"If", "Unless", and Quantification

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Abstract Higginbotham (1986) argues that conditionals embedded under quantifiers (as in 'no student will succeed if they goof off') constitute a counterexample to the thesis that natural language is semantically compositional. More recently, Higginbotham (2003) and von Fintel and Iatridou (2002) have suggested that compositionality can be upheld, but only if we assume the validity of the principle of Conditional Excluded Middle. I argue that these authors' proposals deliver unsatisfactory results for conditionals that, at least intuitively, do not appear to obey Conditional Excluded Middle. Further, there is no natural way to extend their accounts to conditionals containing 'unless'. I propose instead an account that takes both 'if' and 'unless' statements to restrict the quantifiers in whose scope they occur, while also contributing a covert modal element to the semantics. In providing this account, I also offer a semantics for unquantified statements containing 'unless'.

Keywords Conditionals · quantification · compositionality · modality · 'unless'

1 Introduction: Quantified Conditionals and Compositionality

A language is semantically compositional if the meanings of its complex expressions are wholly determined by the meanings of their parts, and the manner in which those parts are combined. The belief that natural languages are semantically compositional has played a central role in contemporary semantics.

The belief is not stipulative, but is an empirical claim. It thus is conceivable that we might discover a counterexample to the thesis that natural languages are semantically compositional. We might, for example, discover that there are complex natural language constructions whose meanings do not depend solely on their parts, and the way in which those parts combine. A few such putative counterexamples have been discussed over the last thirty years, and one highly influential example was discussed by James Higginbotham in 1986. Higginbotham argued

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that, when a conditional containing either "if" or "unless" is embedded under a quantifier, as in "no student will succeed if they goof off", the meaning of the conditional varies depending on the nature of the quantifier in whose scope it occurs. Much discussion has come in the wake of Higginbotham's 1986 article, such as Pelletier (1994a, b), Janssen (1997), von Fintel (1998), von Fintel and Iatridou (2002), and Higginbotham (2003). That quantified conditionals pose a challenge to the idea that natural languages are semantically compositional has acquired an almost folkloric status, and is frequently discussed in surveys and encyclopedia entries on compositionality. Pelletier discusses the possibility in his 1994 survey article on compositionality (1994b); in his *Handbook of Logic and Language* paper on compositionality, Janssen discusses the possibility that quantified conditionals may constitute a counterexample to the thesis that natural language are compositional, and in a *Stanford Encyclopedia of Philosophy* entry on compositionality, Zoltan Szabo discusses quantified conditionals as a possible counterexample to this thesis.

I do not believe that quantified conditionals behave in a non-compositional manner. I will begin by considering conditionals that contain "if", and consider a very simple account of their compositional structure. This simple account, which treats embedded conditionals as predicates of their quantified subjects, delivers satisfactory truth conditions for the most part, but runs into difficulties with conditionals that do not obey the principle of Conditional Excluded Middle. For that reason, I reject this simple account, and instead argue that an account that takes "if"-clauses to restrict quantifiers delivers the desired results, so long as we recognize that there is a covert modal element in the semantics of quantified "if"-statements.

I then consider quantified "unless"-statements, and propose a parallel account. We should understand quantified "unless"-statements as restricting the quantifying determiners in whose scope they occur, while also contributing a covert modal element to their semantics. In order to provide such an account, however, we need to understand the semantics of the unquantified versions of these statements, and so I develop a semantics for unquantified "unless"-statements. The account of quantified "if" and "unless"-statements I propose here provides a uniform meaning of "if" and "unless"; their semantics do not vary depending on the nature of the quantifier in whose scope they occur. We need not ascribe any sort of chameleon-like semantics to "if" and "unless", which would have their meaning depend on the nature of the quantifier under which they are embedded.

Some of the discussion of Higginbotham's claim has centered on the question of whether a chameleon-like semantics for conditionals would constitute a genuine counterexample to compositionality, or whether the principle of compositionality is sufficiently vague as to absorb the possibility (Pelletier, 1994a ,b; Janssen, 1997). The principle of compositionality is sufficiently vague so as to encompass a variety of precisifications. Some of the more liberal formulations of the principle are arguably compatible with an item's possessing a chameleon-like semantics, though the stricter formulations are not. I will not take up the question of whether compositionality is compatible with a chameleon-like semantics for an item, but will rather argue that the proposed chameleon-like semantics does not even accurately capture the truth conditions of the relevant English sentences, and will offer a uniform semantics in its place.

2 The Puzzle of Quantified Conditionals

Higginbotham (1986) claims that "if" makes a different semantic contribution in (1) and (2) below, as does "unless" in (3) and (4):

(1) Every student will succeed if they work hard.
(2) No student will succeed if they goof off.
(3) Every student will succeed unless they goof off.
(4) No student will succeed unless they work hard.

He claims that, while the "if" and "unless" in (1) and (3) have the semantic values they would have were they not embedded under quantifiers, the "if" and "unless" in (2) and (4) have different semantic values altogether. It is important to notice here that Higginbotham (1986) is assuming that indicative conditionals have the semantics of material conditionals:

> Elementary inferences involving these [subordinating conjunctions] proceed very well when they are understood as truth functional connectives, the material conditional [for 'if'] and the non-exclusive 'or' [for 'unless'] . . . The puzzle that I wish to discuss is independent of the issues of most prominent concern in that literature [on the semantics of conditionals], and it will be just as well to state it initially with the understanding that these classical terms of logical theory are truth functional. The puzzle is this: the words 'if' and 'unless' seem to have different interpretations, depending on the quantificational context in which they are embedded.

Higginbotham claims that (1) can be understood to contain a material conditional, and (3) an inclusive logical disjunction, and so no puzzle arises for those sentences. But if (2) were to contain a material conditional, then (2) would be true if and only if every student goofed off and didn't succeed. Similarly, if (4) were to contain a disjunction, it would be true if and only every student both failed to work hard and failed to succeed.[1] Those truth conditions are not appropriate to the English sentence, however: (2) does not seem to entail that every students goofs off, and

[1] *No student will succeed if he goofs off* is equivalent to: *for every student, it's false that he will succeed if he goofs off*, which in turn is equivalent to*: for every student, he will goof off and he won't succeed.* Similarly, *No student will succeed unless he works hard* is equivalent to: *for every student, it's false that he will succeed unless he works hard*, which, on the assumption that "unless" means *or*, is equivalent to: *for every student, he will not succeed and he will not work hard*. Here and for the rest of the paper I will make occasional reference to the truth functional equivalence of 'no x (A)' and 'every x (not A)' when both quantifiers have wide scope over the sentence, as do Higginbotham (2003) and von Fintel and Iatridou (2002). This is not intended as a claim about the semantics of 'no', nor as a claim that the two constructions are everywhere intersubstitutable, but merely as the observation that they are truth functionally equivalent when they have wide scope over the sentence in which they occur.

(4) does not entail that every student will fail to work hard. In fact both (2) and (4) are intuitively compatible with every student's recognizing them to be true and working hard as a result. Higginbotham (1986) notes this, and suggests that the truth conditions of (2) and (4) are rather given by (2') and (4'):

(2') No student goofs off and succeeds.
(4') No student succeeds and doesn't work hard.

These truth conditions contrast with the truth conditions of (1) and (3), where "if" and "unless" contribute a material conditional and an inclusive "or" respectively. Higginbotham concludes then that "if" and "unless" make different contributions depending on the nature of quantifier they are embedded under. This, he claims, is a counterexample to compositionality.

We should wonder whether Higginbotham's (1986) analysis adequately captures the truth conditions of (1)–(4). He proposes that (1) and (2) can be analyzed as (1') and (2'):

(1) Every student will succeed if they work hard.
(1') Every student will either succeed or not work hard.
(2) No student will succeed if they goof off.
(2') No student goofs off and succeeds.

(For clarity, I have formulated the material conditional in (1') as a disjunction.) These putative paraphrases do not adequately capture the truth conditions of the English sentences (1) and (2).[2]

To see the intuitive non-equivalence of (1) and (1'), consider poor Bill, who, no matter how hard he works, will never succeed at calculus. Bill knows this, and does not in fact try hard in his calculus class since he knows it is futile. Bill will then satisfy the material conditional in (1'), since he does not satisfy its antecedent – the equivalent disjunction "will either succeed or not work hard" is satisfied by Bill in virtue of his failing to work hard. Thus (1') may be true of a class containing Bill, since Bill presents no obstacle to its truth. But is (1) true if Bill is among the relevant students? The answer is quite clearly *no*. Bill is a student in that class, and so it is simply not true that every student will succeed if they work hard. Bill is a clear counterexample to this; no matter how hard he works, he won't succeed in this class.

Counterexamples to the paraphrasing of (2) by (2') also exist. Imagine a student in a New Jersey high school – let's call her Meadow – whose father has managed to scare the life out of her teacher. This teacher has no intention of giving Meadow anything less than an A in his class, no matter what she does. So it is simply not true that no student in the class will succeed if he goofs off, for Meadow will succeed no matter what she does. It so happens, though, that Meadow is quite interested in the

[2] Higginbotham (2003) and von Fintel and Iatridou (2002) discuss counterexamples of this nature, though they use them to object to 'restrictive analyses', which I will consider below. I am indebted to them for the structure of the counterexamples presented in this section of the paper.

subject matter, and does not in fact goof off. Meadow is no obstacle to the truth of "no student goofs off and succeeds", then, since she does not goof off, and so does not satisfy the conjunction "goofs off and succeeds". Thus it can be true of a domain containing her that no student in it goofs off and succeeds. While (2) cannot be true of a class that includes Meadow, (2') can be, so we must reject (2') as an analysis of (2).

These same counterexamples tell against Higginbotham's (1986) analysis of (3) and (4) as (3') and (4'):

(3) Every student will succeed unless they goof off.
(3') Every student either succeeds or goofs off.
(4) No student will succeed unless they work hard.
(4') No student succeeds and doesn't work hard.

Intuitively, (3) cannot be true of any class that contains Bill, who will fail no matter what he does. But if Bill is again aware of his predicament, and so resolves not to waste his time trying in vain, then (3') may be true of a class containing Bill. Bill satisfies the disjunction "succeeds or goofs off", and so poses no obstacle to the truth of (3'). Thus we might have a class that contains Bill, of which (3) is false but (3') is true.

Similarly, if Meadow is amongst the relevant students, (4) cannot be true, since she will succeed no matter what. It is intuitively false that no student will succeed unless she works hard, if Meadow is one of the students. If Meadow is once again interested in the subject matter and so elects to work hard, however, (4') may be true of a class containing her. If Meadow works hard, then she will not satisfy the conjunction "succeeds and doesn't work hard", and so (4') might still be true of Meadow's class. Thus neither (3) and (3'), nor (4) and (4') are equivalent. Thus Higginbotham's (1986) non-compositional account does not even adequately capture the truth conditions of quantified conditionals, and so is untenable.

3 The Semantics of Conditionals Containing "If"

Let us set aside conditionals that contain "unless" for now, and focus on ones that contain "if". "Unless"-statements are considerably more complex than "if"-statements, so it will be helpful to first formulate an account of "if"-statements. I will take up "unless"-statements in Part III of this paper.

3.1 A Simple Solution

There is a tempting solution to Higginbotham's puzzle of quantified conditionals, which would seem to let us deliver a fully compositional account in a most straightforward manner. To see this "Simple Solution", let us put aside worries specific to conditionals for a moment, and consider the truth conditions of quantified sentences in general. Standard accounts of quantified sentences of the form "Q Ns VP" assign to them truth conditions that depend on how many of the Ns possess the property denoted by the VP – in particular on whether the number or portion of Ns required by the quantifying determiner Q possess the property denoted by the VP. A relevant question to ask, then, is whether the truth of quantified conditionals depends on how many of the relevant items possess the conditional property, or – to put it in terms that do not make reference to conditional properties—how many of the relevant items satisfy the open conditional in question? Von Fintel and Iatridou (2002) argue that we can indeed provide a fully compositional account of quantified conditionals in this manner, and I argued as much myself in Leslie (2003a, b). While the Simple Solution offers an elegant, appealing and uniform treatment for the majority of cases, I will argue in the next section that, if we pursue the Simple Solution, we will be forced once again to adopt a chameleon-like semantics for "if" in a limited number of cases. I will take this to be good reason to look for an alternative account.

Let us consider in more detail how the Simple Solution would proceed. We saw above that the unfortunate Bill raised difficulties for Higginbotham's non-compositional account of conditionals, since his presence is enough to render false "every student will succeed if they work hard", *even if Bill does not in fact work hard*. On the Simple Solution, we would predict that Bill would falsify "every student will succeed if they work hard" iff Bill fails to satisfy "x will succeed if x works hard". Intuitively, Bill does not satisfy this conditional: it is false that Bill will succeed if he works hard. Thus we would predict that Bill's presence would be incompatible with the truth of "every student will succeed if they work hard".

Similarly, we would predict that Meadow would indeed be a counterinstance to the claim "no student will succeed if they goof off". For the quantified statement to be true of a domain containing Meadow, Meadow would have to fail to satisfy "x will succeed if x goofs off". However, on any natural interpretation of the conditional, it is true that Meadow will succeed if she goofs off. It is clear, then, why "no student will succeed if they goof off" cannot be true of a class that includes Meadow.

This treatment is completely compositional with respect to the contribution of the conditional to the truth conditions of the entire sentence. It is also completely independent of any particular semantic treatment of conditionals themselves. We have offered no explanation of when an object satisfies the embedded conditional; this account of how conditionals compose appears to be independent of whatever the ultimate account of semantics for conditionals turns out to be. Just as it is not necessary to provide an account of *when* an item satisfies the predicate "is F" in order to highlight the compositional structure of "Q Ns are F", if the Simple Solution was to succeed, it would not be necessary to provide an account of when an item satisfies an open conditional in order to see that a compositional analysis of quantified conditionals is possible. The Simple Solution, then, is an appealing option, and thus far it appears to handle our data correctly.

There is, however, a class of "if"-statements that are not well handled by the Simple Solution, namely those "if"-statements that do not obey the Law of Conditional Excluded Middle. I will also argue that "unless"-statements are simply not amenable to anything like the Simple Solution, but first let us consider those quantified "if"-statements that resist the Simple Solution.

3.2 Conditional Excluded Middle

Higginbotham (2003) and von Fintel and Iatridou (2002) each claim that we can give compositional interpretations to the troublesome quantified conditionals, but only if we assume that “if”-statements obey the law of Conditional Excluded Middle (CEM). Higginbotham describes this principle as follows:

> Writing the Stalnaker conditional as ‘$\Rightarrow$’, we have the validity of (CEM), or Conditional Excluded Middle:
> (CEM) $(\varphi \Rightarrow \psi) \vee (\varphi \Rightarrow \neg\psi)$ (2003, p. 186)

Higginbotham is reluctant to endorse CEM, but takes it to be the only means of giving a compositional account of quantified conditionals. He writes, “Compositionality can be restored under certain assumptions [namely CEM] about the meaning, or the presuppositions, of conditionals. However, I am not aware at present of any way of grounding these presuppositions that is not stipulative” (p. 182). Von Fintel and Iatridou (2002) are more enthusiastic in their endorsement of CEM, since it is part of a theory of conditionals to which von Fintel is antecedently committed. Neither von Fintel and Iatridou, nor Higginbotham provide much explanation of why they believe CEM is a necessary assumption when analyzing *quantified* conditionals in particular, however. That von Fintel and Iatridou would assume CEM is perfectly understandable, since one of the authors has defended such an analysis of conditionals elsewhere. It is less than clear from his 2003 paper, though, why Higginbotham feels obliged to accept CEM.

The Simple Solution is just a way of dealing with *quantified* conditionals, and so should be neutral on the truth of CEM. If CEM is a true principle governing unquantified conditionals, then it should also govern quantified ones, but if certain unquantified conditionals do not obey CEM, we have no explanation of why these conditionals should suddenly obey it when they appear under a quantifier.

The Simple Solution made no assumptions whatsoever about the semantics of unquantified conditionals – we gave the truth conditions of quantified conditionals solely in terms of how many items satisfied or failed to satisfy the embedded conditional. If we encounter a conditional that does not obey CEM, then, we should be able nonetheless to analyze quantified versions of that conditional compositionally. Suppose, for example, (5) is a conditional that does not obey CEM:

(5) a is Q, if it is P.

Then by assumption “it’s false that a is Q, if it is P” is not equivalent to “if a is P, then it’s false that a is Q”, though “it’s false that: a is Q, if it is P” is nonetheless interpretable and acceptable. Then (6) should also be interpretable and acceptable:

(6) No x is Q if x is P.

(6) should be true just in case none of the relevant items satisfy the open conditional “x is Q, if x is P”. That an item can fail to satisfy the open conditional without satisfying “if x is P then it’s false that x is Q” should not affect our analysis. There is

nothing in the account presented here that even *suggests* that CEM is an assumption required to provide a semantics for quantified conditionals.

It is a controversial matter whether CEM is a principle governing all conditionals, or whether there are some that do not obey it. A good candidate for a conditional that does not obey CEM is (7):

(7) This fair coin will come up heads if flipped.

Suppose that we have a fair coin before us, and we are contemplating what will happen if we decide to flip it. On the assumption that the coin in question really is fair, (7) is intuitively false. Since (7) is a false conditional, if it obeyed CEM, then (8) would be true:

(8) This fair coin will not come up heads if flipped

However, (8) seems to be false also; it seems that we have a conditional that does not obey CEM.[3]

Let us now consider how the Simple Solution handles quantified conditionals whose embedded conditionals do not satisfy CEM. The above discussion suggests that the arbitrary fair coin fails to satisfy "x will come up heads if x is flipped". The Simple Solution would then predict that (9) would be true of any given collection of fair coins, since each fair coin will fail to satisfy the embedded conditional:

(9) No fair coin will come up heads if flipped.

But (9) strikes us as false under these circumstances![4] (9) expresses a much stronger claim: (9) would be true only if each coin was sure *not* to come up heads if flipped. That is, (9) is true iff each coin satisfies the open conditional "x will not come up heads if x is flipped".

A friend of the Simple Solution might respond by invoking CEM here. The conditional "x will not come up heads if x is flipped" is related to (9)'s embedded conditional via CEM: if CEM holds, then an item can fail to satisfy "x will come up heads if flipped" *if and only if* it satisfies "x will not come up heads if flipped".

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[3] One might deny that (7) and (8) really are false, and claim instead, for example, that they are simply indeterminate, or lack a truth value. Certainly the defender of CEM as a general principle should argue for some such claim. I will not discuss such a possible defense here, but rather the discussion will proceed on the highly intuitive assumption that this is a genuine counterexample to CEM. It is worth noting, though, that it is far easier to convince oneself that (7) and (8) are indeterminate, than it is to convince oneself that that their quantified counterparts (9) and (10) are:

(9) No fair coin will come up heads if flipped.

(10) Every fair coin will come heads if flipped.

(9) and (10) strike most people as quite clearly false. Thus even if one is inclined to reject (7) and (8) as counterexamples to CEM on the grounds that they are indeterminate rather than false, one still needs an explanation of why (9) and (10) seem quite clearly false and not at all indeterminate. Any natural extension of the simple solution to cases of indeterminacy would predict that the quantified statements should be indeterminate if their embedded conditionals are indeterminate.

[4] I am indebted to Jim Higginbotham and David Chalmers for pointing this out to me.

Intuitively, it appears that (9) requires something like this for its truth: the coins in question must all fail to come up heads if flipped for (9) to be true. Thus it seems that the Simple Solution will be adequate only if we assume that an item fails to satisfy an open conditional "if P(x) then Q(x)" if and only if it satisfies the conditional "If P(x) then not Q(x)" – i.e. if we do assume that all conditionals obey CEM.

Higginbotham (2003) notes that this assumption is strange and stipulative; we have no explanation of why we would need to assume CEM for our analysis. On the account sketched here, we would in fact predict, on the face of it, that we would *not* need to assume CEM. If our difficulties were resolved by assuming that quantifiers demand that conditionals in their scope obey CEM, though, perhaps this would justify our adopting the stipulation. The situation, however, is not quite so straightforward.

To provide an adequate analysis of (9), we were forced to assume that the coins in question failed to satisfy "x will come up heads if x is flipped" if and only if they satisfied "x will not come up heads if flipped". Fair coins do not intuitively satisfy "x will come up heads if flipped", but "no fair coin will come up heads if flipped" is clearly false. We explained this by assuming that, in order to *fail* to satisfy "x will come up heads if flipped", an item must *satisfy* "x will *not* come up heads if flipped". Fair coins clearly do not satisfy this latter conditional, so we concluded that, despite appearances, fair coins must satisfy "x will come up heads if x is flipped" after all. We were then able to explain the falsity of (9), which is true if and only if none of the coins satisfy "x will come up heads if flipped". But this explanation of why (9) is false unfortunately predicts that (10) will be true:

(10) Every fair coin will come up heads if flipped.

In our explanation of (9)'s falsity, we stipulated that to fail to satisfy "x will come up heads if flipped" *just is* to satisfy "x will not come up heads if flipped", and used that equivalence to arrive at the conclusion that each of the relevant coins must, in fact, satisfy "x will come up heads if flipped". These conditions, though, are exactly ones in which (10) ought to be true; thus our analysis predicts the truth of (10), despite its obvious falsity. We have purchased our explanation of (9)'s falsity only at the price of predicting (10)'s truth. Out of the frying pan and into the fire.

It is clear that (10) is false as long as (at least some of) the coins fail to satisfy the open embedded conditional, *even though they also fail to satisfy the CEM-equivalent conditional.* (9), however, is only true if the coins satisfy this CEM-equivalent conditional; it is not enough that they simply fail to satisfy the open embedded conditional. The proposed defense of the Simple Solution has led to the awkward position of requiring that our quantified conditionals both obey and fail to obey CEM. It appears that CEM is a necessary stipulation when we are providing a semantic analysis of conditionals under quantifiers such as "no", but not if the quantifier is one such as "every", CEM applies only if it applies to the unquantified version of the conditional. Thus if conditionals such as (7) and (8) do not obey CEM, we are forced to alter their semantics so as to conform to CEM when they occur under quantifiers like "no", but not when they occur under quantifiers like "every". In this way we find ourselves back at square one; one semantic analysis applies to conditionals under "every", and another to conditionals under "no".

This suggests, I think, that we have not properly understood the logical form of conditionals embedded under quantifiers. The Simple Solution so far fares considerably better than Higginbotham's original account – it provides adequate truth conditions in the vast majority of cases, and the violations are localized to those marginal and controversial conditionals that fail to obey CEM. Nonetheless, we have no explanation of why CEM is a necessary assumption for providing the semantics of conditionals embedded under "no". We have even less of an explanation of why this assumption does not apply to conditionals embedded under "every". The Simple Solution, though initially most appealing, is not ultimately adequate. Another approach is called for.

3.3 A Modalized Restrictive Account

A popular account of quantified conditionals emerges from the tradition that began with David Lewis (1975), which takes "if"-statements to restrict quantifiers and quantificational adverbs.[5] Lewis argued that "if"-statements that occur in the scope of quantificational adverbs restrict the domain of quantification of that adverb. For example, we would analyze "always, if m and n are positive integers, the power m^n can be computed by successive multiplication" as involving quantification over pairs of positive integers. The sentence is analyzed to mean that, for all pairs of positive integers m and n, the power m^n can be computed by successive multiplication. Thus the "if"-clause "if m and n are positive integers" provides the domain of quantification for the adverb "always".

Most contemporary theorists in this tradition assume that, if no explicit adverb of quantification is present in a conditional statement, then a covert universal quantifier over possible situations[6] occurs in the sentence's logical form. On this view, conditionals serve to restrict the domain of possible situations over which the quantifier ranges – be it an explicit quantificational adverb or a covert universal quantifier. It is almost always assumed that, if an explicit adverb of quantification occurs in the sentence, then the conditional will restrict that adverb, and no covert universal will occur in the sentence's analysis.

On such an account, an "if"-statement of the form "If R, then M" (i.e., in which no explicit quantificational adverb occurs) would be analyzed as:

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[5] A quantificational adverb is an adverb such as "always", "sometimes", "often", "never", and so on. Lewis (1975) argued that these adverbs quantify over cases or situations. Thus, for example, the sentence "John always wins" is to be analyzed to mean that all relevant situations involving John are ones in which he wins.

[6] I.e. parts of possible worlds; see Kratzer (1989). In our discussion, nothing will hang on the use of situations rather than worlds. (An account that uses situations rather than worlds is useful in dealing with so-called 'donkey' sentences, such as "if a farmer owns a donkey, he beats it" (Heim, 1990). We will not be concerned with such sentences here.)

All [C ∩ R] [M]

where *C* denotes the set of contextually relevant situations, and *R* and *M* are the interpretations of the antecedent and consequent respectively. Thus "if R, then M" is true iff all of the contextually relevant situations in which "R" is true are ones in which "M" is true. If an explicit adverb of quantification occurs in the sentence, then that adverb will take the place of the covert universal quantifier. For example, "Never, if R, then M" would be analyzed as:

No [C ∩ R] [M]

Thus "never, if R, then M" is interpreted to mean that no relevant situations in which "R" is true are situations in which "M" is true.

Lewis confined his original discussion to adverbs of quantification, but it is a natural further step to treat "if"-statements as restricting quantificational NPs such as "no students", if the "if"-statement occurs in the scope of such an NP (see, e.g. Kratzer 1991; von Fintel 1998). On this view, we would construe (1) and (2) as (1*) and (2*) below:

(1) Every student will succeed if they work hard.
(1*) Every student who works hard will succeed.
(2) No student will succeed if they goof off.
(2*) No student who goofs off will succeed.

Or more formally:

(1*LF) Every x [x is a student and x works hard] [x will succeed]
(2*LF) No x [x is a student and x goofs off] [x will succeed]

Kratzer's treatment of "if"-statements as restricting quantificational operators has been very influential. As it stands, though, it does not accurately capture the truth conditions of (1) and (2), since it is susceptible to the same counterexamples as Higginbotham's (1986) account. Let us consider Bill once again – doomed to failure regardless of how hard he works – whose presence suffices to falsify (1). Should Bill decide not to work hard, though, then he poses no obstacle to the truth of (1*): he is not among the students who work hard, and so is irrelevant to (1*)'s truth or falsity. Thus (1) will be false while (1*) may yet be true. Similarly, the inclusion of the fortunate Meadow – who will succeed no matter what – among the relevant students is enough to render (2) false. Should Meadow decide not to goof off, though, then (2*) may well still be true, since only those students that actually goof off are relevant to the truth of (2*). This analysis, then, does not fare any better than Higginbotham's original (1986) account.

It should be clear, though, exactly what the root of the difficulty is for this version of the restrictive account – the analysis is ignoring possible circumstances that are relevant for the truth of the quantified conditional because they are merely possible, and not actual. This difficulty does *not* arise for the restrictive analysis when the quantificational element is an adverb of quantification or a covert universal, because we are taking those quantifiers to range over *possible* situations. The truth conditions of conditionals such as "Bill will succeed if he works hard" do not simply depend on the happenings of the actual world, because the covert universal is taken to range over possible situations. If we restricted the domain of the universal to actual situations, then we would predict inappropriate truth conditions if, as it happens, Bill never *actually* works hard. A modal element is needed to deliver the correct truth conditions for conditionals.

This suggests that our objection to treating *quantified* conditionals as restricted quantifiers, then, would be defeated were we able to include such a modal element in their truth conditions. Meadow falsifies "no student will succeed if they goof off" even if she does not actually goof off, because *were she to goof off, she would succeed nonetheless*. This modal fact is enough to guarantee that Meadow falsifies the quantified conditional, regardless of how events in the actual world unfold. We need to take these possible events into account when giving the truth conditions of quantified conditionals, just as we must when we are giving the truth conditions of conditionals that contain quantificational adverbs. Indeed, it would be rather surprising were the two types of constructions *not* to require such parallel treatment.

There are a variety of ways, it would seem, in which this idea might be implemented. We might take the quantifier to range over possible individuals, for example. Here, I will pursue a particular means of implementing the idea, which fits rather well with some recent work by Bart Geurts (m.s.), though there are other ways that one might implement the idea.

Geurts (m.s.) argues that, even when a conditional statement contains an explicit quantificational NP or quantificational adverb, the conditional may still serve to restrict a covert universal, in the same way that it does when no explicit quantifier or quantificational adverb is present. Geurts asks us to consider the following sentence:

(11) If Beryl is in Paris, she often visits the Louvre.

Geurts points out that (11) can be read as saying that on many of the occasions in which Beryl is in Paris, she visits the Louvre, or as saying that whenever Beryl is in Paris, she pays many visits to the Louvre. The first reading is obtained by taking the "if" clause to restrict the overt quantificational adverb "often", while the second is obtained by taking the "if" clause to restrict a covert universal, of the sort that is standardly taken to occur in the absence of a quantificational adverb.

Geurts' account differs from some more conventional views in that he claims that a conditional may have a covert universal associated with it, *even when the sentence contains an explicit quantifier or quantificational adverb*. Thus Geurts does not take such explicit items to block the emergence of a covert universal. Geurts, though, only discusses this covert operator in contexts where it is the operator that the conditional is restricting.

However, there is no reason that I know of that would prevent this covert universal quantifier over possible worlds from occurring in the logical form of a conditional statement, *even though the conditional is itself restricting an explicit quantifying determiner*. I propose that a conditional may contribute a covert universal quantifier to the semantics, even though the conditional itself serves to restrict an explicit quantifier. Further, I suggest that, when a conditional restricts an explicit quantifier, this covert universal takes wide scope over the entire statement. Thus, when a conditional restricts a quantifier, every relevant possible world must be such that the quantified statement holds in it, for the entire statement to be true.

This account delivers the correct results for the quantified conditionals we have been considering. The unfortunate Bill – doomed to failure regardless of how hard he may work – posed a problem for a straightforward account of the conditional as restricting the quantifier. If we understood the conditional as restricting the quantified NP, with no modal element present, we would predict that the quantified conditional would be true, so long as Bill did not in fact work hard. The quantified conditional is not, however, intuitively true under those circumstances. The fact that, had Bill worked hard, he still would not have succeeded is enough to falsify the quantified conditional. I propose that we amend the above analysis, so as to include wide-scope quantification over contextually relevant possible worlds:

∀w Cw, w_0: Every x [x is a (relevant) student in w & x works hard in w] [x will succeed in w]

"Cw, w_0" picks out a contextually determined restriction on the possible worlds over which we are quantifying. These truth conditions correctly predict that "every student will succeed if they work hard" will be false if Bill is among the relevant students. Since there are relevant worlds in which Bill works hard but does not succeed, the statement is false. Similar remarks apply to the quantified conditional "No student will succeed if they goof off", which is falsified by Meadow's presence, regardless of how hard she actually works. Since there are relevant possible worlds in which Meadow goofs off and still gets an A, the quantified conditional cannot be true.[7]

[7] There is a fair amount of contextual variability associated with the restricting nominal "student" here. I have been eliding the details of this restriction, other than including a parenthetical 'relevant' in my representation of the logical form of these statements. There is far more that needs to be said here. In particular, it seems that some contextual restrictions allow the extension of the restricted nominal to change across the possible situations, while others do not. For example, if I say "every student will succeed if they work hard" with my introductory logic class in mind, there is a reading of the sentence on which it applies to any students who might possibly take my class. The utterance would then be a commentary on how I run my course. On this reading, the statement is false if the likes of Bill is even a possible member of my class. There is another reading of the sentence, though, on which it only applies to the students that have actually enrolled in my class, and thus understood is a commentary on the intellectual abilities of these students. On this reading, it does not matter whether Bill might have enrolled – that he has not in fact enrolled is enough to discount him from the evaluation of the statement. We should, I think, understand this variability as part of the general phenomenon of contextual variability in nominals – the property picked out by "is a student" might be such that its extension does not vary across the relevant possible situations, or it might be less rigid. (We could also locate difference between the readings in the set of relevant possible worlds we are considering. The proposal presented here is neutral between the two implementations, however, I am inclined to locate the restriction in the restricted nominal.) It should be noted, though, that it is less clear how these two readings would be generated, if we understood the statement to be quantifying over actual individual students, and attributing conditional properties to them, as we would under the Simple Solution. Unless we take the quantificational NP to range over possible individuals, it may be hard to avoid the consequence that the only available readings of the statement should be ones that pertain to the students that are, in fact, members of my class.

This Modalized Restrictive Account is thus able to deliver the correct truth conditions for (1) and (2). The Simple Solution, of course, was also able to handle these sentences correctly. However, our Modalized Restrictive Account, unlike the Simple Solution, delivers the intuitively correct results when faced with conditionals that do not obey Conditional Excluded Middle, without employing ad hoc assumptions.

Higginbotham (2003) claimed that a compositional account of quantified conditionals is forthcoming only if we assume that conditionals under quantifiers obey CEM. He was rightly uncomfortable with this result, feeling it to be little more than stipulation. As we saw above, the troubles run deeper than unexplained stipulation; the stipulation only applies to conditionals embedded under quantifiers such as "no". If a conditional occurs under "every", it obeys CEM only if its unquantified counterpart obeys CEM. Thus, in our above example, "every coin will come up heads if flipped" is a false claim, even though there is no coin in the domain that satisfies "x will not come up heads if flipped". If CEM held here, the universally quantified claim would only be predicted to be false if there were such a coin. Thus CEM has to be imposed differentially on conditionals, depending on the nature of the quantifier they are embedded under. It was just this sort of chameleon-like semantics, though, that we set out to avoid.

Our Modalized Restrictive Account yields the right predictions without recourse to such uncomfortable assumptions and chameleon-like analyses. The Modalized Restrictive Account would render "no fair coin will come up heads if flipped" as:

$\forall$w Cw, w_0: No x [x is a fair coin in w & x is flipped in w] [x will come up heads in w]

On this analysis, the statement is true iff in all relevant possible circumstances, none of the coins that are flipped will come up heads. These are the truth conditions we have been seeking, and we are able to arrive at them without making questionable assumptions about the plausibility of CEM in such a case.

Similarly, we have at hand a straightforward, parallel analysis for "every coin will come up heads if flipped":

$\forall$w Cw, w_0: Every x [x is a fair coin in w & x is flipped in w] [x will come up heads in w]

It is clear that this analysis correctly predicts that "every coin will come up heads if flipped" will be false. The Modalized Restrictive Account is able to capture the strong truth conditions of *both* the quantified conditionals. The Simple Solution issued in overly weak conditions for the conditional under "no", unless CEM was assumed to apply. However, once CEM was assumed, the truth conditions for the conditional under "every" were predicted to be overly weak. Only a differential application of CEM captured the strong truth conditions of both statements. Our restrictive analysis allows us to avoid any such differential assumptions. This consideration constitutes good reason to prefer a restrictive analysis of conditionals to the Simple Solution.

Furthermore, we will see in the next section that no version of the Simple Solution is applicable to quantified "unless"-statements, while a Modalized Restrictive

Account delivers the desired results. Treating quantified "if" and "unless"-statements in a uniform manner constitutes further reason to prefer the restrictive account to the Simple Solution in the case of "if"-statements.

4 The Semantics of Conditionals Containing "Unless"

The Simple Solution to the puzzle of quantified conditionals treated embedded "if"-statements as predicating a conditional property of the quantified NP subject. The truth value of a sentence of the form "Q Ns P, if R" would then depend on how many of the relevant Ns possess the conditional property. The logical form of such a sentence, we have claimed, might be given as follows:

Q [N] [P if R]

A parallel account for "unless" would render the logical forms of (3) and (4) as follows:

(3) Every student will succeed unless he goofs off.
(3 LF) Every x [x is a (relevant) student] [x will succeed unless x goofs off]
(4) No student will succeed unless he works hard.
(4 LF) No x [x is a (relevant) student] [x will succeed unless x works hard]

(3 LF) handles Bill's case adequately: Bill does not satisfy "x will succeed unless x goofs off", since it's false that Bill will succeed unless he goofs off. Thus if (3 LF) is the logical form of (3), we would predict that (3) would not be true if Bill is among the relevant students. But what of (4 LF)? We wish to predict that a sentence whose logical form is given by (4 LF) will not be true if Meadow is among the relevant students. (4 LF) is true if none of the relevant students satisfy the open "unless"-statement, or alternatively if all of the relevant students fail to satisfy it. Meadow will present an obstacle to the truth of (4 LF) iff she satisfies "x will succeed unless x works hard" . . . and here we encounter a difficulty.

"Meadow will succeed unless she works hard" is intuitively false. This is not a true sentence in the scenario we have described. Meadow will succeed no matter what she does, so *it's false that Meadow will succeed unless she works hard*. Thus, if the logical form of (4) was given by (4 LF), Meadow would pose no obstacle to the truth of (4). She fails to satisfy the open "unless"-statement, and so it is quite possible that *no student* in a class containing her would satisfy it.

The Simple Solution, then, does not even begin to accommodate "unless"-statements. It appears that the truth conditions of quantified "unless"-statements do *not* depend on how many members of the domain satisfy the open "unless"-statement. Statements of the form "No Ns P unless t hey R" cannot be understood to mean that *No Ns satisfy "P unless they R"*. In the case of "unless"-statements, we do not need to invoke conditionals that fail to obey CEM to raise difficulties for the Simple Solution. It cannot handle these rather basic examples of quantified "unless"-statements.

One might, of course, just deny that "Meadow will succeed unless she works hard" really is false. One might argue that it is merely pragmatically unacceptable for one reason or another. I find such a solution deeply unsatisfying. To my ear, and the ears of my informants, it is simply false that Meadow will succeed unless she works hard. Any account that validates that intuition should be preferred to one that dismisses it. In what follows I will propose such an account, and to the extent that it is successful, it provides us with a far more satisfactory account than one that chalks up the appearance of falsity here to mere pragmatic factors.[8]

Let us then accept at face value the intuition that it's false that Meadow will succeed unless she works hard. One way that we might frame our puzzle is as follows: for unquantified "unless"-statements, there appears to be a "uniqueness" requirement. This "uniqueness" requirement has it that, for the "unless"-statement to be true, it would have to be the case that working hard is the only relevant way in which Meadow will fail to succeed. Since this is false in the case described, the "unless"-statement is predicted to be false. This uniqueness requirement, however,

[8] Treating 'unless' as meaning 'if . . . not' is the most obvious way to fill out the claim that Meadow really does satisfy the relevant 'unless'-statement: It's true that Meadow will succeed if she doesn't work hard. Higginbotham (2003) proposes that we handle 'unless' in this manner, and claims that a compositional treatment of quantified 'unless'-statements is possible so long as 'unless' is assimilated to 'if . . . not". (Higginbotham provides few details, so it is not clear whether he proposes this to deal with situations such as Meadow's, or for some other reason.) Besides a general desire not to simply dismiss as pragmatic any phenomenon that threatens semantic simplicity, there are other considerations that weigh against treating 'unless' as 'if . . . not'. Geis (1973) produces a battery of reasons not to equate 'unless' with 'if . . .not', and I refer my reader to his excellent article for more detailed discussion than I can provide here.

Geis notes that 'unless' and 'if . . . not' behave differently with respect to the possibility of coordinate structures. There is no obstacle to conjoining clauses containing 'if . . . not', but we cannot do the same with clauses containing 'unless'. Compare, for example:

John will succeed if he doesn't goof off and if he doesn't sleep through the final.

*John will succeed unless he goofs off and unless he sleeps through the final.

'Unless' and 'if . . . not' also interact differently with negative polarity items. Naturally, negative polarity items can occur in the scope of 'if . . . not'. They cannot, however, occur in the scope of 'unless':

John won't succeed if he doesn't ever attend class.

*John won't succeed unless he ever attends class.

As a final point against the identification of 'if . . . not' and 'unless', we should note that clauses containing 'if . . . not' can be modified by 'only', 'even', 'except', while clauses containing 'unless cannot:

John will succeed only if he doesn't goof off.

*John will succeed only unless he goofs off.

John will succeed even if he doesn't work hard.

*John will succeed even unless he works hard.

John will succeed except if he doesn't work hard.

*John will succeed except unless he works hard.

I will take these considerations and others in Geis (1973) to tell strongly against the identification of 'unless' with 'if . . . not' that Higginbotham (2003) suggests, and so this particular means of deriving the falsity of "Meadow will succeed unless she works hard" is untenable. Perhaps other means might be proposed, but I do not know of any other such proposals.

seems to disappear when "unless"-statements are embedded under some quantifiers such as "no students". "A will succeed unless A works hard" is false if A can succeed while working hard. However, the mere fact that working hard and succeeding are compatible for each student does not suffice to make true "No student will succeed unless they work hard". The quantified statement is much stronger. It is not made true by the mere *compatibility* of working hard and succeeding. For Meadow, hard work and success are certainly compatible, but this does not mean that "No student will succeed unless they work hard" can be true of a class containing her. It cannot. "No student will succeed unless they work hard" specifically rules out the possibility of students like Meadow, who may succeed without hard work.

I will argue that a Modalized Restrictive Account of quantified "unless"-statements will deliver the results we are seeking. Once we have a satisfactory account of "unless"-statements that occur in the presence of adverbs of quantification, it will be a simple matter to extend this account to handle "unless"-statements that are embedded under quantifiers.

4.1 Von Fintel's Account of "Unless"

To make progress here, we will need to understand the semantics of unquantified "unless"-statements in more detail. There has been relatively little contemporary discussion of "unless", but fortunately von Fintel (1992, 1994) offers an excellent discussion that will be extremely helpful to us here. Von Fintel's account extends and formalizes Geis (1973), and includes a uniqueness condition that explains why "Meadow will get an A unless she works hard" is false.

Von Fintel's account of "unless"-statements follows in the Lewis-Kratzer tradition of treating conditionals as restrictions on quantificational adverbs, and he assumes, along with most theorists, that a covert universal quantifier occurs in the absence of an explicit quantificational adverb.

Let us begin by considering cases in which no adverb of quantification is present in the sentence, and so the quantifier in question is a covert universal. Von Fintel's account of "unless"-statements has two parts. The first part treats "unless"-statements as having as part of their meaning something akin to "if . . . not". Thus "M unless R" has its interpretation given in part by:

All [C – R] [M]

It is thus part of the truth conditions of "M unless R" that all relevant situations in which "R" is false are ones in which "M" is true. It should be clear that this is extensionally equivalent to the analysis we would give for "If not R, then M", and so the common intuition (see, e.g., Higginbotham 2003) that "unless" is akin to "if . . . not" is captured by this part of von Fintel's treatment.

"Unless" does not simply mean "if . . . not" (Geis, 1973, see also fn 9). Von Fintel recognizes this, and so includes a so-called uniqueness condition, which he formulates as follows:

$$\forall S\ (\text{All } [C - S]\ [M] \rightarrow R \subseteq S)$$

Thus, for any set of situations S, if all relevant situations that are not S situations are also M situations, then S includes R as a subset. It is this condition that explains the falsity of, e.g., "Meadow will get an A unless she goofs off". It is certainly true that all relevant situations in which Meadow does not goof off are situations in which she will get an A, thus the first condition of the analysis is satisfied. But the uniqueness condition will not be satisfied. Consider a proper subset of the (possible) situations in which she goofs off – say, situations in which she both goofs off and chews gum in class. Clearly, the set of situations in which she goofs off is not a subset of the situations in which she both goofs off and chews gum in class, at least on the very natural assumption that there are some relevant, possible situations in which she goofs off but does not chew gum. However, since Meadow will get an A in all relevant situations, she will a fortiori get an A in situations in which she *either* doesn't goof off, *or* doesn't chew gum in class. But this disjunctive set of situations just consists of the situations denoted by [C – S], where S is the set of situations in which she both goofs off and chews gum. Thus, we have found a set S of situations such that all the relevant non-S situations are situations in which Meadow gets an A, but the set of situations in which Meadow goofs off is not a subset of this set S. Thus the uniqueness condition is not satisfied. The uniqueness condition will only be satisfied if all the situations in which "R" holds are situations in which "M" does not hold. If there are any R-situations that are also M-situations, then if we subtract these situations from R, we will obtain a set S that falsifies the uniqueness condition.

Von Fintel's account of statements of the form "M unless R" thus contains two conjuncts:

$$\text{All } [C - R]\ [M]\ \&\ \forall S\ (\text{All } [C - S]\ [M] \rightarrow R \subseteq S)$$

It should be obvious by now that we will not be able to use this analysis to give an account of quantified "unless"-statements in any straightforward manner. If we try to treat "No students are M unless they are R" as

No x [x is a student] [x is M unless x is R]

and use von Fintel's analysis of the "unless"-statement, we will obtain:

$$\text{No x [x is a student] [All } [C - \{s\text{: x is R in s}\}]\ [\{s\text{: x is M in s}\}]\ \&\ \forall S\ (\text{All } [C - S]\ [\{s\text{: x is M in s}\}] \rightarrow \{s\text{: x is R in s}\} \subseteq S)]$$

(where C is the set of relevant situations.) But as long as all the students fail to satisfy at least one of the conjuncts of the analysis, the statement will be true. As before, this predicts that Meadow will pose no obstacle to the truth of "no student will get an A unless they work hard", since she will not satisfy the uniqueness condition of the "unless"-statement. Once again, the uniqueness condition – essential for an account of "unless"-statements that do not occur under quantifiers – creates difficulties once we try to embed the statement under "no".

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4.2 A Modified Account of "Unless"

Before we return to our main project of giving an account of "unless"-statements under quantifiers, let us consider how von Fintel's account fares when there is an explicit adverb of quantification present in the "unless"-statement. Von Fintel (1992) formulates his account in general terms as follows:

$$Q\ [C - R]\ [M]\ \&\ \forall S\ (Q\ [C - S]\ [M] \rightarrow R \subseteq S)$$

where "Q" is the relevant quantifier – either a covert universal as before, or an adverb of quantification that explicitly occurs in the sentence. Let us see how his account handles a statement such as (12):

(12) John never succeeds unless he works hard

(Or to make the scope of the adverb more apparent, we may substitute the more awkward "Never, unless he works hard, does John succeed".) Clearly, (12) cannot be true if there are any possible, contextually relevant situations in which John succeeds without working hard. Von Fintel (1994) claims that (12) also requires for its truth that any time John works hard, he succeeds, but this seems to me too strict a requirement for the truth of (12). (12) may be true, yet there be some relevant situations in which even hard work does not suffice for John's success. My intuitions, and those of my informants, have it that it should not be part of the truth conditions of (12) that every situation in which John works hard is one in which he succeeds. If John is someone who finds his coursework extremely difficult, and so never succeeds without hard work, (12) will be true, *even if John sometimes finds the work so difficult, that he fails despite working hard.*

Von Fintel's account, however, predicts that the truth conditions of (12) would include such a strict requirement. His above analysis, applied to (12), would be as follows:

$$\text{No}\ [C - \{s: \text{John works hard in } s\}]\ [\{s: \text{John succeeds in } s\}]\ \&\ \forall S\ (\text{No}\ [C - S]\ [\{s: \text{John succeeds in } s\}] \rightarrow \{s: \text{John works hard in } s\} \subseteq S)$$

The first conjunct above is perfectly correct – it states that no relevant situation in which John does not work hard is a situation in which John succeeds. The second conjunct – the uniqueness condition – imposes an overly demanding condition, however. The second conjunct is not satisfied as long as there is some set of situations S such that none of the relevant non-S situations are situations in which John succeeds, and yet S does not contain the situations in which John works hard. Suppose, for example, that amongst the contextually relevant situations are ones in which the subject matter is just too difficult for John to master. No matter how hard he works, he won't succeed in those situations. Intuitively, (12) can be true despite the possibility of such situations, but the uniqueness clause in von Fintel's account is violated under these circumstances.

To see that this is so, let us take S to be the set of situations in which the subject matter is *not* too difficult for John. Let us further suppose that there are some relevant possible situations in which John works hard, even though the subject matter, regrettably, is just too difficult him. (This supposition is just the one described the preceding paragraph.) Then the set of situations in which John works hard will not be a subset of S, and so for this S it is false that:

$\{$s: John works hard in s$\} \subseteq$ S

However, since S is the set of situations in which the subject matter is not too difficult for John, [C – S] is the set of relevant situations in which the subject matter *is* too difficult for John. In the scenario we are describing, none of these situations are situations in which John succeeds. Thus it is true that:

No [C – S] [$\{$s: John succeeds in s$\}$]

Thus von Fintel's uniqueness clause is violated, and so (12) is predicted to be false, so long as there are some situations in which John works hard but still doesn't succeed. Intuitively, however, it may be true that John never succeeds unless he works hard, even though sometimes his hard work isn't enough to secure his success. Sometimes the subject matter is simply beyond him. Thus von Fintel's account does not correctly handle "unless"-statements that contain the quantificational adverb "never".

If von Fintel's account included only its first part – the requirement that no situations in which John does not work hard be ones in which he succeeds – we would have the intuitively correct truth conditions for "John never succeeds unless he works hard". As we saw above, however, the uniqueness clause is needed to provide adequate truth conditions for "unless"-statements that contain universals, be they covert or overt. How can we accommodate this data in a compositional manner?

I believe that the problem lies in the formulation of von Fintel's uniqueness clause. Further evidence that it is not properly formulated emerges when we consider "unless"-statements that contain adverbs of quantification such as "usually" or "rarely", as in (13) and (14). Von Fintel (1994) claims that statements such as (13) and (14) are ill-formed and semantically deviant. I must admit that I simply do not share this intuition, nor do my informants. Since (13) and (14) are perfectly fine to my ear, I will aim to provide an account of "unless" that captures their truth conditions adequately.

(13) John usually succeeds unless he goofs off.
(14) John rarely succeeds unless he works hard.

(Or to make it absolutely clear that the quantificational adverbs have scope over the whole statements:

(13') Usually, unless John goofs off, he succeeds.
(14') Rarely, unless John works hard, does he succeed.

I cannot find anything objectionable about these sentences.)

Von Fintel's account cannot be successfully applied to (13) and (14); this is natural since von Fintel does not intend that it should apply to them. The account applied to (13) would yield the following:

$$\text{Most } [C - \{s: \text{John goofs off in } s\}]\ [\{s: \text{John succeeds in } s\}]\ \&\ \forall S\ (\text{Most } [C - S]\ [\{s: \text{John succeeds in } s\}] \rightarrow \{s: \text{John goofs off in } s\} \subseteq S)$$[9]

As before, I cannot find fault with the first conjunct of the account – it is certainly necessary for the truth of (13) that most situations in which John does not goof off are ones in which he succeeds. It is the uniqueness condition that gives us cause for concern.

Suppose, for example, that for the most part, when John doesn't goof off, he succeeds, and again for the most part, when John does goof off, he doesn't succeed. Let us say, though, that once in a while John bribes his teacher, in which case he usually succeeds, no matter what he does. It seems that (13) is true under these circumstances, as long as John very rarely bribes his teacher, but the uniqueness clause is violated. We may take our S to be the set of situations in which John does not bribe his teacher. John almost never bribes his teacher if he is planning to work hard – what would be the point? – so the situations in which he does bribe his teacher are generally ones in which he goofs off. Thus the set of situations in which John goofs off are *not* a subset of S, i.e. of the situations in which he refrains from bribing his teacher. However, as we have described the example, most of the situations in which John *does* decide to bribe his teacher are ones in which John succeeds, so it is true that:

$$\text{Most } [C - S]\ [\{s: \text{John succeeds in } s\}]$$

Once again, the uniqueness clause is not satisfied, and so we would predict that "John usually succeeds unless he goofs off" would be false as described. It is enough to falsify von Fintel's analysis that John very occasionally bribes his teacher and, having done so, usually succeeds as a result. Intuitively, however, "Usually, John succeeds unless he goofs off" is not so strong a claim as to be incompatible with such circumstances.

In the above example, it was important that we stipulated that John only occasionally bribes his teacher to succeed. If this was common practice for him, then (13) would not be true. It does not seem correct to say, for example, that Meadow usually succeeds unless she goofs off. Thus in the case of "most" or "usually", some second conjunct is needed, for it is not enough for the truth of the claim that most of the situations in which Meadow does not goof off be ones in which she succeeds. The first conjunct of von Fintel's analysis alone would not suffice here, though it seemed that it would suffice when the adverb of quantification was "never".

We can mount a similar argument against the appropriateness of the uniqueness clause in the case of (14), which is an "unless"-statement that contains the adverb "rarely". Suppose, for example, that it only occasionally happens that John succeeds without working hard – for the most part, he only succeeds when he works hard. Then (14) is intuitively true. If we suppose further that, sometimes, the subject

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[9] I am assuming here that 'usually' can be understood as 'most', and so am setting aside any additional normative or otherwise modal import 'usually' may possess; nothing will hang on this simplifying assumption.

matter is simply too hard for John, and despite his best efforts, he does not succeed, then (14) remains intuitively true. Once again, however, von Fintel's semantics predicts that the statement will be false. I shall not go through the details again, but my reader may convince herself that this is so by taking the set S to be the set of situations in which John works hard, and the subject is not too difficult for him.

Let us then summarize our desiderata for an account of "unless"-statements of the form "Q M unless R". The first conjunct of von Fintel's analysis was absolutely correct in all cases:

Q [C – R] [M]

It would be surprising if this part of the analysis was not correct, given the strong intuitions that "unless" is semantically similar to "if . . . not". The uniqueness clause so far has proved tricky, however. We would like it to be equivalent to von Fintel's uniqueness clause when the quantifier is a universal, but we would like it to effectively evaporate when the quantificational adverb is "never". We would like to have some version of a uniqueness clause when the adverb is "usually", but we would like it to amount to the requirement that most of the situations in which M holds are ones in which R doesn't hold, so as to allow the truth of "John usually succeeds unless he goofs off" if John very occasionally bribes the teacher, but not if he does so as a matter of course.

I propose that we analyze statements of the form "Q M unless R" as follows:

Q [C – R] [M] & Q [M ∩ C] [C – R]

"Q M unless R" is true, then, if and only if Q of the relevant non-R situations are M situations, and Q of the relevant M situations are non-R situations.

If there is no explicit adverb of quantification in the sentence, then I assume that a covert universal is present. Thus "John will succeed unless he goofs off" is analyzed as:

All [C – {s: John goofs off in s}][{s: John succeeds in s}] & All [{s: John succeeds in s} ∩ C] [C – {s: John goofs off in s}]

The sentence is true just in case all relevant situations in which John doesn't goof off are ones in which he succeeds, and all relevant situations in which John succeeds are ones in which he doesn't goof off. These truth conditions are equivalent to the ones that von Fintel provides for "unless"-statements that contain universal quantifiers.[10]

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[10] The formulation of von Fintel's uniqueness clause needs to be amended in order for these to be strictly equivalent, but it is a minor adjustment, and is independently motivated. As it stands, von Fintel has the following as his uniqueness clause:

$\forall S\ (Q\ [C - S]\ [M] \rightarrow R \subseteq S)$

However, the clause, as it stands, is violated if there are 'irrelevant' R-situations (i.e. situations that are in R, but not in C). That is, statements such as "John will succeed unless he doesn't work hard" would be predicted to be false if there are possible situations outside of the contextually relevant ones in which John doesn't work hard – situations in which, e.g., John dies in a freak accident.

Our first desideratum, then, is satisfied: If the quantifier is a universal, our account is equivalent to von Fintel’s.

What, though, of the quantifier “no”, or “never”? We wished that the uniqueness clause would “evaporate” in such cases, and this is indeed what we obtain. The determiner “no” is a *symmetric* determiner (Barwise & Cooper, 1981); “no As are Bs” is true iff “no Bs are As” is also true. We may “swap” the material in the restrictor with that in the scope, without changing the truth value of the claim, if the quantifier is “no” or its equivalent. But the uniqueness clause we are considering amounts to just this exchange! We might just as easily have written “M ∩ C” in place of “M” in the first conjunct, and so formulated our analysis as follows:

$$Q\ [C - R]\ [M \cap C]\ \&\ Q\ [M \cap C]\ [C - R]$$

If Q is symmetric, then the two conjuncts are equivalent. We are thereby able to capture the intuition that there is no real uniqueness clause when the quantifier is “no” – it is enough for the truth of the “unless”-statement that no relevant non-R situations be M situations. The uniqueness clause does not in fact evaporate in a non-compositional manner, but simply becomes redundant if the quantifier in question is “no”.

There is, I think, a suggestion of sorts to the effect that there are *some* situations in which M and R both hold, and the “uniqueness” clause provides an explanation of this suggestion, so it is not completely vacuous. For example, “John never gets an A unless he works hard” suggests that there are some possible situations in which John gets an A by working hard. This would seem to be related to the implication or presupposition carried by “if”-statements that contain “never”, such as “John never gets an A if he goofs off”. We would analyze the “if”-statement as

No [C ∩ {s: John goofs off in s}] [{s: John gets an A in s}]

Strictly speaking, this analysis predicts that “John never gets an A if he goofs off” is true if there are simply no relevant possible situations in which John goofs off. Intuitively, though, the English conditional suggests that it is a live possibility that John will goof off, and, of course, that in such possible situations, John will fail to get an A.

I do not think that the situation is much different in the case of “John never gets an A unless he works hard”, which we would represent as:

No [C – {s: John works hard in s}] [{s: John gets an A in s}] & No [C ∩ {s: John gets an A in s}] [C – {s: John works hard in s}]

To see that the uniqueness clause is violated, take S to be the contextually relevant situations in which John doesn’t work hard (i.e. S = C∩R). This difficulty is easily remedied by rendering the uniqueness clause as:

$$\forall S\ (Q\ [C - S]\ [M] \rightarrow C \cap R \subseteq S)$$

The adjustment is minor, and surely reflects von Fintel’s original intentions. Once we have made this adjustment, the two clauses are provably equivalent when the quantifier in question is a universal.

The second conjunct here is a perfect parallel to the analysis of the "if"-statement above, and it carries with it a similar suggestion (implication or presupposition, depending on the details of one's account) that there are some live possibilities in which John gets an A. Those possibilities cannot be ones in which John *doesn't* work hard, so we derive the suggestion that it's possible for John to work hard and get an A. We do not need to make any assumptions specific to "unless"-statements here – however we account for the parallel suggestion with "if"-statements should carry over here. (Von Fintel's account of "if"-statements is an example of an account that treats this suggestion as a presupposition.)

The account set out so far also provides an appealing analysis of "unless"-statements that contain "usually", as in "usually M, unless R". We wanted our account to require that most of the situations in which "M" holds be situations in which "R" holds. For example, we wished to explain why "John usually succeeds unless he goofs off" was compatible with John's occasionally slipping the teacher a bribe, but not with his doing so as a matter of course. We are now able to do so; "John usually succeeds unless he goofs off" will be analyzed as:

Most [C – {s: John goofs off in s}] [{s: John succeeds in s}] & Most [{s: John succeeds in s} ∩ C] [C – {s: John goofs off in s}]

The "unless"-statement will be false if most of the relevant situations in which John succeeds are just ones in which he bribes the teacher, then kicks back, since the second conjunct will not be true under those conditions. As long as we are only considering the occasional bribe, however, the "unless"-statement will be true.

We thus arrive at a plausible and appealing account of "unless" by adopting this formulation of the uniqueness clause. Our account now yields the right results even when the sentence in question contains a quantificational adverb that is not a universal.

4.3 Aside: Uniqueness Clauses and Coordinate Structures

One might worry that, in allowing the uniqueness clause to evaporate in "unless"-statements containing "never", we lose an explanation of why "unless" clauses cannot be conjoined. Geis (1973) points out that coordinate structures with "unless" are not permissible, for example:

(15) *John will get an A unless he goofs off and unless he sleeps through the final.

Von Fintel (1991, 1994) proposes that his uniqueness clause explains the impermissibility of this statement – since the "unless" clause expresses the unique minimal restriction that makes the conditional true, there cannot be another such clause. If both restrictions made the conditional true, then the uniqueness clause would not be satisfied in either case. Von Fintel's account of "unless"-statements containing "never" also features a uniqueness clause, and so he claims that it also predicts the unacceptability of conditionals such as

(16) *John never gets an A unless he works hard and unless he bribes the teacher.

I have argued that his uniqueness clause issues in overly strong truth conditions for "unless"-statements containing "never", and so is not a desirable component of an account of such statements. The uniqueness clause also did violence to "unless"-statements containing "usually" and "rarely", which, *pace* von Fintel, are quite acceptable. But do we achieve our intuitively correct truth conditions at the cost of losing our explanation of the impermissibility of coordinate structures like the ones above?

On closer inspection, it is far from clear that von Fintel's uniqueness clause does in fact explain the unacceptability of the coordinate structures. His semantics predict *only* that the two sets of situations denoted by the two "unless"-clauses are coextensive. If they are not coextensive, the statement is false, not defective. And if they are coextensive, then his semantics predicts that the statement will be true! Consider, however, statements such as:

(17) *I will respect the list of endangered species unless it contains renates and unless it contains cordates.

This statement is just as unacceptable as the two above, but it is far from clear why this should be so on von Fintel's account. Since the two "unless"-clauses denote states of affairs that are coextensive in the possible worlds that are likely to be relevant, there is no obstacle to the uniqueness clause being satisfied for both "unless" clauses. Relatedly, it is not clear why statements such as:

(18) *John will get an A unless he goofs off and unless he sleeps through the final are *impermissible*, as opposed to simply entailing that John will goof off if and only if he sleeps through the final.

We should also be hesitant to offer a straightforwardly semantic explanation for the impermissibility of these constructions, since conjoined "unless" clauses are far more acceptable when they occur at the left periphery of the sentence. Consider, for example:

(19) Unless he goofs off, and unless he sleeps through the final, John will succeed.

Rearranging the sentence in this way significantly increases its acceptability, but von Fintel's account, or any obvious variation on it, would predict that such rearrangement would not impact the sentence's acceptability. Unless we assume that moving the clauses to the left periphery alters the truth conditions of the statement, a truth conditional explanation of the permissibility of coordination will not be forthcoming.[11]

We should also not lose sight of the lingering phenomenon that von Fintel (1991, 1994) points to – namely that "unless" clauses can be disjoined, as in:

(20) I won't go to the party unless Bill comes, or unless there is free beer.

[11] I am indebted to John Hawthorne for bringing this phenomenon to my attention.

These data together suggest that the behavior of "unless" clauses in coordinate structures needs considerably more investigation before it will be understood. Positing a uniqueness clause does not provide us with the explanation we seek. While more work is certainly in order, the phenomenon of coordination does not provide us with a reason to prefer von Fintel's account to mine.

4.4 "Unless"-Statements Embedded under Quantifiers

We have formulated a promising account of "unless"-statements that occur with quantificational adverbs. The "unless"-statements serve to restrict the range of possibilities that fall under the domain of the adverbial quantifiers. It is not difficult, then, to extend this account so that "unless"-statements embedded under quantifying determiners serve to restrict those quantifiers. As in the case of "if"-statements, a modal element must be introduced into the semantics, and I will continue to do so by means of a wide-scope covert universal quantifier over possible worlds.

I propose that we analyze quantified "unless"-statements of the form "Q Ns M, unless they R" by letting the antecedent R restrict the quantifier in the same way that it restricts an adverb of quantification in the account provided above. The logical form of such a statement would then be:

$\forall$w Cw, w_0: Qx [Nx – Rx] [Mx] & Qx [Nx & Mx] [Nx – Rx]

Or more perspicuously:

$\forall$w Cw, w_0: Qx [Nx & not Rx] [Mx] & Qx [Nx & Mx] [Nx & not Rx]

We will thus treat, e.g., "no student will succeed unless they work hard" as:

$\forall$w Cw, w_0: No x [x is a (relevant) student in w & x does not work hard in w] [x succeeds in w] & No x [x is a (relevant) student in w & x succeeds in w] [x is a (relevant) student in w & x does not work hard in w]

We correctly predict that Meadow's presence is enough to falsify the claim, no matter how hard she in fact decides to work. Since there is a relevant possible world in which Meadow succeeds without working hard, the statement is false. Let us recall the intuition we had earlier: that "unless"-statements embedded under "no" seem to be in some sense equivalent to "if . . .not"-statements. We had no sense that there was a uniqueness clause making a contribution to the truth conditions of the statement. On this analysis we can understand why this is so. Just as "unless"-statements that contain the quantificational adverb "never" seem ed to be equivalent to "if . . . not" statements, the same is true for ones embedded under "no", since in both cases the quantifiers are symmetric, and so the uniqueness clause does not add any additional demands to the truth conditions.

We are also able to predict at last that both the over-protected Meadow and the unfortunate Bill suffice to falsify "every student will get an A unless they goof off".

∀w Cw, w_0: Every x [x is a (relevant) student in w & x does not goof off in w] [x succeeds in w] & Every x [x is (relevant) student in w & x succeeds in w] [x is a (relevant) student in w & x does not goof off in w]

No matter how hard Bill and Meadow actually work, the statement is false if either is among the relevant students. The statement is false in Bill's case because there is a relevant possible world in which he does not goof off and yet does not succeed, and so the first conjunct of the analysis is false in that world. It is false in Meadow's case because of the relevant possibility of her succeeding without working hard, and so falsifying the second conjunct in that world.

"Unless"-statements containing "most" and "few" can be given a parallel analysis. "Most students will succeed unless they goof off" will be analyzed as:

∀w Cw, w_0: Most x [x is a (relevant) student in w & x does not goof off in w] [x succeeds in w] & Most x [x is (relevant) student in w & x succeeds in w] [x is a student in w & x does not goof off in w]

Similarly, "few students will succeed unless they work hard" is to be analyzed as:

∀w Cw, w_0: Few x [x is a (relevant) student in w & x does not work hard in w] [x succeeds in w] & Few x [x is a (relevant) student in w & x succeeds in w] [x is a student in w & x does not work hard in w]

We have thus managed to provide an account of quantified "unless"-statements that adequately captures their truth conditions, without attributing a chameleon-like semantics to "unless". Quantified statements containing "unless" could not be understood as attributing conditional properties to a particular number or proportion of items in a domain restricted by the relevant nominal, as the Simple Solution would have it. They can, however, be analyzed by way of taking the "unless"-statement to restrict the quantifier, albeit in a somewhat complex manner. We have seen, though, that an adequate account of unquantified "unless"-statements extends naturally to accommodate quantified "unless"-statements.

5 Conclusion

A uniform semantic analysis of "if" and "unless" embedded under quantifiers is possible. These constructions thus do not pose a threat to the thesis that natural language is semantically compositional. The semantics of these statements is not, however, a straightforward matter. The Simple Solution to Higginbotham's puzzle – according to which their truth and falsity depend on the number or proportion of the relevant items that satisfy the open conditional – ran into difficulty when we considered "if"-statements that do not obey Conditional Excluded Middle, and was wholly unable to deal with "unless"-statements. Ultimately, we found that both types of conditional ought to be treated as restricting their quantified NP subjects, while also contributing a covert modal element to the semantics. Given the complexity of the analysis required to give adequate truth conditions for these constructions, it is hardly surprising that theorists have doubted that a successful, uniform account of them would be possible. I hope to have shown that, despite these doubts, we can indeed provide such an analysis.

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