# Unless, Exceptionality, and Conditional Strengthening

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# Contents

# 1  Introduction

Higginbotham (1986) puts forward the subordinating conjunctions "if" and "unless" as putative counterexamples to a compositional theory of semantics, claiming that they vary in their semantic contribution when embedded under different quantifiers.[1] Although various "fixes" have been proposed for this problem (Pelletier 1994), these have proven unsatisfactory enough that the "if" and "unless" counterexamples have entered the literature as two of the standard objections to compositionality, and have been replicated as such in a number of seminal articles (Janssen 1997, Szabó 2008). A satisfactory resolution of Higginbotham's puzzle, therefore, holds a certain significance for the debate over compositionality at large.

An account of "if" and "unless" has value in an additional respect. They belong to a broader class of natural language connectives which includes words like "and" and "or" (which have formal counterparts), as well as words like "but" and "except" (which do not seem to). *Prima facie*, this class appears truth-functional: its members seem to express truth-conditional relationships between propositions. A robust semantics of this class, then, promises to shed light on the logic of natural language, insofar as it differs from formal logic.

"If" and "unless" hold a slightly different position in this regard. In particular, "if" uncontroversially has a formal counterpart: the study of the relationship between them forms a nontrivial body of work, to which I do not propose to add. "Unless," on the other hand, has so far evaded a comprehensive account. In the following, I examine some of the past proposals, and discuss where they fall short. In addition, I propose a new strategy for considering the meaning of "unless," and hope in so doing to provide a framework in which some, if not all, of its as-yet unexplained behavior can be treated.

# 2  Truth conditions

## 2.1  Higginbotham's puzzle

Higginbotham highlights a major difficulty in treating "unless," and I begin with an overview of his claims:

(1)  a. John will succeed unless he goofs off.

b. Everyone will succeed unless he goofs off.

c. No one will succeed unless he goofs off.

According to Higginbotham (p.33), "unless" in (1)a and (1)b is "pretty well represented" by non-exclusive disjunction ($\vee$). However, replacing "unless" with $\vee$ in (1)c gives:

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[1]Compositionality holds that the meanings of complex expressions are built from the meanings of their components. Although it is not universally accepted, the majority of semantic theories incorporate compositionality as a fundamental aspect of the process of establishing meaning. Particularly faithful adherents hold that the principle requires individual words to make the same semantic contribution in every context, and thus proposed counterexamples often involve words with apparently variable semantics.

(2)  $\neg\exists x\ [(x \text{ will succeed}) \lor (x \text{ goofs off})]$

and, as Higginbotham points out, this cannot be the correct interpretation. (2) requires that each person neither succeeds nor goofs off, whereas it is intuitively clear that (1)c also permits individuals who do both.

Higginbotham proposes that "unless" takes the form "and not" under the negative quantifier:

(3)  $\neg\exists x\ [(x \text{ will succeed}) \land \neg(x \text{ goofs off})]$

(3) disallows success without goofing off, but does not rule out both options; this improves upon (2). From this, Higginbotham concludes that "unless" behaves differently under $\neg\exists$ than under $\forall$, and attributes to it a variable semantics.[2]

Consider the facts of Higginbotham's puzzle. While it might be the case that "unless" is sensitive to quantifier polarity, Higginbotham has not shown that this is necessarily so. What is clear is that "$\lor$" cannot provide invariant semantics.

Higginbotham's initial choice of the disjunction dovetails with the traditional account, which holds that "unless" represents a negative conditional, "if not" (Jespersen 1961, Reichenbach 1947, Quine 1959).

(4)     a. John eats steak unless he eats lobster.

        b. John eats steak if he does not eat lobster.

Since $p \lor q$ is logically equivalent to $\neg q \to p$, (4)b is equivalent to a disjunction. This account not only gives (per Higginbotham) a variable semantics for "unless," but also holds that it is compatible with (4)a for John to eat both steak and lobster. Neither of these consequences is ideal. While (4)a does indicate that John will eat at least one of steak or lobster, it also suggests that he will eat *at most* one. Similarly, exclusivity appears to hold in (1)a; John will succeed if he does not goof off, but he will not succeed otherwise. The "if not" account, then, seems inadequate, even in the absence of quantification.

## 2.2   Truth-conditional equivalences

Exclusivity suggests a biconditional interpretation for "unless." One direction is given by "if not," as in (4)b. The other ("not if") direction holds that John will not eat steak if he has lobster. Thus "$p$ unless $q$" contains both $\neg q \to p$ and $q \to \neg p$ and therefore apparently represents $p \leftrightarrow \neg q$.

Perhaps due to the absence of lexicalized *iff* in natural language, biconditional interpretations of "unless" are mostly absent in the literature – it would seem peculiar to have a negative biconditional without the (arguably) more straightforward positive one. Accounts which reduce to "if not" or "not if," however, are readily available.

Fillenbaum (1986) points out the similarity between the following:

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[2]Pelletier (1994) proposes a compositional "fix": either the lexical entry for "unless" has a parameter sensitive to quantifier polarity, or "unless" has two homophonic entries (one for negative quantifiers, and one for positive). Neither solution seems especially elegant.

(5)    a. I'll kill you unless you give me your money.

        b. Only if you give me your money will I not kill you.

Although "only if" in (5)b *sounds* like an improvement over material implication, these proposals are truth-functionally identical. "Only if $q$, not $p$" can be written $\neg p \to q$, which gives $\neg q \to p$ by contraposition, and is precisely "if not."

    On the "not if" side, Clark & Clark (1977) claim the following are equivalent:

(6)    a. Twain liked people unless they were hypocrites.

        b. Twain liked people only if they were not hypocrites.

    Here, "$p$ unless $q$" is given by "$p$ only if not $q$," or $p \to \neg q$. For (4)a, this gives:

(7)    John will eat steak only if he does not eat lobster.

On this view, John cannot consume both lobster and steak, but he might choose neither. This goes against (4)a: one of the options must be selected.

    While both directions capture aspects of "unless," it seems that neither is independently adequate. This supports the biconditional interpretation $p \leftrightarrow \neg q$. The real test of this proposal, of course, is Higginbotham's puzzle:

(8)    a. $\neg \exists x$ {[($x$ will succeed) $\to \neg$($x$ goofs off)] $\wedge$ [$\neg$($x$ goofs off) $\to$ ($x$ will succeed)]}

        b. $\forall x$ {[($x$ will succeed) $\wedge$ ($x$ goofs off)] $\vee$ [$\neg$($x$ will succeed) $\wedge \neg$($x$ goofs off)]}

(8)a and b are logically equivalent,[3] and it is easier to see the truth conditions of (8)b: it must be the case that each individual both succeeds and goofs off, or does neither.

    Unfortunately, even this is not sufficient. (8) has goofing off as both a necessary and sufficient condition for success. (1)c, however, only stipulates necessity; an individual who goofs off and still does not succeed is allowed. This is Higginbotham's puzzle again: "unless" behaves differently when embedded under $\neg \exists$.

## 2.3   Additional observations

All of this argues against a truth-functional interpretation of "unless." Such an account is subject to Higginbotham's puzzle; and it seems (at best) counterintuitive to permit variability in a truth-functional operator.

    As a first step in moving away from truth-functionality, it is useful to examine "unless" on its own terms. Dancygier (1975) provides a starting point for this, arguing that, in using

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[3] Let $P(x) = x$ will succeed and $Q(x) = x$ goofs off. We get the following chain of equivalences:

$$\neg \exists x[(P(x) \to \neg Q(x)) \wedge (\neg Q(x) \to P(x))]$$

$\Longleftrightarrow \neg \exists x[\neg(P(x) \wedge Q(x)) \wedge (P(x) \vee Q(x))]$    by the definition of '$\to$'

$\Longleftrightarrow \forall x \neg[\neg(P(x) \wedge Q(x)) \wedge (P(x) \vee Q(x))]$    by DeMorgan's laws for quantifiers

$\Longleftrightarrow \forall x[(P(x) \wedge Q(x)) \vee \neg(P(x) \vee Q(x))]$    by DeMorgan's laws for connectives

$\Longleftrightarrow \forall x[(P(x) \wedge Q(x)) \vee (\neg P(x) \wedge \neg Q(x))]$    again by DeMorgan's laws for connectives.

"$p$ unless $q$," a speaker intends to assert $p$, but also considers the conditions under which $p$ might not hold. On her view, "$p$ unless $q$" is to be understood as "$p$; not $p$ if $q$." Thus $p$ is the primary assertion: "unless" specifies the unique circumstances $q$ under which $p$ does not hold.

The idea that exceptionality is central to "unless" is not Dancygier's alone. Geis (1973) suggests that "unless" patterns with "except if" rather than "if not," and Zuber (1999) compares "unless" sentences to "exclusion phrases."[4] Geis also provides an extensive examination of "unless." His observations are meant to differentiate between "if not" and "unless," but are worth considering independently.

First, Geis claims that "unless"-clauses cannot be coordinated:

(9)   ?Professor Arid will pass you in Linguistics 123 unless you fail the final exam and unless you make less than a C on the final paper.

At best, (9) is ambiguous between a reading on which passing either exam or paper is sufficient to pass the course, and one on which passing both exam and paper is necessary. At worst, (9) is uninterpretable.

Second, "unless" does not combine well with negative polarity items (NPIs):

(10)   *Mary will be angry unless Bill has called yet.

To the extent that "if not" accounts treat "unless" as inherently negative, this is a fact in need of explanation; it is worth noting in any case.[5]

"Unless" also interacts oddly with counterfactuality:

(11)   ?Unless you had helped me, I would not have finished on time.

While "if"-conditionals are easily rendered counterfactual, (11) resists interpretation.

Lastly, Geis observes that "unless" does not combine with "even," "only," and "except."

(12)   a. *I will phone you even unless you phone me.

        b. *I will phone you only unless you phone me.

        c. *I will phone you except unless you phone me.

(12)a-c are syntactically bad, but highlight a semantic effect: these data support exceptionality in "unless" by showing that it combines poorly both with other "exceptional" operators ("only" and "except") as well as with something like the reverse ("even"). The former can be attributed to redundancy, the latter to contradiction.

The relevant patterns, then, for the most part support an "exceptional" model. Geis's "except if" proposal is a good starting point for developing a more nuanced account, and his observations provide a starting set of facts to be captured by this account.

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[4]E.g. *No/every student except Leo.*

[5]Brée (1985) dismisses this observation, claiming that any underlying "not" in "unless" is inseparable and cannot be a licenser.

# 3 The exceptive account

The most current account of "unless" treats it as belonging to an exceptive class, which includes operators like "but."[6] This approach, pioneered by von Fintel (1992, 1993, 1994), formalizes Geis's suggestion that "unless" behaves like "except if."

## 3.1 The original proposal

Von Fintel (1992) provides the following analysis of "unless," based on his general account of exceptives.

(13)  $Q[C]$ $M$ **unless** $R$
$:= (Q\ [C - R]\ [M]) \wedge (\forall S\ (Q\ [C - S]\ [M]) \to R \subseteq S)$

where $Q$ is the interpretation of the "adverb of quantification," $C$ is a set of currently relevant situations, $M$ is the clause being quantified over, and $R$ is the excepted set. $S$ is an arbitrary collection of situations.

This is best illustrated by an example:

(14)   a. John will succeed unless he goofs off.

   b. ($\forall x$ where $x$ is a relevant situation in which John does not goof off, $x$ is a situation in which John succeeds) $\wedge$
   ($\forall$ arbitrary collections $S$ of situations where John succeeds in all relevant non-$S$ situations, $S$ contains all of the situations in which John goofs off)

This strongly resembles the biconditional proposed earlier. The first conjunct is essentially "if not": John will succeed if he does not goof off. The second is what von Fintel calls the "uniqueness" clause: it expresses that the excepted set $R$ (situations where John goofs off) is the unique set causing unexcepted quantification to fail. Specifically, the uniqueness clause in (14) says that if there is a set of situations for all of which John succeeds, no situation in which John goofs off may be included. This is "not if": success *only* occurs in the absence of goofing off.

This account improves on preceding attempts by explaining some of the behavior of "unless" described in 2.3. Consider coordination again:

(15)  ?$p$ unless $q$ and unless $r$

Von Fintel shares Geis's view of (15), and argues that the exceptive account predicts ungrammaticality. Assuming that $q$ and $r$ are independent, (15) requires the existence of two

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[6]E.g.:

(i)   Every student but John attended the meeting.

distinct unique smallest sets of circumstances under which $p$ does not hold. This is logically impossible, explaining why such constructions are uninterpretable. This is a point of difference with the biconditional account, on which sentences with form (15) ought to be interpretable.

Exceptionality also addresses counterfactuality. Von Fintel (1994) attributes the problem with (11) to the interaction between counterfactuality and the restrictive power of "unless." In brief, modal operators like "will" and "would" quantify over possible situations:

(16)    a. I will plant an apple tree today.

        b. #I would plant an apple tree today.

While "will" quantifies over accessible situations, "would" quantifies over those that are not "epistemically accessible." The space of such inaccessible worlds, however, is *a priori* unbounded. "Would," therefore, needs a restrictive clause – precisely what seems to be missing in (16)b.

Counterfactuals are generally subjunctive, and thus pattern with "would" in requiring a domain restrictor. "Unless" is not restrictive, but instead an exceptive operator on restrictive arguments. Counterfactuals using "unless" are domain-unrestricted and thus uninterpretable.

## 3.2    Obstacles

The exceptive account leaves some open questions. I address these in order of significance.

### 3.2.1    Polarity

Von Fintel does not directly address the NPI issue. However, he points out the existence of acceptable cases:

(17)  Unless anyone objects, we will move to the next item on the agenda.

If polarity is a semantic issue, it will be difficult to explain why (17) should be allowed when (10) is not. Both examples can be interpreted via (13). Moreover, while (10) is grammatically bad, it is interpretable. An explanation of these facts may need to reach beyond the strictly semantic.

### 3.2.2    Coordination

As noted, the exceptive account predicts non-coordination. It is not entirely clear, however, that (9) is uninterpretable; it may be ambiguous between the two readings discussed. This is a problem for the exceptive account.

Leslie (2008) suggests that this effect is pragmatic, as reversing clause order improves matters:

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

This, too, is problematic for the exceptive account.

### 3.2.3 Higginbotham's puzzle again

Leslie (2008) observes that von Fintel's proposal has trouble with examples containing explicit "adverbs of quantification."

(19)    a. John usually succeeds unless he goofs off.

        b. John rarely succeeds unless he goofs off.

        c. John never succeeds unless he goofs off.

Interpreting "usually" as the quantifier "most," "rarely" as "not many," and "never" as "no," (13) gives:

(20)    a. $\text{Most}[C - \{\text{John goofs off}\}]\,[\{\text{John succeeds}\}]\,\wedge$
           $\forall S\,(\text{Most}[C - S]\,[\{\text{John succeeds}\}] \rightarrow \{\text{John goofs off}\} \subseteq S$

        b. $\text{Not many}[C - \{\text{John goofs off}\}]\,[\{\text{John succeeds}\}]\,\wedge$
           $\forall S\,(\text{Not many}[C - S]\,[\{\text{John succeeds}\}] \rightarrow \{\text{John goofs off}\} \subseteq S$

        c. $\text{No}[C - \{\text{John goofs off}\}]\,[\{\text{John succeeds}\}]\,\wedge$
           $\forall S\,(\text{No}[C - S]\,[\{\text{John succeeds}\}] \rightarrow \{\text{John goofs off}\} \subseteq S$

(20)a requires that John succeed in most of the situations where he does not goof off. However, it also requires that any subset of relevant situations containing mostly success situations contains no goofing off – uniqueness here is incoherent. (20)b is similar.

    (20)c is pathological in a more familiar way. (19)c patterns with the negatively quantified (1)c in that goofing off is necessary but not sufficient for John's success. (20)c, however, contains the unnecessary "not if."

    These problems are all due to uniqueness; Leslie thus proposes to modify (13). By relativizing to the comparison set, she forces the two conjuncts to reduce to the same thing when embedded under a symmetric quantifier:

(21)  $Q[C]\ M\ \textbf{unless}\ R$
      $:= Q[C - R]\,[M] \wedge Q[M \cap C]\,[C - R]$

This has no practical effect on implicitly quantified examples.

(22)    a. John will succeed unless he goofs off.

        b. $\forall[C - \{\text{John goofs off}\}]\,[\{\text{John succeeds}\}]\,\wedge$
           $\forall[\{\text{John succeeds} \cap C\}]\,[C - \{\text{John goofs off}\}]$

Translation via (21) still produces the desired "if not" and "not if" directions. Now consider (19)a-c:

(23)    a. $\text{Most}[C - \{\text{John goofs off}\}]\,[\{\text{John succeeds}\}]\,\wedge$
           $\text{Most}[\{\text{John succeeds} \cap C\}]\,[C - \{\text{John goofs off}\}]$

    b. Not many$[C - \{$John goofs off$\}]$ $[\{$John succeeds$\}]$ $\wedge$
       Not many$[\{$John succeeds $\cap\ C]$ $[C - \{$John goofs off$\}]$

    c. No$[C - \{$John goofs off$\}]$ $[\{$John succeeds$\}]$ $\wedge$
       No$[\{$John succeeds $\cap\ C]$ $[C - \{$John goofs off$\}]$

In (23)a, most non-goofing situations are success ones, as needed. In addition, most success situations are non-goofing. Uniqueness seems to fit well with (19)a: John may occasionally succeed despite goofing off, but it is not "usual." (23)b is similar: uniqueness requires that not many success situations are non-goofing.[7] The change in (23)c is more striking: the first conjunct says that there are no non-goofing success situations, and the second that no success situations are non-goofing. These are logically equivalent: uniqueness has vanished, and goofing off is only a necessary condition, as desired.

    Unfortunately, Leslie's modification does not display the same dexterity when quantification is over entities (individuals).

(24)    a. No one will succeed unless he works hard.

        b. $\neg\exists x$ $(\forall[C - \{x$ works hard$\}]$ $[\{x$ succeeds$\}]$ $\wedge$ $\forall[\{x$ succeeds$\} \cap C]$
          $[C - \{x$ works hard$\}])$

For Leslie, (24)b holds that there is no one for whom all non-hard work situations are successful *and* all success situations do not involve hard work. Thus, it allows someone for whom all non-hard work situations are successful, as long as he sometimes also succeeds when he works hard. This is inconsistent with (24)a.

    Leslie does provide an explanation for this: the overt quantifier must have immediate scope over both "if not" and uniqueness. Her modification of uniqueness works for examples like (19)c because it exploits the symmetric nature of the negative quantifier – if no $x$s are $y$s, then no $y$s are $x$s either. Since the negative quantifier in (24) is external to the "unless" framework, and the internal quantifier is universal, modification does not help here. For entity-quantified examples, Leslie instead proposes (25).

(25)  $Q$ $N$s $M$, **unless** they $R$
     $:= \forall w, Cw : Qx[Nx - Rx]$ $[Mx]$ $\wedge$ $Qx[Nx \wedge Mx]$ $[Nx - Rx]$

where the outside quantification is over relevant situations $w$, and the inner is over entities $x$.

    This gives the desired result for (24)a (verification left to the reader), but at a significant cost. If "unless" must be interpreted one way when embedded under an entity-quantifier and another when adverbially or circumstantially quantified, then it is again non-compositional.

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[7]It is not immediately clear whether or not Leslie's version of uniqueness for (23)a-b is part of the semantics of (19)a-b. The meanings are certainly compatible, but this may be a question of felicity.

### 3.2.4 Quantifier interaction

(25) seems to me to make an unwarranted assumption: that in any case involving entity-quantification, circumstantial quantification will be universal. As a result, Leslie is unable to handle dually-quantified sentences:

(26) Everyone usually succeeds unless he goofs off.

There is a quick "fix": adjust the outside quantification in (25) to reflect circumstantial quantification present in the "unless"-statement.

(27) $Q$ $N$s $K$ $M$, **unless** they $R$
$:= Kw, Cw : Qx[Nx - Rx]\ [Mx] \land Qx[Nx \land Mx]\ [Nx - Rx]$

This works reasonably well for (26):

(28) Most $w$ $Cw$: ($\forall x$ where $x$ is a person in $w$ who does not goof off in $w$, $x$ is successful in $w$) $\land$ ($\forall x$ where $x$ is a person in $w$ who is successful in $w$, $x$ is a person who does not goof off in $w$)

but seems backwards. In sharper relief:

(29)  a. No one always succeeds unless he goofs off.

b. In all relevant situations $w$, no relevant person in $w$ who doesn't goof off in $w$ succeeds in $w$, and no relevant person in $w$ who succeeds in $w$ doesn't goof off in $w$.

This says that it is always the case that no one succeeds unless he goofs off. It ought instead to say that there is no one who succeeds in all situations $w$ unless he goofs off in $w$. To get this right, the quantifiers should be reversed:

(30) $Q$ $N$s $K$ $M$, **unless** they $R$
$:= Qx, Nx:\ K[C - R]\ [M] \land K[M \cap C]\ [C - R]$

Unfortunately, this produces the same result as (21) for (24) and (29)a: if the entity quantifier is external, it fails to give symmetric "if not" and uniqueness components.

This approach is not going to work. Revised uniqueness only evaporates when immediately under a negative quantifier, but we have two types to consider:

(31)  a. No one always succeeds unless he goofs off.

b. Everyone never succeeds unless he goofs off.[8]

In the first case, uniqueness will behave as desired only if the entity-quantification is internal; in the second, only if circumstantial quantifier is. It is impossible to construct a formula satisfying both conditions: Higginbotham's puzzle persists for any purely semantic account.

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[8] (31)b sounds ungrammatical under a certain intonation. The meaning "everyone never" is usually presented as "no one ever." I have left the awkward form for the purposes of explication; however, "No one ever succeeds unless he goofs off" is closer in meaning to "Everyone never succeeds unless he goofs off" than "No one succeeds unless he goofs off."

## 3.3 Rapprochement

Leslie and von Fintel omit one final point: an overt adverbial universal quantifier derails biconditionality in "unless"-clauses in much the same way as a negative quantifier.

(32)    a. John always succeeds unless he goofs off.

b. $\forall[C - \{\text{John goofs off}\}]\ [\{\text{John succeeds}\}]\ \wedge$
$\forall[\{\text{John succeeds} \cap C]\ [C - \{\text{John goofs off}\}]$

For Leslie, (32)a is the same as (22)a. Unlike (22)a, however, (32)a crucially does not require that John fail every time he goofs off. Uniqueness in (32)b *does* demand this.

A few things emerge. First, Higginbotham's puzzle is clearly rooted in uniqueness. Moreover, the "now-you-see-it-now-you-don't" behavior of the clause is not limited to overt negative entity-quantification, but extends also to adverbial quantifiers, including universals. The trouble with uniqueness may also bear on coordination. Uniqueness provides an explanation of the unacceptability of some coordinated cases, but (18) shows that the problem is not universal. The effect is at least plausibly due to the evaporation of uniqueness.

The preceding section shows that a fully semantic, exceptive approach cannot handle uniqueness under interacting quantifiers. Furthermore, peculiar behavior is not restricted to negative quantifiers, making it unlikely that all instances of "vanishing uniqueness" can be treated with a single semantic formula.

One last observation: although attachment is less predictable than hoped, uniqueness behaves in a structurally consistent fashion when in evidence. This suggests that it attaches in some strong (albeit not impermeable) way to the core of "unless," and points to the realm of structured pragmatic inference.

# 4    Regularized inference

Before investigating pragmatic aspects of "unless," I review what is invariant. This is straightforward: Geis points it out in observing that "unless" implies "if not" (p.232). In particular, "*p* if not *q*" is entailed by "*p* unless *q*."

It is clear that "unless" is more than this. In particular, uniqueness (in some version) arises in a number of cases. I take the position that uniqueness is pragmatically associated with "unless." This is supported by a few points.

First, "regular" semantic content (entailments) cannot be reinforced or negated without causing redundancy or contradiction, respectively. (33)a-b show that uniqueness permits both:

(33)    a. John will leave unless Bill calls, and he will stay if Bill does call.

b. John will leave unless Bill calls, but he may leave in any case.[9]

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[9] The addendum is not full-fledged negation of uniqueness, which would yield:

(ii)   ?John will leave unless Bill calls, but he will leave in any case.

This is, generally, infelicitous, most likely due to the pragmatic oddness of stating a condition with no apparent bearing on John's plans.

This suggests that uniqueness is weaker than entailment.

Uniqueness is also contextually cancellable:

(34)    a. John cheated unless he wrote his own questions.

       b. John cheated unless he wrote his own questions and his own answers.

On its own, (34)a has uniqueness: it presumes that there was no cheating if John wrote his own questions. Suppose now that the test required John to come up with questions *and* answers: (34)a no longer has uniqueness. Moreover, in the presence of (34)b, (34)a remains acceptable: it is simply now known, in addition, that John may have written his own questions but still cheated.[10] Defeasibility creates a heavy presumption towards a pragmatic account.

Finally, consider the interaction of "unless" with modal operators:

(35)  John might leave unless Bill calls.

If Bill does not call, it is possible that John leaves. Uniqueness, by (21), would give us that the relevant situations in which John leaves are possibly situations in which Bill doesn't call. In fact, uniqueness gives something stronger: it negates the *possibility* of John's leaving if Bill calls.

This seems to be due to the pragmatic effect of stating conditionality: if the possibility of John's departure exists either way, why discuss Bill? The information is assumed to have some causal relevance, and it is peculiar to discover that it does not. Crucially, this shows that the interpretation of uniqueness is not fixed, but instead connected to assumptions about communicative intent and conversational behavior. Uniqueness, then, is a pragmatic affair.

## 4.1   Categories of inference

There are a few received types of pragmatic inference. These include conversational implicature (particularized or generalized), conventional implicature, and presupposition (Grice 1975, Potts 2005, Levinson 2000, Levinson 2008).

Particularized conversational implicature can be easily rejected, as PCIs are not usually associated to specific words. Moreover, PCIs are characterized by calculability: an unencoded proposition can be recovered from utterance context by considering expectations about conversational behavior. Although uniqueness does interact with such expectations (see (35)), it does not typically involve calculation. The consistency and especially the imperceptibility with which uniqueness attaches also argue against a PCI classification.

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[10]One might argue that the exceptive treatment's relativization to "currently relevant circumstances" handles this. However, this implies that the relevant circumstances for (34) are always *only* those in which John has done everything else right. This is arbitrarily narrow: extrapolated to the general case, it would preclude uniqueness.

Presupposition is also unlikely. The presuppositions of an utterance $A$ are frequently taken to be those facts or conditions which must hold in order for $A$ to be interpreted: uniqueness does not behave like this. (34)a-b demonstrate that its failure does not derail the entire utterance. A false presupposition, by contrast, renders an utterance absurd (consider the oft-cited claim about the French king's hair).

Presuppositions are also constant under negation. Uniqueness is not:

(36)    a. John will leave unless Bill calls.

        b. It is not the case that John will leave unless Bill calls.

(36)b is not really "naturally" negated, but it is unclear how else to achieve sentential negation. Unfortunately, (36)b may be interpreted in a number of ways, and this seems to only be explicitly resolvable.[11] Crucially, uniqueness does not survive in (37)a-e.

(37)    a. It is not the case that John will leave unless Bill calls – he won't leave if Bill doesn't call.

        b. It is not the case that John will leave unless Bill calls – he will leave even if Bill calls.

        c. It is not the case that John will leave unless Bill calls – he will stay if Bill calls and leave if he does not.

        d. It is not the case that John will leave unless Bill calls – he won't leave at all.

        e. It is not the case that John will leave unless Bill calls – he will leave in any case.

It seems clear that uniqueness is not a presupposition.

Conventional implicature (CI) and generalized conversational implicature (GCI) are more promising. Uniqueness is a strong, regular, and automatic attachment, suggesting a "generalized" theory. Moreover, uniqueness seems to attach to an isolated word (although capable of being contextually modified), which is also characteristic of certain CIs and GCIs.

On Potts's theory, CIs behave as if they are part of the conventional meanings of words, and are commitments made by speakers in the same way that entailments are, differing from the latter in the sense that they do not belong to those aspects of meaning "at issue" in a discourse.[12] Unfortunately, this seems to be the extent of the similarity to uniqueness. CIs exhibit antibackgrounding (they seem redundant if previously stated), project out of attitude predicates, and are neither malleable nor reinforceable. Uniqueness fails the first two criteria, as shown by (38)a and b, respectively.

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[11]Conditionals are generally difficult to negate:

(iii)    It is not the case that John will leave if Bill doesn't call.

[12]Potts does not consider conventional implicatures to be pragmatic phenomena in the traditional sense. However, in differentiating uniqueness from the "if not" entailment, the important fact is that the latter is "at issue," while the former is not. Thus, what I have been referring to as "pragmatic" is not *a priori* incompatible with CI.

(38)     a. John won't leave if Bill calls, but he will leave unless Bill calls.

         b. Mary believes that John will leave unless Bill calls – but he'll leave even if Bill does call.

Malleability is demonstrated by (35), and reinforceability by (33)b. Taken together, this evidence rules out a CI account.

This leaves just GCI. Levinson (2000) argues that GCIs are "default" inferences: they "capture our intuitions about a preferred or normal interpretation" (p.11). This describes uniqueness well. Moreover, "generalization" indicates a strength of attachment compatible with uniqueness.

Levinson divides GCIs into three broad types, according to the "heuristic" that gives rise to them.[13] Each has specific identifying properties, but Levinson also outlines some shared characteristics.

Grice lists defeasibility, nondetachability, calculability, and nonconventionality as properties of implicature in general. To these, Levinson adds reinforceablity and a tendency towards universality for GCIs. Uniqueness is certainly defeasible (Higginbotham's puzzle, and contextually in (34)) and reinforceable ((33)b); its tendency towards universality falls out from the default nature of the attachment.

Nonconventionality, for Levinson, addresses noncodedness. This can be subsumed under malleability – although regular, uniqueness has no strict formula, but is subject to considerations about context and conversational logic ((35)). Nonconventionality thus applies.

Similarly, while uniqueness is not calculable in the PCI sense, this does not necessarily undermine a GCI account. Levinson points out that a key difference between GCIs and PCIs is that PCIs "leave no room for the assumption that implications of this sort are *normally* carried" (p.16). Where PCIs are *induced* by specific context, GCIs are only defeated or modified by context. The calculation in (35), which modifies "normal" uniqueness is an example of GCI-type calculability.

Nondetachability refers to the fact that conversational implicatures are typically carried by all alternatives for communicating a certain semantic content. That is, PCIs are associated with meaning in the abstract rather than specific lexical choices. Through generalization, however, GCIs can attach to specific expressions, and, consequently, the choice of one word over another can trigger the implicature. Levinson, indeed, argues for some principled exceptions to nondetachability. and this criterion is not of huge significance here.

Nevertheless, I have argued that "if not" carries the *semantic* content of "unless." Nondetachability would then suggest that uniqueness attaches to "if not" statements:

(39)   John will leave if Bill does not call.

(39) does seem to suggest that Bill's calling will prevent John's leaving (or at least that it has some hope of so doing), mostly because it would be strange to stipulate the condition

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[13]Q-implicatures are prompted by the Gricean quantity maxim's injunction to the speaker to provide as much information as required, I-implicatures by the injunction to provide only as much as required, and M-implicatures by manner's "be perspicacious."

if it has no effect on John. At least some "if not" sentences, then, carry an inference like uniqueness.

These last observations draw a parallel between "unless"-statements and other conditionals, which points the way to more precise classification. A tendency towards the biconditional interpretation of statements like (39) has been robustly observed, and is referred to as "conditional perfection" (Geis & Zwicky 1973). Levinson classifies perfection as an I-implicature. Since a listener can easily infer a condition's necessity from its being mentioned, a speaker need provide only sufficiency: both would be *more* than required, violating the I-heuristic.

I-implicatures "[maximize] informational load by narrowing the interpretation to a specific subcase of what has been said" (p.118). This applies both to uniqueness as a strengthening of "unless," and to conditional perfection. Moreover, we have seen that "unless" behaves like "if" in other regards, including negation ((36)-(37)). Analogizing uniqueness to perfection seem to capture its broad parameters, and I classify it, therefore, as an I-implicature.

## 4.2   Conditional strengthening and exceptives

This provides a neat way of reconciling the pragmatic aspects of "unless" with the exceptive account. Alongside regular exceptives, von Fintel (1993) proposes a weaker class of "free exceptives," which includes expressions like "except for."

(40)  Except for John, every student attended the meeting.

Like regular exceptives, free exceptives delimit quantifier domain. However, while regular exceptives specify the unique smallest exception set, free exceptives simply specify *an* exception set. Formally, they lack a uniqueness clause.

Von Fintel's classification of "unless" as regular rather than free rests on two observations. First, regular exceptives only occur with universal quantifiers ("every," "no," "always," "never"). For von Fintel, "partial" quantifiers ("most," "few," "usually," "rarely") already indicate an exception, and there would be no sense in using them (instead of universals) with an operator that fully specifies the unique exception. Lacking uniqueness, however, free exceptives may occur with partial quantifiers. Von Fintel proposes "unless" as regular because he finds (41)a-b unacceptable. If they are fine, as I have argued, "unless" must be free.

(41)      a. John usually succeeds unless he goofs off.

          b. John rarely succeeds unless he goofs off.

Secondly, von Fintel regards noncoordination as a uniqueness-derived property of regular exceptives. Free exceptives, *sans* uniqueness, can be coordinated. Von Fintel finds (42)a unacceptable; however, I have argued that it is at best questioned, and concur with Leslie that (42)b is fine.

(42)      a. ?John will succeed unless he goofs off and unless he sleeps through the final.

b. Unless he goofs off, and unless he sleeps through the final, John will succeed.

Treating "unless" as a regular exceptive rules out both (42)a and b. Thus, coordination data also also support the free account. On this view, (42)a-b are in theory acceptable, and it may simply be pragmatic clause-order considerations that affect (42)a.

Based on (41)-(42), von Fintel's own criteria support "unless" as free. Adapting his treatment of "except for" yields the following:

(43)  $Q[C]$ $M$ **unless** $R$
$\quad := (Q\ [C - R]\ [M]) \wedge \neg(\forall S\ (Q\ [C]\ [M]))^{14}$

where $S$ is an arbitrary set of circumstances. (44) illustrates this:

(44)   a. John eats steak unless he eats lobster.

  b. $\forall$ [ C - {John eats lobster}] [{John eats steak}] $\wedge \neg$ ($\forall$ [C] [{John eats steak}])

The first conjunct is familiar – the second is not. Von Fintel calls it a "restrictiveness" clause: it requires that the exception actually occurs, in some sense. For example, in (44)b, it establishes the existence of a non-steak-eating event. Von Fintel concedes restrictiveness may be pragmatic; I leave it for now.

This retains some benefits from the original exceptive account. For instance, counterfactual "unless"-clauses remain problematic. Moreover, the tendency towards uniqueness may be due to analogy with regular exceptives: while "unless" does not *necessarily* specify the unique exception set, it seems reasonable that it would often do so. Indeed, "the weakness of the lexical meaning of free exceptives does not preclude pragmatic strengthening" (von Fintel 1993; p.138). Such strengthening gives rise to "perceived equivalence" between some exceptives and their free counterparts. "Unless" does not have a counterpart, but is enough like other exceptives to be subject to similar processes.

This explains why "unless" has conditional perfection, but not how. There are a number of proposals for this (Horn 2000, van der Auwera 1997); von Fintel's (2001) analysis is particularly useful. He points out that unperfected conditionals are often subject to a (weaker) strengthening.

(45)  If you get a B on your next test, I will give you 5 dollars.

Said to a habitual C-student, (45) is not perfected: an A will almost certainly be rewarded. However, beyond stating the sufficiency of a B, von Fintel notes that (46) suggests the existence of relevant *insufficient* conditions: for instance, a C or lower. Strengthening of this sort also seems to be at work with "unless."

(46)  John always succeeds unless he goofs off.

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[14]Von Fintel (1993) uses quite different notation. For consistency, I have adopted the the notation from von Fintel (1992).

While (46) does not imply full uniqueness, it does seem to be the case that there are situations (presumably involving goofing off), in which John does not succeed. This matches the effect of restrictiveness.

Conditional strengthening is usually cast as scalar implicature. "If $p$, $q$" is the weaker alternative, and the stronger (rejected) statement is "q no matter what." Strengthening becomes full perfection if the speaker could have reasonably been expected to mention all sufficient conditions. "Unless" behaves similarly: consider (34). Uttered on its own, it might be a listing of conditions under which John will have cheated, and uniqueness holds. Once it is *known* that there are additional conditions, (34)a simply relates information about one of them, and perfection is lost.

It seems plausible that uniqueness attaches to "unless" by a similar (scalar) means. Here, "$p$ unless $q$" is weaker than "$p$ without exception": this would handle restrictiveness, uniqueness where applicable, and the intermediate positions observed.

At this point, it seems worth revisiting the most regularized cases of non-attachment. In particular, why should negatively quantified "unless"-clauses preclude strengthening? Actually, they may not.

(47)   John never succeeds unless he works hard.

Using (43), this says that there are no relevant situations in which John does not work hard and succeeds. Restrictiveness adds that there is some relevant situation in which John succeeds – thus, he must succeed at least on one hard-working occasion. This seems correct: if John never succeeded at all, (47) would be misleading. To the extent that restrictiveness represents partial strengthening, then, negative examples are subject to the same process as other "unless"-statements.

The reason negatively quantified examples escape *full* strengthening follows from von Fintel's explanation for the occasional failure of conditional perfection. In stating a consequence that will *not* occur, it is not normally expected that a speaker convey all of the potential contingencies. There may be many factors involved in John's success on, e.g., an exam – general knowledge suggests the amount of sleep he has had, his level of anxiety, etc. A speaker is not expected to convey all of these "known" scenarios in qualifying the extent to which one factor – working hard – will have an impact.

This is bolstered by the following:

(48)   a. John doesn't succeed unless he works hard.[15]

       b. John won't leave unless Bill calls.

(49)   a. John doesn't succeed if he doesn't work hard.

       b. John won't leave if Bill doesn't call.

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[15]I assume this translation:

(iv)  $\forall$ [C - {John works hard}] [{John doesn't succeed}] $\wedge$ $\neg\forall$ [C] [{John doesn't succeed}]

(48)a-b show that negation in the apodosis, even *sans* negative quantifier, produces only restrictiveness (that not all situations are non-success ones for John, and that not all Bill-calling situations are non-leaving ones, respectively). The "if not" examples similarly show only strengthening and not perfection. It seems reasonable to adopt the explanation for (49) to (48) as well.

One final hole remains in the free exceptive account. As with von Fintel's original proposal, cases involving overt entity-quantification are handled.

(50)     a. No one will succeed unless he works hard.

         b. $\neg\exists x \ (\forall \ [\text{C - } \{ \ x \text{ works hard}\}] \ [\{\text{x succeeds}\}] \wedge \neg\forall \ [\text{C}] \ [\{x \text{ succeeds}\}]$

(50)b claims that there is no one for whom all non-hard-work situations are success situations, and not all situations are successful. This is very far from (50)a.

A Leslie-type solution can be given by adapting (27) to the current proposal:

(51)  $Q$ $N$s $K$ $M$, **unless** they $R$
      $:= Kw, Cw : Qx[Nx - Rx] \ [Mx] \wedge \neg Qx[Nx] \ [Mx]$

For (50)a, we now get:

(52)  $\forall w \ Cw, \ \neg\exists x \ [x$ is a person who does not work hard in $w] \ [x$ succeeds in $w] \wedge$
      $\exists x \ [x$ is a person in $w] \ [x$ succeeds in $w]$

This works, but (53)-(55) do not:

(53)     a. No one always succeeds unless he works hard.

         b. $\forall w \ Cw, \ \neg\exists x \ [x$ is a person who does not work hard in $w] \ [x$ succeeds in $w] \wedge$
            $\exists x \ [x$ is a person in $w] \ [x$ succeeds in $w]$

(54)     a. Everyone usually succeeds unless he goofs off.

         b. Most $w \ Cw, \ \forall x \ [x$ is a person who does not goof off in $w] \ [x$ succeeds in $w] \wedge$
            $\neg\forall x \ [x$ is a person in $w] \ [x$ succeeds in $w]$

(55)     a. Most people usually succeed unless they goof off.

         b. Most $w \ Cw,$ Most $x \ [x$ is a person who does not goof off in $w] \ [x$ succeeds in $w] \wedge$
            $\neg$ Most $x \ [x$ is a person in $w] \ [x$ succeeds in $w]$

There are two problems. First, restrictiveness seems less solidly "semantic" in (53)-(55). This is easily handled by removing it to pragmatics. The second issue, however, is that, as in (28)-(29), the quantifiers appear in the wrong order.

Earlier, reversing the formula did not solve the problem. This was due to the need to quantify over both "if not" and uniqueness, and to the embedding requirements imposed by trying to capture symmetry under negative quantification. These constraints no longer apply.

18

(56) $Q$ Ns $K$ $M$, **unless** they $R$
   $:= Qx, Nx : K[C - R] \ [M]$

(57) improves upon the situation for (53)-(55). However, it produces a translation of (50)a that is roughly equivalent to (50)b (minus restrictiveness), which is what (51) was meant to solve.

What is to be made of this? Is it impossible to resolve in abstract the relative scope of quantifiers in "unless"-clauses? Consideration of a wider range of examples may reveal this to be the case, but I do not think it likely. The problem in (50)a seems to me to result from the mistaken assumption that it contains an implicit universal quantifier. In fact, (50)a does not refer to "all" circumstances, but instead to some particular future instance. As a result, it only should be quantified over entities. Broadly, "unless"-clauses may be quantified over both entities and circumstances, or only one. OIn the latter case, the other variable is either explicitly or contextually given a fixed representative. I propose the following formula:

(57) $[\![Q$ Ns $\mid K]\!]$ $M$, **unless** $R$
   $:= [\![(Qx)|(Kw)]\!] : [\text{Rel}(x, w) - R(x, w)] \ [M(x, w)]$

where $\text{Rel}(x, w)$ indicates $w \in C, x \in N$, and the bracket notation indicates that one or both of the options may occur, in either order – the order in the sentence must correspond to the order in the translation. In the absence of a circumstantial quantifier, $Kw$ is dropped, and $w$ refers to the single relevant situation. Similarly, in the absence of an entity-quantifier, $Qx$ is dropped, and $x$ is replaced by the single relevant entity (John in (47)).

Undoubtedly, this proposal will need refinement. However, it handles the cases so far considered, and provides a good starting point for future work.

## 4.3   Outstanding issues

A few points remain. First among these is Geis's NPI restriction. None of the approaches considered here seem to explain the facts. It seems increasingly unlikely that lexical restrictions will provide sufficient explanation, especially as the problem is not universal:

(58)    a. Unless anyone objects, we will proceed to the next item on the agenda.

   b. ?Unless Bill has called yet, Mary will be angry.

This is similar to the variability in coordinated "unless"-clauses, suggesting a pragmatic explanation. These examples perhaps provide a motivation for considering the role of context in current theories about NPI licensing.

Nondetachability is also significant. While "if not" sometimes carries strengthening and/or uniqueness, there is nevertheless a disparity between this and "unless."

There are cases where "unless" carries uniqueness and "if not" does not. Von Fintel (2001) provides:

(59)    a. Every WFF in the system is a theorem unless the axioms are consistent.

b. Every WFF in the system is a theorem if the axioms are not consistent.

Restrictiveness aside, (59)a reduces to material implication (modulo currently relevant circumstances), and as a result, uniqueness ought to be non-detachable. How are we to resolve the fact that it is not?

I believe the answer to this question lies in the continuum between implicature and semantic meaning. A strong attachment can shift from a PCI to a GCI. It may be that, with "unless," attachment is continuing to strengthen to lexicalization. This would, for instance, explain why restrictiveness fits into the semantics with "regular" quantifiers, but appears too strong in the less frequent partially-quantified cases: it may be only *partly* in the semantics. Uniqueness lies on the same continuum, but as a stronger inference, is less strongly attached. If "unless" is even partially lexicalized towards carrying the strengthened meanings, it would explain their absence and/or weakness in certain "if not" cases: the latter do not carry the inferences to the same extent that "unless" does. This is *because* "unless" is available. A scalar argument, then, would have a speaker choosing "if not" in example (59) as rejecting the stronger option, and thus implying the negation of the stronger meaning available with "unless."

Finally, this would also account for Higginbotham's puzzle. If restrictiveness and/or uniqueness is lexicalizing to "unless," it can of course only be in cases where attachment is not blocked. Thus "unless" may be in a situation where it is ambiguous between biconditionality and monoconditionality. This would allay Higginbotham's concerns: "unless" is not non-compositional, per se, but is rather a case of emerging polysemy.

# 5    Conclusion

Starting from Higginbotham's observations, I have examined several approaches for treating the meaning of "unless." I have argued that it is not a (formal) truth-functional operator, and have also shown that its meaning cannot be fully captured by a purely semantic account. In particular, I have identified the two aspects of "unless" as belonging to different classes of meaning. "If not" fully captures the semantics, and any strengthening (up to uniqueness) is a GCI akin to conditional strengthening.

This analysis treats some of the behavior that has not been captured by previous accounts, although some loose ends remain, most notably the quantifier interaction in formula (58). Uniqueness as a conditional-strengthening-type phenomenon draws out some interesting comparisons between "unless" and regular conditionals. On this front, certain aspects of the meaning of "unless" may be subject to ongoing lexicalization, providing a possible solution to Higginbotham's puzzle.

These ideas, finally, open the way for some questions about lexicalization processes. It is an open question as to whether the intervening stages of such a process constitute a new "level" of meaning between the semantic and pragmatic, which may not fit into the current taxonomy of meaning and inference types. Further exploration in this area might establish whether or not such a level has robust, reliable characteristics, and therefore deserves to be treated as a phenomenon in its own right.

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