entailing contexts (in the scope of decreasing functions):

(34)   Alex doesn't have any friends (in Berlin).

    a. $\neq$Alex doesn't have two or more friends (in Berlin).

    b. $\approx$'There isn't anyone in Berlin who is a friend of Alex.'

(35)   No students came to the party.

    a. $\neq$No group of two or more students came to the party.

    b. $\approx$'No student came to the party.'

In recent work by Spector (2005) and Anderson et al. (2005), it is argued on the basis of such facts that the plural has a weak semantics, such that plural variables range over entities which must simply contain at least one atomic part. The 'true' plurality conveyed in non-DE contexts – the fact that *Some passengers got sick* 'means that' at least two did – is argued to be derived as a pragmatic effect of competition with singular forms. Under both theories, the effect is predicted to disappear in DE contexts, so that (34), for example, conveys just its (desired) literal meaning – namely, that there is no group of one or more individuals which are friends of Alex.

Adopting this assumption, *John may not have beer* is represented as follows, where 'X' ranges over objects consisting of one or more atomic individuals, and as

standard we understand the relation 'is-part-of' as extending to hold between an atomic individual and the 'degenerate' plurality consisting of just that individual.

(36) $\neg[\exists W: Acc_D(W)]$ ($[\forall w:$ w is-part-of W] B(w)

  a. 'There is no group of one or more accessible worlds, such that each world in it is a world in which John drinks beer (i.e. there neither one nor more than one accessible B world).'

Having adopted these more realistic assumptions about plurality, (36) is equivalent to $\Box\neg B$, as desired. I assume that, unlike the case of plurals in the individual domain, there is no inference to 'true' plurality based on competition/comparison: but the existence of a more than one accessible world, if there is any, will follow automatically from the vastness of the space of possibilities.[19]

A crucial observation we began with is that conjunctive strengthenings strongly tend to disappear in DE contexts: embed *John may have beer or wine* under negation, and the overwhelmingly natural reading is the negation of its standardly predicted meaning, not the negation of the free choice permission reading. This will remain a result of the present account, since the theory of embedded implicature will (per force) require that embedded implicatures dissolve in DE contexts (by default). Since the distributivity implicature is calculated in an upward entailing context, the (immediate) scope of an existential, embedding this entire constellation in a DE context would then force the implicature to be calculated in a DE context, precisely the phenomenon which must independently be blocked. The result is simply a built in property of the recursive semantic

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[19]Of course, in the case of free choice permission, the calculation of distributivity implicatures 'forces' there to be more than one world in the plurality quantified over, but this fact alone is uninteresting – the work done is to force there to be worlds of both both types (i.e. permissible beer drinking worlds and permissible wine drinking worlds, in the case of *John may have beer or wine*).

rules which calculate strengthened meanings in the system of Chierchia (2004), and are retained in our modification thereof.

Given these considerations about plural meaning, the claim that possibility modals are plural doesn't amount to anything radical – in fact it yields a semantics which is equivalent to the old one, once distributivity is taken into account.[20] Furthermore, given the vastness of the space of possibilities, it follows at pain of absurdity that our statements involving possibility modals (be they in fact singular or plural) will always have a plurality of witnesses anyway.[21] But the refinement to a plural semantics is far from vacuous, as the present proposal shows: a unified account of two puzzles, an old one about modals, and a new one about plurals, becomes available within an existing general framework for calculating implicatures – something which has the core properties of the system

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[20]Again, in principle there could be different predictions if there are the equivalent of collective readings in the modal domain.

[21]Suppose for example that there is **exactly one world** which is witness to (i):

(i)   Jenny may$_D$/might$_E$ smoke

     a. $\Diamond S$ ($[\exists w: Acc(w)]\ S(w)]$)

It would follow that:

(ii) $\forall P[\Box(S \Rightarrow P) \vee \Box(S \Rightarrow \neg P)]$

Which is to say that the law, or what is known, would completely determine the conditions under which S (under which Jenny smokes). In the epistemic case this means that discovering that Jenny smokes – suppose she actually does – is the one thing in the way of the speaker and total omniscience. In the deontic case it amounts to the law specifying in impossibly fine detail the conditions under which Jenny can smoke – Do her toes have to be crossed or uncrossed? Can her mother have recently gotten an anchor tatoo? On which forearm?, etc. The reason is the elementary fact that for any single world, e.g. one compatible with what is known or required, a proposition is either true of/in it, or not. (Adding a Kratzer style ordering source doesn't change this point': (ii) would still follow from (i) if there were exactly one S world among the 'best' accessible worlds. Neither would using situations instead of worlds change anything. Any situation which can reasonably count as one in which Jenny smokes, no matter how 'minimal', will include an infinite number of details (the way her lips are pursed, for example) irrelevant to what the law says about Jenny smoking, and potentially underdetermined by our knowing that she does.

in Chierchia (2004).

The core of the proposal is that **distributivity** is at base responsible for conjunctive strengthenings of existentials with disjunctive nuclear scopes – in both the modal and non-modal domains. Importantly, this proposal may remain intact and interesting even under a more sophisticated global approach to implicature. What would ensure that it will be is the existence of independent evidence that possibility modals are plural.

5   Previous Accounts of Free Choice Permission

The proposal sketched in the proceeding sections was motived in large part by the observation (due to Alonso-Ovalle (2005), Geurts (2005), Simons (2005b), and Fox (2006)) that the free choice interpretation of *or* under a possibility modal disappears when the modal itself is embedded in a DE context. *John may not have beer or wine*, for example, seems to have exactly the meaning that the standard semantic assumptions predict: there does not exist a (deontically accessible) world w such that John has beer in w or John has wine in w. This would seem to straightforwardly rule out any theory that accounts for free choice permission semantically – by interpreting a possibility modal POSS or *or* in such a (non-standard) way that POSS *A or B* is equivalent to POSS *A and* POSS *B*. •
Unless their are independent facts about disjunction which come to the rescue, the prediction is far too weak of a meaning for POSS *A or B*: *John may not have beer or wine*, for example, could come out true if John *may* have beer, so long as he may not have wine. The authors cited above (excepting Geurts) have proposed analyses which, like the present proposal, explain the free choice effect as due to (something like) a scalar implicature, in order to explain the fact of its disappearance in DE context, and the further fact that it seems to be cancelable,

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cf. (19) above.

Among the semantic accounts that have been proposed are Higginbotham (1991), Simons (2005a). I will limit my discussion of semantic accounts to the former, since Simons abandoned her account in later work (Simons (2005b), discussed below), acknowledging the problem with DE contexts, and since, as far as I can tell, Higginbotham's stands a better chance of addressing it.[22]

Higginbotham proposed that *or* has an incarnation as a free choice item, drawing (at least rhetorically) on the fact that *either* appears as both a determiner that appears in free choice contexts and as something like a scope marker for disjunction (Larson, 1985). It also appears in NPI contexts, much like *any*: see below.

(37)   a.   Alex can take either package.

           b.   *Alex took either package

It is not clear how literally he intends there there is connection between FC *either* and FC disjunctions, but the question is independent of the basic move, which is to assimilate free choice *or* to the general phenomenon of free choice *either*, *any*, etc. He assumes that the semantics of free choice items is essentially that of universal quantification. Questions about the exact semantics of free choice items and their distributional properties are logically independent of the basic proposal, as far as I can tell, and so I leave them aside. The point I would like to make about Higginbotham's approach is that, even though it is semantic in nature, it may stand some possibility of resolving the apparent conflict with the observation of Alonso-Ovalle et al. about the free choice effect in DE contexts.

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[22]See §7.1 for comments on Geurts (2005), who proposes a semantic account that is not subject to the DE problem (in the form described above).

For ill understood reasons, FCIs seem to be resistant to DE contexts, as attested by the following examples, where an NPI interpretation (=existential scoping under negation) is by far the most salient:

(38)   a.   Susie can't take any of the packages.

           b.   Susie can't take either package.

If the data are correct, and there is some (ill-understood) feature of free choice items which (strongly) disprefers their appearance in the scope of negation, then there will be an independent loophole for Higginbotham's theory to exploit to explain the difficulty of the free choice effects with *or* in DE contexts. FCIs under negation are of course not completely impossible; a crucial question is whether they are more readily available than the free choice effect with *or*. My sense is that the answer is maybe, as suggested by the following examples:

(39)   context: you invite some friends to experience their first Christmas. Your friend's child, who you bought a present for, is eagerly looking back and forth between some packages under the tree

        a.   She can't take any package (under the tree), she has to take the one with her name on it.

        b.   She can't take either package (under the tree), she has to take the one with her name on it. [further context: there are 2 packages under the tree]

        c.   ?She can't take the little package or the big one, she has to take the one with her name on it. [further context: there are just 2 packages, a small and large one, one of which is for her]

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While this pattern might be suggestive against (the essential part of) Higginbotham's proposal, I take it that the data are not completely clear, and that even if there were a contrast between *or* and other FCIs, his basic approach could not be discounted in lieu of a complete theory of FCIs.

There may however be a more solid argument against Higginbotham's approach, coming from VP ellipsis. It has to posit that *or* is ambiguous, and in particular that there is something like a Boolean *or* as well, in order to account for its appearance in contexts that disallow FCIs, e.g. simple episodic ones as in *John or Mary came.* [23]. (Likewise, it would be this *or* that would (preferably?) appear when a construction in which FCIs are allowed is itself embedded in a DE context – notably *not* POSS *a or b*: vis. *John may not have beer or wine*). Since it posits this ambiguity, it predicts (40), given the assumption (41), which is a (presumably uncontroversial) subcase of the general identity/parallelism constraints on ellipsis:

(40)   the FC variant of *or* should not be able to appear in the antecedent of an ellipsis site in which only the boolean variant can appear, and vice versa

(41)   lexical ambiguities must be resolved the same way in an ellided VP and in its antecedent

The prediction seems to be falsified by (42a) and (42b):[24]

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[23]It is worth noting that the parallel to *either* breaks down in this respect: there is no non-FC, non-NPI determiner *either*: *Alex saw Bush or Cheney*; **John saw either chief executive.* While this is not directly an argument against the proposal, one could ask whether it requires some explanation.

[24]In some contexts lexical ambiguities can apparently be resolved differently in the ellipsis site and its antecedent:

(42) a. (since) Drew can go to Harvard or MIT, and she is probably going
           to

      b. Drew is probably going to go to Harvard or MIT, since she can

The free choice effect for *or* is available in the ellipsis antecedent in (42a), and in
the ellided VP in (42b), but crucially *is probably going to* does not allow for FCIs:
John is probably going to either good school in Boston/any of the top schools in
Boston. There are of course well known cases in which the interpretation of
a lexical item in an ellipsis site differs from that of its correspondent in the
antecedent, cases of so-called vehicle change, as in

(43) John$_i$ loves his$_i$ mother, and Mary$_j$ does ~~love her, mother~~, too

(Importantly, such cases don't necessarily falsify (41), since they don't neces-
sarily involve lexical ambiguities). I don't think that Higginbotham's theory can
be saved by treating (42a) as a case in which the ellipsis site contains something
like a 'vehicle-changed' free choice *or*. There is potential problem to explain why
this process is not available for other (uncontroversial) FCIs:

(44) a. *Drew can go to either of the top Boston schools, and she is probably
           going to

      b. *Drew can go to any of the top schools in Boston, and she is probably
           going to

(i)   Babe Ruth had many hits, and The Beatles did too.

I am not however convinced that such examples falsify (41). I think that there is an intuition
that such cases are special and involve word play in a way that (42a) and (42b) do not. This
is a subtle intuition of course.

In any case, essentially the same argument against Higginbotham's theory can be made using right node raising, which avoids possible complications involving vehicle change, and also potential problems with assumption (41) (cf. fn. 24).

(45)   Drew can and Mary is probably going to go to Harvard or MIT.

       a.   'Drew can go to Harvard or MIT and Mary is probably going to go to Harvard or MIT'[25]

Assuming the classical analysis of right node raising as literally simultaneous extraction from two conjuncts (due to Ross (1967), most recently Sabbagh (2007)), Higginbotham's theory will not be able to explain why the free choice interpretation arises in the *can* conjunct of (45).

(46)   [[Drew can t_i and Mary is probably going to t_i] [go to Harvard or MIT]$_i$]]

The right-node-raised constituent *go to Harvard or MIT* could not contain free choice *or*, since FCIs are not 'licensed' in the base position in the second conjunct (under *probably going to*) – and since there is no expectation that movement of an FCI out of a context in which it is unlicensed – into another in which it would still be – should repair a violation.

A different point is that Higginbotham's proposal does not extend to 'free choice effects' (conjunctive strengthenings) for disjunction under plural existentials (e.g. (6), (7)). The reason is that FCIs are not grammatical in general under plural existentials (unless in a context that independently allows them to appear):

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[25]While the example is admittedly not the greatest, any awkwardness about it is also present in this paraphrase as a full conjunction. So there's nothing inherently problematic about the right node raising.

(47)   Some men exposed to the fumes got sick or had trouble breathing. [FC]

(47)   *Some women exposed to the fumes had any/either of those problems (too)

This is of course only a strong argument against Higginbotham's theory (or anyone's) if we have independent reason to believe that the conjunctive effect with plural existentials, etc. is the same phenomenon as free choice permission. But unless we have a reason to think that they **aren't**, I take it that a theory which covers both cases in a parallel way is preferable.

A similar point applies to many of the existing pragmatic accounts of free choice permission. Whether or not is is possible for them to explain why a conjunctive interpretation *is* possible with plural existentials, they would seem to also wrongly predict it with *singulars* (cf. (8), (9)). In particular this problem seems to arise for Simons (2005b) and Alonso-Ovalle (2005).

The proposal of Simons (2005b) is embedded in a theory that takes the semantic contribution of *or* to be that of set formation, and posits hidden operators or lexical entries that operate on these sets in order to account for the semantic contribution of disjunction in various contexts. As far as I can tell such a semantics for *or* is conceptually independent of her account of free choice permission, and so I will simply translate the account in Boolean terms to avoid introducing superfluous details. Simons' theory assigns to a sentence like *John may have beer or wine* the standard truth conditions of a translation into modal logic, $\Diamond(B \vee W)$. To derive the free choice effect, a pragmatic principle is appealed to which says roughly the following:

(48)   for any disjunction D *(a (or...) or b)*, an utterance containing D is conversationally licit iff there is some salient property P that each of the

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disjuncts of D shares.

It would seem that this condition could be easily satisfied by any number of properties, and so it's not immediately clear how it will do any work to derive the free choice effect. *B* and *W*, for example, share the (salient) property of being true only in possible worlds in which John drinks an alcoholic beverage, and of being things that have just been uttered, when someone says *John drank beer or wine*. What Simons clearly wants to derive is that when a sentence like *John may have beer or wine* is uttered, it cannot be felicitous unless the disjuncts B and W share a *particular* property, namely that of having a non-empty intersection with the set of deontically accessible worlds (i.e. the property of being a proposition p such that $\diamond$p is true). It is not clear whether she accomplishes this. As I understand it she takes it that there is some kind of a preference that the truth conditions themselves should (transparently) "make available" the property used to satisfy condition (48), and that, moreover, truth conditions can be locally enriched (somehow) where doing so will allow for this preference to be met. The proposal then is that $\diamond(B \vee W)$ can be (somehow) locally enriched to $\diamond B \wedge \diamond W$, and that the latter (transparently) provides a property that the disjuncts B and W share, namely that of each being a p such that $\diamond$p. So by enriching the truth conditions in a way that free choice permission follows, (48) and the preference that it be met by the truth conditions are met.

Many questions arise for this account. For example, why are the truth conditions enriched locally in exactly the one way that yields free choice permission (among the many logically possible ways) in order to meet (48)? Where does the requirement come from that (48) is to be satisfied by the truth conditions (note that she crucially assumes that it doesn't have to be in the case of unembedded disjunctions *A or B*)? Why do the many properties which *are* made available by

(the truth conditions of) $\Diamond$(B $\lor$ W) not suffice to satisfy (48)? For example, why does the aforementioned property shared by B and W, that of being true only if John drank an alcoholic beverage, not count? Is it not salient? Why not? I don't know whether these can be given satisfactory answers. Even if they can, there is a further problem of explaining our observation that singular existentials do not behave like possibility modals. The same considerations that she appeals to should, prima facie, apply to *Some boy drank beer or wine*: strengthen the truth conditions, in a parallel way, to [$\exists$x: boy(x)] drank-beer(x)) $\land$ [$\exists$x: boy(x)] wine(x)), and (48) is transparently satisfied by the truth conditions, in a parallel way (the disjuncts share the property of having a non-empty intersection with the set of boys).

A different pragmatic approach is taken in Alonso-Ovalle (2005), essentially following Kratzer and Shimoyama (2002)'s proposal for free choice indefinites in German. As far as I can tell, the approach as it stands also faces the final problem noted for Simons (2005b), how to rule out free choice effects with singular existentials. Because his proposal is not embedded within a full theory of implicature, it is difficult to evaluate how serious the problem is. I will instead discuss the pragmatic approach to free choice disjunction in Fox (2006), since I understand to be an explicit formalization of the rough intuition behind Kratzer and Shimoyama (2002) (and in turn Alonso-Ovalle (2005)), and since it specifically · tries to address the problem of singular existentials. (A further comparison of our approach to Fox (2006) is found in Chapter 3).

On Fox's theory, scalar implicatures (of the type that account for the free choice effect) are derived by application of a syntactic operator, akin to *only*, which associates with scalar terms. The trick is that the operator can apply more than once – and that a second application results in a kind of higher order

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implicature. We illustrate using a somewhat simplified version his proposal. Fox assumes that alternatives to '$\Diamond$(A or B)', $\text{ALT}_{\Diamond\text{(A or B)}}$, include $\{\Diamond A, \Diamond B, \Diamond(A$ and $B)\}$; we ignore the others assumed since they are irrelevant to deriving the basic free choice affect. The operator that adds implicatures takes as arguments a sentence and a set of (alternative) sentences (to it), and can be defined in terms of the following operator, 'Exh'.

(49)   '$\text{Exh}(S)(\phi)$' is equivalent to a conjunction of ϕ with the negations of the members s of S such that $\neg\exists s_1 \neq \phi(s_1 \in S$ and $(\phi \wedge \neg s) \Rightarrow s_1)$

In the case of $\phi=$'$\Diamond$(A or B)', then, '$\text{Exh}(\text{ALT}_\phi)(\phi)$' is equivalent to '$\Diamond$(A or B) and $\neg\Diamond$(A and B)' ('$\neg\Diamond A$' cannot be included in the conjunction because its conjunction w/ '$\Diamond$(A or B) and $\neg\Diamond A$' entails another member of ALT_ϕ), namely '$\Diamond B$'. Identically for '$\Diamond B$'). The trick is then to define a set of alternatives that should be used when the operator applies again (to) '$\text{Exh}(\text{ALT}_\phi)(\phi)$', which will result in free choice for $\phi=\Diamond$(A or B). The basic idea is that alternatives will be the results of applying 'Exh' successively to the alternatives to ϕ themselves, but using ϕ's alternatives rather than their own. Making use of this idea, we define a simple syntactic operator, in terms of 'Exh', that can apply multiple times:

(50) $\text{STRONG}(\phi)$ is equivalent to

   a. $\text{Exh}(\text{ALT}_\phi)(\phi)$, if ϕ is atomic
   b. $\text{Exh}(\{\text{Exh}(\text{ALT}_\psi)(s)\colon s\in\text{ALT}_\psi\})(\phi)$, if $\phi=\text{Strong}(\psi)$

By the reasoning above, '$\text{STRONG}\ \Diamond$(A or B)' is equivalent to '$\Diamond$(A or B) and $\neg\Diamond$(A and B)'. By (50b), the meaning of '$\text{STRONG}\ \text{STRONG}\ \Diamond$(A or B)' depends crucially on that of '$\text{Exh}(\text{ALT}_{\Diamond\text{(A or B)}})(\Diamond A)$', and '$\text{Exh}(\text{ALT}_{\Diamond\text{(A or B)}})(\Diamond B)$', i.e.

the implicature strengthened meanings of '◇A' and '◇B' with respect to the alternatives of '◇(A or B)'. The former will be equivalent, by (49), to '◇A and ¬◇B', and the latter to '◇B and ¬◇A'. By (49), 'STRONG STRONG ◇(A or B)' will be equivalent to a sentence in which their negations are conjoined to '◇(A or B) and ¬◇(A and B)': '◇(A or B) and ¬◇(A and B) and ¬(◇A and ¬◇B) and ¬(◇A and ¬◇B)'. This is in turn equivalent to '◇A and ◇B and ¬◇(A and B)', i.e. free choice is derived.[26]

We return to the problem of singular existentials. It should be clear that the theory as it stands will wrongly generate implicatures of *some N-sing(ular) φ* and *some N-sing ψ* for *some N-sing φ or ψ*, by an entirely parallel process.[27] Fox (2006) proposes to deal with the problem by adding an assumption that *some N-sing φ* has as an alternative the (logically stronger) sentence *at least 2 Ns φ*. Under his algorithm for calculating implicatures (cf. (49)), the presence of this *(at least) 2* alternative directly blocks the free choice effect for singular existentials. An application of the implicature adding operator to *Some N-sing A or B* effectively conjoins to it ¬*(at least 2 Ns A or B)* ((49)). This implicature already contradicts the conjunctive meaning (that some N-sing A and some N-sing B) – and, crucially, the application of a second implicature operator cannot remove it (cf. (50b)).

The crucial assumption predicts that *some N-sing φ* will in general implicate

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[26]Perhaps it is useful to think of it in the following way. Fox's theory formally encodes an intuition in Kratzer and Shimoyama (2002), that free choice is the result of second order reasoning starting from the premise that '◇A' and '◇B' *would* have each implicated the negation of the other. (Importantly, the question of whether this is a dubious premise even in a context in which the speaker could be taken to be well informed, does not arise for Fox. His theory is purely formal and thus does not depend on any (putative) facts about (rational) conversastion). The idea would be that the speaker, if well-informed with respect to the possibility of A and B, must have used '◇(A or B)', and not one of the simpler non-disjunctive sentences, in order to avoid these implicatures. Given that he meant what he said he must therefore know that both ◇A and ◇B.

[27]Unless of course *some N-sing φ* and *some N-sing ψ* are blocked by stipulation from counting as alternatives.

that not more than one N ϕ, i.e. that it has a strengthened meaning that exactly one N ϕ. Fox suggests that this is correct for examples like *Some/a woman bought me a drink at the bar last night*. There are however cases in which the predicted implicature is not detectable:

(51)   The sun is shining somewhere in Europe (but certainly not in Pars).

    a.   ¬ ⇝The sun is shining in only one place in Europe.

(52)   Someone knew the answer (but everyone was too shy to speak up).

    a.   ¬ ⇝Only one person knew the answer.

This fact is in itself not clearly problematic for Fox's account, since the examples could be cases in which the putative implicature is 'cancelled' (as a function of the context) – a possibility which any theory must allow for. For the sake of argument I will assume that they do involve cancellation, and that Fox's assumption about the alternative class for singular existentials is generally tenable. The more significant observation about these examples, then, is that in parallel cases *with a disjunction*, the free choice effect is (still) absent.

(53)   It's raining or snowing somewhere in Europe (but certainly not in Barcelona).

    a.   ¬ ⇝It's raining somewhere in Europe and it's snowing somewhere in Europe.

(54)   Someone knew the answer or knew someone who did (but everyone was too shy to speak up).

    a.   ¬ ⇝Someone knew the answer and someone knew someone who did

In principle in Fox's system implicature 'cancellation' could be explained in two different ways: as certain alternatives failing to be active in contet (and hence the implicatures they trigger failing to arise), or as an implicature operator simply not being applied. There is a possible argument that Fox needs to appeal to the former possibility in order to explain the lack of the *exactly one* implicatures in the above examples. There seem to remain in each case weaker *not all* implicatures: (53) implicates that it's not the case that everywhere in Europe it's raining or snowing, (54) that it's not the case that everyone knew the answer or knew someone who did.

This presumably forces Fox to say that implicatures *are* being calculated, but that the putative *at least 2 Ns* alternatives are simply being suppressed (one would standardly assume that *every N ϕ* is also an alternative to *some N ϕ*). If this is correct, then it seems that Fox's theory would wrongly predict that in (53) and (54) (in the relevant context) a conjunctive 'reading' *should* be available. The reason is simply that, as discussed above, and observed by Fox, successive application of two implicature operators to *some N-sing A or B would* (wrongly) derive implicatures of *some N A* and *some N B* in his system, if *some Ns A or B* (plural) were not an alternative to it. This of course applies equally if it is inactive/suppressed in context.[28,29]

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[28]A further argument could possibly be derived from the fact that singular expressions with   •
existential force systematically fail to yield free choice effects – even expressions that *never*
trigger *exactly one* implicatures:

(i) a. {At least one student/one student or more} drank wine
     b. ⌐⤳Exactly one student drank wine
(i) {At least one student/one student or more} drank beer or wine

     a. ⌐⤳At least one student drank beer and at least one student drank wine

However, it is possible that there are further complexities to the meanings of such quantifiers
that complicate the argument. I leave this issue for future research.

[29]This type of consideration applies equally to a general class of pragmatic theories of free
choice permission (and conjunctive strengthenings) that work in the following way. Give (some-

6   Overview of Content of Thesis

In Chapter 2, we develop a formal account of embedded implicature following Chierchia (2004) which implements the proposal sketched in this chapter. Chapter 3 considers implicatures of disjunction in existential quantifier **restrictions**. We present data and independent considerations about distributivity in quantifier restrictions which provide supporting evidence for the core aspect of the proposal in Chapters 1 and 2: that conjunctive strengthenings are due to implicatures triggered by distributivity. (The data and considerations have general implications for the theory of plural marking, which are explored in Chapter 3's final section). The fourth and final chapter extends the innovations of the thesis – modal as plurals, and the treatment of distributivity implicatures – to account for a long standing puzzle about the interpretation of disjunction in the antecedent of (counterfactual) conditionals.

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how) a weak pragmatics of disjunction (that works in general) and which entails that a sentence of the form $[\exists\ Ns]\ (A\ or\ B)$ (and $\Diamond(A\ or\ B)$) is felicitous iff either (i) the speaker doesn't know whether $[\exists\ Ns]\ A$ is true and doesn't know whether $[\exists\ Ns]\ B$, or (ii) knows that *both* are true. Then conjunctive strengthenings can be explained as deriving the conjunction of this felicity condition being met *and* there being a contextual assumption in place that the speaker is well-informed, i.e. does know whether $[\exists\ Ns]\ A$ is true and whether $[\exists\ Ns]\ B$ is true). This is essentially the strategy appealed to by Alonso-Ovalle (2005) (following Kratzer and Shimoyama (2002)), and by Schulz (2004) (for free choice permission; they don't discuss conjunctive effects with plural existentials). The problem is to make sure that the a parallel disjunctive felicity condition is not derived for singular existentials over disjunction $[\exists\ N]\ (A\ or\ B)$. If it is, there is a prediction that they should strengthen to conjunctions (at least in some cases), since a well-informedness assumption can arise just as well. The important point is that this type of 'weak pragmatics' approach cannot be saved in general by making Fox's move (i.e. assuming plural competitors for singular existentials) in order to block deriving the parallel felicity condition for singular existentials. The problematic prediction is likely return for examples like (53) and (54), i.e. where there is no 'not two' (and plausibly not even a 'doesn't know that two') implicature.

7 Issues Left for Future Research

7.1 Free Choice Effects with Wide Scope Disjunction

Disjunctions of statements of possibility ('$\Diamond A$ or $\Diamond B$') often behave exactly like disjunctions in the scope of a possibility modals ('$\Diamond(A \lor B)$') in having the force of (wide scope) conjunctions (Zimmermann (2000), Geurts (2005), Simons (2005a)):

(55)   Alex can have beer, or he can have wine

      a. $\rightsquigarrow \Diamond$(Alex has beer) $\land$ $\Diamond$(Alex has wine)[30]

Like many previous authors (Alonso-Ovalle (2004), Simons (2005a), Simons (2005b), Fox (2006)), this thesis focuses exclusively on cases in which or (apparently) appears within the scope of a possibility modal. The account sketched above and developed in Chapter 2, like those of the mentioned authors, makes no predictions about (55). The reason is that its explanation of the free choice effect depends crucially on the disjunction appearing in the scope of the possibility modal (and distributive operator), which seems quite obviously to not be the case in (55).

On the other hand, Simons (2005a) observes that the conjunctive/free choice meaning of '$\Diamond A \lor \Diamond B$' could be given the same account as that of '$\Diamond(A \lor B)$', if in the former the modal can undergo across the board movement (at LF):

(56)   Possible$_i$ [t$_i$ A or t$_i$ B]

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[30]As noted by Simons (2005a) and Geurts (2005), there seems to be some difference in meaning between (55) and *Alex may have beer or wine*: there is an intuition that the former more strongly suggests that beer and wine exhaust Alex's (drinking) options, while the latter suggests that they are simply among them. I leave this aside, as it is orthogonal to the basic point I want to make about the two cases.

Leaving the exact details aside, the crucial assumption would be that the scope of the ATB raised modal would have the same interpretation as that of *A or B* itself. The account developed here could then be applied directly to (55). There may be independent, syntactic ways to test whether Simons' basic idea is tenable. I have none to offer, and know of no other ways to test the feasibility of this option, and therefore leave it aside.

There have been explicit proposals which attempt exactly the reverse of Simons' suggestion – to give an account of cases like (55), and reduce the ostenible cases of $\Diamond$(A or B) to them (Zimmermann (2000), Geurts (2005)). Obviously crucial to this line of an analysis is an assumption that any disjunction that would appear to be in the scope of a possibility modal (surface form: *poss a or b*), can by some mechanism (ellipsis, non-standard semantics) be interpreted as a disjunction of possibilities *poss a or b*. I will not discuss their interesting and influential proposals for the free choice effect with *poss a or poss b*, primarily because I doubt that the crucial assumption is warranted. As pointed out by Fox (2006), the free choice effect arises in cases in which there is independent reason to believe that disjunction must be taking narrow scope with respect to a possibility modal.

(57)   a.   John may either eat the cake or the ice cream. [FC available; Fox (2006), ex. 95a]

       b.   John either may eat the cake or the ice cream. [FC unavailable]

Larson (1985) noted that *either* – when separated from *or* as in these examples – explicitly marks the scope of a disjunction, i.e. the amount of material that is coordinated. This is suggested by the following, for example:

(58)   Bill believes that Bill John either ate the cake or the ice cream.

      a.   *_John believes that Bill invited Sue, or he believes that Bill invited Mary_

(59)   John either believes that Bill invited Sue or Mary.

      a.   [ok]_John believes that Bill invited Sue, or he believes that Bill invited Mary_

Given Larson's generalization about displaced _either_ is correct, (57a) must be treated as involving a narrow scope disjunction. Since Geurts/Zimmermann have no account of how free choice effects could arise for narrow scope disjunctions, their account is not in conflict the proposal in this thesis, which accounts _only_ for such cases. I leave for future research the question of how free choice effects with disjunctions of possibilities ((55)) are to be accounted for (for example, the possibility that Geurts/Zimmermann are right about them, even though their account can't generalize to all cases).

7.2   Generalized Free Choice Effects With Indefinites

Existential quantifiers generally give rise to (at least limited) free choice effects when in the scope of a possibility modal:

(60)   John may eat a piece of fruit

      a. $\leadsto \Diamond$(John has a_1) $\land$ ... $\Diamond$(John has a_n) [where a_1-a_n denote the objects (fruits) i_1-i_n in the domain of the existential quantifier]

As in the case of disjunction, the free choice effect does not follow under a standard semantics for possibility modals and an existential semantics for indefinites.

Truth of $\Diamond([\exists x:\ \phi(x)]\ \psi(x))$ is consistent with, for example, $\neg\Diamond([\exists x:\ \phi(x) \wedge x{\neq}a]\ \psi(x))$ (where 'a' names some object). In the case of (60), this would mean that there is only one fruit that John may eat. This should seem familiar, since it is entirely parallel to the problem that free choice disjunction poses under a standard modal semantics and boolean semantics for *or*. The parallel is unsurprising since (as is well known) existential quantifiers and boolean disjunction are mutually inter-definable. (We illustrate informally that (60) can be restated with *or* qua boolean disjunction. Let w be a witness to the (existential) modal quantification in (60), and let the individual i be a witness in w to the existential quantification in *John eats a piece of fruit*; then w will also witness the modal in *John eats a_i or a_a*, where a_i names i, and a_a names an arbitrary object a – and vice versa (so long as a_i names something that is a fruit in w)).

A solution to the free choice effect with indefinites (under the standard assumptions) is thus in principal available by generalizing the proposed account of free choice disjunction. What would need to be assumed is sets of alternatives for indefinites that are formally analogous to those assumed for disjunction. One way to cash this out: let the alternatives to s=*some ϕ ψ* include the set of sentences identical to s, but with a more restricted domain for the existential.[31] We illustrate a derivation of the free choice effect, for *John may eat a piece of fruit*:

(61) $\textsc{Alt}(a\ \phi\ \psi)$=the smallest set of sentences S such that $\forall\phi'([\![\phi']\!]\subset[\![\phi]\!] \rightarrow a\ \phi'\ \psi\in S)$[32]

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[31]To see why this is roughly what is wanted: suppose the domain of the existential includes the objects named by a and b. Then s is equivalent to $\psi(a)$ *or* $\psi(b)$, for which we needed to assume alternatives $\psi(a)$, $\psi(b)$ in order to account for the free choice effect. For the existential, then, the relevant alternatives would thus be: *some $\phi^{-a}\ \psi$* and *some $\phi^{-b}\ \psi$*, where ϕ^{-a} has the same interpretation of ϕ, but excludes the object named by a.

[32]Making the gross oversimplification that neither ϕ nor ψ itself contains an additional scalar item; ultimately a recursive definition of alternatives is needed. See Chapter 2.

(Note that under this definition S will include a vastly many subsets of equivalent sentences – no doubt the basic result could be obtained with a simpler/more elegant definition of alternatives with smaller domains for the existential). Suppose for simplicity that there are just two pieces of fruit, one an apple, and one a pear (which exist as such in the worlds quantified over by the modal) – call them a and p. In any world quantified over by the modal, then, the weakest stronger alternatives to *John eats a piece of fruit* are all equivalent to one of the following two alternatives: *John eats a pear*, *John eats an apple*, abbreviated respectively as A and P. The free choice effect is derived exactly as with a disjunction, by adding implicatures at the level of the embedded distributive operator (let $F=$*John eats a piece of fruit*):

(62)   a. $[\exists W: \mathrm{Acc}_D(W)]$ STRONG$([\forall w: w \text{ is-part-of } W] F(w))$

b. $=[\exists W: \mathrm{Acc}_D(W)] ([\forall w: w \text{ is-part-of } W] F(w) \wedge \neg[\forall w: w \text{ is-part-of } W] A(w) \wedge \neg[\forall w: w \text{ is-part-of } W] P(w))$

c. $=[\exists W: \mathrm{Acc}_D(W)] ([\forall w: w \text{ is-part-of } W] F(w) \wedge ([\exists w: w \text{ is-part-of } W] A(w) \wedge \neg P(w)) \wedge ([\exists w: w \text{ is-part-of } W] A(w) \wedge \neg P(w)))$

d.   'There is a plurality of worlds consistent with the rules which includes at least one world in which John eats an apple but not a pear, and at least one world in which John eats a pear but not an apple'

Given the assumption that the two pieces of fruit throughout the modal domain are just the apple a and the pear p, it follows that John may eat a and that John may eat p. I hope that these brief remarks suffice to make it plausible that the account for disjunction can be generalized to indefinites, and that it

would be reasonable to do so.[33] I leave for future work a complete discussion of existentials – although, given their interdefinability with disjunction, the reader can presumably draw some conclusions about how the generalization would fare by reference to the complete account of free choice disjunction in Chapter 2.[34]

7.3 Independent Arguments for a Plural Semantics for Possibility Modals

There are some relevant considerations that come from the domain of cross-sentential anaphora, where we find that possibility modals pattern with true plural existentials, and against synonymous morphologically singular existentials, in their possibilities for anteceding pronouns. We assume for now without argument that 'would' in the following example is anaphoric to the witness world(s) to the preceding modal statement.

(63)   (Don't smoke.) My sister might come in.

  a.   She **would** (probably/definitely) kill us.

  b.   ...'(It is probable/certain) given that my sister comes in, she kills us.'

(64)   At least one musician will come in...

  a.   ...He/#They will be female.

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[33]One important point is that a 'total' free choice effect need not arise with indefinites (contra what is predicted under (61)): *John may eat a piece of fruit, but/just not this one/an apple* – seemingly in contrast with disjunction [?*]*John may eat an an apple or an orange, just/but not an orange.* In principle this could be due to an initial domain restriction on the existential quantifier, but the data need to be considered carefully.

[34]For example one might wonder why assertion-contradicting implicatures are not derived for unembedded sentences like *John ate a piece of fruit*, or, even for *John may eat a piece of fruit* at the global level. See the remarks following (24a) about how exactly implicatures are computed.

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b. ...#Most/all of them will be female.

(65)   One or more musicians will come in.

a.   ...They/#he will be female.

b.   ...Most/all of them will be female.

The generalization seems to be that plural indefinites require plural pronouns for cross sentential anaphora, while morphologically singular indefinites require singular pronouns. Given that 'at least one musician' and 'one or more musicians' are synonymous for all relevant purposes, and (crucially) that they don't have different implicatures this pattern seems to be purely 'grammatical'. If this is correct, and given that when anaphoric *would* restricts a modal adverb like *definitely/probably* as in (63a), it must have plural reference (Stone (1999)), it effectively follows from the generalization that emerges from (64)-(65) that possibility modals – e.g. *might* in (63)-(63a) – are plural. If *would* must have plural reference, and there is a purely grammatical requirement on antecedence, then *might* cannot be singular: either both *would* and *might* are unmarked, or both plural. But the two possibilities are essentially equivalent given what plurality means.

The second argument is slightly more conceptual. Given that modals express generalized quantification over possible worlds, the question arises of why we only find modals with *existential* and *universal* force – in contrast, for example, with what is found in the individual domain. This contrast doesn't follow in general from a simple difference in the nature of the domains of modal and individual quantification, since there are ways of expressing non-universal and non-existential quantifications over worlds, periphrastically (e.g. *it is not the case that you may...*, compare *no* in the individual domain) and/or with expres-

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sions that aren't modal in the lexical-syntactic sense (e.g., *it is impossible that*, arguably *it is (50%) likely that*). Taking possibility modals as plurals raises the possibility to bridge the explanatory gap: for example, plurality can be taken to be an underlying feature of all modals, with a truly binary lexical distinction between indefinite (possibility) and definite (necessity) replacing the (more) stipulative existential/universal distinction.

CHAPTER 2

Formal Account of Scalar Implicature

1 Introduction

This chapter introduces a formal theory of scalar implicature, an enriched variant of Chierchia 2004, which retains its crucial properties: it allows implicatures to be added in embedded contexts, and governs the way that they project out of them (in a particular way). The theory implements the proposal that the conjunctive 'interpretations' of $\Diamond (A \lor B)$ and *Some As B or C* are due to embedded distributivity implicatures.

Two crucial points at which the theory departs from Chierchia are (a) the disjuncts A and B on their own are taken to be among the alternatives to a disjunction A *or* B (following Sauerland (2004)) and (b) the alternatives introduced by a lexical item (here, disjunction) can be accessed multiple times by the the algorithm that generates implicatures/strengthened meanings, a possibility blocked by brute force in Chierchia's formulation. §3 introduces the theory and modifications in detail, with derivations of the free choice effect for disjunction. We start with an informal introduction to Chierchia 2004.

2 Introduction to Chierchia's Theory of Scalar Implicature

The theory given in Chierchia (2004) is essentially a grammaticalization, and more specifically a semanticization, of the standard working parts of neo-Gricean pragmatics. The crucial outcome of this move is that it allows implicatures to be literally added to the semantic content of embedded expressions; cases in which implicatures appear to arise under embedding can be derived exactly as such. The implication (1a) of (1), for example, can be derived on Chierchia's account by locally adding the relevant implicature of *some* to the second disjunct :

(1) Kai ate the peas or he ate some of the broccoli. [from Sauerland (2004)]

  a. ↝Kai ate the peas or he ate some but not all of the broccoli.

The putative embedded implicature in the second disjunct could of course be accounted for by a theory that explains away scalar implicatures by positing (systematic) ambiguity, here in the meaning of *some* ('some and possibly all' vs. 'some but not all'). However, the fact that the disjunction is also naturally given an exclusive interpretation precludes this theoretical option (as is well known). The closest that an ambiguity theory could come to deriving the relevant meaning would be the combination of an exclusive variant of disjunction and a 'some but not all' meaning for *some.* In particular, (1) would on this reading be true if Kai ate both the peas *and all of the broccoli,* the wrong result. (What is naturally expressed is that he didn't eat all of the broccoli, and he ate the peas or some of the broccoli but not both).

This point helps illuminate a crucial property of Chierchia's system: it does not (and could not) work by simply adding the *some* implicature to the semantic

content of the disjunct (embedded clause), subsequently 'forgetting' that it did so. It would then be essentially equivalent to an ambiguity theory, and face exactly the kind of problem noted above. Instead it always 'remembers' the plain meaning of an embedded clause when an implicature is added, and keeps it accessible for computation of further implicatures. In effect the desired strengthened meaning is derived as the conjunction of the interpretation with the *some* implicature added locally, and the interpretation with an *or* implicature added and the local *some* implicature ignored, i.e. the conjunction of (2a) with (2b):

(2)   a.   (Kai ate the peas) $\vee$ (he ate some of the broccoli $\wedge$ $\neg$(he ate all of the broccoli))

        b.   (Kai ate the peas $\vee$ he ate some of the broccoli) $\wedge$ $\neg$(Kai ate the peas $\wedge$ he ate some of the broccoli)

As in Neo-Gricean approaches (e.g. Sauerland 2004, owing to the work of Larry Horn), in Chierchia's system it is assumed that (some) lexical items are marked to compete with others (to be parts of a scales). The competitors to a complex expression ϕ that are visible to the implicature generating algorithm are the expressions that differ from ϕ only in that that its scalar items have been replaced with an alternative/competitor.[1] Without this assumption, there is potential that no implicatures can be derived without also deriving a contradiction. If the set of competitors (to a given lexical item, or to a sentence as a whole) is not constrained, there is always the risk that there will be two competitors whose negations, in conjunction with the literal content, are a contradiction (see e.g. Fox 2006, citing Kai von Fintel, p.c., and Kroch (1972)). A commonly given example is *Some students (came)*: an implicature is to be derived that not all

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[1]There are further constraints on how alternatives 'project' assumed by Chierchia, discussed in §3.

students came, but this situation could not arise if, for example, *Some but not all students (came)* were among the competitors. The conjunction of *Some students (came)* with the negation of (the logically stronger) *Some but not all students (came)* entails the *negation* of the desired implicature (i.e. that all students **did** come). Thus, if the basic theory is correct, then competitor sets must somehow be constrained. It is commonly assumed that this can only be done by stipulation (e.g. Matsumoto 1995). I don't think this assumption is obvious in all cases, for example the one under consideration: there are principled differences between the relevant competitors (*All* vs. *some but not all (students came)* – for example syntactic – which could in principle underly the exclusion of the latter as a competitor. This issue is not crucial to the proposal developed here, in the sense that, at worst, we follow Chierchia and the rest of the literature in stipulating competitors. In some sense it is all the better from the present perspective if there is *not* a principled (say, Gricean) way of deriving what counts as an alternative to a given expression. This could count as evidence against a purely Gricean account of scalar implicatures, and suggest that they are derived in some kind of conventional.grammatical system, as assumed here (as pointed out by Fox (2006)).

Chierchia's system does not derive the observed diversity implicatures of universals over disjunction, which are the basis for our account of the free choice • effect with possibility modals and plural existentials:

(3) Every student has a bike or a motorcycle

     a. $\leadsto$ ¬(Every student has a bike), ¬(Every student has a motorcycle)

(4) John must/always ride(s) a bike or a motorcycle

     a. $\leadsto$ ¬(John must/always ride(s) an bike), ¬(John must/always ride(s)

a motorcycle)

The most obvious (albeit superficial) reason that Chierchia doesn't derive the attested implicatures is that he assumes *or* to be in competition only with *and*. A 'not and' implicature is is too weak to do the job, whether added within the scope of the universal (*Every student has a bike or a motorcycle but not a bike and a motorcycle*), or globally (*Every student has a bike or a motorycle, and not every student has a bike and a motorcycle*). The diversity implicatures ((3a), (4a)) can be derived entirely straightforwardly by ensuring that each disjunct is in competition with the disjunction, at least when considered globally: for example *Every student has a bike* and *Every student has a motorcycle* would compete with/be alternatives to (3), and, being logically sronger, their negations derived as implicatures. (There is an intuitive motivation for this: these alternatives are not only logically stronger but also predictably related to and briefer than the assertion itself – they simply involve the elmination of *or* and the other disjunct). The more substantial point is that Chierchia *cannot* derive diversity implicatures, because of a combination of basic assumptions that make it impossible to have the needed alternatives available for implicature computation at the global level. We address and remedy this issue in section §3.

For independent reasons Sauerland (2004) developed a theory of scalar impli- .
cature that allows the type of alternative needed to derive the diversity effect. His aim was in fact to take away some of the central motivation for (a theory like) Chierchia('s). The innovation was to allow that A and B count as alternatives to A *or* B in general, and an algorithm that avoids deriving undesirable implicatures in the case of a simple unembedded instance of A *or* B – i.e. that $\neg A$ or $\neg B$, or – at pain of contradiction – both. This innovation allows him to derive examples involving disjunctions with implicature triggering items embedded within them

(e.g. (1)) in a global, essentially neo-Gricean fashion. A second piece needed to accomplish that is that alternatives 'project' in a pointwise fashion, with the result that the alternatives needed to yield the diversity implicatures (and the ability to do so) are derived as a byproduct. In Fox (2006), Sauerland's results are formalized in a system that more closely approximates Chierchia's. The basis of the algorithm is that, rather than deriving the negation of all of the the stronger competitors to a sentence ϕ, the implicature algorithm derives the negations only of stronger competitors C such that it's not the case that $\neg C$ entails that ϕ and C', where C' is another stronger competitor to ϕ.[2] In the case of $\phi = A$ or B, neither $\neg A$ nor $\neg B$ can be derived, since $\neg A$ entails that ϕ and B, and $\neg B$ entails that ϕ and A. (Such an algorithm can be thought of as non-arbitrary, or grounded in rationality, in the sense that it avoids both contradiction and arbitrary choice: where some potential implicatures taken together but not individually contradict the assertion, it derives *none* of them).

In order to account for the the free choice interpretation of $\Diamond$*(A or B)* and *Some As B or C* (as owing to embedded diversity implicatures triggered by a distributive operator added within the scope of the existential/modal), we need to port essentially Sauerland/Fox's innovations into a system that allows for genuinely embedded implicatures (Chierchia's).[3] Most likely this move is needed independently, since universals over disjunction more generally have diversity im- •

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[2] Fox argues that, independently, such an algorithm is what is needed to account for exhaustive interpretations of certain answers to questions, and for the semantics of *only*. In his system these are all tightly related phenomena (*only* being the pronounced version of a covert operator that derives scalar implicatures and exhaustive interpretations).

[3] It is important to recall that, although Fox (2006) uses these innovations in giving his own account of free choice, his account in addition makes use of 'higher order' implicatures not appealed to in ours (cf. 1, §5). Thus our use of the innovations is non-redundant, and our accounts logically distinct. Moreover, as Fox himself notes, he seems to need to appeal to embedded implicatures to account for the full range of facts about free choice (Fox 2006, Section 11.1). If the accounts were empirically indistinguishable, then, ours would seem to be simpler one.

plicatures in contexts in which global computation of implicatures cannot derive
them:

(5)   At least one professor gave every student an A or an F

      a.   ⇝At least one professor is such that he gave every student an A or
           an F and at least one student an A and at least one student an F

           'At least one professor is such that he gave every student an A or an
           F and and not every student student an A and not every student an
           F'

It seems that these implicatures are very natural in a context in which, for ex-
ample, it is being explained that there is at least one professor with an extreme
grading policy. Certainly calculating implicatures globally would lead to some-
thing which (in conjunction with the assertion) *entails* the attested strengthened
meaning (5); the problem is that it would also result in additional entailments
that seem to be unwanted:

(6)   global implicatures: ¬(At least one professor gave every student an A),
        ¬(At least one professor gave every student an F)[4]

It doesn't seem that (5) necessarily leads to the inference that no professor gave
every student an A, for example. The global prediction would thus seem to be
too strong.

Cases can also be constructed in which globally calculated implicatures are
too weak to account for the attested diversity effect (e.g. *John believes that ev-*

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[4]Notice that these implicatures entail the negation of the other plausible alternative, *At least
one professor gave every student an A and an F*, which is absurd anyway. We follow the practice
of giving only the least strong implicatures (i.e. the negations of the weakest alternatives).

eryone drank beer or wine); this is the typical way of arguing that embedded implicatures are real (cf. Chierchia 2004). Such cases are inherently less convincing, since additional premises could always be appealed to in order to strengthen the globally computed implicatures even further, thereby countering the putative argument for the existence of embedded implicatures. I leave for the future the question of how solid the (potentially stronger) argument suggested by (5) really is, and more generally, how much evidence there is for embedded implicatures. I simply follow Chierchia (and many other authors) in assuming that they exist. We turn to developing a variant of Chierchia's system that allows for (embedded) universal over disjunction implicatures (§3).

3 Enriched Variant of Chierchia (2004)

We first need a general definition of the alternatives or competitors to an expression. We define in particular the syntactic structures that compete with a given parse of an expression:

(7) For any expression (syntactic structure) α, $[\![\alpha]\!]^{ALT}$, the set of potentially relevant alternatives to $\alpha =$

    a. $\{\alpha_1, \ldots, \alpha_n\}$, if α is lexical and part of a scale $<\alpha_1, \ldots, \alpha_n>$,[5] and $\{\alpha\}$, if α is lexical and not part of a scale

    b. $\{[\beta'\ \gamma']: \beta' \in [\![\beta]\!]^{ALT} \wedge \gamma' \in [\![\gamma]\!]^{ALT}\}$, if $\alpha = [\beta\ \gamma]$

Effectively (7b) says that the alternatives to any complex structure (expression) are the set of structures obtained by making all possible combinations of replace-

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[5]For present purposes a 'scale' is a set of expressions that are partially ordered by (generalized) entailment.

ments of alternatives to lexical items contained in it.

Taking an example, suppose that *some*, for example, has alternatives as follows:

(8) $[\![some]\!]^{ALT}=\{some, every\}$

Then the alternatives to *some girl* are {some girl, every girl}, and the alternatives to *Some girl got an F* are {Some girl got an F, Every girl got an F} – given that there are no lexical items in it other than *some* that are part of a scale. For the same reason, the set of alternatives to any constituent α of *Some girl got an F* that does not itself contain *some* is just the singleton set $\{\alpha\}$.

The definition of alternatives differs from Chierchia's in two respects; in what alternatives are taken to be, and in how they project. We discuss these in turn. Chierchia takes alternatives to be *interpretations* of expressions rather than expressions simpliciter.[6] It is important that by 'expression' I mean *syntactic structure* and not merely strings of words or sounds (as implicit in the use of structural brackets in (7b)). This is crucial because the implicatures we are concerned with will hinge on the presence of linguistic elements – distributive operators – which (sometimes) have no overt realization. I propose to take the structures in particular to be LFs, since this leaves open the possibility that distributivity is . not represented throughout the derivation of the sentence.[7] All that this move amounts to is the claim that the implicatures of a string ϕ are calculated based

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[6]Chierchia's recursive definition of alternatives (Chierchia 2004, Appendix, Defintion 1) is in fact inconsistent, since the alternatives to any lexical item α are one or more expression/tokens, but the recursion clause defines alternative(s) to an expression containing α as interpretations of expressions, with no provision that allows for the shift. This can be trivially fixed, for example by modifying his definition so that the alternatives to α are interpretations of an 'intermediate' set of competitor expressions, or adding a provision to effect the shift.

[7]Recall from Chapter 1, §3 that, on anyone's theory, it *must* be represented somehow in the logical syntax, which is all that is crucial for our proposal.

on a particular way of resolving any ambiguities in it. As far as I can tell this is not only harmless but a virtual necessity; at very least the usual way of thinking about implicatures depends on it.[8] Overall this departure from Chierchia, while possibly conceptually closer to the spirit of classical pragmatics, is not very substantive: the LF for any expression uniquely determines an interpretation.

(7) does the neo-Gricean tradition (and Chierchia) in that it is only lexical items themselves that introduce alternatives: the definition of alternatives to an expression of arbitrary size is based (entirely) on recursion on the alternatives to the lexical items it contains. The alternatives needed to account for diversity implicatures can be arrived at by assuming the innovation for the alternatives to *or* introduced in Sauerland (2004):

(9) $[\![or]\!]^{ALT}=\{$or, L, R, and$\}$

Where L and R are expressions (not existing overtly in English) created expressly in order to derive that each disjunct is introduced as an alternative to a disjunction: the interpretation of aLb is defined as equivalent to a, and aRb to b. Under this assumption, and the assumption that *some* is an alternative to *every*, the set of alternatives to

(10)   Every student has a bike or a motorcycle

are as follows:

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[8]The point being that scalar implicatures make reference to the *meaning* of what was said, in particular its logical strength relative to some set of alternatives, and thus this must be settled before they can be calculated. In principle it is possible that speakers take into account the various implicatures that a sentence (string) *would* have (in a typical context) on its various disambiguations (and their plausibility), as a basis for disambiguating in the first place. But this kind of reasoning rides on the ability to disambiguate and calculate the respective implicatures in the first place.

$$(11) \quad [\![(10)]\!]^{ALT} = \left\{ \begin{array}{l} \text{Every student has a bike or a motorcycle} \\ \text{Every student has a bike L a motorcycle} \\ \text{Every student has a bike R a motorcycle} \\ \text{Every student has a bike and a motorcycle} \\ \text{Some student has a bike or a motorcycle} \\ \text{Some student has a bike L a motorcycle} \\ \text{Some student has a bike R a motorcycle} \\ \text{Some student has a bike and a motorcycle} \end{array} \right\} \text{[by (7), (9)]}$$

The crucial members are *Every student has a bike L/R a motorcycle*; their negations are ultimately to be derived as implicatures, which will directly yield the diversity effect. (The reason to take *some* as an alternative to *every* ($[\![\text{every}]\!]^{ALT} = \{\text{some, every}\}$) is that when *every* appears in a DE context – such that the *some* alternatives, globally, would be stronger – we will want to derive implicatures involving them: *Alex didn't solve every problem* $\leadsto \neg\neg$(Alex solved some problem)=Alex solved some problem).

Clause (7b) applies only to binary structures; for it to derive this set, strictly speaking, we need to assume a binary structure *[a [or/L/R/and b]]* for *a or b*, *aLb*, etc. Then $[\![\text{or a motorcycle}]\!]^{ALT} = \{$or a motorcycle, L a motorcyle, R a motorcycle, and a motorcycle$\}$, and so forth upward. We proceed with an assumption of binary coordinate structures, though only as a convenience; we could just as easily add a clause for ternary structures (for which (7) is not defined as it stands).

The fact that *L* and *R* are not overt expressions of English could raise conceptual questions. None arise if they are simply *unpronounceable*, given that any theory needs to assume that alternatives are structures (and given the assump-

tion that these can contain covert elements). There may be interesting issues, but it is not worth dwelling on the point. Sauerland's L and R alternatives were just a convenience to formally derive the desired result. I don't know of any strong argument in favor of such a *lexical* scale for disjunction, and it is trivial to define an alternative way of deriving the needed alternatives (the individual disjuncts themselves). We present such an alternative in §B–1.1 (appendix to this chapter) and show that it eliminates certain redundancies that Sauerland's lexical scale for *or* imparts on our system. (In particular, with Sauerland's lexical scale, but not our alternative, the strengthened meanings for certain sentences are derived twice, once locally, and once globally). Since Sauerland's lexical scale is sufficient to do the job, and familiar to many readers, we proceed with it for the sake of exposition.

The second, and more substantive, general departure from Chierchia regarding alternatives is in respect of the way that they project; i.e. how the alternatives of a whole depend on those of its parts (note that this is in principle independent of what they are). His version of the recursive condition (7b) (Chierchia 2004, Appendix, definition (1c)) requires that:

(12)   the alternatives of any complex expression α containing n-many scalar items ($\alpha=[\ldots s_n [\ldots s_{n-1} \ldots]]$) are expressions that differ from α **only** with respect to *the highest scalar item s_n it contains*.[9]

That is, by brute force the alternatives induced by any scalar item s_i disappear at the first higher point in the structure at which another scalar item s_{i+1} appears ($[s_{i+1}\ldots [s_i \ldots]]$). This means that it is not possible to calculate any implicatures

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[9]More precisely in Chierchia's formulation, *the interpretations of* those expressions, as noted above.

inolving the alternatives to s_i at or beyond the scope of s_{i+1}. Thus in conjunction with his assumption that only lexical items introduce alternatives, Chierchia's formulation precludes transparently deriving the diversity effect of universals over disjunction (*every N ϕ or ψ*) as 'global' implicatures of the negations of *every N ϕ* and *every N ψ*. Even if Sauerland's disjunction scale is imported into Chierchia's system, these alternatives – or more specifically, the equivalent alternatives *every N ϕ L ψ, every N ϕ R ψ* – will never be available, by (12). (*or*'s alternatives can only be used to calculate implicatures *within* the scope of the universal). Chierchia's formulation would thus also preclude our derivation of the free choice effect (qua embedded universal over disjunction implicatures) – at least under our proposal to use the Sauerland scale for disjunction. It should be apparent that (7) is not constrained in the way Chierchia's definition of alternatives is: all of the alternatives to an embedded structure – even one embedded under a scalar item – figure in the alternatives to structures containing it; cf. (11).

The diversity implicatures could in principle be derived under Chierchia's recursive definition of alternatives (or any definition with property (12)), if *every N ϕ* and *every N ψ* (or equivalents thereof) are stipulated/derived to enter as alternatives to $\forall$ N ϕ *or* ψ itself, directly. (Crucially, (the equivalent of) ϕ and ψ cannot enter as alternatives lower than the universal itself, since (12) blocks them from 'projecting' to combine with the universal in the needed way). However, (12) also precludes calculation of certain (apparent) implicatures of possibility modals/plural existentials over disjunction that need to be accounted for (in particular, it is often claimed that $\Diamond$(A or B) $\rightsquigarrow$ $\neg\Diamond$(A **and** B), and we need to have access to *or*'s alternatives at the global level in order to calculate this implicature). We tentatively assume, then, that Chierchia's rule is too restrictive, and that (7) is needed (we revisit these issues briefly in §3.2 and §B–1.2).

3.1 Selection of Stronger Alternatives

The next piece of (our modification of) Chierchia's system is the definition of the appropriate stronger alternatives to α, the stronger members of $[\![\alpha]\!]^{ALT}$ whose negations are the desired implicatures. For example in the case of *Every student has a bike or a motorcycle*, what must be selected, minimally, is *Every student has a bike L a motorcycle*, and *Every student has a bike R a motorcycle*. At the same time, for example, *A* and *B* must *not* be selected, in the case of *A or B* (but rather, just *A and B*); i.e. it is here that we make use of aforementioned Sauerland/Fox innovation for computing implicatures. As a first pass, we define the set containing the desired alternatives as follows (to be refined below):

(13)   (for all expressions α) the set T_α of targeted alternatives $= \{\alpha'$:

     a. $\alpha' \in [\![\alpha]\!]^{ALT}$

     b. $\alpha' \models \alpha$

     c. $\neg \exists \alpha'' \neq \alpha \left(\begin{array}{c} \alpha'' \in [\![\alpha]\!]^{ALT} \wedge \\ \alpha'' \models \alpha \wedge \\ \{\alpha, \neg \alpha'\} \models \alpha'' \end{array} \right) \}^{10,11}$

Before illustrating, two general remarks. First, α can never itself be in T_α, because it cannot meet condition (13c); for any α'', $\{\alpha, \neg \alpha\} \models \alpha''$ (everything follows from .

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[10] We intend the usual understanding of entailment: $\alpha \models \alpha'$ iff all assignments that satisfy α satisfy α'. Thus where α and α' contain the same free variables, '$\alpha \models \alpha'$' can understood as if the variables were constants (names). For example, *t has a motorcycle* $\models$ *t has a bike or a motorcycle* (but not vice versa). This becomes important in §3.2, for computing implicatures within the scope of quantifiers.

[11] The definition follows essentially an idea in Sauerland (2004); a similar one is used in Fox (2006). Fox argues that a further refinement of the basic idea is necessary, which in our terms would amount to the following: rather than T_α itself, the targeted alternatives would be: $\{a: a$ is a member of every maximal subset of $\Sigma_\alpha\}$. (Where x is a maximal subset of y iff $x \subseteq y \wedge \neg \exists x'(x' \subset y \wedge x \subset x')$). This revision is not necessary for any of the cases discussed here, as far as I can tell, and so I stick to the simpler version.

contradictory sentences). Second, if $[\![\alpha]\!]^{ALT}$ is singleton, then T_α is empty. For our example (10) (*Every student has a bike or a motorcycle*), the set of alternatives targeted from $[\![(10)]\!]^{ALT}$ (=(11)) is as follows:

$$(14) \qquad T_{(10)} = \left\{ \begin{array}{l} \text{Every student has a bike L a motorcycle} \\ \text{Every student has a bike R a motorcycle} \\ \text{Every student has a bike and a motorcycle} \end{array} \right\}$$

Each of these entails (10), and none is such that its negation together with (10) entails any other alternative that itself entails (10) (condition (13c)). As just noted, (10) – even though it both counts as an alternative to and entails itself – cannot itself be in $T_{(10)}$, by (13c). All of the *some* alternatives *Some student has a bike L a motorcyle, Some student has a bike R a motorcycle, Some student has a bike or a motorcycle*, and *Some student has a bike and a motorcycle* are excluded from T_α by the 'strength' clause (13b); none of them entails (10). The negation of this final *some* alternative, that no student has both a bike and a motorcycle is ostensibly an implicature of (10), but it will ultimately be derived in another way, as a local "not and" implicature within the scope of the quantifier (i.e. a local strengthening to exclusive 'or'). We return to this in following section.[12]

Notice that $T_{(10)}$ has more members than we need to derive the diversity effect: the negation of *Every student has a bike/motorcycle* entails the negation of *Every student has a bike and a motorcycle*, making the latter redundant. In general, only the weakest members of T_α are ever needed. Since having as few alternatives as possible makes the theory easier to work with, we will henceforth

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[12]In principal the implicature could be derived globally (in addition) if clause (13b) were revised to '$\neg(\alpha \models \alpha')$' ($\alpha$ does not entail α'). *Some student has a bike and a motorcycle* is logically independent of (10), and would still meet condition (13c). (The *some L* and *some R* alternatives, though also logically independent, do not meet the latter). A question arises of whether it is ever necessary that the negations of alternatives to α that are logically independent of it be added as implicatures. I leave this open.

use Σ_α to denote the (set of) weakest members of T_α:

(15)   (for all expressions α) $\Sigma_\alpha = \{\alpha': \alpha' \in T_\alpha \land \neg \exists \alpha'' \neq \alpha' (\alpha'' \in T_\alpha \land \alpha' \models \alpha'')\}$

Thus,

(16) $\Sigma_{(10)} = \left\{ \begin{array}{l} \text{Every student has a bike L a motorcycle} \\ \text{Every student has a bike R a motorcycle} \end{array} \right\}$

Crucially, in the case of a simple disjunction, $\alpha = \textit{John has a bike or a motorcycle}$, $[\alpha]^{ALT} = \{$John has a bike or a motorcycle, John has a bike and a motorcycle, John has a bike L a motorcycle, John has a bike R a motorcycle$\}$ (by (7)), and $T_\alpha = \Sigma_\alpha = \{$John has a bike and a motorcycle$\}$.[13] Thus only the negation of the *and* alternative will be derivable as an implicature, as desired. See §B–1.1 for illustration by derivation of the implicatures of multiple disjunctions (*a or b or c*, etc.).

3.2   Addition of Implicatures

Rather than giving a direct recursive definition of implicature-strengthened interpretations for an arbitrary expression α, we define recursively the set of *expressions* whose *regular* interpretations are correspond to them. That is, we give a general syntactic definition of a set of alternative expressions to α which have the strengthened interpretations that α has according to his theory (modulo our modifications of it).[14] The reason that Chierchia's system generates a set of strengthened interpretation*s* (i.e. possibly multiple), is to capture the fact that

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[13]Crucially Σ_α cannot contain *John has bike L a motorcycle* or *John has a bike R a motorcycle*, since each of them entails α and is such that its negation together with α entails the other ((13c)).

[14]*A* (not *the*) set of such expressions, since there are in principle (infinitely) many.

implicatures can be cancelled or fail to arise in context; the algorithm simply generates all possibilities (including the extreme case where none are added, i.e. the plain meaning), rather than having optionality built in. We define this set of 'strong structures' for α, $\mathrm{ss}(\alpha)$, in (17).[15]

(17)   for all expressions (syntactic structures) α, $\mathrm{ss}(\alpha)=$

    a. $\{\alpha\}$, if α is LEXICAL

    b. $\{[\beta'\ \gamma']$: $\beta'\in\mathrm{ss}(\beta) \wedge \gamma'\in\mathrm{ss}(\gamma)\}$, if

        (i) $\alpha=[\beta\ \gamma]$ and β is NOT DE, and

        (ii) α is NOT a possible SCOPE SITE *or* $\Sigma_\alpha = \emptyset$

    c. $\{[\beta'\ \gamma']$: $\beta'\in\mathrm{ss}(\beta) \wedge \gamma'\in\mathrm{ss}(\gamma)\} \cup \{[[\beta'\ \gamma']$ and not σ_n ... and not $\sigma_k]$: $\beta'\in\mathrm{ss}(\beta) \wedge \gamma'\in\mathrm{ss}(\gamma) \wedge \sigma_n, \ldots, \sigma_k$ are the members of $\Sigma_\alpha\}$,[16] if

        (i) $\alpha=[\beta\ \gamma]$ and β is NOT DE, and

        (ii) α IS a possible SCOPE SITE *and* $\Sigma_\alpha\neq\emptyset$

    d. $\{[\beta'\ \gamma]$: $\beta'\in\mathrm{ss}(\beta)\} \cup \{[[\beta'\ \gamma]$ and not σ_n ... and not $\sigma_k]$: $\beta'\in\mathrm{ss}(\beta) \wedge \sigma_n, \ldots, \sigma_k$ are the members of $\Sigma_\alpha\}$,[17] if

        (i) $\alpha=[\beta\ \gamma]$ and β IS DE, and

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[15]It is important to note that (17), like Chierchia's definition, *does* require that at any one point at which any implicatures are added, *all of them* are added together. The multiplicity of strengthened meanings generated for a complex sentence is due only to the possibility of adding or not adding the totality of possible implicatures at each given point. The definition could be further modified to allow each subset of the possible implicatures at a given point to be added independently. (For example, we could then generate for *Every student has a bike or a motorcycle* two additional strengthened meanings, one with just the negation of the L alternative added, and one with just negation of the R.) I don't see an empirical motivation for this.

[16]More precisely; let σ_n be the first and σ_k the last member of Σ_α to appear in a particular enumeration $\mathcal{E}$ of the set of expressions that are the targeted alternative of at least one other expression, i.e. of $\{\gamma\colon \exists\alpha'(\gamma\in\Sigma_{\alpha'})\}$. Thus [not σ_n ... and not σ_k] is the conjunction whose first conjunct is the negation of first element of Σ_α to appear in the enumeration $\mathcal{E}$, whose next conjunct is the negation of the next such element, etc., and whose final conjunct is the negation of the final one. Where it improves readability, we 'flatten' conjunctions, i.e. don't represent the binary coordinate structures previously assumed. See below on the necessity, but triviality, of relativizing to an enumeration.

[17]See fn. 16.

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      (ii) α IS a possible SCOPE SITE

  e. $\{[\beta'\ \gamma]:\ \beta'\in\text{SS}(\beta)\}$, if

      (i) $\alpha=[\beta\ \gamma]$ and β IS DE, and

      (ii) α is NOT a possible SCOPE SITE

The definition directly mirrors Chierchia's definition of strengthened interpretation (Chierchia 2004, Appendix, Definition 3).[18] The reason for our move to a recursive definition of *structures* is simply that it allows us to talk about implicatures/strengthened interpretations while abstracting away from cumbersome or irrelevant details about how *regular* interpretation proceeds.[19] The (set of)

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[18]An exception is what happens when an argument β combines with a DE operator α. We give two conditions, one that applies when the resulting constituent is a possible scope site ((17d)), and one that applies when it isn't ((17e)). In both cases existing implicatures are cancelled, but only in the former are new ones added. In Chierchia's formulation, new implicatures are *always* added when a DE operator applies. Take for example *no girl who has a brother and a sister is selfish*, which has an implicature that ¬(no girl who has a brother or a sister is selfish)=some girl who has a brother or a sister is selfish. Assuming that [$_{DP}$ no [girl who has a brother and a sister]] is not a scope position (position to which quantifiers can adjoin), and that *or* is an alternative to *and*, we derive the implicature at the global level, by conjoining the negation of the alternative *no girl who has a brother or a sister is selfish* (by (17d); derivation left for the reader).

Because of the way that alternatives project in Chierchia's system ((12)), the latter (needed) alternative is not available globally – and in fact the alternatives to *and* are strictly unavailable even at the point at which *no* combines with its NP. Chierchia is thus forced to have his rule for DE contexts 'override' his projection rule for alternatives: not only does a DE operator α (here 'no') cancel implicatures computed in its scope; it also (always) triggers addition of new implicatures calculated based on the alternatives to its argument β (here, its NP restrictor). In the case under discussion, the desired implicature is thus effectively added at the level of DP: 'no girl who has a brother *and* sister but not no girl who has a brother *or* a sister' (cf. Chierchia 2004, def. (84)). I leave aside a general discussion of the differences in prediction between our approaches, noting only that our rules for DE contexts could easily be collapsed to mimic his. At bottom the substantive difference between the proposals is in the way that alternatives project. If our method ((7)) is needed, Chierchia's treatment of DE contexts is probably unnecessary. If his projection rule is independently needed, we will require both (the equivalent of) his rule for DE contexts, and a revision of our assumptions about how the individual disjuncts enter as alternatives to a disjunction. We return to a discussion of these points below.

[19]Note in particular that (17) is not a syntacticization of Chierchia's account in any sense. Implicatures are not derived by adding operators to the syntax, but rather (in effect) by the interpretation procedure for normal sentences itself. Neither is it a syntacticization in the proof theoretic sense: although we derive sentences from sentences, we do so by direct appeal

implicature-strengthened interpretations of any α, $[\![\alpha]\!]^S$, can be defined as the set of interpretations of its strong structures:[20]

(18)   for all α, $[\![\alpha]\!]^S = \{[\![\alpha']\!]: \alpha' \in \mathrm{ss}(\alpha)\}$

Before illustrating an example in detail, we give a derivational/historical description of how strong structures are derived, and remark on some important features and properties of the definition. A general fact that is useful:

(19)   for all α which do not properly contain a scope site, or which have no constituent β such that $\mathrm{ss}(\beta)$ is non-singleton, $\mathrm{ss}(\alpha)$ is the singleton set $\{\alpha\}$

Take an arbitrary structure α. It is only when the first (possible) scope site in α (call it S) is reached that anything interesting happens – implicatures can begin to be added. ('Possible scope site' is to be understood transparently: α is possible scope site iff a quantifier can adjoin to α). Addition of implicatures amounts to forming a new structure/expression S$'$ by conjoining to S the negations of each of the its targeted stronger alternatives (the members of Σ_S)), by (17c) (or (17d), as the case may be). Of course there are multiple such conjunctions, corresponding to the different orders in which the negated alternatives can be conjoined; e.g. if S has two targeted alternatives A and A$'$, we have: [S and not A and not A$'$], [S and not A$'$ and not A]. All such conjunctions are trivially equivalent, and so it is harmless to pick an arbitrary one in order to avoid introducing

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to semantic notions -- monotonicity and entailment (in the ancillary (15)) – which are not themselves analyzed reductively by syntactic rules of inference.

    [20]That is, we arrive at general definition of strengthened interpretation given a formulation of regular interpretation, which allows for some leeway in the latter. Chierchia's strengthened interpretation algorithm, on the other hand, is a generalization of a particular way of defining regular interpretation (via type driven lambda calculus).

redundancy, i.e. to constrain the size of the set of expressions to be worked with. This is precisely what (17c) does (identically (17d)), by its relativization to an enumeration (ordering) of targeted alternatives, which is in turn used to determine a particular conjunction in any given case (see fn. 16).[21] In what follows we pick a conjunction as convenient, assuming it to be the one singled out by the definition.

The strong structures for S include S itself, and in particular are the set {S, S'}. The strong structures for S then figure in the calculation of the strong structures of larger consituents, but in a very particular way. Nothing interesting happens at any constituent A until the next scope site S_1 is reached: ss(A) will contain just two elements, A itself and A with S' replacing S in it. At the next next scope site S_1, they are calculated based on S_1 itself; rather than based on the stronger structure(s) determined for S_1 by its parts: in particular the implicature strengthened structure of the embedded scope site S is ignored for the purposes of calculating these further implicatures (this is the crucial property noted in §2, which distinguishes Chierchia's theory from an ambiguity theory).

We will assume a further articulated structure for the running example *Every student has a bike or a motorcycle*, where the quantifier appears in a scope position ((20)):

(20)   [$_{S1}$ [Every student]$_i$ [$_{S2}$ t$_i$ has a bike or a motorcycle]]

The scope sites in (20) are S1 and S2, the latter an actual scope site, the former (merely) a possible one; implicatures can be added at both. The set of globally

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[21]Since all that is required is that ss determines some class of expressions that give the implicature strengthened meanings of arbitrary α, its relativity to an enumeration $\mathcal{E}$ is irrelevant. For all α and enumerations $\mathcal{E}$, $\mathcal{E}'$ of $\{\gamma: \exists \alpha'(\gamma \in \Sigma_{\alpha'})\}$, $\{[\![\tau]\!]: \tau \in ss(\alpha)$ under $\mathcal{E}\}=\{[\![\tau]\!]: \tau \in ss(\alpha)$ under $\mathcal{E}'\}$.

stronger alternatives, Σ_{S1}, whose negations are to be added at S1, are essentially the same as before, i.e. (16), since the items triggering alternatives are unchanged: (**nb.:** to save space, we henceforth abbreviate '$\phi \, L \, \psi$' and '$\phi \, R \, \psi$' as the respective equivalents, 'ϕ' and 'ψ')

$$(21) \quad \Sigma_{S1} = \left\{ \begin{array}{l} \text{[Every student]}_i \ [_{S2} \ t_i \text{ has a bike]} \\[2mm] \text{[Every student]}_i \ [_{S2} \ t_i \text{ has a motorcycle]} \end{array} \right\}$$

Since (20) is a scope site and $\Sigma_{(20)} \neq \emptyset$, (17c) determines that the negations of these global alternatives are conjoined to each of the strong structures determined by the immediate constituents of S1, [every student]$_i$ and S2, which are as follows:

(22)   ss([every student]$_i$)$=$

      a. $\{[\beta' \ \gamma']_i \colon \beta' \in \text{ss([every])} \wedge \gamma' \in \text{ss([student])}\}$ [by (17b), which applies since $\Sigma_{\text{[every student]}_i} = \emptyset^{22}$]

      b. $=\{$[every student]$_i\}$ *by (17a)*

Since S2 is a scope site, and there are stronger alternatives to it ($\Sigma_{S2} \neq \emptyset$), it falls under (17c):

(23)   ss([t$_i$ has a bike or a motorcycle])

      a. $=\{[\beta' \ \gamma'] \colon \beta' \in \text{ss(t}_i) \wedge \gamma' \in \text{ss([has a bike or a motorcycle])}\}$

            $\cup \ \{[[\beta' \ \gamma'] \text{ and not } \sigma_1 \ldots \text{and not } \sigma_n] \colon \beta' \in \text{ss(t}_i) \wedge \gamma' \in \text{ss([has a bike or a motorcycle])} \wedge \sigma_1\text{-}\sigma_n \text{ are the members of } \Sigma_\alpha\}$ *by (17c)*

      b. $=\{$[t$_i$ has a bike or a motorcycle]$\}$

            $\cup \ \{$[t$_i$ has a bike or a motorcycle] and not [t$_i$ has a bike and a

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[22] The result is thus independent of whether [every student]$_i$ is itself a scope site, or contains one.

motorcycle]} *by (19), (15)*

c. $=\{[t_i$ has a bike or a motorcycle], [[t_i has a bike or a motorcycle] and not [t_i has a bike and a motorcycle]]\}

(For readability we abbreviate the second member of (23c) as t_i *has a bike or$_x$ a motorcycle* ('x' for exclusive)). ss((20)) can now be determined as a function of (23c) and (22b), by (17c)

(24) ss((20))=\{[[Every student]$_i$ t_i has a bike or a motorcycle], [[Every student]$_i$ t_i has a bike or$_x$ a motorcycle], [[[Every student]$_i$ t_i has a bike or a motorcycle] and not [[Every student]$_i$ t_i has a bike] and not [[Every student]$_i$ t_i has a motorcycle]]], [[[Every student]$_i$ t_i has a bike or$_x$ a motorcycle] and not [[Every student]$_i$ t_i has a bike] and not [[Every student]$_i$ t_i has a motorcycle]]]\}

We give a set of (more manageable) synonymous sentences to illustrate the strengthened meanings derived:

(25) every s∈ss((20)) is equivalent to a distinct s′∈{

a. Every student has a bike or a motorcycle

b. Every student has a bike or a motorcycle but not both a bike and a motorcycle

c. Every student has a bike or a motorcycle, but not every student has a bike, and not every student has a motorcycle

d. Every student has a bike or a motorcycle but not both a bike and a motorcycle, and not every student has a bike, and not every student has a motorcycle}

Following Chierchia, the assumption is that (in the absence of reason otherwise), the hearer goes for (the interpretation of) the strongest sentence in the set of strong structures of an asserted sentence, in this case (25d).[23]

Having illustrated the basic theory in some detail (including the addition and projection of embedded implicatures, i.e. the calculation of the strong structures of the scope of the quantifier in (20)), we turn to deriving the conjunctive interpretations of $\Diamond$ *(A or B)* and *Some As B or C.*

3.3 Free Choice

We assume a structure for possibility modal construction, e.g. *Alex may bring Kate or Susan*, as follows:[24]

(26)   [$_3$ may [$_2$ DIST [$_1$ Alex bring Kate or Susan]]]

To make the application of the theory more transparent, and in particular to make transparent the meanings of alternatives, and the entailment relationships among them, we will assume translations of structures like (26) into an extensional language with generalized quantification over individuals and possible worlds such that

(27)   [may [DIST [S]]] $\mapsto$ [$\exists$W: Acc(w*)(W)] [$\forall$w:w$\sqsubseteq$W] S(w)

   a.   where: the domain D_w is the closure of the set W of possible worlds under an operation '$\oplus$' of plural object formation such that

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[23]Notice that (25d) (and (25b)) entail that ¬(some student has a bike and a motorcycle), but that the latter is not derived globally. Although *Some student has a bike and a motorcycle* is a global alternatives to (20), its negation cannot be directly added at that level, since it is logically independent of (20) and thus not in Σ_{QR}.

[24]We ignore the question of whether some possibility modals (modalities) involve control rather than raising. Nothing of interest here hinges on it.

(i) for all a, b∈W, a⊕b∈D_w

(ii) for all a, b∈D_w, a⊕b∈D_w

(iii) for all a, a⊕a=a

(iv) for all a, b a⊕b=b⊕a

b. and: where g is an assignment function from variables to objects, 'w⊑W' is true with respect to g iff for some a, a⊕g(w)=g(W)

c. and: 'Acc(w)(W)'='[∀w': w'⊑w] [∀w'': w''⊑W] w''Rw''

Variables 'w' and 'W' range over D_w, which by the above includes both possible worlds and plural objects formed from them by the '⊕ relation. The use of upper and lower case variables is a convenience: we use 'w' where the domain of quantification is intuitively atoms, and 'W' where it is pluralities (including atoms). (I.e. we use 'w' in lieu of recovering (atomic) possible worlds (membesr of W), via a predicate 'ATOM(w)'). It's useful to keep in mind that every object stands in the '⊑' relation to itself. We follow the practice of moving back and forth between English LFs and the translation language as convenient.

As now explicit, the proposed meaning for *Alex may bring Kate or Susan* is roughly:

(28) There are one or more worlds (deontically) accessible to w (the world of evaluation), such that in each world w' that is a part of that world or worlds, Alex brings Kate or Alex brings Susan

A further assumption is required about what the possible scope sites in (26) are, in order to apply (17) and calculate its strengthened interpretations. Minimally implicatures need to be added at 2 (deriving the free choice effect), and at 3 (as we will see – in order to derive for example implicature that ¬□(A or B)).

Given our algorithm for adding implicatures ((17)), this means 2 and 3 must be assumed to be scope sites. In principle this predicts interactions between quantifiers, the modal, and the distributive operator. In some cases the truth conditions of a quantifier scoping at 3 vs. 2 (vs. 1) could, all else being equal, be different. I leave this issue open, noting that the use of 'possible scope site' in (17) is open to revision.[25]

The alternatives at each scope site are given in (30) (by straightforward application of (7)).[26] (We assume that *may* participates in a scale with *must*, as in (29) – see important comments below. We again follow the practice of replacing 'ϕ L ψ' and 'ϕ R ψ' with 'ϕ' and 'ψ').

(29) $[\![\text{may}]\!]^{ALT}=\{\text{may, must}\}$

(30)   a. $[\![1]\!]^{ALT}=\left\{\begin{array}{l}\text{Alex bring Kate or Susan}\\\text{Alex bring Kate}\\\text{Alex bring Susan}\\\text{Alex bring Kate and Susan}\end{array}\right\}$

         b. $[\![2]\!]^{ALT}=\left\{\begin{array}{l}\text{DIST [Alex bring Kate or Susan]}\\\text{DIST [Alex bring Kate]}\\\text{DIST [Alex bring Susan]}\\\text{DIST [Alex bring Kate and Susan]}\end{array}\right\}$

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[25]More positively this could be a source of independent evidence for the plural semantics for possibility modals.

[26]What the alternatives are to non-scope sites is irrelevant, since implicatures cannot be added at them. Likewise for the value of Σ at such positions.

c. $[\![3]\!]^{ALT}=\left\{\begin{array}{l}\text{may [DIST [Alex bring Kate or Susan]]}\\\text{may [DIST Alex bring Kate]]}\\\text{may [DIST [Alex bring Susan]]}\\\text{may [DIST [Alex bring Kate and Susan]]}\\\text{must [DIST [Alex bring Kate or Susan]]}\\\text{must [DIST [Alex bring Kate]]}\\\text{must [DIST [Alex bring Susan]]}\\\text{must [DIST[Alex bring Kate and Susan]]}\end{array}\right\}$

A question immediately arises about how *must* combines with its complement [DIST ϕ], given the translation procedure assumed above. Nothing needs to be changed from the standard semantics (where universal modals are taken to quantify over atoms): *DIST* will simply add nothing to the meaning. Since the only thing that bears the '$\sqsubseteq$' relation to an atom is the atom itself, '$[\forall w': w'Rw]$ $[\forall w'': w''\sqsubseteq w']$ ϕ' is equivalent to '$[\forall w': w'Rw]$ ϕ'.

A related question is whether *DIST* is *required* in the scope of a possibility modal: given the number neutral semantics, and the observation immediately above, it can be assumed that it is either always present, or optionally present. What matters is the assumption that it can be. In principal we predict that if and when it should fail to be present, the free choice effect should not arise. I do not yet know of an independent way to test the prediction.

The targeted alternatives at each scope position – the values of Σ_1-Σ_3, are as follows (by application of (15)):

(31)   a. $\Sigma_1=\{$Alex bring Kate and Susan$\}$

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b. $\Sigma_2 = \left\{ \begin{array}{l} \text{DIST [Alex bring Kate]} \\ \text{DIST [Alex bring Susan]} \end{array} \right\}_{27}$

c. $\Sigma_3 = \left\{ \begin{array}{l} \text{may [DIST [Alex bring Kate and Susan]]} \\ \text{must [DIST [Alex bring Kate or Susan]]} \end{array} \right\}$

I leave verification of (31) to the reader, only adding a reminder that (for any α, Σ_α is the weakest members the subset T_α of $[\![\alpha]\!]^{ALT}$ which are stronger than α itself, and whose negation together with α does not entail some other member $[\![\alpha]\!]^{ALT}$ (which itself entails α). (Calculation of Σ_2 can be made more transparent by reference to the translation determined in (27): [DIST [Alex bring Kate or Susan]] translates as '$[\forall w : w \sqsubseteq W]$ K(w) or S(W)', and thus the targeted alternatives as '$[\forall w : w \sqsubseteq W]$ K(w)' and [DIST [Alex bring Kate]], [DIST [Alex bring Susan]] as '$[\forall w : w \sqsubseteq W]$ K(w)', '$[\forall w : w \sqsubseteq W]$ S(w)', respectively.

By (19), the strong structures for any constituent c which contains none of 1-3 is a singleton set, the set containing c. Calculation of strong structures can thus proceed from 1. For readability, we abbreviate 'Alex bring Kate' and 'Alex bring Susan' as 'K' and 'S', respectively, and '[[K or S] and not [K and S]]' as 'K or$_x$ S'.

(32)   ss(1)={K or S, K or$_x$ S} *by (17c)*

(33)   ss(2)=
$\left\{ \begin{array}{l} \text{DIST [K or S]} \\ \text{DIST [K or}_x \text{ S]} \end{array} \right\} \cup$

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[27]The calculation Σ_2 can be made more transparent by reference to the translation determined in (27): [DIST [Alex bring Kate or Susan]] translates as '$[\forall w : w \sqsubseteq W]$ K(w) or S(W)', and the targeted alternatives thus translate as '$[\forall w : w \sqsubseteq W]$ K(w)' and [DIST [Alex bring Kate]], [DIST [Alex bring Susan]] as '$[\forall w : w \sqsubseteq W]$ K(w)', '$[\forall w : w \sqsubseteq W]$ S(w)', respectively. I leave it to the reader to verify that these are indeed the members of $[\![2]\!]^{ALT}$ selected by Σ_2.

$$\left\{ \begin{array}{l} \text{[DIST [K or S]] and [not [DIST K]] and [not [DIST S]]} \\ \text{[DIST [K or}_x\text{ S]] and [not [DIST K]] and [not [DIST S]]} \end{array} \right\} \; \textit{by (17c)}$$

As the set of expressions already becomes cumbersome to work with, it is useful to introduce further notational conventions before deriving the final result, ss(3). It is the combination of (either of) the bottom two members of (33) with ss(may) (={may}), resulting from the application (17c), which yields the basic free choice effect (a point which we illustrate below). For readability, we write this combination, 'may [[DIST [K or S]] and [not [DIST K]] and [not [DIST S]]]' as '$\Diamond_{fc}$(K or S)'; identically for the variant containing 'or$_x$'. In addition, we write (transparently) '$\Diamond \; \phi$' for 'may [DIST [ϕ]]', and '$\Box \; \phi$' for 'must [DIST [ϕ]]', *where ϕ contains no occurrence of 'DIST'.*

(34) ss(3)=
$$\left\{ \begin{array}{l} \Diamond(\text{K or S}) \\ \Diamond(\text{K or}_x\text{ S}) \\ \Diamond_{fc}(\text{K or S}) \\ \Diamond_{fc}(\text{K or}_x\text{ S}) \end{array} \right\} \; \cup$$

$$\left\{ \begin{array}{l} \Diamond(\text{K or S}) \text{ and not } \Diamond(\text{K and S}) \text{ and not } \Box(\text{K or S}) \\ \cancel{\Diamond(\text{K or}_x\text{ S}) \text{ and not } \Diamond(\text{K and S}) \text{ and not } \Box(\text{K or S})} \\ \Diamond_{fc}(\text{K or S}) \text{ and not } \Diamond(\text{K and S}) \text{ and not } \Box(\text{K or S}) \\ \cancel{\Diamond_{fc}(\text{K or}_x\text{ S}) \text{ and not } \Diamond(\text{K and S}) \text{ and not } \Box(\text{K or S})} \end{array} \right\} \; \textit{by (17c)} \quad .$$

Each of the crossed out members is equivalent to the sentence immediately above it, and hence can be ignored. The basic free choice effect is given by '$\Diamond_{fc}$(K or S)', our abbreviation of 'may [[DIST [K or S]] and [not [DIST K]] and [not [DIST S]]]' – which translates as follows (we return to '$\Diamond_{fc}$(K or$_x$ S)' below):

(35) $[\exists W: Acc(w^*)(W)]$ $([\forall w:w\sqsubseteq W]\ Kw \lor Sw) \land \lnot([\forall w:w\sqsubseteq W]\ Kw) \land$
        $\lnot([\forall w:w\sqsubseteq W]\ Sw)$

    a. $=[\exists W: Acc(w^*)(W)]$ $([\forall w:w\sqsubseteq W]\ Kw \lor Sw) \land ([\exists w:w\sqsubseteq W]\ \lnot Kw) \land$
            $([\exists w:w\sqsubseteq W]\ \lnot Sw)$

From this it trivially follows that (36a), and in turn (trivally) that (36b):

(36)   a. $[\exists W: Acc(w^*)(W)]$ $([\exists w:w\sqsubseteq W]\ Sw \land \lnot Kw) \land ([\exists w:w\sqsubseteq W]\ Kw\ \lnot Sw)$
     b. $([\exists W:\ Acc(w^*)(W)]\ [\forall w:w\sqsubseteq W]\ Sw) \land ([\exists W:\ Acc(w^*)(W)]$
            $[\forall w:w\sqsubseteq W]\ Sw)$

Formula (36b) gives directly what most authors describe to be the free choice effect, an inference to a wide scope conjunction: it is the direct translation of 'Alex may bring Kate, and Alex may bring Susan'. (35) is of course stronger, entailing that

(37)   a.   Alex may bring Kate without also bringing Susan and
     b.   Alex may bring Susan without also bringing Kate

That is, that neither girl is such that he may only bring her if he also brings the other. (35) thus also entails the weaker: it's not the case that Alex must bring Kate, it's not the case that Alex must bring Susan (as transparent in (37b), and (37a) respectively). That we derive all of these entailments as part and parcel of the basic free choice effect straightforwardly predicts that we should not find even limited free choice without them. That is, we should not find 'possible A or B' strengthening to 'possible A and possible B' without the rest of the entailments of (35) also being present. While the prediction would seem to be intuitively

correct, it is somewhat difficult to test more directly, since the *plain meaning* of 'may A or B' is always *consistent* with 'may A and may B'. I leave this issue for future research.

We turn to the other strengthened meanings derived. The strongest member of (34) is the other one containing '$\Diamond_{fc}(\text{K or S})$', namely '$\Diamond_{fc}(\text{K or S})$ and not $\Diamond(\text{K and S})$ and not $\Box(\text{K or S})$'. It should be clear from the discussion in the previous paragraph that its final conjunct, 'not $\Box(\text{K or S})$', is redundant. Thus its meaning differs from (35) only in that it additionally entails that Alex may not bring both Alex and Kate. While the latter is clearly an implicature of 'Alex may bring Kate or Susan' in many contexts, there is a question of whether it arises "by default" whenever the free choice effect is present (see Simons (2005a) for some discussion). We predict that it should be, since we assumed following Chierchia that hearers by default select the (interpretation of) the strongest member of the strong structures for an assertion. I leave this as an open issue (though see additional remarks in §B–1.2), noting only that the data are not entirely clear, and that in principal Chierchia's assumption could be modified in various ways.

We assume that the other members of (34), excepting '$\Diamond_{fc}(\text{K or}_x \text{ S})$', correspond to different ways of 'canceling' the free choice effect; i.e. possible strengthened meanings of 'Alex may bring Kate or Susan' that arise in contexts in which free choice is implicitly or explicitly cancelled (cf. the discussion of 'but I don't know which' in Chapter 1). As for '$\Diamond_{fc}(\text{K or}_x \text{ S})$', the sentence it abbreviates entails (the sentence abbreviated by) '$\Diamond_{fc}(\text{K or S})$'. Where they differ is that the modal quantification in the latter, but not the former, can be *witnessed* by a plurality containing worlds in which both K and S hold. (This is what makes the struck-out members of (34), which have '$\Diamond_{fc}(\text{K or}_x \text{ S})$' conjoined to the negation of '$\Diamond(\text{K and S})$', equivalent to their variants with '$\Diamond_{fc}(\text{K or}_s \text{ S})$'). Because '$\Diamond_{fc}(\text{K}$

or$_x$ S)' entails '$\Diamond_{fc}$(K or S)' (and because the algorithm (17) filters out implicatures in DE contexts), it is very difficult to independently test our prediction that both are possible strong meanings for 'Alex may bring Kate or Susan'. On the other hand the prediction would seem to be harmless.

The derivation of the free choice/conjunctive effect with *Some As B or C* is entirely parallel, as are the considerations that arise. I do not illustrate the derivation, for the sake of space. The result can be checked for the sentence 'Some passengers got sick or had trouble breathing' by systematically swapping 'some passengers$_i$' for 'may', 'got sick or had trouble breathing' for 'bring Kate or Susan', and 't_i' for 'Alex', throughout the derivation above.

A final, crucial point is that (17) is defined such that the free choice effect, and scalar implicatures in general, disappear under DE embedders, as desired. Take 'Alex may not bring Kate or Susan', for which we assume the following LF:

(38)   [$_4$ not [$_3$ may [$_2$ DIST [$_1$ Alex bring Kate or Susan]]]]

ss(3) is exactly as before, but by (17d), ss(4)={[$_4$ not [$_3$ may [$_2$ DIST [$_1$ Alex bring Kate or Susan]]]]}, i.e. the singleton set containing the sentence itself. That is, all implicatures added in the scope of negation are cancelled (and since there are no stronger global alternative, no new ones are added).

Appendices

B–1 Alternatives Alternatives

We introduce a (trivial) modification of the recursive definition of alternatives, (7), which (i) allows us to eliminate Sauerland's 'L' and 'R' as lexical alternatives to 'or', (ii) gets rid of some redundancy in the overall system, and (iii) opens the possibility for a further modification, taking us closer to Chierchia's own definition (cf. (12)), with particular empirical consequences.

B–1.1 Alternate Derivation of Disjuncts as Alternatives

(39) For any expression (syntactic structure) α, $[\![\alpha]\!]^{ALT}$, the set of potentially relevant alternatives to α, is

    a. $\{\alpha_1, \ldots, \alpha_n\}$, if α is lexical and part of a scale $<\alpha_1, \ldots, \alpha_n>$, and $\{\alpha\}$, if α is lexical and not part of a scale

    b. $\{[\beta'\ \gamma']: \beta' \in [\![\beta]\!]^{ALT} \wedge \gamma' \in [\![\gamma]\!]^{ALT}\}$, if $\alpha = [\beta\ \gamma]$ and $\gamma \neq [\text{or } \delta]$

    c. $\{[\beta'\ \gamma']: \beta' \in [\![\beta]\!]^{ALT} \wedge \gamma' \in [\![\gamma]\!]^{ALT}\} \cup \{\beta, \gamma\}$, if $\alpha = [\beta\ \gamma]$ and $\gamma = [\text{or } \delta]$

The modified definition achieves by force the work done by Sauerland's alternatives for *or*, making the individual disjuncts available as alternatives to a disjunction. It thus allows us to use Chierchia's more restricted set of alternatives to *or*,

(40) $[\![\text{or}]\!]^{ALT} = \{\text{or, and}\}$ *('Chierchia's scale')*

but retains the result crucial for the account of free choice – that among the alternatives to a universal over disjunction, '∀ A or B', are '∀ A', and '∀ B'.[28] While these revisions are in some sense trivial, it is important to note that (39) does not always give equivalent results to what is derived from (7) plus Sauerland's scale. Under the latter, the alternatives to a disjunction as a whole include not only (effectively) the disjuncts themselves, but (effectively) *their own* alternatives. This is the property which allows him/Fox to globally derive the implicatures of sentences with a weak scalar item (*some, or*) embedded under another; e.g. the exclusive interpretation of multiple disjunctions, or (1). It is shown below that we derive the implicatures of multiple disjunctions both 'globally' (a la Sauerland/Fox) *and* 'locally' (a la Chierchia), but that moving to (39) and Chierchia's scale for *or* eliminates the global derivation (point (ii), above).

The move to (39) involves no more of a stipulation than the Sauerland lexical assumption.[29] And it seems that it could be given a principled motivation. It is (exceedingly) rational for a hearer to assume that all of the words that the speaker utters will in some way contribute to the meaning that he intends to communicate – in addition, obviously, to the literal meaning – and particular that his intended effect depends on *all* of the words he actually used. Since the disjuncts are both logically stronger than and systematically derivable from a disjunction (by the simple omission of the other disjunct and the word *or*), it is natural that pragmatic reasoning (however we model it) should take into account that one was used.[30]

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[28] By Chierchia's scale and (39c), $[[\gamma \text{ [or } \delta]]]^{ALT} = \{[\gamma \text{ [or } \delta]], [\gamma \text{ [and } \delta]], [\gamma], [\delta]\}$. By (39b), $[[\text{every } \phi \text{ } [\gamma \text{ [or } \delta]]]]^{ALT}$ includes $[\text{every } \phi \text{ } [\gamma]]$, and $[\text{every } \phi \text{ } [\delta]]$.

[29] The clauses (39b) and (39c) *are* 'non-compositional' – in the syntactic sense that they require looking inside γ to see its structure. This is probably a non-issue, since there's no a priori reason to think that reasoning about what other sentences could have been used should be constrained in the way that normal grammatical processes are.

[30] That's not to say that the Sauerland scale couldn't be motivated – probably in a similar way – but what is to be motivated in inherently stronger; there is the additional question of

We first show how the desired 'mutual exclusivity' implicatures of multiple disjunctions are derived using (7) and Sauerland's scale – e.g. the implicature (41a) of (41):

(41)   (Either) Alex got married, or he went on vacation, or he got sent to prison.

        a. $\rightsquigarrow$ Alex did exactly one of the three things

We abbreviate the sentential disjuncts as M, V, P respectively, and assume the second disjunction to be embedded in the first.[31,32]

(42)   [$_{s2}$ Alex got married or [$_{s1}$ he went on vacation or he got got sent to prison]]

(43) $[\![s1]\!]^{ALT} = \left\{ \begin{array}{c} \text{V or P} \\ \text{V l P} \\ \text{V r P} \\ \text{V and P} \end{array} \right\}$ *by (7), (9)*

(44)   ss(s1)={V or P, [[V or P] and not[V and P]]} *by (19), (17c)*

(Again we abbreviate '[[V or P] and not[V and P]]' as 'V or$_x$ P').

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how/why pragmatic considerations would derive the *lexicalizations* 'L' and 'R'. See Fox (2006) for a view of (recursive) pragmatics – as a solution to a communication problem – that could in principle address this question.

[31] The reader can verify that a (semantically) equivalent result is obtained for the reverse case, in which the first *or* is embedded under the second: [$_{s2}$ [$_{s1}$ M or V] or P].

[32] It is important to note that, in order for the system in §3 to derive the parallel exclusivity implicatures for *non-propositional* multiple disjunctions (e.g. *John at an apple or a pear or an orange*, it needs to be (trivially) revised to allow for implicatures to be added 'hyper-locally', i.e. at non-scope sites.

(45) $[\![s2]\!]^{ALT}=$

$$\left\{\begin{array}{llll}
\text{M or [V or P]}, & \text{M or [V l P]}, & \text{M or [V r P]}, & \text{M or [V and P]} \\
\neg, & \text{M l [V or P]}, & \text{M r [V or P]}, & \text{M and [V or P]} \\
\neg, & \text{M l [V l P]}, & \text{M r [V l P]}, & \text{M and [V l P]} \\
\neg, & \text{M l [V r P]}, & \text{M r [V r P]}, & \text{M and [V r P]} \\
\neg, & \text{M l [V and P]}, & \text{M r [V and P]}, & \text{M and [V and P]}
\end{array}\right\}$$

by (7), (9)

We can temporarily replace (45) with an equivalent, more manageable set of sentences,

$$(46)\quad\left\{\begin{array}{llll}
\text{M or [V or P]}, & \text{M or V}, & \text{M or P}, & \text{M or [V and P]} \\
\neg, & \text{M}, & \text{V or P}, & \text{M and [V or P]} \\
\neg, & \neg, & \text{V}, & \text{M and V} \\
\neg, & \neg, & \text{P}, & \text{M and P} \\
\neg, & \neg, & \text{V and P}, & \text{M and [V and P]}
\end{array}\right\}$$

in order to see that

$$(47)\quad\Sigma_{s2}=\left\{\begin{array}{llll}
\neg, \ \neg, & & \neg, & \neg \\
\neg, \ \neg, & & \neg, & \text{M and [V or P]} \\
\neg, \ \neg, & & \neg, & - \\
\neg, \ \neg, & & \neg, & - \\
\neg, \ \neg, & \text{M r [V and P]}, & & -
\end{array}\right\}$$

(All the cells of (46) entail *M or V or P*; the ones that remain in (47) are those whose negation together with *M or V or P* does not entail some other cell (distinct from *M or V or P* itself); (13c)).

By (17c), ss(s2) is as follows (we go back to abbreviating 'M r [V and P]' as the equivalent 'V and P', for readability):

(48)
$$
\left\{ \begin{array}{l} \text{M or [V or P]} \\ \text{M or [V } \text{or}_x \text{ P]} \end{array} \right\} \cup
$$
$$
\left\{ \begin{array}{l} \text{[M or [V or P]] and not[M and [V or P]] and not[V and P]} \\ \text{[M or [V } \text{or}_x \text{ P]] and not[M and [V or P]] and not[V and P]} \end{array} \right\}
$$

The bottom two sentence (the long ones) are equivalent, and in particular express directly the strengthened meaning that exactly one of the three propositions holds. We derive this meaning twice precisely because is we import into Chierchia's system – which crucially uses local/embedded implicatures to derive it – precisely the aspects of the Sauerland/Fox approach that allow them to derive it with *global* ones. (The 'global derivation', so to speak, corresponds to the first of the final two sentences, the 'local derivation' to the second). The redundancy comes in because of the alternative r to the higher *or*: by the projection rule we get 'M r [A and B]' as a global alternative, which is to say, effectively, that the alternative 'A and B' to the embedded disjunction percolates up. While the redundancy is harmless, we show that it is eliminated if (39) and Chierchia's scale ((40)) is used in place of (7) and Sauerland's scale:

(49)
$$
[\![\text{s1}]\!]^{ALT} = \left\{ \begin{array}{c} \text{V or P} \\ \text{V} \\ \text{P} \\ \text{V and P} \end{array} \right\} \quad \textit{by (39), (40)}
$$

(50)   ss(s1)={V or P, [[V or P] and not[V and P]]}   *by (19), (17c)*

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(Again we abbreviate '[[V or P] and not[V and P]]' as 'V or$_x$ P').

$$(51) \quad [\![s2]\!]^{ALT} = \left\{ \begin{array}{cccc} \text{M or [V or P],} & \text{M or V,} & \text{M or P,} & \text{M or [V and P]} \\ & \text{M and [V or P]} & & \\ & \text{M,} & \text{V or P} & \end{array} \right\}$$

by (39), (40)

$$(52) \quad \text{ss(s2)} =$$
$$\left\{ \begin{array}{c} \text{M or [V or P]} \\ \text{M or [V or}_x \text{ P]} \end{array} \right\} \cup \left\{ \begin{array}{c} \text{[M or [V or P]] and not[M and [V or P]]} \\ \text{[M or [V or}_x \text{ P]] and not[M and [V or P]]} \end{array} \right\}$$

by (17c)

The bottom member directly yields the overall mutual exclusivity effect – that exactly one of the three disjuncts holds. It should be evident that its derivation depends crucially on adding an implicature in the lower disjunction, just as it does in Chierchia (2004). Unlike before, there is no member of ss(s2) in which the effect is derived by adding implicatures at the global level. The move to (39) and (40) has another interesting consequence. There is an additional member of (52) which is not present in (48): '[M or [V or P]] and not[M and [V or P]]'. This would capture the (ostensible) possibility of contextual or explicit cancelation of mutual exclusivity *only* between V and P – for example, where 'M or V or P' is followed up with, "and maybe even both V and P'. The mirror case, 'M or [V or$_x$ P]' is contained in both (52) and (48). Given that both possibilities are empirically attested, the move thus has some independent support.

B–1.2 Constrained Projection

The treatment of disjunction in (39) is consistent with a further revision, a severe restriction to the basic way that alternatives project; essentially that assumed by

Chierchia (2004).

(53)   For any expression (syntactic structure) α, $[\![\alpha]\!]^{ALT}$, the set of potentially relevant alternatives to α, is

    a. $\{\alpha_1, \ldots, \alpha_n\}$, if α is lexical and part of a scale $<\alpha_1, \ldots, \alpha_n>$, and $\{\alpha\}$, if α is lexical and not part of a scale

    b. $\{[\beta\ \gamma']\colon \gamma' \in [\![\gamma]\!]^{ALT}\}$, if $\alpha=[\beta\ \gamma]$, $[\![\beta]\!]^{ALT}$ is singleton, and $\gamma \neq [\sigma$ or $\tau]$

    c. $\{[\beta\ \gamma']\colon \gamma' \in [\![\gamma]\!]^{ALT}\} \cup \{[\beta\ \sigma], [\beta\ \tau]\}$, if $\alpha=[\beta\ \gamma]$, $[\![\beta]\!]^{ALT}$ is singleton, and $\gamma=[\sigma$ or $\tau]$

    d. $\{[\beta'\ \gamma]\colon \beta' \in [\![\beta]\!]^{ALT}\}$, if $\alpha=[\beta\ \gamma]$ and $[\![\beta]\!]^{ALT}$ is not singleton

(53) follows directly Chierchia's own definition, and differs from (7) (and (39)), in that, when an expression γ combines with another expression β which itself has a (non-trivial) set of alternatives (i.e. a β that is or contains a scalar item), γ's own alternatives disappear.[33] The important consequence is that implicatures involving alternatives to γ (or any constituent of γ) cannot be computed beyond that point.[34] For example, under (53) (as with Chierchia's own rule), an implicature that $\neg\Diamond$(A and B) cannot not be derived for '$\Diamond$(A or B)'. Similarly for the formal analogue with a singular existential: *Somewhere in France it is cold or rainy* would not (even possibly) lead to an implicature that nowhere in France is it cold and rainy. It is not entirely clear to me what the facts are, and thus whether the general result (see section §3.3) is desirable in all cases. (It would seem to be for the latter example).

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[33]In order for (53) to work properly, it needs to be assumed that heads/functors always come to the left of their complement/argument (at LF). This is an inessential simplification; it could be rewritten to be order independent (by reference to the category of α/the types of β and γ).

[34]At least not without a special stipulation, which Chierchia needs, and we would need, to handle scalar items embedded under DE operators (with non-trivial scales). See fn. 18.

Importantly, clause (39c) rule still allows us to always recover $[\beta\ \phi]$ and $[\beta\ \psi]$ as alternatives to $[\beta\ [\phi\ \text{or}\ \psi]]$. This means that free choice, and diversity implicatures of universals over disjunction more generally, can still be derived, at least in simple cases. However, where another (constituent containing a) scalar item intervenes between the universal/distributive operator and disjunction, (53) predicts that the diversity/free choice effect should disappear. The following suggest that the prediction is too strong:

(54)   The hospital can hold someone$_i$ against their$_i$ will with their$_i$ parents' or their$_i$ spouse's consent

      a. $\leadsto$ The hospital can hold someone$_i$ against their$_i$ will with their$_i$ parents' consent, and the hospital can hold someone$_i$ against their$_i$ will with their$_i$ spouse's consent

(55)   Every man caused some woman$_i$ to fight with her$_i$ parents or her$_i$ husband

      a. $\leadsto$ Some man caused some woman$_i$ to fight with her$_i$ parents, and some man caused some woman$_i$ to fight with her$_i$ parents

(We force the intervening scalar-item-containing constituent, the existential quantifier, to bind into the disjuncts, in order to rule out the possibility that the disjunction could be outscoping it). We tentatively conclude, then, that (53) is too stringent to be compatible with our account of free choice. However, we leave open the question of whether (7)/(39) give results that are too strong in some cases at the global level (for example, since they lead to the derivation of an implicature that nobody A and B for *Someone A or B*, as discussed above).

CHAPTER 3

Distributivity and Implicatures within DP

1 Introduction

The strengthening to a wide scope conjunction (often) associated with *Some As B or C* – 'some As B and some As C' – is not in general preserved when the restriction and nuclear scope of the existential are permuted:

(1)   The FBI isn't limiting its investigation of the campus bomb threat to known terrorists. For example...

    a.   Some people under investigation are foreign or politically active professors.

    b.   Some foreign or politically professors are under investigation.

    c.   (a) but not (b) $\rightsquigarrow$ Some foreign professors are under investigation, and some politically active professors are under investigation[1]

(2)   Many people become security guards after retiring from another career. For example...

    a.   Some security guards are former cops or retired soldiers.

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[1]The inference to a wide scope conjunction may for some people be marginally possible for (1b), in particular with a certain intonation pattern. I expect that for everyone it is much easier with (1a), however, and I doubt that anyone accepts it with (2b). I have nothing to offer about this point, but I think that all that is essential is that there is a (strong) contrast between the (a) and (b) cases.

    b.   Some former cops or retired soldiers are security guards.

    c.   (a) but not (b) $\leadsto$ Some security guards are former cops, and some are retired soldiers

This chapter proposes an explanation of the contrast within the proposal in Chapters 1 and 2. The account of scalar implicature discussed in Chapter 2 derived the overall conjunctive effect with the (a) sentences as a result of implicatures calculated based on a distributive operator, added within the scope of the existential. Schematically, it derives an implicature-strengthened meaning for (3) which entails (3a):

(3)   [$_{DP}$ some ϕ] [DIST [...β or γ ...]]

    a.   [$_{DP}$ some ϕ] [DIST β] and [$_{DP}$ Some ϕ] [DIST γ]

(4)   where: $[\![\text{DIST}]\!] = \lambda P_{<et>}\lambda X. [\forall x: x \sqsubseteq X] Px$

The account, as it stands, also predicts that the 'permutation' of (3), (5), should have an overall strengthened meaning which entails (3a):

(5)   [$_{DP}$ some [DIST [...β or γ ...]]] ϕ

This prediction arises from the conjunction of the following facts: (i) the entailment to (3a) from the overall strengthened meaning assigned to (3) was derived solely via implicatures added locally to the nuclear scope of the existential, '[DIST [β or γ]]', (ii) nothing in the proposal in directly blocks adding the same implicatures in the restriction of a quantifier, and (iii) (trivially) permuting the restriction and nuclear scope of an existential quantifier is truth preserving.

Taking a concrete case, the conjunctive effect for (1a), an instance of the configuration (3), was derived by assigning it the strengthened meaning (6) – the universal corresponds to 'DIST', and the underlined material to the locally added implicatures:

(6) $[\exists X: PI(X)]$ $([\forall x: x \sqsubseteq X]$ $FPx \lor PAPx)$ $\land$ $([\exists x: x \sqsubseteq X]$ $PAPx \land \neg FPx)$ $\land$ $([\exists x: x \sqsubseteq X]$ $FPx \land \neg PAPx)$
        where 'PI' translates 'people who were investigated', 'FP', 'foreign profes-
        sor', and 'PAP', 'politically active professor'

Trivially the entailment to a conjunction remains under permutation of the restriction – 'PI(X)' – and the nuclear scope. Thus the proposal in Chapter 2 would seem to (wrongly) predict the conjunctive effect for (1b), and identically for (2b), at least *given that* they can have the structure (5), and in the absence of further constraints.

The theory of scalar implicature in Chapter 2 could be modified in at least two ways to account for the (a)/(b) contrasts, given that (5) is indeed an available structure for the (b) cases. The first possibility would be to force it to be the case that implicatures cannot be added at the relevant point in (5), i.e. DP internally, to the quantifier restriction. I don't know of any independent reason to do so. The operative assumption in Chapter 2 was that implicatures can be added at scope sites, and it seems plausible that there is a scope position internal to DP – cf.

(7)   Every author of an award winning novel/at least one award winning novel was invited

        a.   for every x such that there is an award winning novel y such that x

is the author of y...

A second possible revision would be to force alternatives to *project* differently within quantifier restrictions (as compared to other contexts), such that the alternatives that would lead to the (implicatures leading to) the conjunctive effect are unavailable in (5). Again this would seem to be ad hoc.

This chapter argues that no such implausible or ad hoc provisions need to be added to the proposal in Chapter 2 in order to explain the (a)/(b) contrasts, since there is independent evidence that the configuration (5) is in fact unavailable for the (b) cases.[2] **In particular, independent evidence is given that a distributive operator cannot take the disjunction in its scope within DPs like those in the (b) examples** – and that neither can the plural morpheme itself, often taken to be effectively a distributive operator (e.g. Link 1983). It is further shown that the correlation goes both ways. There *are* 'permuted', logically equivalent variants of the (a) examples that *do* strengthen to conjunction – namely in which the disjunction is moved into a relative clause...

(8) The FBI isn't limiting its investigation of the campus bomb threat to known terrorists. For example...

    a. Some professors who are foreign or politically active are under investigation.

      ⤳ Some foreign professors are under investigation, and some politically active professors are under investigation

(9) Many people become security guards after retiring from another career. For example...

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[2]This is essentially to say that the contrast follows because the (a) and (b) sentences have different alternatives (despite being logically equivalent).

a. Some people who were cops or soldiers are (now) security guards.

  ⤳ Some security guards are former cops, and some are retired soldiers

...but it is shown that disjunction *can* be distributed over internal to relative clauses. These facts are established (in §2) by way of novel observations about the truth and felicity conditions of sentences containing quantifiers with disjunctive restrictors. Their importance is that they show that the contrast between the (a) and (b) examples, rather being a puzzle, *attests the most basic prediction the account of the (a) cases (and free choice permission) developed in Chapter 2*: no distributive operator (or equivalent thereof) scoping over disjunction, no strengthening to conjunction.[3]

2 The Plural Morpheme and Distributivity within Nominals

We first make explicit, then motivate, the assumptions about plural NPs and the plural morpheme which are required to (a) derive the appropriate meaning for plural existentials as in (1b), (2b), and (b) prevent them from strengthening to conjunctions like their permuted counterparts (under the theory of implicature in Chapter 2). Consider the following:

(10) a. Some cops or soldiers are surrounding the building

     [$_{DP}$ some [$_{NP}$ cops or soldiers]] ...

   b. John bought some red or yellow socks for a total price of $25.00

     ...[$_{DP}$ some [$_{NP}$ red or yellow socks]] ...

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[3]As discussed in Chapter 1, this prediction is difficult to test directly with disjunctions in VP/the nuclear scope of an existential, because distributivity is systematically possible with VPs, even collective ones -- viz. cover readings/distribution to sub-pluralities.

Intuitions about the truth conditions of these examples suggest that the domain of the quantifier should include, in the former case, (at least) pluralities of cops, and pluralities of soldiers, and in the latter, (at least) pluralities of red socks, and pluralities of yellow socks. The former is judged true if there is a plurality of cops, or a plurality of soliders, surrounding the building; the latter if there is a plurality red socks, or a plurality of yellw socks, purchased by John for a sum total of $25.00. For the former, this result is trivially derived by taking the plural morpheme ('pl') to apply to a noun root, qua predicate of atoms, and deliver the set of pluralities composed of atoms it is true of (Link, 1983):

(11) $[\![N\text{-pl}]\!]={}^{*}[\![N]\!]$

    a.   where $^{*}F$ is the characteristic function of the smallest set such that

        (i) $\forall X(F(X) \Rightarrow {}^{*}F(X))$

        (ii) $\forall X \forall Y({}^{*}F(X) \wedge {}^{*}F(Y) \Rightarrow {}^{*}F(X \oplus Y))$

           where '$\oplus$' is mereological sum formation

(12) $[\![[_{NP}\ \text{cop-pl or soldier-pl}]]\!]=$

    $[\![\text{cop-pl}]\!] \cup [\![\text{soldier-pl}]\!]=\lambda X.$ X is one or more cops, or X is one or more soldiers

To get the right result for (10b), one of the following needs to be assumed. Either 'red' and 'yellow' are themselves (covertly or inherently) pluralized, such that the NP is (equivalent to) (13), or the plural morpheme itself takes wider scope than on the surface, over the NP ((14)).

(13) $[_{NP}\ \text{red-pl or yellow-pl [sock-pl]}]$

a. $[[(13)]]=(*[[red]] \cup *[[yellow]]) \cap *[[sock]]^4$

b. $=\lambda X.$ X is one or more red socks, or X is one or more yellow socks

(14) $[_{NP}$ red or yellow [sock]]-pl

    a. $[[(14)]]=*[([[red]] \cup [[yellow]]) \cap [[sock]]]$

    b. $=*[\lambda x.$ x is a red sock or x is a yellow sock]

    c. $=\lambda X.$ X is one or more red socks, X is one or more yellow socks, or

        X is the sum of one or more red socks and one or more yellow socks

The denotation of (14) properly includes (13), containing in addition 'mixed' pluralities, composed of both red socks and yellow socks. Because of the upward monotonicity of *some*, we have that,

(15) $[[some]]([[(13)]])(\phi) \rightarrow [[some]]([[(14)]])(\phi)$

Given this, (14) could in principle be the (unique) correct analysis for (10b): it covers any cases where the sentence is intuitively true. However, there is an argument that is is not even a possible one. The important observation is that (10b) is *judged false* when the witness to its existential quantification is one of the pluralities that is in (14) but not (13) – i.e. a mixed plurality. In other words, where the right hand side of (15) is true but the left false, (10b) seems to be false:

(16) John bought some red or yellow socks for a total price of \$25.00 (and he spent exactly \$25.00 on socks).

    a. No, some of the socks that he bought (for \$25.00) were red, and

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[4] We presuppose a standard intersective semantics for adjectives (issues about comparison classes, etc. are irrelevant here), and a generalization of '$\cup$' and '$\cap$' to characteristic functions of sets: for characteristic functions F, G with domain α, $F \cup G = \lambda x_\alpha.\ F(x) \vee G(x)$.

some were yellow.

Thus (13) rather than (14) seems to be what is wanted. It is crucial to establishing this point that the nuclear scope of the existential in (10b), λX. John bought X for a total price of \$25.00, is a (true) collective predicate. For distributive predicates, the left-right implication in (15) also holds in the other direction. (Accordingly, a counterpart of (10b) with a distributive predicate, e.g. *John bought some red or green socks*, seems not to be false under a mixed witness).[5]

Similar considerations to the above apply to (10a). If its NP could be analyzed (somehow) as,

(17)   [[cop or soldier]-pl]

it would (wrongly) be expected to be able to be witnessed by mixed pluralities:

(18)   Some cops or soldiers are surrounding the building.

      a.   No, it's a mixed group of some cops *and* some soldiers who are surrounding the building.

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[5]There are several potential wrinkles in the argument which are worth noting, but which I doubt to be serious. First, the intuition of falsity under a mixed witness could in principle be an illusion due to some implicatures (of the disjunction in (13)), i.e. to judgment being passed on a strengthened meaning of (14) rather than (14) itself. However, the intuitive judgment is not in my judgment suspendable/cancelable as would be expected if this were the case. (It is also not clear that such implicatures, which would have to entail the non-existence of a mixed witness, would be expected under any otherwise warranted assumptions).

Second, the intuition could be an indication that disjunction is taking wider than apparent scope, yielding something equivalent to:

(i)   (John bought) some red socks or some yellow socks (for a total price of \$25.00)

There may be cases in which disjunctions in quantifier restrictions outscope their determiners. But the robustness of the intuition would require that it *must* be doing so here, and there seems to be no reason to expect this. See below for further considerations on this point.

Switching to a different determiner, the definite article, it can be seen even more directly that the analyses (14), (17) are unavailable:

(19)　CONTEXT: Having mixed up the laundry for his housemates, A says: "There are many different types of socks, and in many different colors – red, yellow, blue, and green. Which ones are yours?

　　　a.　(I don't know exactly which ones are mine but) The red or yellow socks belong to someone else. (...I don't own any red or yellow socks)

　　　b.　(I don't know exactly which ones are mine but) The socks that are red or yellow belong to someone else. (I don't own any red or yellow socks)

The important observation is that (19a) does not lead to a conjunctive interpretation, 'the socks that are red and the socks that are yellow belong to someone else', which *is* available for (19b) (we return to the latter below). But it would have this interpretation directly *if* the structure (14) were available for the description in (19a), i.e. it would be equivalent to 'the things each of which is a red or yellow sock'. The latter description refers to the plurality containing (all of) the red socks and the yellow socks (given the existence of red and yellow ones, which is explicitly stated in the context). The description in (19a) would thus refer to the plurality containing the red socks and the yellow socks, and the sentence would say that those socks belong to someone else. Identical considerations apply to the following; its NP cannot be (17), or else it should refer to a mixed plurality (modulo the relevent presupposition being met):

(20)　a.　The cops or soldiers...

b.   The men who are cops or soldiers...

(a) but not (b)='the men each of which is a cop or a soldier'

We conclude from these observations about the meanings of (10b), (10a), (19a), (20a) that structures like (14), (17) are not possible – under the assumed interpretation of the plural morpheme, or any equivalent analysis. This result is of interest since these structures are effectively instances of the problematic configuration (5); amounting to a distributive operator scoping over disjunction. If they were possible, (10a) and (10b) ((1b), (2b)) would be predicted, under the assumptions in Chapter 2, to lead to implicatures ensuring precisely that their witness is a mixed plurality (i.e. to strengthen to conjunction). It also follows from the observations that it must be impossible for a *distributive operator* to apply to the NPs in (10b), (10a), (19a), (20a). The reason is simply that the resulting meanings would be equivalent to (14) and [[cop or soldier]-pl], respectively (we illustrate just for the former):

(21) $[$DIST $[_{NP}$ red-pl or yellow-pl $[$sock-pl$]]]$

    a. $=[\![\text{DIST}]\!](\lambda X.$ X is one or more red socks, or X is one or more yellow socks$)$

    b. $= \lambda X. [\forall x: x \sqsubseteq X] [\lambda X.$ X is one or more red socks, or X is one or more yellow socks$](x)$ *by (4)*

    c. $= \lambda X.$ X is one or more red socks, X is one or more yellow socks, or X is the sum of one or more red socks and one or more yellow socks

Abstracting away from the details of the semantics of plurals, we have the following generalization, which is enough to explain why (1b) and (2b) don't strengthen to conjunction:

(22)   disjunctions 'immediately contained' in NP cannot fall under the scope of
        a pluralizing/distributive operator (where immediately contained means
        'not in a relative clause')

In addition, The fact that a mixed witness/mixed reference *is* possible with the relative clause examples correlates directly with the fact that we (strongly) get a conjunctive effect in examples like (8a) and (9a), in which the disjunction appears in a relative clause. This correlation between the possibility of disjunction to be distributed over and the conjunctive strengthening effect lends independent support to our basic proposal for the latter, since the proposal crucially depends on distributivity.

It is worth noting that (22) holds independently of the assumption that the plural morpheme has a **'one or more'** meaning (as made explicit in (11); cf. Chapter 1 for discussion). Even with a 'two or more' meaning, it would be possible to derive the unattested readings of the examples discussed above.[6] The reason is that, as observed in Chapter 1, distributivity can in general be relative to a cover, i.e. to sub-pluralities rather than to atoms (Schwarzschild, 1996). For example, if interpreted with respect to a cover distributing (just) over sub-pluralities of two or more red socks or two or more yellow socks, [DIST [$_{NP}$ red-pl or yellow-pl [sock-pl]]] would (wrongly) come out equivalent to $\cdot$ (14).[7]

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[6]To get the '2 or more' meaning, trivially redefine (11) as follows:

(i) $[\![N\text{-pl}]\!] = \lambda X.\ ^*[\![N]\!](X) \land \neg[\![N]\!](X)$

[7]Redefine (4) to be relative to a (contextually determined) cover, C, as follows (Schwarzschild, 1996),

(i) $[\![\text{DIST}_c]\!]^g = \lambda P_{<et>} \lambda X.\ [\forall Y:\ C(Y)\ \text{and}\ \text{Cover}(C)(X)]\ P(Y)$

I will not provide here an analysis of plurals that fully derives the observations in this chapter – the empirical observation (22) being sufficient for present concerns. An analysis that would account for (22) is given in Kratzer (2007) (for independent reasons). It differs slightly in that she takes roots/lexical items to have an *inherently* plural meaning (effectively, closed under sum formation by a *-operator). In her system, it is possible (and necessary) to 'pluralize' at the phrasal level – the equivalent of applying a distributive operator – but she assumes that this can only happen as the result of movement. Put into our terms, a distributive operator can only apply to scope of a DP/operators which has undergone QR. Kratzer's assumptions are put to use in Ferreira (2005) to derive a set of facts involving indefinites that are entirely parallel to those observed here for disjunction. Ferreira's observation was essentially that, unless in relative clauses, indefinites fail to be distributed over internal to a plural DPs.

(23)   a.   The/some wives of a professor (were at the party)

        b.   The/some women who are married to a professor (were at the party)

              (b) but not (a)='The/some individuals such that each of them is the wife of some professor...'

This combination of facts indicates a parallel conclusion to that drawn above: neither the plural morpheme (qua Linkean *-operator) nor any distributive operator can appear immediately within NP in (23a) with wider scope than the indefinite – otherwise precisely the missing reading is derived:[8]

where C is the value of $g(c)$, and Cover(C)(X) iff X is the maximal Z such that $*C(Z)$

Let $C = \lambda X.$ [red-pl sock-pl](X) $\vee$ [yellow-pl sock-pl](X), with 'pl' interpreted as in fn. 6. Then
[[DIST$_c$ [$_{NP}$ red-pl or yellow-pl [sock-pl]]]]=$\lambda X.$ [$\forall x: x \sqsubseteq X$] [red sock](x) $\vee$ [yellow sock](x)

[8] nb. $*[\lambda x.$ [$\exists y:$ doctor(y)] wife(x)(y)]=the (characteristic function of the) set of pluralities women who are married to doctor=the restriction of (24).

(24)   [the/some X: [∀x: x⊑X] [∃y: doctor(y)] wife(x)(y)]...

Ferreira assumes (plausibly) that there is no movement in (23a) to allow distributivity to apply at the phrasal level, i.e. over the NP containing the indefinite, as opposed to (23b), where there is operator movement in the relative clause. He shows that under these assumptions, exactly the correct readings are derived. It should be apparent (given the interdefinability of disjunctions and existentials) that Kratzer/Ferreira's account could be extended directly to the disjunction cases discussed here.[9] An open question for their approach is whether the direct tie it assumes between movement and distributivity can be generally defended or motivated.[10] I leave these issues for future research.

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[9]An alternative possibility is that disjunctions and indefinites immediately contained in nominals simply systematically take wider scope than both any distributive operator or the plural morpheme (qua Linkean *-operator). This could mean either that they systematically take scope outside of DP itself, or at a position internal to DP that is higher than the plural or any distributive operator. I doubt that either of these possibilities is correct; at least they would seem to be ad hoc. While I have no direct arguments against the former, the latter seems to be untenable, for two reasons.

First, it is not generally the case that disjunctions (immediately contained) in nominals must scope out of DP; cf. *No doctors or lawyers came to the party, Every blue or yellow sock is mine.* Second, definite description as in (19a) and (20a) seem to have at least a reading whose felicity conditions suggest the scope of the disjunction to be internal to DP. There is a salient reading on which 'the red or green socks' and 'the doctors or lawyers' seem to presuppose the existence of, respectively, a (maximal, salient) plurality of socks that are either all red or all green, and a (maximal, salient) plurality of individuals who are either all doctors or all lawyers. This is precisely as expected given that the disjunction has DP-internal scope, and that it cannot be distributed over. There may also be readings as (wide scope) disjunctions of descriptions, equivalent to 'the red socks or the green socks', 'the doctors or the lawyers'. But (at least out of the blue) these descriptions trigger much stronger presuppositions – of the existence of *both* red socks *and* green socks, and doctors *and* lawyers. It thus doubtful that only a widescope reading is possible. While it is in principle possible to derive the weaker presupposition from a wide scope logical form (i.e. one equivalent to a disjunction of descriptions), using not unattested properties of local presupposition accommodation; cf. *Either John has (just) started smoking or he has (just) stopped smoking.* But this begs the question of why the weaker presupposition isn't readily available out of the blue for overt disjunctions of descriptions.

[10]An alternative way of explaining (22) and Ferreira's observations, without such an assumption, is suggested by the following fact. Ferreira observed that just as distribution over the indefinite in (23a) is alleviated by moving it into a relative clause, i-within-i effects are alleviated by moving an offending pronoun into a relative clause:

(i)   a.   *[The wife of the author of her$_i$ autobiography]$_i$ [due to P. Jacobson]
        b.   [The woman who$_i$ is married to her$_i$ autobiographer]

There is an obvious parallel in that a distributive operator effectively contains a variable that is bound by some plural DP – in the case of (23a)/(23b) (and the parallel examples with disjunction), the one containing it. It thus seems possible that our/Ferreira's contrasts could be explained as i-within-i effects, without appealing to any stipulation about the distribution of distributive operators.

CHAPTER 4

Disjunctive Antecedents

1 Introduction

In this chapter we address a well-known puzzle about the interpretation of disjunction in antecedents of conditionals (Fine (1975), Nute (1975), Lewis (1977)): inferences from (counterfactual) *If A or B, C* to *If A, C* and *If B, C* are robust, (1), but not validated by Lewis (1973)'s (otherwise well-motivated) semantics, (2):

(1)   If John had studied hard or cheated, he would have passed

      a.   ⇝ If John had studied hard, he would have passed, and If John had cheated, he would have passed

(2)   (counterfactual) *if A, B* is true in w* iff $\forall w(w \in f(\llbracket A \rrbracket, w^*) \rightarrow \llbracket B \rrbracket(w))$ where $f(\llbracket A \rrbracket, w^*)$ is the set of worlds most similar to the actual world in which A holds

      a.   (1) is true in w* iff for each of the worlds w in which John cheated or studied hard *that are most similar/closest to w**, John passed in w^1

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[1]I will take the liberty of idealizing/simplifying features of Lewis's account which are inessential to the issues discussed here. For example, I systematically make the 'Limit Assumption', not shared by Lewis, if only to simplify the exposition.

The inference pattern exemplified by (1) to (1a), Simplification of Disjunctive Antecedents ('SDA'), is not in general valid under Lewis's semantics, given a boolean semantics for disjunction, as indicated by the paraphrase (2a). The most similar worlds to w* (the actual world/world of evaluation) in which the proposition that either John cheated or John studied hard holds could all be worlds in which he did one thing but not the other. If for example they are all worlds world in which he studied hard (John being honest), (1) is equivalent to *If John had studied hard, he would have passed*, and the truth of *If John had cheated, he would have passed* stands or falls as it may.[2] But intuitively we understand the sentence as making a claim about both kinds of situations, i.e. as a conjunction.

Under a standard boolean semantics for disjunction and Lewis's conditional semantics, SDA stands no hope of being valid in general, because it is exactly the kind of entailment pattern whose intuitive *invalidity* motivated Lewis in the first place. For example, an inference from (3) to (3a) is (problematically) valid if conditionals are treated as material or strict implications, but blocked by Lewis's account,

(3)   If Dan had been at the party, Alex would have been happy

    a.   If Dan had been at the party violently drunk, Alex would have been happy

since the closest worlds in which Dan is at the party need not be ones in which he is violently drunk. Since Lewis's semantics doesn't take into account (for example) the form of the antecedent, but only its meaning, the truth-value of (3) is preserved if its antecedent is replaced with a logically equivalent sentence.

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[2]This is the only way that the inferences can fail, since Lewis's semantics ensures that if there are any A worlds (B worlds) among the closest worlds in which the proposition that A or B holds, all of the closest A (B) worlds are.

Assuming that *or* is boolean disjunction, replacing its antecedent with 'Dan was at the party or Dan was at the party violently drunk', for example, is truth preserving, since they are logically equivalent. Because of this property there is no way to alter Lewis's account to validate SDA – keeping the assumption that *or* is boolean – without re-validating unwanted inferences like (3) to (3a). Let $A>B$ be the Lewis counterfactual, but with its semantics (somehow) modified such that: for all X, Y, Z, $(X \lor Y)>Z$ entails $X>Z$ and $Y>Z$. This will hold in particular for all antecedents A, A' such that A' entails A. Since (for all Z) $A'>Z$ will be entailed by $(A \lor A')>Z$, it will also be entailed by $A>Z$, (for all such A, A'), since $A \lor A'$ is equivalent to A itself. Taking an example, since (3a) will be entailed by *If Dan was at the party or Dan was at the party violently drunk, Alex would have been happy*, it will also be entailed (3).[3]

In any event, there are cases that suggest that SDA shouldn't be valid (McKay and van Inwagen, 1977), and for which the attested meaning is, it seems, exactly what Lewis's semantics predicts:

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[3]The problem posed by disjunction to Lewis's semantics is now folkloric. It was first discussed, as far as I know, by Fine (1975) and Nute (1975); see also Ellis et al. 1977; Lewis 1977; Warmbrod 1981. There are obvious ways out which are worth mentioning. First, Nute himself advocated a semantics similar to Lewis's, *but without* the assumption that $f(P, w)=f(P', w)$ for any equivalent P and P' (a move which amounts to letting f be a hyperintensional operator). He was thus able to validate SDA by a special axiom, i.e. by brute semantic force, without running into the problem of re-instating an entailment from (3) to (3a) (more generally, validating 'strengthening of the antecedent'). As will become clear below, I don't advocate this move, since I doubt that SDA is systematically valid (cf. (4) and discussion). Even if it were, I assume that we wouldn't want it validated by mere stipulation.

The second loophole is hidden under the assumption (tacit above) that there is no context dependency regarding which antecedent worlds are quantified over in a given utterance of a counterfacutal – i.e. that the value of f is fixed either once and for all, or at least prior to the utterance taking place. This assumption seems to be stronger than what Lewis himself intended. If there is such context dependency, then the form of the antecedent could become (indirectly) relevant to determining the meaning of the counterfactual as a whole (i.e. to the determination of f). We return in §3 to the question of whether this can be exploited to explain away the intuitive validity of SDA. (What would need to be shown, minimally, is that disjunctions have pragmatic properties that should systematically influence the contextual resolution of f so as to make SDA "pragmatically" valid, i.e. valid *modulo* modulo the presence of those properties).

(4)   a.   If John had married Susan or Alice, he would have married Alice.

        b.   If John had taken the red pill or the green pill – any maybe even either of them – he wouldn't have gotten sick.

There are many possible responses to apparently disparate data like (1) and (4), many of which have been explored in the literature. One could for example plead ambiguity, with a special non-boolean meaning for *or* in examples like (1) that validates SDA by brute force (as explored first in Fine (1975), McKay and van Inwagen (1977), and Lewis (1977)). A variant of this is to appeal to an underspecified semantics for disjunction to the same effect – one which can, on one specification, validate SDA by brute force, and on the other behave like normal boolean disjunction (Alonso-Ovalle, 2004). I will not evaluate these responses in detail here.

Rather, I want to simply suggest that, if we take the facts in (4) seriously – and in lieu of a strong proof that they should be discounted or can be explained away – it is natural to pursue a pragmatic explanation for the cases where SDA is valid. But this leads directly to a familiar paradox. Suppose that someone asserts *If A or B, C*, and knows that *If B(A), C* is true – i.e. his statement is true, and known by him to be true, in virtue (at least) of the closest A or B-worlds having among them (at least) *A-worlds* that are C worlds. If the conversational situation is usual, it seems hard to imagine any (non-sociopathic) reason for the speaker to have used a disjunction in the first place, given his epistemic state. Thus a hearer should conclude that the speaker is not in fact in this epistemic state – i.e. *does not know* that if A, C. Entirely parallel reasoning should lead to the conclusion that the speaker does not know that if B, C. This was exactly the puzzle that arises with free choice permission – with the strengthening of $\Diamond$(A or B) to (entail) $\Diamond$A and $\Diamond$B).

The analytical problem posed by conditionals is thus formally analogous to that posed by possibility modals (and plural existentials) scoping over disjunction (as discussed in Chapter 1): (1) a narrow scope disjunction strengthens to a wide scope conjunction, contrary to what the (standard/plausible) semantics otherwise leads us to expect, (2) the strengthening is cancelable, and therefore presumably should not be guaranteed by the semantics in any event,[4] but (3) otherwise motivated assumptions about pragmatics predict exactly that the strengthening should be *im*possible. With possibility modals, our analysis (Chapter 2) built from the observation that *plural* existential quantifiers with disjunctive nuclear scopes exhibit exactly the same pattern of strengthening to conjunction, and argued for an analysis that reduces the former to a case of the latter. As discussed in Chapter 3, the analysis developed also allows for strengthening to (a wide scope) conjunction in some cases in which a disjunction appears in the *restriction* of plural quantifier, for example plural definite descriptions:

(5) a. The students who were tired or lazy failed the exam.

       (i) ⤳ The tired students failed the exam, and the lazy students failed the exam

    b. The board members who are founders or chairmen are very powerful.

       (i) ⤳ The founders are very powerful and the chairmen are very powerful

Such examples were accounted for directly on the assumption that the disjunction in the relative clause is in the scope of a distributive operator. The conjunctive meaning follows directly from the addition of locally computed diversity (universal < disjunction) implicatures:

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[4]Barring the possibility of ambiguity

(6)   the   X: *student(X)   ∧   ([∀x: x⊑X]   Tired(x)   ∨   Lazy(x))
∧ ¬[∀x: x⊑X] Tired(x) ∧ ¬[∀x: x⊑X] Lazy(x)

    a.   'the maximal plurality of students containing at least one student who was tired and at least one student who was lazy'

    b.   = 'the students who were tired and the students who were lazy'

It has been proposed independently that *if*-clauses *are* plural definite descriptions (of possible worlds) (Bittner (2001), Schein (2001), Schlenker (2004), Bhatt and Pancheva (2006)). I will take this basic idea for granted here, without repeating their arguments. I show in this chapter that under a certain, natural implementation of their idea, an account of SDA falls out directly – not surprisingly, given the discussion of definite descriptions immediately above. That is, we argue that SDA is the direct modal analogue of the strengthening attested in examples like (1), i.e. that it is due to the addition of embedded implicatures triggered by a distributive operator.

Under Schlenker's proposal, the analysis of conditionals is essentially as follows:

(7)   the closest A worlds are B worlds

However, this meaning is not arrived at by literal quantification over plural objects: *if* is simply given a semantics that delivers a plurality of worlds (the referent of the description in (7)). We propose to take a rather literal view of what it means for *if*-clauses to be plural: it's not just that their semantics involves delivering a set or sum of objects (Schlenker, 2004); it's that they do this by taking as argument a property of pluralities of worlds. Thus:

(8)   The plurality of worlds which is the closest plurality of A worlds is a
        plurality of B worlds

Since what needs to be delivered is worlds in which the antecedent holds, and by
assumption the antecedent denotes a proposition – a function from single/atomic
worlds to truth values, in order that an argument of the proper type be supplied,
a distributive operator (over pluralities of worlds) needs to be applied to the
antecedent. The presence of this distributive operator means than when the
antecedent is a disjunction *A or B*, our system will generate diversity implicatures
locally in the antecedent clause in the familiar way. The property that is input
to the conditional meaning is then a property of 'mixed' pluralities, pluralities
containing *both* A *and* B worlds:

(9) $\lambda W. ([\forall w: w \sqsubseteq W]\ Aw \lor Bw) \land \neg([\forall w: w \sqsubseteq W]\ Aw) \land \neg([\forall w: w \sqsubseteq W]\ Bw)$

Since any plurality satisfying this property contains both A and B worlds, the
plurality denoted by the *if*-clause will per force also have among it both types.
This provides the basis of an account of SDA. As we saw above, a conditional
seems to make a claim about the *closest/most similar* worlds in which the
antecedent holds. We are taking conditionals to literally involve plural refer-
ence/quantification, with the antecedent clause denoting a property of pluralities,
but the relevant notion(s) of similarity/closeness involve comparing (the features
of) *individual* possible worlds. So we want the *if*-clause to select a plurality, with
the property expressed by the antecedent clause, based on the relative similar-
ity (to the evaluation world) of the *parts of* that plurality to the parts of other
pluralities also having the property. In other words, we need to define the con-
ditional meaning in terms of a relation of closeness to the evaluation world that

holds *between pluralities*, but defined in terms of a Lewis comparative possibility -- a relation between atomic worlds.

There are (infinitely) many way to define such a relation. It turns out that exactly the notion of 'pluralizing' a relation that is relevant to the semantics of (transitive) verbs and relational nouns can deliver a semantics for conditionals which, when diversity implicatures are added within the antecedent clause, predicts the attested strengthening of *If A or B, C* to a conjunction *If A, C and If B, C*. The next section presents an explicit, overtly plural semantics for conditionals and establishes this result. In the final section we prove that is is otherwise equivalent to the standard semantics on which it is based.

2 A Plural Conditional Semantics

We follow the basic line in Schlenker (2004) et al., taking conditionals to be plural definite descriptions, but in the literal sense discussed above. (Counterfactual) *if A* will have roughly the following meaning:

(10)   the (maximal) plurality of worlds each of which is an A-world and which is at least as close to the actual world as every plurality of A-worlds

As implicit in the discussion above, we also assume that a genuinely non-monotonic semantics for conditionals is needed (following Lewis (1973) and Schlenker (2004)); indeed the way of framing the problem surrounding inferences from *If A or B, C* to *If A, C and If B, C* hinges on this assumption. We return to a general discussion of these two assumptions, and in what ways they are crucial to the proposal, in the §3.

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As discussed above, and as made evident in the paraphrase (10), we need a 'pluralized' variant of the standard closeness/similarity relation between possible worlds – a relation defined for plural objects in term of a relation defined for their atomic parts. The basic/atomic relation to be used is of course a Lewis similarity relation, which we take to bedenoted by '$\preceq_{w*}$'. This relation holds between two possible worlds iff the first is as least as similar to w* (the actual world) as the second. Following Lewis (1973, §2.3), we assume it to be transitive, total, reflexive, and such that for every w, $w*\preceq_{w*}w$ ('centered').[5] The pluralized variant of the '$\preceq_{w*}$' relation to be used is its 'simultaneous cumulation'. The simultaneous cumulation of an arbitrary relation R gives a new relation, by convention referred to with $^{**}R$, and defined as follows:

(11) $^{**}R$ denotes the smallest set of ordered pairs (relation) such that the following two conditions hold:

   a. $([\![R]\!](<x,y>) \wedge [\![R]\!](<x',y'>)) \rightarrow [\![^{**}R]\!](<x\oplus x', y\oplus y'>)$

   b. $([\![^{**}R]\!](<x,y>) \wedge [\![^{**}R]\!](<X,Y>)) \rightarrow [\![^{**}R]\!](<x\oplus X, y\oplus Y>)$[6]

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[5] Although in the 'official' proposal in Lewis (1973), the truth conditions of counterfactuals are given in terms of assignments of 'spheres' of antecedent worlds surrounding the evaluation world (sets of sets of worlds including it), he showed in §2.3 that the sphere method was interdefinable with a semantics that uses a relation of comparative possibility directly. The proposal here follows the latter method more or less directly. The only notable points of divergence are as follows. (i) Lewis allowed that some antecedent worlds could be simply ignored for evaluating a counterfactual – "non-accessible" ones. This was affected by two additional constraints on the relation of comparative similarity, to the effect that any non-accessible worlds are equally similar to one another, but *less similar* to the evaluation world than any *accessible ones* (and thus perforce not among the closest antecedent worlds, so long as there are some accessible ones). We ignore these constraints, since they have no immediate relevance for the issues discussed here, as far as I can tell. (ii) We adopt the pretense of the validity of the 'Limit Assumption' – that there is always at least one antecedent world which is at least as close to the evaluation world as any other (if the antecedent is not the contradiction) . This is to simplify the statement of the semantics ((16)). Questions about the plausibility of the limit assumption are not relevant to, and beyond the scope of, the issues discussed here.

[6] In words, for any x and x' that stand in the R relation to any y and y', the plural object x⊕x' stands in the $^{**}R$ relation to the plural object y⊕y', and for any plural objects X and Y that stand in the $^{**}R$ relation, and any x and y that do to, the merological sums obtained by

Thus, for an arbitrary expression R denoting a relation, we have (12): (for reference we instantiate for '$\preceq_{w*}$' in (13). We use '$\preceq_{w*}^{**}$' to express the simultaneous cumulation of the $\preceq_{w*}$ relation, breaking the notational convention of prefixing a '**', for the sake of readability)

(12) $\forall X \forall Y$, X**RY iff

$\forall x(x \sqsubseteq X \rightarrow \exists y(y \sqsubseteq Y \wedge xRy)) \wedge \forall y(y \sqsubseteq Y \rightarrow \exists x(x \sqsubseteq X \wedge xRy))$

(13) $\forall X \forall Y$, $X\preceq_{w*}^{**}Y$ iff

$\forall x(x \sqsubseteq X \rightarrow \exists y(y \sqsubseteq Y \wedge x\preceq_{w*}y)) \wedge \forall y(y \sqsubseteq Y \rightarrow \exists x(x \sqsubseteq X \wedge x\preceq_{w*}y))$

It is often assumed that a simultaneous cumulation operation on relations is needed to capture the truth conditions of certain sentences involving transitive verbs and relational nouns, e.g. Sauerland (1998), Beck (2000), Beck and Sauerland (2000)):

(14)   The soldiers shot the prisoners

    a.   'each of the soldiers shot at least one of the prisoners, and each of the prisoners got shot by at least one of the soldiers'

    b. $=[\![^{**}shot]\!](<[\![the\ soldiers]\!], [\![the\ prisoners]\!]>)$

(15)   The Senators from the Western states don't (all) fit in the room

    a.   ='the maximal plurality of senators X such that each of X is from some western state y, and for each western state y at least one of X is from y...'

    b. $=[the\ X: [\![senators]\!](X) \wedge [\![^{**}from]\!](<X, [\![the\ Western\ states]\!]>)]...$

adding x to X (X⊕x) and y to Y (y⊕Y) stand in the **R relation. (And no other X and Y stand in the **R relation).

c. $\neq$'The Senators who are (each) from each of the Western states...'

d. $\neq$'Each of the Western states x is such that: the senators from x don't fit in the room' (too strong: requires that the room be too big for two Senators)

The crucial observation is that the (natural) readings cannot be derived by distributively interpreting both of the plural nouns phrases (in any scope position – see), though they do involve partial distributivity. There have been alternative accounts of these readings proposed that do not make use of a special operator or lexical shift to simultaneously cumulates the arguments of a relation. However, if e.g. Beck and Sauerland (2000), etc. are correct that such an operation is generally needed, and in particular to interpret relational predicates internal to DPs (Beck, 2000), notably plural definites like (15), then there is some independent support for its use in the analysis of conditionals as (literally) plural definite descriptions.[7]

if will have the following meaning (at a world of evaluation w*), essentially that of a plural definite description (with non-monotonicity built in):[8]

(16) $[\![if]\!]^{w*} = \lambda P.\ \lambda Q.$ the maximal W such that P(W) and $\forall W'[P(W') \rightarrow W \preceq^{**}_{w*} W']$ is Q

(16) requires that the consequent will denote a property of pluralities, and thus, like the antecedent, must be prefixed with a distributive operator (since the

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[7]In turn, because the analysis to be developed draws this further connection between conditionals and plural definite descriptions, it could be viewed as offering new support for the view that conditionals are plural definites.

[8]Specifically, there are three features of this treatment of *if*-clauses that have also appeared in semantic analyses of descriptions; in descending order of commonality: that they are essentially referential devices, that they involve a maximality based semantics (e.g. Sharvy (1980)), and that they involve a notion of salience or similarity (e.g. Lewis (1973); Schlenker (2004)).

antecedent will denote an function whose domain is atomic possible worlds). The logical syntax and (paraphrased) interpretation is as follows:

(17)   [if [DIST A]] DIST B

   a. 'The maximal W such that W is a plurality each atomic part of which is an A-world, and W stands in the '$\preceq^{**}_{w*}$' relation to every plurality W' each atomic part of which is an A-world, is such that each part of W is a B world[9]

Where A is an atomic sentence, the proposal boils down to a standard Lewisian analysis: 'the closest A worlds are B worlds' (we prove this below). However, under the semantics (16), an *if*-clause can in principle denote a plurality of worlds whose parts are not each as close to the actual/evaluation world as the others. In particular, (16) ensures that an *if*-clause with disjunctive antecedent *A or B* – with diversity implicatures locally added – includes in its denotation the closest A worlds, and the closest B worlds, regardless of their relative closeness. However, (16) does not in general make *If A or B, C* (with diversity implicatures locally added) *equivalent* to *If A, C and if B, C*. The following will hold for any disjunction *A or B*:

(18) If diversity implicatures are locally added, [[If A or B]] will denote: the plurality of worlds which includes

   a. the closest A worlds

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[9]This meaning makes an *if*-clause a generalized quantifier, rather than a referring expression. We choose this option for presentational simplicity and completeness, and will speak where convenient as if it refers. This is harmless since the meaning determined for a particular *if*-clause is just (the characteristic function of) the set of properties that a particular plurality of worlds has (and so we could have just as easily treated the *if*-clause as referring to this plurality).

b.   the closest B worlds

c.   any A worlds that are at least as close as the closest B worlds, if the closest B worlds are more remote than the closest A worlds

d.   any B worlds that are at least as close as the closest A worlds, if the closest A worlds are more remote than the closest B worlds

According to (18) it is possible for the (strengthened) meaning of *if A or B, C* to be stronger than the meaning of *if A, C and if B, C*. Before considering this particular property of the proposal, we establish (18).

Adding diversity implicatures locally, the interpretation of the antecedent clause is:

(19) $\lambda W. ([\forall w: w \sqsubseteq W] Aw \vee Bw) \wedge \neg([\forall w: w \sqsubseteq W] Aw) \wedge \neg([\forall w: w \sqsubseteq W] Bw)$
       'the property of being a plurality of worlds containing both A and B worlds, and no worlds that are neither A nor B worlds'

(We henceforth use 'M' to refer to this property). Since M is its first argument, *if A or B*, with diversity implicatures added to *A or B*, will denote a 'mixed plurality' including both A and B worlds. This provides the basis for the strengthening to a conjunction. Which mixed plurality does the antecedent denote?

It is first useful to see why it can denote a plurality containing both A and B worlds *which are not each at least as close as the others*. Besides being a mixed plurality (having property M), the condition that the referent must meet (by (16)), is that it stand in the '$\preceq_{w*}^{**}$' relation to every plurality with property M. The latter condition is fairly weak, and in particular can by a plurality with property M whose A worlds are the closest A worlds simpliciter, and whose *B* worlds are the closest B worlds simpliciter, regardless of the relative closeness of

these A and B worlds. To see whether a plurality W with property M stands in the '$\preceq^{**}_{w*}$' relation to an arbitrary plurality W′ with property M, it need only be the case that each world in the former is at least as close as *some* world in the latter (and that the latter include no worlds that aren't at least as close as some world in the former). Thus A worlds can always be checked against A worlds, and B worlds against B worlds. So long as W contains the closest of the A worlds and the closest of the B worlds, W can meet the condition (16) to be the referent of the antecedent. We show next that W *must* contain at least these worlds:

W (the potential referent) must include $\mathcal{C}$, the sum of the closest A worlds and the closest B worlds. We establish this by reductio. Assume that W does not include $\mathcal{C}$. By (16), W must be the *maximal* object with property M that stands in the relation to every object having property M. But $\mathcal{C}$ has property M, and $\mathcal{C}\preceq^{**}_{w*}$W (by the reasoning below), and therefore must be included in W, contradicting the assumption. Because $\mathcal{C}$ includes the *closest* A worlds, for each of its *A worlds* a, there will be a world in W, say another A world a′, such that a$\preceq_{w*}$a′, and for each A world a′ in W, there will be an A world a in $\mathcal{C}$ such that a$\preceq_{w*}$a′.[10] Parallel reasoning applies to the B worlds in $\mathcal{C}$ (which are the closest B worlds). In other worlds, for every A or B world w in $\mathcal{C}$, there is at least one world w′ in W such that w$\preceq_{w*}$w′, and for every A or B world w′ in W, there is at least one world w in $\mathcal{C}$ such that w$\preceq_{w*}$w′; i.e., $\mathcal{C}\preceq^{**}_{w*}$W. So W at least includes $\mathcal{C}$. It may further *properly* include $\mathcal{C}$; we establish this, and *which* additional worlds it may contain, as follows:

Take the sum, S, of $\mathcal{C}$ and some world w ($\mathcal{C}\oplus$w) such that w is not part of $\mathcal{C}$, but A or B is true in w. Either there is a w′ in C such that w$\preceq_{w*}w′$, or there isn't. Suppose that there isn't: for no w′ in $\mathcal{C}$ is w$\preceq_{w*}$w′. Then it is not the case

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[10]This is a consequence of the assumption that $\preceq_{w*}$ is total, i.e. that $\forall w\forall w′(w\preceq_{w*}w′ \lor w′\preceq_{w*}w)$.

that $\mathcal{C}\oplus w \preceq^{**}_{w*} \mathcal{C}$, and so $\mathcal{C}\oplus w$ is not a plurality with property M which stands in the '$\preceq^{**}_{w*}$' relation to every plurality with property M, and does not meet the condition for being the referent of the *if*-clause. So either $\mathcal{C}$ is the referent of the *if*-clause, or there *is* a w′ in $\mathcal{C}$ such that $w \preceq_{w*} w'$. In the latter case, the sum $\mathcal{C}\oplus w$ does stand in the '$\preceq^{**}_{w*}$' relation to $\mathcal{C}$, and thus to every plurality that has property M (since $\mathcal{C}$ itself does). Since $\mathcal{C}$ is part of $\mathcal{C}\oplus w$, and since the referent of the *if*-clause must be maximal, $\mathcal{C}$ cannot be the referent. $\mathcal{C}\oplus w$ must at least be included in the referent.

Since w must be at least as close as some world in $\mathcal{C}$, it is either at least as close as some closest A world, or at least as close as some closest B world. Since the closest A worlds are equally close to one another, and likewise for the closest B worlds, it is therefore either at least as close as each of the closest A worlds, or at least as close as each of the closest B worlds. If it's an A world, then the latter must be the case (since it is by assumption not in $\mathcal{C}$, and hence not a closest A world). Parallel reasoning applies if it's a B world. Since the referent of the *if*-clause must be a *maximal* plurality ((16)), not only w, but every w″ that meets the same conditions, must be part of the referent. In sum, if the closest A worlds are closer than the closest B worlds, then every w″ that is at least as close as the closest B worlds must be included in addition to C. Likewise for the closest B worlds. This establishes (18).

It can now be seen that the predicted (strengthened) meaning of *if A or B, C* is stronger than the meaning of *if A, C and if B, C*. We derive that where distributivity implicatures are locally added, *If A or B, C* entails *If A, C,* and *If, B, C,* i.e. that in the closest A worlds, C holds, and in the closest B worlds, C holds. But suppose that there are some A worlds not among the *closest* A worlds, but closer than the closest B worlds: these will be included in the plurality

denoted by the *if*-clause (with locally added diversity implicatures), and the truth of *if A or B, C* will accordingly require that these A worlds be C worlds, while the truth *If A, C* does not. In this situation, the sentence *if A or B, C* might in principle be judged false (nb., on its *strengthened interpretation*), while *If A, C* is judged true. To make things concrete:

(20)   If John had studied hard or cheated, he would have passed (the exam).

Suppose that it's true that had John studied hard, he would have passed, *so long as he didn't also drink while studying* (thereby compromising his retention of the material), but that, being generally responsible, he doesn't in fact drink in the closest worlds in which he studies hard. Suppose that it's also true that had he cheated he would have passed. Since John is an honest guy, there are only very remote worlds in which he cheats – remoter still than the implausible ones in which he studies drunk. The plurality selected by *if J studies hard or cheats* will therefore have to include more study worlds than the closest ones, and in particular ones in which he studies drunk. Since the latter are worlds in which he fails, (20) is predicted to be false *on its strengthened meaning*. However the sentence would seem to be true in the given scenario as an expression of the conjunctive meaning that if John studied hard, he would have passed, and if he had cheated, he would have passed. The ostensible conclusion is that the account is falsified.

It is doubtful that this conclusion is really warranted. To be clear, the prediction is that the (strengthened meaning of) *If A or B, C* can in principle be stronger than *If A, C, and if B, C*, and examples/situations like the one considered should in principle provide a test for this prediction. As for this particular case, I suspect that the notion of closeness/similarity assumed in constructing

the example is dubious. Although better analogues might be constructed, the serious problem is that the notion of closeness relevant to the semantics of conditionals is itself context dependent (and once fixed, vague), and I doubt that it can be fixed by linguistic/contextual means as strictly enough as is required to test the prediction.[11]. I leave for future research the development of carefully controlled examples, and a full consideration of what their implications would be for the proposal, nothing that, even if examples like the above are/could be made reliable, we would have to be cautious in concluding anything. There may be independent (pragmatic) reasons that would explain why we tend to not reject our predicted strengthened meaning *in its entirety* (i.e. to conclude that that $\neg$(*If A, C and If B, C*) in the kind of situation described above.[12]

One possibly relevant point is that there is always a notion of closeness – one which makes no distinction between A and B worlds which would otherwise be intermediate between the closest A and the closest B worlds – which would make (the strengthened meaning of) *If A or B, C* come out equivalent to *If A, C, and*

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[11]An entirely parallel set of issues arises with plural definite descriptions. Our treatment of conditionals thus far differs from our treatment of plural definite descriptions in that the former have non-monotonicity – via a metric of similarity, built in. In Schlenker (2004), one of the argument for treating *if*-clauses as plural definite descriptions is that exactly the same non-monotonic behavior is exhibited by the latter, e.g. failure of 'strengthening of the antecedent': *The dogs are barking, but fortunately the neighbor's dogs aren't.* The proposal is that there is a general non-monotonic semantics underlying both conditionals and definite descriptions: in the modal domain, a relation of closeness to the evaluation world is supplied, and in the individual domain, a relation of salience. If this is correct, we expect in principle that conjunctive strengthenings with plural definite descriptions should behave identically to those of conditionals. In particular, we expect to find also that examples like *The students who were tired or lazy failed the exam* should be able to have a stronger meaning than *The students who were lazy and the students who were tired failed the exam.* The salience relation, which will play exactly the role of the closeness relation in conditionals, could in principle be such such that the disjunctive definite description ends up picking out *more* individuals than the corresponding conjunction. Again the prediction is difficult to test, since fixing the salience relation is non-trivial.

[12]On the other hand, as Nute (1975) noted, we do tend to judge *if A or B, C* false in case *if B, C* (or *if A, C*) is. Nute (and Alonso-Ovalle 2004) take this as an argument in favor of a semantic account of SDA. I don't think that it is trivial to decide what these judgments are about; at least in some contexts, we seem to judge sentences as false one the basis of their implicatures rather than their (regular) meaning.

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if B, C. In fact there may be independent evidence that there is pressure to resort to such a notion of closeness when interpreting disjunctive antecedents, coming from the following kind of example:

(21)   If France were (now) under the rule of Germany or Sweden, the French would be driving better cars.

The relevant point is that, while it can readily be understood conjunctively (as making claims about both Germany and Sweden), it can not be understood without a suggestion of *ignorance* or *indifference* to the facts (of world history and politics). For France to now be ruled by Sweden, things would have to have been drastically different than they in fact were; German rule was very nearly actualized. My intuition is that the sentence treats the two possibilities on a par – either by pretense or ignorance; that the basis for evaluating similarity to the actual world makes no fundamental difference between German-rule worlds and Sweden-rule worlds. Since the antecedent in this example is precisely of the type used to frame SDA as a problem for the standard non-monotonic semantics for conditionals (one of the disjuncts describing worlds that are putatively much more remote than those described by the other), the example poses a puzzle to any account that averts the problem by somehow stipulating *If A or B, C* to be equivalent to *If A, C and if B, C.* I leave such examples for future investigation, noting that, if the effect is robust, it could be accounted for directly under a minimal modification to the proposal:

(22) $[\![if]\!]^{w*} = \lambda P.\ \lambda Q.$ the (maximal) W such that $P(W)$ and $\forall W'[P(W') \to W^* \preceq^{**}_{w*} W')$ is Q

    a.   where: $X^* \preceq^{**}_{w*} Y$ iff $\forall x \forall y ((x \sqsubseteq X \wedge y \sqsubseteq Y) \to x \preceq_{w*} y))$

Here the notion the notion of the similarity of pluralities of worlds is cashed out as a bi-distributive relation:[13] every world in the first plurality must be at least as close as every world in the second. This gives a very strong result, namely that with an antecedent *A or B* with locally computed distributivity implicatures, an *if*-clause will fail to pick out anything at all unless the closeness relation is one such that the closest A worlds are at least as close as the closest B worlds. Thus for the example to be felicitous the context would have to provide such a notion of closeness, or one would have to be accommodated. This would explain the intuition about the Germany/Sweden example above directly.

In the simple case (e.g. for an atomic antecedent S), we derive the standard result that the referent of the *if*-clause will be the (boolean join of the) maximal set of worlds that are each at least as close to w^* as any other, as desired. In particular, unlike the case of a disjunctive antecedent with locally added distributivity implicatures, the referent of the *if*-clause must include only worlds that are *each as close to w^* as the others* (and closer than any worlds not included; it must of course also be the largest such referent). The reason is that the property P denoted by the antecedent clause ($\lambda W. [\forall w: w \sqsubseteq W]\ [\![S]\!](w)$) is such that if it applies to a plurality W, it applies to any part of that plurality. Call this being monotonic on the part-whole structure of its domain:

(23) a function of type $<A, B>$, is monotonic on the part-whole structure of its domain, $\{X: X \text{ is of type } <A>\}$, iff $\forall X, \forall X'(X \text{ is of type } A \wedge X' \text{ is of type } A \wedge X \sqsubseteq X' \rightarrow P(X) \subseteq P(X')$

(The property/function denoted by a disjunctive antecedent $A \vee B$ with locally added distributivity implicatures is not monotonic on the part-whole structure of

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[13]It should be noted that the same thing is needed in the individual domain.

its domain: take worlds w^1 and w^2, in which A, and worlds w^3 and w^4 in which B (but not A): the sum of w^1-w^4 has this property, but not every part of it does (for example the sum of w^3 and w^4).)

We prove that where the antecedent clause denotes a property of pluralities that is monotonic on the part-whole structure of its domain, the meaning (16) yields the standard result:

(24)   Let $[\![DIST\ S]\!]$ be a function that is monotonic the part-whole structure of its domain. Then $[\![if]\!]([\![DIST\ S]\!])$=W=the maximal element in the closure under sum formation of $\{w: [\![S]\!](w) \wedge \forall w'([\![S]\!](w') \rightarrow w \preceq_{w*} w')\}$. That is, (a) each part of W is (in $[\![S]\!]$ and) at least close to w^* as the others, (b) There is no w, w' such that w and w' are in $[\![S]\!]$ and w' is at least as close to w^* as w, but w is part of W while w' isn't.

a.   By the meaning of *if* ((16)), W must be the largest plurality such that: $[\![DIST\ S]\!]$ is true of it and it stands in the '$\preceq^{**}_{w*}$' relation to every plurality that $[\![DIST\ S]\!]$ is true of. Suppose that there were a w and a w', each part of W, such that $w \preceq_{w*} w'$ but $\neg(w' \preceq_{w*} w)$. Then there is W', for example that W' which is identical to W, but doesn't have w' as a part (the W' such that W=W'$\oplus$w'), such that $\neg(W \preceq^{**}_{w*} W')$. Since W' is a (proper) part of W, and and by assumption W is in $[\![DIST\ S]\!]$, and $[\![DIST\ S]\!]$ is monotonic on its part whole structure, W' must be in $[\![DIST\ S]\!]$. But then W does not stand in the the '$\preceq^{**}_{w*}$' relation to every plurality that $[\![DIST\ S]\!]$ is true of, contradicting the assumption. In particular it is not the case that every part of W stands in the '$\preceq_{w*}$' relation to some part of W'; no part w of W' is such that $w \preceq_{w*} w'$.

b.   Suppose there were a w and a w' both in $[\![S]\!]$, and $w' \preceq_{w*} w$, and w but

not w' is part of W. Then there is a plurality W' that W is a proper part of, for example that $W' = W \oplus w'$, such that [DIST S](W'), and such that $\forall W''$ such that [DIST S](W''), $W' \preceq_{w*}^{**} W''$. (The latter condition is met since by assumption $\forall W''$ such that [DIST S](W''), $W \preceq_{w*}^{**} W''$, and $W' \preceq_{w*}^{**} W$). Since W' is a proper part of W, W is non-maximal, contradicting the assumption.

3   Summary and General Remarks on Non-Monotonicity

We started from the observation that there seems to be a deep and inherent tension between a non-monotonic analysis of conditionals in the spirit of Lewis (1973), and the behavior of disjunctive antecedents. In short, inferences from *if A or B, C* to *if A, C* and *if B, C* are robust, but they are instances of a pattern – strengthening of the antecedent – which Lewis observed to *not* be robustly/generally valid, and which his semantics was designed specifically to block. I have assumed (following a rich tradition) that a non-monotonic analysis is correct, and have attempted to resolve the tension, pragmatically, under the constrained assumption that *or* always has a simple Boolean semantics. In particular, it was argued that the facts are accounted for directly, given a literal implementation of the proposal in Schlenker (2004) (et al) that *if*-clauses are plu- . ral definite descriptions, and the approach to scalar implicatures of disjunction in plural quantifications developed in the preceding chapters.

As noted, there appear to remain open questions about the data and analysis. First whether the proposal derives a meaning that is problematically too strong in cases in which there is a significant difference in the comparative possibility of the disjuncts. However, we saw reason to think that this question does not ever arise – that as a matter of empirical fact disjunctive antecedents force a

relation of comparative possibility that treats the disjuncts as equally similar (to the evaluation world) (cf. example (21)). If this characterization of the facts is correct, the basic analysis can accommodate them under a slight, natural modification of the notion of comparative possibility between pluralities ((22))). These questions are left for future research. A more general open question is the plausibility of the assumption, crucial to our analysis, that implicatures can be added locally to conditional antecedents (and in non-monotonic environments in general). It is typically claimed that implicatures disappear there, on the basis of examples like the following:

(25)   If John or Mary had come, Bill would have been happy

     a.   doesn't $\rightsquigarrow$ If exactly one of John and Mary had come, Bill would have been happy

(26)   If John had eaten some of the cake, Mary would have been be happy

     a. $\rightsquigarrow$ If John eaten all of the cake, Mary would have been happy

This fact, if it is one, is independently puzzling under Lewisian non-monotonic semantics for conditionals; precisely because the antecedent is not a DE context, the putative fact cannot be subsumed under the generalization that implicatures disappear in DE contexts, and hence would have to be given a different explanation. The proposed account has a problem in addition to this, which is to explain why the embedded implicatures which putatively give rise to SDA are different (i.e. robust). I leave this as an open problem, noting only two important points. First, the conjunctive meaning of (25) is typically ignored when it is claimed that implicatures disappear in the antecedent. Second, it has also often been noted that implicatures do sometimes arise in the antecedent of conditionals (especially

w/ 'some' and other existentials), and perhaps more easily than they do in scope of unquestionably DE operators. I don't think it implausible that the putative cases of implicatures disappearing in antecedents can be explained away.

A second problem, prima facie, is that SDA seems to be retained in DE contexts:

(27)   It is not the case that if John had studied hard or cheated, he would have passed.

    a.   ...if he had cheated, he would have gotten caught and hence failed. (But of course if he had studied hard he would have passed)

    b.   (27) = ¬(if J had studied hard he would have passed ∧ if J had cheated he would have passed)

Supposing that this generalization is correct, in order to account for it directly, the (embedded) scalar implicatures which are claimed to be responsible for SDA on my proposal would have to be retained in the scope of a DE operator, contra what the theory developed in Chapter 2, following Chierchia, predicts. As it stands the prediction that we make is that in the case that the closest antecedent worlds are, say, all worlds in which John, being honest, studies hard, nothing should follow about what would have happened if he *had* cheated. This would seem to be in conflict with the sequence (27), (27a), given that such a similarity relation is possible in a context in which they are asserted.

However, it is important to note that on our analysis the antecedent of a counterfactual is a non-monotonic context, and like any other one, will remain so when embedded under a DE context; cf.

(28)   Nobody invited exactly three students ↛ Nobody invited exactly three

French students

Although our algorithm for computing implicatures, following Chierchia, filters out all implicatures within the scope of a DE operator (Chapter 2, §3.2, (17)) it could be revised straightforwardly such as to simply filter out implicatures added in contexts *that the DE operator makes downward entailing*. This would retain Chierchia's result in any case where every sub-context of the scope of the DE operator is upward entailing (as is the case in the examples discussed, like *John didn't run or jump*). The only issue about negated conditionals, then, boils down to the one discussed above: whether it is reasonable to assume that scalar implicatures can be added locally in the antecedents of conditionals (and in non-monotonic contexts more generally; nb. that we followed Chierchia (2004) in assuming that they can be). I leave a full discussion of these issues for the future; see Appendix D–1, though, for relevant remarks.

It is also worth noting that, should the needed assumptions about scalar implicatures turn out to be problematic, there are in principle alternative pragmatic explanations that could derive the result that is crucial for the semantics (16) to make SDA (pragmatically) valid. The needed result is just that the *if*-clause should be taken to refer to a plurality containing at least one world satisfying the first disjunct, and at least one world satisfying the second. (Something like a pragmatic principle that each disjunct should be (known by the speaker) to contribute to the overall meaning he intends to convey would yield this, and seem plausible).

I want to conclude with some remarks regarding the necessity of a non-monotonic analysis of (counterfactual) conditionals, and the connection between this issue SDA. If conditionals could plausibly be given a semantics under which

the antecedent is a downward entailing context – e.g. that of a strict implication – SDA would be semantically valid. However, aside from the fact (noted above) that such a semantics would also reintroduce all of the inferences that Stalnaker/Lewis observed to be *in*valid, it is not even obvious that validating SDA would be desirable (cf. examples (4)-(4b)). A loose but useful way of putting the problem is that what seems to be wanted is a semantics for conditionals that is at once downward monotonic for disjunctive antecedents (at least in the normal case), but non-monotonic for antecedents in general. A strict implication analysis obviously does not deliver this.

However, in what follows I want to suggest that the tension is naturally resolved *if* one can defend a suggestion considered (though rejected) by Lewis himself – that the apparent non-monotonicity of conditionals is an illusory byproduct of shifting context. The suggestion was that counterfactuals are strict implications, but that the force of the necessity modal (say, it's accessibility relation) can shift with context. Trivially, where '$\Box$' has different interpretations in the translation of counterfactuals *If A, B* and *If A^+, B* as strict implications $\Box(A \rightarrow B)$, $\Box(A^+ \rightarrow B)$, the latter counterfactual will not follow from the former:

(29) $[\forall w: wR_1w^*][A \rightarrow B](w) \not\Rightarrow [\forall w: wR_2w^*]([A^+ \rightarrow B](w)$

Using a slightly different notation, it becomes transparent that this explains away non-monotonicity by a process analogous to shifting the (implicit) domain restriction of a (universal) quantifier:

(30) $[\forall w: wR_1w^*][A \rightarrow B](w) \equiv [\forall w: D(w) \wedge [A](w)] [B](w)$ [where D(w) iff wR_1w^*]

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cf. *every student got a good grade*, understood as restricted to students in this class. Let D be the implicit domain restriction (i.e. true of things in the relevant class)

(31)   [∀x: D(x) ∧ student] got-a-good-grade(x)

Lewis dismissed the context shift account largely because he assumed that the accessibility relation (domain restriction) for a modal should not change from one surface occurrence to another within the course of a single sentence.[14] As he observed, a single (conjunctive) sentence of the general form *If A, C, and If A and B, not C* can be consistent, which would seem to force a non-monotonic semantics, given this assumption. But as Schlenker (2004) notes, crediting Szcabolsci, Lewis's assumption seems to be unwarranted for contextually determined parameters in the general case[15]:

(32)   [Situation: A committee must select some applicants. Some of the applicants are Italian, and there are also Italians on the committee, though of course they are not the same.]   (Schlenker (2004)'s (17))

    a.   Every Italian voted for every Italian

    b.   natural reading: 'Every Italian on the committee voted for every Italian who was an applicant'

I take it that for a strict implication analysis to have any chance of working, the particular domain restriction for a given counterfactual C must be *very* strict, in a

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[14]Lewis also thought that the non-monotonic behavior of conditionals was regular and systematic in a way that a story about shifting domain restriction *could not* do justice to. To me, however, this is not obvious a priori. We need to understand the facts about domain restriction, and have a theory, before we can ask whether it does justice to the facts about conditionals.

[15]However, he also presents possible evidence that in the case of *overt* definite descriptions, non-monotonicity is genuine, i.e. cannot be explained away as (shifting) domain restriction.

fairly regular way – at pain of every counterfactual with a contingent consequent coming out false. (If q is contingent, there will always be *some* world in which p but not q). Put differently, I take it that the predictions of Lewis's semantics are roughly correct – modulo conditionals with disjunctive antecedents, and that a domain restriction account must explain why the domain restriction for a given counterfactual should be, in the normal case, *the closest worlds in which the antecedent holds.*

However, if a genuine domain restriction account can be maintained, then in consideration of independent facts about domain restriction, it would seem to make an explanation of the behavior of disjunctive antecedents available. It is of course formally possible that the domain restriction D for an utterance of *If A or B, C* be a set of worlds in which one of the disjuncts, say B, is systematically false, making the entailment to $\Box_D(\text{B} \to \text{C})$ vacuous (i.e. making that strict implication trivially true). (We ignore the degenerate case in which D contains only worlds in which both A and B are false, and thus the conditional itself is vacuously true. I assume that this is ruled out by a presupposition or a general pragmatic condition, as is common). Thus at first glance it would seem that the (domain restricted) strict implication analysis faces essentially the problem with disjunctive antecedents that the Lewis analysis faces. It is *possible* for a conditional with a disjunctive antecedent to come out true (wrongly) simply because one of the disjuncts is 'ignored'. For example suppose that if John would have come to the party, he would not have brought Bill, who Mary hates. *If John had brought Susan or Bill to the party, Mary would have been happy,* for example, could then come out true if the domain restriction were to respect the supposition that John would not have brought Bill (i.e. include no worlds in which he does), even though Mary would not have been happy in Bill's presence. This does not seem to be correct in a normal context.

However, it can be shown independently that speakers just don't use such domain restrictions. Take a universal quantification like *Every student who took the bus or got a ride from their mother was on time*; the claim may be understood as limited to students known to the conversants/in the room/etc., but certainly not to students (known/in the room) *who got a ride*. Intuitively, for a speaker to (be taken to) intend such a domain restriction would be degenerate in the normal case – for example because he would have wasted his breath and risked confusion by pronouncing the impotent disjunct in the first place.[16] I am not concerned with cashing out a precise pragmatic theory that derives this intuition; the point is that the data force something to be said, and whatever the right story, it can plausibly elminate much of problem for the (domain restricted) strict implication account.

I say much because observation is not alone sufficient to explain why SDA is valid (in the cases where it is). Because domain restriction can by assumption change even in a very local fashion (and crucially so), it does not follow that if *If A or B, C* is true (in a given context), *If A, C* and *If B, C* are/will be – *unless the domain restriction is the same/held constant* in the new context in which they are evaluated. But again, it would seem that independent facts about domain restriction do the required work. The following case, which is completely formally analogous under the assumptions being entertained, suggests that domain restrictions just do not change (or at least, don't change easily) when a disjunct is eliminated from a universal quantifier restriction:[17]

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[16]On the assumption that the speaker knows *what* domain restriction is relevant. I think that in the normal case the domain restrictions we evaluate an utterance with respect to are the ones that (we think that) the hearer intends, making this assumption almost trivial. For example, if I say (to the old professor I grade for), 'Every student did well on his final exam', and he disagrees on the grounds that his grandson at another university flunked, he can rightfully said to be confused, even if genuinely thought that the context/topic of discussion was broad enough to include our student relatives.

[17]One could still object that even with these observations in place, SDA is not 'valid', in the

(33)   [Context: A campus tour guide explains to prospective students what is unique about his university.]

   a.   Every first or second year student is guaranteed the dorm that he prefers, #whereas/but not every first year student is guaranteed the dorm that he prefers. [contradiction?][18]

   b.   Every first or second year student is guaranteed the dorm that he prefers, whereas/but not every first year student at other universities is guaranteed the dorm that he prefers.

I do not know of any explicit attempt to work out a domain restriction account, or whether it can in fact be made plausible. For independent reasons von Fintel (2001) and Gillies (2006) have proposed that counterfactuals are strict implications, whose domain restriction/accessibility relation is context dependent. Neither theory explains away non-monotonicity in the way Lewis entertained. In many cases (contexts), the semantics they give appeals directly to a function selecting the closest antecedent worlds, a la Lewis, in order to determine *which* strict implication is expressed (i.e. what the accessibility relation/domain is). For example in a context in which no counterfactual has been previously asserted, the semantics assigned to *if A, B* is the following strict implication, obviously equivalent to a Lewis counterfactual

sense that *If A or B, C*, qua strict implication, does not (contextually) entail both *If A, C* and *If B, C as interpreted under Lewis's semantics*. The reason is that none of these independent considerations about domain restriction force that the domain should have to include *the closest A worlds and the closest B worlds*. I take it that this is an independent issue to some extent, since (i) it is an independent issue whether Lewis's truth conditions are correct, and (ii) the domain restriction theory still needs to say something in the general case about what possible domain restrictions are. The point stands that the intuitive *entailment* patterns are given an explanation, even if the precise truth conditions are left indeterminate or vague.

[18]Of course if more material is added (e.g. *whereas, in the general case/in most places...*), the contradiction goes away. This is irrelevant to the point, since the domain restriction theory already wants and needs to say that a change in the local linguistic context can have dramatic effects on domain restriction.

(34) $[\forall w: w \in F(A)(w^*)] \; [\![A \to B]\!](w)$

     a.   where $F(A)(w^*)$ is the set of closest A worlds to w^*

More generally, under von Fintel's semantics, if an inference from a counterfactual C_1 to C_2 fails, where the antecedent of C_2 entails the antecedent of C_1, it ultimately fails only and exactly for the reason that it does under Lewis's semantics. von Fintel's use of a Lewis selection function is not surprising, given the remarks above. It would seem that any strict conditional analysis will have to roughly mimic Lewis's semantics, and the most explicit, systematic way to do so is precisely to define the domain restriction for the necessity modal in a Lewisian fashion, as the set of closest antecedent worlds.

von Fintel's theory has the advantage of giving (some) explicit conditions for how the domain of a strict implication is determined, but since it does so (in many cases) by directly referencing Lewis's semantics, it fails to validate SDA, both in general and when it intuitively does go through. For example, it assigns the following meaning to *If A of B, C* in a context in which no counterfactual has been asserted (or no counterfactual whose antecedent in compatible with A or B has been asserted):

(35) $[\forall w: w \in F(A \text{ or } B)(w^*)] \; [\![(A \text{ or } B) \to C]\!](w)$.

     a.   where $F(A \text{ or } B)(w^*)$ is the set of closest A-or-B worlds to w^*

Not surprisingly this analysis the same problem as did Lewis's semantics; SDA doesn't go through in case the closest A-or-B worlds are all A (B) worlds. It is not obvious how the pragmatic condition that the domain should contain both A-worlds and B-worlds should help, since it is in conflict with the semantic condition (which is by assumption inflexible). This illustrates what I take to be the general

problem for a strict implication account of counterfactuals. Some condition on the domain has to be imposed, systematically, in order to derive the correct meaning for counterfactuals in the general case (i.e., something like a condition which ensures that the domain include the closest antecedent worlds). But at the same time, it needs to be loose or flexible enough to not reintroduce Lewis's problem (a la von Fintel). Since domain restrictions in general are a function of context – which includes speaker intention, and the fact that a disjunction was used, there is nothing inherently problematic in assuming that the pragmatics of disjunction will force a domain restriction that selects both A and B worlds (e.g. the closest of both). The question is how to state a general (semantic) condition on domains for counterfactuals that will interact appropriately with the pragmatics of disjunction, in order to systematically account for SDA.

It is also worth noting that the (general) validity of SDA poses a problem for the Lewis semantics *only* under the assumption that a context determines, prior to the utterance of a counterfactual taking place, *the* relation of comparative similarity (selection function) to then be used to interpret it. This assumption is valid, trivially, if there is no context dependency to counterfactuals in the first place, with respect to how similarity to the actual world is measured. That is, if there is such a thing as *the* relation of comparative possibility among worlds that our semantic knowledge makes reference to.

Lewis himself seems to not have intended this strong assumption. As he put it:

> Overall similarity consists of innumerable similarities and differences in innumerable respects of comparison, balanced against each other according to the relative importances we attach to those respects of comparison. Insofar as these relative importances differ from one

person to another, or differ from one occasion to another, or are indeterminate even for a single person on a single occasion, so far is comparative similarity indeterminate... The truth conditions for counterfactuals are fixed only within rough limits; like the relative importances of respects of comparison that underlie the comparative similarity of worlds, they are a highly volatile matter, **varying with every shift of context and interest** [my emphasis] (Lewis, 1973, pp. 91-92).

Suppose that there is (this type of) context dependency to counterfactuals – that interpretation requires fixing a particular similarity relation, answers to questions like (most) similar in *what* respects. If so it seems reasonable to assume that the fact of the utterance taking place and the form of the utterance itself is part of what determines the context in which the counterfactual is interpreted. Thus it should be possible to give an account of SDA in much the way sketched above for the (contextually restricted) strict implication account. A hearer will have to recover from the context the intended similarity relation, and presumably will take into account – just as in recovering the intended domain domain restriction for a quantifier – the fact that a disjunction has just been used. This would require choosing a similarity relation that allows both disjuncts to contribute to the meaning. As with the domain restriction account, this cannot be the end of the story – there is a further leap to but it would seem that the main hurdle is overcome.

I have intended that the remarks in this section be preliminary. I offer them primarily to try to get clearer on the the scope of the problem posed by SDA. I leave for the future a comparison of my own proposal (developed in the previous sections) to these possible alternatives.

Appendices

D–1 Negated Counterfactuals and Disjunctive Antecedents

The behavior of disjunctive antecedents in DE context seems to be more complex than (27) suggests, and in a way that, as far as I can tell, is not entirely accounted for under the tandem of theories. The conjunctive reading seems to arise only when the *if*-clause is initial (preposed?) as in (27). Where it is not the meaning is stronger, the negation of a wide scope *dis*junction:

(36)   It is not the case that John would have come if Mary or Susan had.

     a. #...He might not have come if Mary had (although he would have come if Susan had).

     b.   (36)≈¬(J would have passed if he had studied hard ∨ J would have passed if he had cheated)=not(J would have passed if he had cheated) ∧ not(J would have passed if he had studied hard)

This meaning is not (straightforwardly) predicted even if SDA is semantically valid. However, the status of 'it is not the case that' as (semantically and pragmatically) equivalent to a logical negation not entirely uncontroversial. Under other DE embedders the reading for non-initial disjunctive antecedents is *even stronger* still. Although like (36) a paraphrase is available in terms of a negation of a disjunction (=conjunction of negations), the paraphrase itself is interpreted even more strongly. We show this for the "neg-raising" verb *think*, *doubt*, and the DE quantifier *no* (by forcing it to bind a pronoun in, and thus outscope, the *if*-clause):

(37)   John doesn't think that Mary would have come if Bill or Susan had

    a.   ≈John doesn't think that Mary would have come if Bill had, and he doesn't think that she would have come if Susan had

    b.   ≈John thinks that Mary would **not** have come if Bill had, and he thinks that she would **not** have come if Susan had

(38)   John doubts that Mary would have come if Bill or Susan had

    a.   ≈John doubts that Mary would have come if Bill had, and he doubts that she would have come if Susan had

    b.   ≈John **suspects** that Mary would **not** have come if Bill had, he **suspects** that she would **not** have come if Susan had

(39)   No boy$_i$ would have failed if he$_i$ had studied hard or cheated

    a.   ≈No boy$_i$ would have failed if he$_i$ had studied hard, and no boy$_i$ would have failed if he$_i$ had cheated

    b.   ≈**Every boy$_i$** (is such that he$_i$) would **not** have failed if he$_i$ had studied hard, and every boy$_i$ (is such that he$_i$) would **not** have failed if he$_i$ had cheated

    c.   nb. (39)≠'no boy is such that if he had studied hard/cheated, he would have failed', i.e. no boy is such that studying hard/cheating was a sufficient condition (all else being equal) for failure

The observation that the conjuncts of the (a) paraphrases have strong paraphrases (as their conjunct in the (b) parphrases) is an old one. von Fintel and Iatridou (2002) and Higginbotham (2003) both observe that these strengthenings would follow directly, without assuming literal neg-lowering or lexical decomposition, under the assumption that – at least for non-initial *if*-clauses – the

conditional excluded middle is valid. I illustrate with one case:

(40)   No boy$_i$ would have failed if he$_i$ had studied hard

    a.   [No x: boy(x)] if x had studied hard, x would have failed

    b.   Suppose the conditional excluded middle holds:

    c. $\forall$x((if x had studied hard, x would have failed) $\lor$ (if x had studied hard, x would not have failed))

    d.   ((40a) $\land$ (40c)) $\Rightarrow$ every boy is such that if he had studied hard, he would not have failed

Higginbotham and von Fintel & Iatridou argue explicity against a decompositional analysis (of *no* to *every... not*) to account for examples like (40). To their arguments I would add that, under such such an analysis, it becomes a mystery that *no* can appear in existential *there* constructions, and in particular the existential-*there* counterpart of (40): *There is no boy who would have failed if he had studied hard*; **There is every boy who would not have failed if he had studied hard.*

Under the view adopted here that conditionals are plural definite descriptions, the validation of the conditional excluded middle can be achieved in an interesting way. It doesn't yet follow from the semantics in (16), for the same . reason it doesn't under Lewis's semantics: the plurality of closest A(ntecedent) worlds) could have among it both worlds in which the consequent is true, and worlds in which the consequent is false. But it can be assimilated to the general phenomenon of 'homogeneity' presuppositions of plural definites (as suggest in Schlenker (2004)):

(41)   The boys didn't come

a.   =None of the boys came; $\neq\neg$(the boys each came)

The standard way of cashing this out (e.g. Schwarzschild (1996)) is as follows: a distributive property of pluralities is defined only for pluralities such that it applies either to all of its parts, or none. Thus the negation of a distributive predication (the boys came), where defined and true, entails that the property applies to none of the parts of the plurality. Under our assumption about conditionals, the consequent always denotes a distributive property of pluralities, and and hence, when a negated conditional is true and defined, the consequent proposition must hold in none of the worlds denoted by the antecedent.

We can then explain the behavior of the disjunctive examples in (37)-(39) as consistent with our proposal about SDA. The *if*-clause will refer to, roughly, the sum of the closest A-worlds and the closest B-worlds. But since the entire conditional is under a DE operator, these must all be not-C worlds, and the (b) paraphrases follow. The status of (36) is still a puzzle, since it does not seem to have the strong reading that would be predicted under these assumptions (and it is not clear how to derive it). There is also a question (for anyone) of why the excluded middle should be valid for non-initial *if*-clause, but not initial ones (in our terms, why the homogeneity presupposition should hold in the former but not the latter case). Cf. the following, which, to the extent that they are • acceptable, clearly do not allow the 'excluded middle' strengthening attested by their counterpart conjuncts in the (b) paraphrases of (37)-(39):

(42)   a.   It is not the case that if Bill had come, Mary would have

       b.   ?John doesn't think that if Bill had come, Mary would have.

       c.   ?John doubts that if Bill had come, Mary would have

       d. ??No boy is such that he would have failed if he had studied hard.

It is important to note that, whatever the explanation for this asymmetry, it explains why we get a very weak reading (=negation of a conjunction) for an initial disjunctive antecedent under a DE operator; cf. (27) (repeated), and the following:

(43)   a.   It is not the case that if John had studied hard or cheated, he would have passed.

     b.   ?John doesn't think that if Bill or Susan had come, Mary would have.

     c.   ?John doubts that if Bill or Susan had come, Mary would have.

     d.   ??No boy is such that if he had studied hard or cheated, he would have failed.

(in fact I am not entirely sure of the judgments for (43b)-(43d). They might pattern more with (36). I leave this issue for future research.)

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