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Parsing and presuppositions in the calculation of local contexts[*]

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Abstract In this paper, we use antecedent-final conditionals to formulate two problems for parsing-based theories of presupposition projection and triviality of the kind given in Schlenker 2009. We show that, when it comes to antecedent-final conditionals, parsing-based theories predict filtering of presuppositions where there is in fact projection, and triviality judgments for sentences which are in fact felicitous. More concretely, these theories predict that presuppositions triggered in the antecedent of antecedent-final conditionals will be filtered (i.e. will not project) if the negation of the consequent entails the presupposition. But this is wrong: *John isn't in Paris, if he regrets being in France* intuitively presupposes that John is in France, contrary to this prediction. Likewise, parsing-based approaches to triviality predict that material entailed by the negation of the consequent will be redundant in the antecedent of the conditional; but *John isn't in Paris, if he's in France and Mary is with him* is intuitively felicitous, contrary to these predictions. Importantly, given that the trigger appears in sentence-final position, both incremental (left-to-right) and symmetric versions of such theories make the same predictions. These data constitute a challenge to the idea that presupposition projection and triviality should be computed on the basis of parsing. This issue is important because it relates to the more general question as to whether presupposition and triviality calculation should be thought of as a pragmatic post-compositional phenomenon or as part of compositional semantics (as in the more traditional dynamic approaches). We discuss a solution which allows us to maintain the parsing-based pragmatic approach; it is based on an analysis of conditionals which incorporates a presupposition that their antecedent is compatible with the context, together with a modification to Schlenker's (2009) algorithm for calculating local contexts so that it takes into account presupposed material. As we will discuss, this solution works within a framework broadly similar to that of Schlenker's (2009), but it doesn't extend in an obvious way to

other parsing-based accounts (e.g. parsing-based trivalent approaches). We conclude that a parsing-based theory can be maintained, but only if we adopt a substantial change of perspective on the framework.

Keywords: presuppositions, presupposition projection, conditionals, disjunctions, local context, triviality, incrementality, scalar implicatures

1 Introduction

Schlenker (2008a, 2009) has recently questioned the explanatory power of traditional dynamic approaches to presupposition projection,[1] posing an explanatory challenge for any theory of presupposition projection:

> **Explanatory Challenge for Presupposition Projection**:
> Find an algorithm that predicts how any operator transmits presuppositions once its syntax and its classical semantics have been specified.   (Schlenker 2009)

This challenge has sparked a debate which has led to a variety of new theories, both static (Schlenker 2009, George 2008, Fox 2008, 2012, Chemla 2010) and dynamic (Chierchia 2009, Rothschild 2008, 2011).

One aspect of this debate is whether the algorithm for predicting presupposition projection should be based on parsing, a process which takes as input a string of linguistic items; or on the compositional calculation of meanings, a process which takes as input a syntactic structure. This debate is important because, in turn, it relates to the more general question whether presupposition calculation should be thought of as a pragmatic post-compositional phenomenon, in the sense of Chierchia et al. 2012, or as part of compositional semantics, as in the more traditional dynamic approaches.

In this paper, we will discuss sentences in which presuppositions are triggered in the antecedent of an antecedent-final conditional. We will argue that these cases present a challenge to parsing-based accounts of presupposition projection, as well as to theories of triviality that build on those accounts. We will focus in particular on the predictions of Schlenker (2009),

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[1] Building on previous observations by Soames (1989) and Heim (1990). For traditional dynamic approaches, see Karttunen 1974, Heim 1983, Beaver 2001 among others.

who uses a parsing-based approach to reconstruct the notion of a local context. This allows us to illustrate the challenge to parsing-based accounts of both presupposition and triviality in a simple way. However, as we will show, the problems extend to other parsing-based accounts, including those which make use of a trivalent valuation instead of local contexts (e.g. Fox 2008, 2012) as well as pragmatic parsing-based theories (Schlenker 2008a).

To briefly sketch the problem: the parsing-based approaches to presupposition projection which we will consider come in both symmetric and asymmetric versions. Both versions predict that presuppositions triggered in the antecedent of antecedent-final conditionals will be filtered (i.e. will not project) if the negation of the consequent entails the presupposition. But this is the wrong prediction; for instance, (1) presupposes that John is in France, contrary to this prediction.

(1)   John isn't in Paris, if he regrets being in France.

Likewise, parsing-based approaches to triviality predict that material entailed by the negation of the consequent of an antecedent-final conditional will be redundant in the antecedent of the conditional. But, again, this is wrong; for instance, (2) is felicitous, contrary to these predictions.

(2)   John isn't in Paris, if he's in France and Mary is with him.

The remainder of the paper is organized as follows. In the rest of this introduction, we introduce Schlenker's (2009) algorithm for computing local contexts. In Section 2, we lay out the problem for presupposition projection from antecedent-final conditionals, and in Section 3, the problem for triviality. In Section 4, we discuss a possible solution in a parsing-based framework. We show that this solution allows us to maintain a broadly parsing-based approach, but requires substantial revision to the theoretical and technical underpinnings of that approach: the solution only works if we assume, *pace* Schlenker, that the calculation of local contexts always takes presuppositional material into account. We show that this solution, however, doesn't extend in an obvious way to trivalent parsing-based accounts. We conclude in Section 5.

1.1 A parsing-based theory of local contexts and presupposition projection

Schlenker (2009) addresses the explanatory challenge for presupposition projection by using a parsing-based algorithm to reconstruct the notion of a local context in a static, bivalent semantics.[2] In this section, we summarize Schlenker's theory of local contexts and presupposition projection; those familiar with the theory should skip to the next section.

The basic intuition motivating Schlenker, which is similar to the intuition motivating trivalent theories of presuppositions (Peters 1979, Beaver & Krahmer 2001, George 2008, Fox 2008, 2012), is that as we evaluate a sentence against some contextual information, we try to minimize our effort by evaluating the sentence only in those worlds of the context that "matter" for the evaluation. Further, we assume (at least initially) that the interpreter evaluates expressions of a sentence proceeding left-to-right. Before evaluating an expression, the interpreter will choose the smallest domain she needs to take into consideration in evaluating such expression. This smallest domain is the local context for the expression.

Thus, for example, as we evaluate a conditional like *If A then B$_p$* (where B$_p$ is a sentence B which presupposes $[\![P]\!]$), as we proceed left-to-right, we will evaluate the consequent only in those worlds of the context in which the antecedent is true.[3] This is because we know that in those worlds in which the antecedent is false, the sentence as a whole is true irrespective of the value of the consequent, and thus we can ignore those worlds (assuming for the moment that *If… then* expresses the material conditional; we revisit this assumption below). But we cannot ignore any worlds where $[\![A]\!]$ is true, since we must check whether the consequent is true at those worlds to see whether the sentence as a whole is true. This means that the local context for B in *If A then B$_p$* is $C \cap [\![A]\!]$.

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2 Schlenker's approach is parsing-based in the sense we gave above: its input is a string, rather than a syntactic structure. We remain neutral on the connection of a theory like his to theories of parsing in general.

3 We use sans serif capital letters as sentence variables, and italics to set off a linguistic example in running text. We move freely between talking of presuppositions as sentences and as propositions. Where P is a linguistic item, $[\![P]\!]^c$ is the meaning (intension) of P at context C (a non-empty set of possible worlds); we often omit reference to the context for readability. We use 'C' throughout to refer to the global context, and sometimes use 'C' as a corresponding linguistic item whose intension is the global context.

We can then formulate a theory of presupposition in this framework as follows: we say that a sentence S is assertable in a context C only if, for every expression B_p in S, $[\![P]\!]$ is entailed by B_p's local context in S. We then say that a sentence presupposes anything that is entailed by every context where it can be asserted. This means that the predicted presupposition of *If A then B_p* is $A \rightarrow P$: in other words, *If A then B_p* is assertable at C only if $A \rightarrow P$ holds at every world in C.[4] This approach correctly predicts that a sentence like (4) presupposes only the tautology that if John used to smoke he used to smoke:

(3)   If John used to smoke, he stopped smoking.

But — as Schlenker (2008a, 2009) and Chierchia (2009), building on Heim 1990, Soames 1979 and others discuss — antecedent-final conditionals pose a problem for the asymmetry encoded in this algorithm. (4), like (3), appears to have only a trivial presupposition, but this is not predicted by the incremental left-to-right algorithm, which only considers material to the left of the presupposition trigger.

(4)   John stopped smoking, if he used to.

Intuitively, we would like material on the right of the presupposition trigger to count in this case. In response to these data, Schlenker (2009) proposes a symmetric version of his algorithm, which works on the entire sentence, rather than proceeding left-to-right: it considers both material on the left and the right of the expression to be evaluated. The result is that the symmetric local context for B in a conditional with the form B_p*, if A* is $C \cap [\![A]\!]$; thus we predict that a conditional like (4) has no presupposition, as desired.

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4 With $\rightarrow$ standing for the material conditional. Notice that for some cases, the predicted conditional presuppositions of conditionals appears too weak. This is the so-called Proviso Problem (Geurts 1996 and much subsequent work; see Schlenker 2011 among others for recent discussion). This problem is orthogonal to the one we discuss here, however. Although the problem we raise for presupposition projection, like the Proviso Problem, stems from a gap between the observed projection and what is predicted, there is a crucial structural difference: in Proviso cases, the gap is between observed presuppositions with the form $[\![P]\!]$, and predicted presuppositions with the form $[\![A\rightarrow P]\!]$. It is possible that a principled story can be told about how we move from the latter to the former (and indeed just such a story has been told in the literature; see Mandelkern 2016b for citations and criticism). By contrast, in the cases we raise here, the gap is between observed presuppositions with the form $[\![P]\!]$, and a predicted trivial presupposition — i.e. a presupposition of $\top$. It is much harder in this case to see how a strengthening story would help: there is no obvious principled way to get from $\top$ to $[\![P]\!]$.

Schlenker makes these intuitive ideas precise as follows. First, the incremental, left-to-right version:

Definition 1.1. Local Contexts, Incremental Version:[5]
The *incremental local context* of expression E in syntactic environment a_b and global context C is the strongest $[\![Y]\!]$ s.t. for all sentences D and good finals b′, $a(Y \wedge D)b' \leftrightarrow_c aDb'$.

In addition to this incremental algorithm, Schlenker (2009) also defines a symmetric version, which applies as a dispreferred rescue strategy:

Definition 1.2. Local Contexts, Symmetric Version:[6]
The *symmetric local context* of expression E in syntactic environment a_b and global context C is the strongest $[\![Y]\!]$ s.t. for all sentences D: $\mathbf{a}(Y \wedge D)\mathbf{b} \leftrightarrow_c \mathbf{a}D\mathbf{b}$, where **a** and **b** are derived from a and b by removing any presupposition material.

This symmetric algorithm is like the incremental version except for two features. First, it takes into account all material in the sentence, regardless of whether it precedes or follows the expression to be evaluated: this is what makes it symmetric. Second, it ignores presuppositions in the surrounding material. The reason for this second feature is that, as Rothschild (2008) and Beaver (2008) point out, without it, the symmetric algorithm incorrectly predicts that on a symmetric parse, presuppositions can cancel each other out. Thus we would predict e.g. that a sentence like (5), with the form A_p *and* B_p, should not presuppose p.

(5)   The King of France is bald and the King of France is tall.

But this is wrong; to see that (5) presupposes that there is a king of France, note that this inference projects when (5) is embedded in the antecedent of a conditional, as in (6):

(6)   If the King of France is bald and the King of France is tall, there will be no diplomatic incident.

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5 We restrict our attention here to a propositional fragment; for a general version, see Schlenker 2009. The good finals of an expression are all strings that can grammatically follow that expression. '$\leftrightarrow_c$' is material equivalence *modulo* a context C.

6 This formulation assumes that it is possible to "delete" a sentence's presuppositions from the sentence. It is not obvious to us that this is possible; in any case we will argue below that we may want to eliminate this part of the algorithm.

Analogous data can be generated with disjunction (see Rothschild 2008). This problem is avoided by the algorithm given above, according to which we ignore the presuppositional material of a and b when calculating the local context of the constituent between a and b.

Notice that if we are evaluating an expression D which appears sentence-final, the symmetric and incremental local context of D are identical. This is important for our purposes: it follows that for the data we are concerned with in this paper — the antecedents of antecedent-final conditionals — the incremental and symmetric versions of the algorithm will make the same predictions.

2 The problem for presupposition projection

To work up to our puzzle, consider first a conditional with a presupposition trigger in the antecedent, as in (7).

(7)   If A_p then B.

Here the incremental and symmetric algorithms for calculating local contexts make different predictions, since the trigger appears sentence-initial. The incremental algorithm predicts that (7) presupposes P. The symmetric one, on the other hand, takes into consideration the material following A_p in evaluating it. $[\![B]\!]$-worlds would make the whole sentence true regardless of the value of the antecedent; thus we only need to consider $[\![\neg B]\!]$-worlds in evaluating A_p.[7] In particular we must consider every $[\![\neg B]\!]$-world in the context. Thus the symmetric local context of A_p in (7) is $C \cap [\![\neg B]\!]$, and so the predicted presupposition of the symmetric algorithm is $\neg B \rightarrow P$.

Schlenker (2009), Chemla & Schlenker (2012) and Rothschild (2011) discuss whether the prediction of the symmetric algorithm for (7) is correct. But this discussion is complicated by the fact that the symmetric algorithm is taken to be a dispreferred interpretive strategy, making it hard to see how to evaluate this prediction.

We can avoid this complication, however, by considering the antecedent-final counterpart of (7), in (8).

(8)   B, if A_p.

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[7] We sometimes use '$\neg$' and other logical connectives as abbreviations for the corresponding natural language conectives. We leave most of our derivations of local contexts at the present level of informality; the reader can check them for herself, or refer to Schlenker 2009.

Here the incremental and the symmetric algorithms make the same predictions, since in both versions of the algorithm the material on the left of the trigger is taken into account, and there is no material to the right of the trigger in this case. This allows us to avoid difficult questions about the relation between an incremental and symmetric algorithm,[8] and directly evaluate the plausibility of a parsing-based algorithm of either form.

Both algorithms predict that at the point at which we process A, we only need to consider $[\![\neg B]\!]$-worlds of C, because $[\![B]\!]$-worlds would make the sentence true regardless of the value of the antecedent. Therefore the incremental and symmetric local context for A in (8) is $C \cap [\![\neg B]\!]$. Thus the predicted presupposition of (8), for both the incremental and symmetric approach, is $\neg B \rightarrow P$.

But this prediction is problematic. It follows from this prediction that if the negation of the consequent of an antecedent-final conditional entails the presupposition of the antecedent, the sentence will be presuppositionless. Schematically, a case like (9), where $[\![P^+]\!]$ entails $[\![P]\!]$, is thus predicted to presuppose nothing.

(9) $\neg P^+$, if A_p.

This prediction, however, does not match intuitions. To see this, consider first the conditionals in (10a), (11a), and (12a). They appear to presuppose that John is in France, that he is sick, and that he is a linguist, respectively, as predicted by the incremental parsing approach.

(10)   a.   If John regrets being in France, he isn't in Paris.
        b.   John isn't in Paris, if he regrets being in France.

(11)   a.   If John's wife is happy that he is sick, he doesn't have cancer.
        b.   John doesn't have cancer, if his wife is happy that he is sick.

(12)   a.   If John is happy he is a linguist, he isn't a semanticist.
        b.   John isn't a semanticist, if he is happy that he is a linguist.

Consider now the corresponding antecedent-final conditionals in (10b), (11b), and (12b), which have the form of (9). Intuitively these have the same presuppositions as the antecedent-initial versions. The problem is that the

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8 On which see Schlenker 2008a, 2009, Chemla & Schlenker 2012 and Rothschild 2011.

symmetric and incremental versions of the algorithm both predict that (10b), (11b), and (12b) have no presuppositions.[9]

Both the symmetric and incremental parsing-based algorithms given in Schlenker 2009 thus apparently make the wrong predictions for antecedent-final conditionals with a presupposition trigger in the antecedent: they predict that, when the conditional has the form of (9), its presupposition will be filtered, whereas the presupposition in fact projects.

3 The problem with triviality

The parsing-based theory of local contexts can be straightforwardly extended to a theory which predicts when a sentence strikes us as trivial or redundant. We show in this section that the problem raised in the last section extends to this theory.

Reconstructing the notion of local context allows Schlenker (2009) to connect his theory to a general theory of triviality, a theory with roots in Stalnaker 1978 (see also Singh 2007, Fox 2008, Chierchia 2009, Mayr & Romoli 2016 among others).[10] Given the account of local contexts sketched above, we say that a sentence S is infelicitous if, for any part E of S, ⟦E⟧ is entailed or contradicted by its local context.

This approach correctly predicts that a sentence like (13) should be infelicitous, since it has a part, namely *he is in France*, whose content is entailed in its local context (whether we calculate it incrementally or symmetrically):

(13)   #If John is in Paris, he is in France and Mary is with him.

Similarly, this approach predicts that (14) should not be assertable, given that *he is in Paris* is contradictory in its local context.

(14)   #If John isn't in France, he is in Paris and Mary is with him.

So far so good. Now consider the predictions of the parsing-based algorithm for antecedent-final conditionals. Recall in particular that the local

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9 In other words, that all three have trivial presuppositions: respectively, that if John is in Paris, then he is in France; that if John has cancer, then he is sick; and that if John is a semanticist, then he is a linguist.

10 A theory of triviality can also be formulated in terms of equivalence to simplifications of the sentence, in the sense of Katzir 2007, to which one can add an incremental component (see Mayr & Romoli 2016, Meyer 2013 and Katzir & Singh 2013 for discussion). The problems discussed here extend to this approach as well.

context of the antecedent of an antecedent-final conditional like *B, if A* is predicted by both the incremental and symmetric algorithms to be $C \cap [\![\neg B]\!]$. The theory of triviality under discussion thus predicts that if $[\![A]\!]$ is entailed or contradicted by $C \cap [\![\neg B]\!]$, the sentence should not be assertable. Both the symmetric and incremental algorithms thus predict that a sentence with the form

(15) $\neg P^+$, if P and Q.

will be infelicitous, since P will be redundant. But this is wrong. To see this, consider first the antecedent-initial conditionals in (16a) and (17a).

(16)   a.   If John is in France and Mary is with him, then he's not in Paris.
        b.   John isn't in Paris, if he is in France and Mary is with him.

(17)   a.   If John is sick and his wife is happy that he is sick, then he doesn't have cancer.
        b.   John doesn't have cancer, if he is sick and his wife is happy that he is sick.

We judge these conditionals to be perfectly felicitous. Now consider the antecedent-final versions, in (16b) and (17b). We judge these versions to be equally felicitous. However, the parsing-based theory of triviality (on both its incremental and symmetric versions) wrongly predicts that the antecedent-final versions will be infelicitous, since both have material that is locally redundant (*he is in France* and *he is sick*, respectively).

4   A parsing-based solution

In this section, we discuss a solution to the challenges just sketched. The solution maintains a parsing-based approach, but modifies Schlenker's algorithm and enriches our semantics for the conditional in a way that allows us to make the right predictions about the cases discussed above.

4.1   The solution

We have been assuming that *If...then* expresses the material conditional. Although this simplifying assumption is widely made in the literature on presupposition, it is also widely taken to be false in the literature on conditionals. As we will show here, replacing this assumption with a more realistic

assumption about the main (non-presupposed) content of conditionals does not immediately help with the present issues. We will argue, however, that careful attention to the *presuppositions* of conditionals does help. In particular, if we assume that conditionals presuppose that their antecedent is compatible with the context set, and this presupposition is itself taken into account in calculating local contexts, then a parsing-based algorithm can make the right predictions about antecedent-final conditionals. This approach, however, requires both a technical revision to the parsing-based algorithm, as well as a more abstract change in perspective on the kind of content that the algorithm takes into account.

4.1.1 The strict conditional

We begin by exploring the predictions of the parsing-based approach if we assume a strict conditional analysis of the natural language conditional, one of the two main semantic analyses of the conditional. This approach can be implemented in a variety of ways; we will not worry about the compositional implementation here.[11]

The strict conditional account assumes that conditionals are evaluated relative to a contextually determined function from worlds to sets of worlds g_c:[12]

Definition 4.1. Strict Conditional
$[\![\text{If A then B}]\!]^{c,w} = 1$ iff $\forall w' \in g_c(w)\colon [\![\text{A}]\!]^{c,w'} = 1 \to [\![\text{B}]\!]^{c,w'} = 1$

We will assume for concreteness that g_c takes every world in C to C itself. This may not be precisely correct, but it is a good enough approximation to suffice for our purposes.[13] Then the strict conditional analysis says that a conditional *If A then B* is true in a context C and world w in C just in case every $[\![\text{A}]\!]$-world in C is a $[\![\text{B}]\!]$-world.

Adopting this semantics does not immediately help with our problem. Consider again a conditional with the form *B, if A_p*. Assuming this has the same meaning as the antecedent-initial form, to see if this is true in any world at the context set, we need to see whether the material conditional

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11 See Lewis 1975, Heim 1982, Kratzer 1986, von Fintel 1999, Gillies 2009 and others for a variety of approaches to the compositional semantics of conditionals; the latter two in particular spell out strict conditional analyses.

12 Roughly equivalent to a *modal base* or *accessibility relation*.

13 See e.g. Williams 2008, Gillies 2009 for suggestions along these lines.

$A_p \to B$ holds at every world in the context set. Once we process that the consequent is B, we will know that, to evaluate *B, if A_p*, we need only check the value of the antecedent at the worlds in the context where $\llbracket B \rrbracket$ is false. And so according to the parsing-based algorithm, the local context for A_p is, again, predicted to be $C \cap \llbracket \neg B \rrbracket$.

4.1.2 The presupposition of conditionals

Changing our assumption about the main content of a conditional does not immediately help us, then. However, attention to the *presuppositional* component of the meaning of a conditional does point the way towards a promising solution. Conditionals are commonly thought to presuppose that their antecedent is compatible with the context set (see Stalnaker 1975, von Fintel 1998, Gillies 2009, among others). This is very natural to implement on the strict conditional approach, according to which conditionals essentially have the meaning of a universal quantifier over the context set, since universal quantifiers are generally taken to presuppose that their restrictor has non-empty intersection with their domain (see Heim & Kratzer 1998 and citations therein). Augmenting the strict conditional semantics with a presupposition along these lines, we arrive at a semantics like Definition 4.2:

Definition 4.2. Strict Conditional with Presupposition
$\llbracket \text{If A then B} \rrbracket^{c,w}$ presupposes $\llbracket A \rrbracket^c \cap g_c(w) \neq \varnothing$; if its presupposition is satisfied, is true iff $\forall w' \in g_c(w) \colon \llbracket A \rrbracket^{c,w'} = 1 \to \llbracket B \rrbracket^{c,w'} = 1$

Although the presuppositional component of this semantics goes naturally with a strict conditional analysis, it is separable from the strict conditional analysis. We will continue to present the solution in the strict conditional framework, but this is purely for expositional purposes; as will become clear, what is doing the work here is the presuppositional component.

Now, consider the predictions of Schlenker's incremental algorithm about the local context for A_p in a conditional of the form *B, if A_p*, if we adopt the presuppositional meaning for the conditional given here. Once we have processed the consequent B, we know that to see if the conditional as a whole is true, we have to check whether there are any $\llbracket \neg B \rrbracket$ worlds in C that verify the antecedent (whatever it turns out to be). But *in addition*, given the presupposition of the conditional, we must make sure that there is some world in C (the value of $g_c(w)$) that verifies the antecedent (whatever it turns out to be). And, for all we know — recall that we don't yet know what the

antecedent is — it could be that the only worlds which verify the antecedent are $[\![B]\!]$-worlds. This means that, when processing the antecedent, we cannot restrict our attention to the $[\![\neg B]\!]$-worlds in C, since in doing so we might end up ignoring all antecedent worlds, and thus wrongly concluding that the sentence's presupposition fails.[14]

Thus on Schlenker's incremental algorithm, we do *not* predict that the local context for A_p in *B, if A_p* is $C \cap [\![\neg B]\!]$. Put slightly more formally, this is because, given the truth conditions in Definition 4.2, (18a) is not in general contextually equivalent to (18b) for every D:[15]

(18)   a.   If ¬B∧D then B.
         b.   If D then B.

In particular, if $C \cap [\![B]\!] \neq \varnothing$, then just take D to be B; (18a) will be a presupposition failure, whereas (18b) will be true. More generally, the strongest restriction which renders (18b) and (18a) contextually equivalent for all D is the restriction to C. We prove this fact in Appendix A.

Focusing just on Schlenker's incremental algorithm for the moment, this result is exactly what we are looking for. It follows that the presupposition $[\![P]\!]$ will project out of the conditional *B, if A_p*, and more generally that presuppositions will project out of the antecedents of conditionals whether they are preposed or postposed. Thus we rightly predict e.g. that (19) will presuppose that John is in France.

(19)   John isn't in Paris, if he regrets that he is in France.

We also predict that the negation of the consequent of a conditional will not be taken into account in the antecedent of the conditional when determining whether it is redundant, and thus that (20) is non-redundant:

(20)   John isn't in Paris, if he is in France and Mary is with him.

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14 And thus that the sentence as a whole is false, if we adopt Schlenker's bivalent approach to presuppositions; or a third value, if we adopt a trivalent approach; when in fact it is true. Note that this is so even if we know that $C \cap [\![\neg B]\!] \cap [\![A_p]\!]$ is non-empty, since on both the incremental and symmetric version of Schlenker's algorithm, in calculating the local context for a certain syntactic environment, we are blind to the meaning of the element which is actually in that environment: we must proceed without knowing what we will find there, and thus proceed so that *for any possible antecedent*, we will not inadvertently come to the wrong conclusion about the truth-value of the sentence.

15 Unless $C \cap [\![B]\!] = \varnothing$ in which case $[\![\neg B]\!]$ *is* an appropriate restriction only because C is; see Appendix for discussion.

Note, finally, that this approach also explains a contrast between antecedent-final conditional and the corresponding disjunctions. Disjunctions with the form *A or B_p* are widely taken to presuppose $\neg A \to P$.[16] Thus e.g. (21) does not presuppose that John is in France.

(21)   Either John isn't in Paris or he doesn't regret that he is in France.

Assuming disjunctions lack any kind of compatibility presupposition like the one we have posited for quantifiers, the local context for a right disjunct will be the context set intersected with the semantic value of the negation of the left disjunct (we discuss this further in Section 4.2.2). Thus, assuming this difference in their presuppositional component, our solution rightly predicts the contrast between presuppositions in right disjuncts versus those in the antecedents of antecedent-final conditionals.[17]

Although we have cast this solution in a strict conditional analysis, it can be extended to other frameworks. For instance, parallel presuppositions could be stipulated for a material conditional analysis of the conditional; as well as for a variably strict approach to the conditional, though that approach raises further complications (see Section 4.3.1 for discussion). What is crucial to the present solution is not the main, asserted component of the particular semantics of conditionals we adopt, but rather the presupposition that the antecedent of the conditional is compatible with the context set.[18]

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16 See e.g. Schlenker 2008a, 2009, Rothschild 2011. Barbara Partee's *Either there's no bathroom in this house or the bathroom's in a funny place* is a classic example taken as evidence of this pattern.

17 Notice, however, that the corresponding predictions about triviality for disjunction appear *prima facie* incorrect: (i) is felicitous, despite the fact that it has a part that is redundant in its local context (*John is in France*). See Mayr & Romoli 2016 for discussion of cases like (i) and a proposed solution involving exhaustification.

   (i)   Either John isn't in Paris or (he is in France and) Mary is with him.

18 Our proposed solution relies on the presupposition of indicative conditionals that the antecedent is compatible with the context. Counterfactuals lack such a presupposition, and it is therefore important to explore the corresponding data for counterfactuals. If we stick with a strict conditional analysis of counterfactuals, the prediction would then be that presupposition should not project from analogous cases with counterfactuals. Contrary to this prediction, (i) appears to suggest that John is in France.

   (i)   John wouldn't be in Paris, if he were unhappy that he were in France.

4.2 Challenges

4.2.1 The challenge of interacting presuppositions

The present proposal is compatible with Schlenker's incremental algorithm for calculating local contexts. We have diverged from him only in our assumption about the presuppositions of conditionals. Implicitly, however, our proposal assumes that presupposed material in a sentence plays a role in calculating the local context of material later in the sentence. While this is strictly compatible with Schlenker's incremental algorithm, it gives a new perspective on the kind of calculation involved in determining local contexts.

A starker departure from Schlenker seems to be required, however, when we turn our attention from Schlenker's incremental algorithm to his symmetric algorithm. Our solution crucially depends on the assumption that, in calculating the local context for the antecedent of an antecedent-final conditional, we take into account the presuppositional material in the material that precedes it. But Schlenker's symmetric algorithm stipulates that, in calculating the symmetric local context for a syntactic environment a_b, we must *ignore* all the presuppositional material in a and b. Thus adopting a presuppositional analysis of conditionals does not help with the problems we have raised regarding antecedent-final conditionals, in the context of Schlenker's symmetric algorithm.

At first glance, this may not look too serious. If the symmetric approach is dispreferred to the incremental approach, then in both the antecedent-final and antecedent-initial conditionals we may predict the observed presupposition and triviality results as the preferred reading (since these are derived from the incremental algorithm), and assume that the symmetric results are dispreferred, and thus do not color intuitions.

The problem with a case like (i), however, is that it suggests independently that John is in Paris, which by itself allows us to conclude that John is in France; to see this, note that (ii) licenses this inference to the same degree.

(ii)   John wouldn't be in Paris, if he hated cheese.

Therefore it is unclear whether the inference that John is in France is due simply to that or whether it is due to the presupposition of the antecedent projecting out, as not predicted by our proposal. We leave a more detailed investigation of these counterfactuals cases for further research. (Thanks to Emmanuel Chemla (p.c.) and Hedde Zeijlstra (p.c.) for discussion on this).

This response does not suffice, however. We can set up examples with antecedent-final conditionals where the symmetric algorithm is required in order to explain observed presupposition filtering. And, even in these cases, projection behavior suggests that the local context of the antecedent of the conditional does not entail the negation of its consequent. Consider (22):[19]

(22)   [Either John isn't in Paris, or he hasn't given up his vegan diet,] if [he regrets being in France and he used to be a vegan].

(22) is felt to presuppose that John is in France, but not that he was ever a vegan. To control for the possibility of local accommodation here, we can set up a similar case with strong triggers, which are known to be difficult or impossible to locally accommodate (see Chemla & Schlenker 2012). Suppose it's common ground that John is traveling with his girlfriend. Consider (23):

(23)   [Either John isn't in Paris, or he's a vegan too,] if [he regrets being in France and his girlfriend is a vegan].

Again, (23) is felt to presuppose that John is in France, and also licenses the additive particle *too* in the consequent. The licensing of *too* in (23) by *his girlfriend is a vegan*, and the filtering of *he used to be a vegan* in (22) by the second conjunct of the antecedent, are predicted in Schlenker's framework only if we use the *symmetric* algorithm to compute local contexts of these sentences. But the fact that both (23) and (22) are felt to presuppose that John is in France is *not* predicted by the symmetric algorithm, even if we adopt a presuppositional analysis of the conditional: since that algorithm ignores the presuppositions of the surrounding material, even with a presuppositional analysis of the conditional, it will predict that the local context for the antecedent entails the negation of the consequent.

We see two possible ways to proceed. The first, suggested to us by an anonymous reviewer for this journal, maintains Schlenker's system as it is, but posits that different presupposition triggers can be evaluated relative to different parsing algorithms. Thus the interpreter of a sentence like (22) or (23) will use the symmetric algorithm in processing *his vegan diet* or *too*, respectively, ensuring that their presuppositions do not project; and then use the incremental algorithm to ensure that the presupposition of *regrets* in the antecedent does project.

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19 Brackets indicate the scope of the disjunction and conjunction.

This approach can indeed capture our data. The puzzle it leaves open, however, is why speakers choose to use these algorithms in this way. A natural first thought would be that speakers aim to minimize projection, and thus choose the algorithm that minimizes projection from each trigger. But this would then predict that speakers process *both* triggers with the symmetric algorithm, and that we would not observe projection from the antecedent or the consequent. An alternative assumption would be that speakers aim to maximize projection. But then we would predict that speakers process *both* triggers with the incremental algorithm, and that we would observe projection from both the antecedent and consequent. Thus neither of these assumptions would match observations. Yet another option would be to assume that speakers decide based on local pragmatic pressures, in the style of Gazdar 1979: they prefer the incremental algorithm, but adopt the symmetric one to avoid pragmatic infelicity. We leave it open whether some such story could be spelled out for (22) and (23). But we can use a version of Heim's (1983) argument against Gazdar's approach to show that this approach won't work in general. Consider (24):

(24)   [Either John isn't in Paris, or he's with his kids,] if [he regrets being in France and he has twins].

(24) is not felt to presuppose that John has kids, but we cannot think of a principled pragmatic story that would predict this: why would speakers not stick with the incremental algorithm for both triggers, predicting that (24) presupposes that John has kids?

The examples here are, admittedly, rather complex. We can also formulate a broader, more architectural worry about Schlenker's symmetric algorithm: namely, that we have no explanation of why the symmetric algorithm ignores presuppositions, while the incremental one does not. We do not know of a principled explanation of this feature of Schlenker's theory, and — quite apart from the local concerns raised here — we think it is worth exploring whether an alternative approach can be spelled out which avoids this stipulative structural difference between the incremental and symmetric algorithms.

One way to achieve this is to modify the symmetric algorithm for calculating local contexts, so that, *pace* Schlenker, and like the incremental algorithm, it takes presupposed material into account:

Definition 4.3. Local Contexts, Symmetric Version with Presuppositions:

The *symmetric local context* of expression E in syntactic environment a‿b and global context C is the strongest $[\![Y]\!]$ s.t. for all sentences D: $a(Y \wedge D)b \leftrightarrow_c aDb$.

This approach eliminates the stipulated structural contrast between the incremental and symmetric approach. And this algorithm, together with a presuppositional semantics for the conditional, makes the correct predictions about the presuppositions of antecedent-final conditionals, for the same reason the incremental algorithm does, since it now takes into account presupposed material. It is, however, vulnerable to the challenge raised by Rothschild and Beaver: namely, that an algorithm like this predicts that presuppositions can cancel each other out in sentences like (5):

(5)   The King of France is bald and the King of France is tall.

To answer this challenge with the present account of symmetric local contexts, we must change our theory of presupposition. We will sketch a possible approach here; a full account will have to wait for future work.

The idea would be to adopt a multi-dimensional theory of presupposition, along the lines of Karttunen & Peters 1979.[20] For any linguistic expression A, we will have $[\![A]\!]$ be an ordered pair $\langle \alpha, \beta \rangle$, where α represents A's presuppositional content, and β its main content. We then separately calculate the symmetric local context for *each dimension of content* by running the symmetric algorithm just sketched in parallel for the two dimensions of content, deriving the *main* local context and the *background* local context via this algorithm from the main and presuppositional contents, respectively.

Then we say that a presupposition projects *unless* it is both *entailed* by its main local context, and *not* entailed by its background local context. This approach lets us make the right predictions about sentences like (5) of the form A_p *and* B_p, since in this case $[\![P]\!]$ is entailed by the background local context for both A and B, and thus will project. Thus, for instance, the background local context for the left conjunct of (5) on the symmetric algorithm will entail that there is a king of France, since this is entailed by the *background* content of the right conjunct; and likewise for the right conjunct. Thus we predict that this presupposition projects through both conjuncts, since the condition for failing to project — being entailed by the main local context but not the background local context — is not met. Similar considerations will extend to variants on sentences like (5), e.g. sentences with the form $\neg A_p$ *or* $\neg B_p$.

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20 See also Dekker 2008, Sudo 2012, Mandelkern 2016a.

But this approach also preserves the correct predictions of Definition 4.3 about antecedent-final conditionals (if we maintain a presuppositional account of the conditional), provided that we assume that presupposed content is always entailed by the main content.[21] This latter assumption ensures that the main local context is always identical to the local context as derived on the approach given in Definition 4.3. Thus any presupposition predicted to project on that approach (because it failed to be entailed by the local context) is predicted to project on the present approach (because it won't be entailed by the main local context). This move thus preserves our solution to the problem of antecedent-final conditionals, while avoiding Beaver and Rothschild's objection.

This is just a promissory note. Much more needs to be said to make it precise. However, this suffices to indicate a possible solution to the present difficulty, and also to show how far these issues force us to depart from the theoretical underpinnings of the parsing-based account: the present suggestion works only if we adopt a multi-dimensional theory of presuppositions, rather than the one-dimensional, bivalent theory that Schlenker hoped to vindicate.

4.2.2   Presupposition, implicatures, and the contrast with disjunction

In the last subsection, we discussed the theoretical upshots of assuming that a conditional's presupposition enters into the calculation of the local context of its components. We now briefly discuss two close variants on this proposal.

The first is to adopt roughly the solution we have suggested, but to treat the compatibility inference of conditionals as part of the conditional's main, *asserted* content, rather than as a presupposition. This approach would allow us to avoid the difficulties just discussed for the symmetric version of Schlenker's algorithm. But the compatibility inference in question appears to behave like a presupposition in its projection behavior, not like asserted content: it projects through negation, negative quantifiers, questions, disjunctions, and so on. Consider, for instance, (25a): (25a) appears to suggest that Mary might have come to the party. Moreover, this inference appears to

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21 See again Mandelkern 2016a for a two-dimensional approach which makes this assumption.

project through negation in (25b); negative quantifiers, in (25c); questions, in (25d); and across disjunction, in (25e).[22]

(25)   a.   If Mary came to the party, John did too.
       b.   It's not true that if Mary came to the party, John did too.
       c.   No one else came to the party if Mary did.
       d.   Is it true that, if Mary came to the party, John did too?
       e.   Either John came to the party if Mary did; or else they've had a fight.

Therefore, treating the compatibility inference as part of the asserted content does not seem like a plausible route.

   The second alternative, suggested to us by Philippe Schlenker, is to treat the compatibility inference not as a a presupposition or as part of the asserted content, but rather as an implicature. This is the line suggested, for instance, by Gazdar (1979) and Veltman (1985).[23] Any approach along these lines would have to explain the projection data in (25). If this could be done, however, then this approach is compatible with our general strategy. If we were to take this line, then we would need to argue that parsing-based calculation of local contexts take into account implicated content (see Mayr & Romoli 2016 for a similar assumption).

   A worry about this strategy is that it risks overgenerating. In particular, it is commonly thought that the assertion of a disjunction implicates that both disjuncts are compatible with the context set (see Stalnaker 1975, Gazdar 1979, Fox 2007, Meyer 2013 among many others). If we were to take implicatures into account in computing local contexts, then we would lose the

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22 Thony Gillies (p.c.) points out to us that the first of these data points — projection through negation — is also explained by a non-presuppositional strict conditional analysis, which predicts that the negation of *If A then B* entails *Might A*. The strict conditional analysis, however, does not by itself explain the other projection data; nor does it by itself explain the infelicity of asserting *If A then B* in a context which entails that A is false.

23 A parallel line has been taken for the compatibility inference of quantifiers by Abusch & Rooth (2005) and Schlenker (2012). Arguments for not treating the compatibility inferences of quantifiers as presuppositions come from cases like (i), from Schlenker 2012, which does not suggest that there will be a student who will get a perfect score on the next test (i.e., the compatibility inference does not project as a presupposition in this case).

(i)   I'll give a bottle of Champagne to every student who gets a perfect score on the next test.

correct prediction that the local context for B in *A or B* is $C \cap [\![\neg A]\!]$.[24] This is because, in processing B, we would not be able to disregard all $[\![A]\!]$-worlds, since the compatibility implicature may only be satisfied at one of the $[\![A]\!]$-worlds (i.e. it may be the case that the only $[\![B]\!]$-worlds in C are $[\![A]\!]$-worlds). While this approach would make correct predictions about projection out of the antecedent of an antecedent-final conditional, then, it would make the wrong predictions about projection out of right disjuncts, losing the contrast predicted by our presuppositional approach (a contrast, again, illustrated by (19) vs. (21)). An implicature based approach, therefore, faces a serious challenge. Speaking more generally, any solution to this problem must distinguish the kind of compatibility inference generated by conditionals from the kind of compatibility inference generated by disjunctions, and ensure that the algorithm for calculating local contexts only takes into account the former kind, in order to account for the difference in projective behavior between the two.[25]

It may be objected that we are drawing a rather fine line between presuppositions and implicatures. We have not offered an explanation, first, of why disjunctions only implicate that their disjuncts are compatible with the common ground, while conditionals presuppose that their antecedents are; second, of why we take presuppositions but not implicatures into account when calculating local contexts. While we will have to leave a more thorough exploration of these issues for future work, we want to offer some further evidence suggesting that the compatibility condition on the antecedent of conditionals behaves more like a presupposition than the corresponding condition of the disjuncts of a disjunction. We have already given evidence in (25) which suggests that the compatibility inference for conditionals projects

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24 For the rest of the paper, we will set aside the two-dimensional approach suggested above, and continue to treat '$[\![\cdot]\!]$' as a function from strings to a single dimension of content, as is standard.

25 An anonymous reviewer for this journal has suggested that one way of doing this is to align these two kinds of inferences with secondary and primary implicatures in the sense of Sauerland 2004, respectively, and then maintain that the algorithm only takes into account secondary implicatures. Alternatively, one could treat one of these compatibility inferences as an anti-presupposition, arising from the requirement that the antecedent should not be presupposed to be empty. Yet another option, suggested to us by Thony Gillies, is to treat the compatibility inference of *or* as an entailment (cf. e.g. Zimmerman 2000), which would leave us free to treat the compatibility inference of conditionals as either an implicature or a presupposition (though it would remain to be explained why calculation of local contexts takes into account the latter but the former). We leave exploration of these options for future work.

like a presupposition. But this is not so for the compatibility inference for disjunctions. As we noted above, (24a) suggests that John might be in Europe, and this inference projects through negation in (24b). But the corresponding possibility inferences of (26a) — that it's possible that John is in London and that it's possible that John is in Paris — clearly disappear in (26b) (if it didn't, an assertion of (26b) would be incoherent).

(26)   a.   John is in London or Paris.
        b.   It's not true that John is in London or Paris.

One way to confirm this projection behavior is to set up a context where the possibility inferences in question are explicitly denied. In such a context, the relevant disjunction in the scope of a negation or negative quantifier remains felicitous, while the corresponding cases with conditionals appear unacceptable, again suggesting that the possibility inference projects in the latter case but not in the former.

(27)   I know that John is in Japan and that he hates London.

        a.   Then obviously it's not true that he is in London or Paris.
        b. ??Then obviously it's not true that he is in London, if he is in Europe.

(28)   I know my students are all in Japan and all of them hate London.

        a.   Then obviously none of my students is in London or Paris.
        b. ??Then obviously none of my students is in London if he is in Europe.

Note further that there is strong reason to think that the unacceptability of (27b) and (28b) stems from the failure of a compatibility presupposition: if we change the context sentences to *I know that John hates London* and *I know my students hate London*, respectively, so that the compatibility presupposition is not inconsistent with the context, then (27b) and (28b) are acceptable.

While the differences between the possibility inferences for conditionals and disjunction, respectively, require further exploration, these data thus support our assumption that the possibility inference for conditionals is a presupposition, while the possibility inference for disjunction is an implicature. Under the hypothesis that presuppositions but not implicatures are taken into account in the calculation of local contexts, this will capture the

difference in projective behavior out of the antecedent of an antecedent-final conditional, versus out of the right disjunct of a disjunction.[26]

4.3 Alternative directions

In this subsection, we discuss two alternative approaches to our puzzle within a parsing-based framework. The first is a different semantics for the conditional, the variably strict semantics, while the second is a different theory of presuppositions and triviality, the parsing-based trivalent approach. We suggest that the first is a promising alternative, but requires the same revisions to Schlenker's parsing-based approach laid out just now; by contrast, we show that the trivalent approach faces the puzzles sketched above from antecedent-final conditionals, and our presuppositional solution does not extend to the trivalent approach.

4.3.1 The variably strict approach

Given the extent of the revisions required to make our proposed solution compatible with the parsing-based approach to presupposition projection, it is worth revisiting the question of whether a different solution is possible which does not require revision to the parsing-based approach. In this section we briefly explore whether a variably strict semantics for conditionals provides such a solution.[27] Our conclusion is negative: although the variably strict approach does indeed solve the puzzles we have raised without adverting to a presuppositional component of its meaning, it brings with it new, equally serious problems, which in turn are most naturally solved by adverting to a presuppositional component which plays a role in calculating local contexts.[28]

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26 An alternative to either a presuppositional or implicature based approach, suggested to us by an anonymous reviewer, is to assume that the relevant condition for conditionals is a condition on what the Question Under Discussion should leave open (i.e. a conditional of the form *If A then B* is a response to a QUD which leaves open whether ⟦A⟧ is true). This is an interesting alternative; to spell out this approach we would have to show that this condition projects like a presupposition, and that this condition does not extend to disjunction.

27 We are not assuming here that a variably strict semantics is in any way simpler than a strict conditional semantics; the sense in which this approach might be more conservative is just insofar as it allows us to maintain the parsing-based algorithm without modification.

28 Thanks to Danny Fox for encouraging us to explore this approach.

According to variably strict semantics ([Stalnaker 1968], [Lewis 1973], and many others), conditionals are evaluated relative to a contextually provided selection function f_c. f_c takes a proposition p and world w to the p-world "most similar" to w, and obeys (at least) the following constraints:[29]

Success:
$\forall C \forall w \forall p \colon p \neq \varnothing \to f_c(p, w) \in p$

Strong Centering:
$\forall C \forall w \forall p \colon w \in p \to f_c(p, w) = w$

CSO:
$\forall C \forall w \forall p \forall q \colon (f_c(p, w) \in q \land f_c(q, w) \in p) \to f_c(p, w) = f_c(q, w)$

Then the conditional is given the following semantics:

Definition 4.4. Variably Strict Semantics:
$[\![\text{If A then B}]\!]^{c,w} = 1$ iff $f_c([\![\text{A}]\!]^c, w) \in [\![\text{B}]\!]^c$.

In other words, *If A then B* is true just in case the closest $[\![\text{A}]\!]$-world is a $[\![\text{B}]\!]$ world.

An equivalent formulation can be given in terms of orderings: we say that a conditional is evaluated relative to a contextually given function $\preceq_c$ from worlds to a well-ordering of worlds, with w treated as minimal by $\preceq_{c,w}$, for all w. Then $[\![\text{If A then B}]\!]^{\preceq_c, w} = 1$ just in case $[\![\text{B}]\!]^{\preceq_c, w'} = 1$, with w' the $\preceq_{c,w}$-minimal $[\![\text{A}]\!]$-world.

Given this semantics, what does Schlenker's symmetric or asymmetric algorithm predict about the local context for A in an antecedent-final conditional like *B, if A*? In other words, what is the strongest value for Y such that for all D, (29) and (30) are contextually equivalent?

(29)   B, if Y∧D.

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29 We follow Stalnaker in making the limit and uniqueness assumptions, but our main points go through without these assumptions. We use lower-case italic letters to range over propositions. Note that one could adopt a variably strict semantics without these assumptions, and one could also to differing degrees couple these assumptions with other semantic frameworks, like the strict conditional framework. We will make clear in what follows what parts of this package our results depend on; we leave it to the reader to explore how these parts could be coupled with other semantic frameworks to achieve similar results. Thanks to Thony Gillies for discussion.

(30)   B, if D.

Assuming that the meaning of *B, if A* is the same as the meaning of *If A then B*, the good news from the point of view of our puzzles is that the local context for A does *not* entail $[\![\neg B]\!]$, provided that $C \cap [\![B]\!] \neq \varnothing$ and $[\![B]\!] \neq \top$. Suppose we put ¬B in for Y in (29) and (30). Choose D = ⊤.[30] Then at every world in the context, (29) will be false (thanks to *Success*), but at some worlds in the context (30) will be true (namely, at the $[\![B]\!]$-worlds, thanks to *Strong Centering*).

The variably strict approach, thus, *does* avoid our puzzles without adverting to a presuppositional component of meaning, since it does not predict that the local context for the antecedent of an antecedent-final conditional entails the negation of its consequent. But this success is fleeting, for the variably strict approach faces new, equally serious, puzzles. Consider what this approach, plus the incremental theory of local contexts, predicts the local context to be for the *antecedent* of a conditional (we will focus on antecedent-initial conditionals for simplicity, but these points extend to antecedent-final conditionals). Note that, if *C* is a non-trivial global context (i.e. $C \neq \top$), it is *never* the case that, for all D and all B, (31) and (32) are contextually equivalent:

(31)   If C∧D then B.

(32)   If D then B.

Simply choose D=¬C and B=C. Then (31) will be trivially true, since its antecedent is trivially false;[31] but *Success* guarantees that (32) will be false.[32]

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30 We use ⊤ as an arbitrary tautology; we also use it to stand for the trivial proposition, i.e. the set of all worlds.

31 This follows from a stipulation in Stalnaker 1968 about how to evaluate conditionals with impossible antecedents. This assumption is controversial, and is separable from the core semantics presented here; but we can make the same point even if we assume that conditionals with impossible antecedents are trivially false, instead of trivially true, simply by choosing B=¬C. If we do not make either of these assumptions, then what follows will depend on what assumption we make instead; however we decide that question, we will be able to show that it is not always the case that the global context is entailed by the local context for the antecedent of conditionals. Similar caveats go for the proof that follows in the symmetric framework.

32 This result can be extended to the symmetric algorithm — and thus to antecedent-final conditionals — as follows. Consider a conditional with the form *If A then B*. Provided $C \neq \top$ and $[\![B]\!] \neq \top$ and $[\![B \vee C]\!] \neq \top$, it is not the case that for all D, (i) and (ii) are equivalent:

It follows that the local context for the antecedent of a conditional does not entail C in the present framework. Worse, we can run similar arguments to show that *for any* non-tautological sentence Y, the local context for the antecedent of a conditional is predicted not to entail $\llbracket Y \rrbracket$.[33] That means that the local context for the antecedent of a conditional, on the incremental theory, will always be $\top$. And that, in turn, means that, given our background theories of presupposition projection and triviality, presuppositions are predicted to never be licensed in the antecedents of conditionals; and globally entailed content is predicted not to be felt to be trivial in the antecedent of a conditional. But these predictions are plainly wrong.

In order to avoid these predictions, we will need to further constrain the selection functions. One possibility is to follow Stalnaker 1975, who suggests that, for indicative conditionals, f_c always takes worlds in the context set to other worlds in the context set:

> **Indicative Constraint:**[34]
> $\forall C \forall w \in C \forall p \colon f_c(p, w) \in C$

Now note that *Indicative Constraint*, together with *Success* and *CSO*, entails **Context Inclusion**:

> **Context Inclusion:**[35]
> $\forall C \forall w \in C \forall p \colon p \cap C \neq \varnothing \rightarrow f_c(p, w) = f_c(p \cap C, w)$

(i)   If C∧D then B.

(ii)   If D then B.

To show this, let D=(¬C∧¬B); then (i) is trivially true, (ii) false (by *Success*).

33 For any such Y, just choose D=¬Y, and B=Y; then *If Y∧D then B* will be trivially true, while *If D then B* will be false.

34 Note that the constraint that the antecedent of conditionals are compatible with the context, which played a crucial role in the discussion above, follows from this constraint together with *Success*.

35 Proof: *Indicative Constraint* entails that for any world in C, for any p, the closest p-world is also in C; *Success* entails that it is in p when p is non-empty; and thus together they entail that it is in $C \cap p$ if $C \cap p$ is non-empty. *Success* entails that for any world in C, the closest $p \cap C$-world is in p, provided $p \cap C \neq \varnothing$. And so *CSO* entails that for any world in C, the closest p-world is the same as the closest $p \cap C$-world. Note that this is the only place that *CSO* has come into discussion here; the other points we have made so far depend only on *Success* and *Strong Centering*.

And it is easy to see that *Context Inclusion* guarantees that C *is*, in general, a trivial restriction to the antecedents of conditionals, and thus that *C* will be entailed by the local context for the antecedents of conditionals in general.[36]

The variably strict semantics thus does have the resources to avoid our puzzles from antecedent-final conditionals (thanks to its semantics), and to predict that the local context for the antecedent entails the global context (thanks to the *Indicative Constraint*, *Success*, and *CSO*). But the *Indicative Constraint*, and the other constraints which play a crucial role here, are typically, and most naturally, viewed as *presuppositions* of indicative conditionals. This is, for instance, the way Stalnaker (1975) seems to be thinking about them, and, indeed, their projection behavior strongly suggests that they are presuppositions, not implicatures or part of the asserted content of conditionals. In order to predict that the local context for antecedents of conditionals entails the global context, these presuppositions must be taken into account in calculating local contexts. So, as with the first solution we discussed, the present approach offers a viable solution only if presupposed material is taken into account in calculating local contexts.[37]

This discussion does not, of course, close the door to a parsing-based solution which solves our problems without invoking a presupposition of some kind; an alternate semantics may yet work in this respect. But we do not at present see a solution of this kind.

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36 In particular, the proof above that this is false will be blocked by the fact that both (31) and (32) will violate the conjunction of *Indicative Constraint* and *Success* (and thus both have the same truth value, as presupposition failures — either false, or the third value) if D=¬C.

37 An anonymous reviewer for this journal points out that one way to see whether the explanation of our key data turns on the characteristic non-monotonicity of embedding environments (one of the key logical features which distinguishes the variably strict from the strict semantics) is to compare the behavior of presupposition projection out of *whenever*-conditionals, which are monotonic but otherwise much like *if*-conditionals. This seems like a promising path to explore; one issue with this, however, is that presuppositions which are bound by adverbs of quantification like *whenever* do not project in a straightforward way. Thus (i) does not seem to presuppose that John is in France. It is thus not immediately clear to us how to use *whenever*-conditionals to address this question.

(i)   Whenever John is happy to be in Paris, he is with Mary.

4.3.2 Extending to other parsing-based accounts?

The second alternative we discuss is an extension of our solution to a parsing-based trivalent approach like the one given in Fox 2008, 2012 or Chemla & Schlenker 2012. We will argue that — whereas the solution we have suggested can be straightforwardly extended to theories which are built on similar derivations to Schlenker 2009, like Schlenker 2008a, Schlenker 2009: sect. 3.2 — it is unclear to us how to extend it to parsing-based trivalent approaches to presupposition.

On the trivalent approach, the domain of truth-values includes, in addition to the classical values, a third value, denoted #, which we interpret as something like uncertainty about the actual underlying classical value. At a world where $⟦P⟧$ is false, a presuppositional atomic sentence A_p is assigned #.[38] The following principle tells us how # percolates up from atomic to complex sentences (adapted from Beaver & Geurts 2011):[39]

Definition 4.5. Strong Kleene:
For each atomic part E of a sentence S, if E is third-valued at w, check whether, on the basis of everything else in S, you can determine that assigning an arbitrary classical value to that occurrence of E would not have an effect on the value of $⟦S⟧^w$. If so, just assign E an arbitrary value, and carry on. Otherwise, $⟦S⟧^w = \#$.

The principle requires us to do the best we can with classically valued arguments to try to assign the sentence as a whole a classical value. We can then derivatively define a notion of sentence presupposition as follows: a sentence presupposes whatever is required to ensure that it can be assigned a classical value in any context through this method.

Just as for Schlenker's parsing-based algorithm, we can also define an incremental version of the trivalent algorithm (see Peters 1979, George 2008, Fox 2008, Beaver & Geurts 2011, Romoli 2012, Fox 2012, Chemla & Schlenker 2012):

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38 $⟦\cdot⟧$ is thus now treated as a trivalent function which takes sentences to truth values 1 or 0, or to the undefinedness value #. This is in contrast to Schlenker's treatment of $⟦\cdot⟧$ as a bivalent function which takes sentences to 1 or 0, and also in contrast to standard approaches to presupposition which treat $⟦\cdot⟧$ as a partial function, defined on a sentence at a context only if that sentence's presuppositions are satisfied in that context.

39 This is similar to a Supervaluationist approach; see Egré & Spector 2016 for discussion of the differences between the two approaches.

Definition 4.6. Incremental Strong Kleene:[40]
For each atomic part E of a sentence S, if E is third-valued at w, check whether, on the basis of the material to the left of E, you can determine that assigning an arbitrary classical value to that occurrence of E would not have an effect on the value of $[\![S]\!]^w$. If so, just assign E an arbitrary value, and carry on. Otherwise, $[\![S]\!]^w = \#$.

For negation, disjunction, and conjunction, *Strong Kleene* makes the same predictions about presupposition projection as the symmetric version of Schlenker 2009, and *Incremental Strong Kleene* makes the same predictions as the incremental version of Schlenker 2009.

When we turn our attention to antecedent-final conditionals, we find that this approach again makes the wrong predictions.[41] Consider first the predictions of the account for a sentence of the form (33) if we adopt a non-presuppositional material implication analysis of the conditional.

(33)   B, if A_p.

First note that the trigger in (33) is sentence-final, so the incremental and symmetric versions of the trivalent algorithm make the same predictions. Second, it is easy to see that at any world w, the value of $[\![A_p]\!]^w$ is relevant to whether we can assign a classical truth value to the sentence as a whole only if $[\![B]\!]^w = 0$, since if $[\![B]\!]^w = 1$, then the sentence as a whole is true regardless of arbitrary assignment of a classical value of its antecedent. Thus (33) is again wrongly predicted to presuppose $\neg B \rightarrow P$.

In this framework, however, assuming a presuppositional approach to conditionals does not avoid this problem. Suppose we analyze conditionals again with the presuppositional strict conditional semantics sketched above. The presupposition of a complex sentence in the trivalent framework is, again, the condition that a context must meet to be guaranteed that the sentence will have a classical value: in other words, the disjunction of the conditions under which it is sure to be assigned true and under which it is sure to be assigned false. For (33) to be true no matter how we fill in non-classical values at a given context and world in that context, there must be some $[\![A_p]\!]$-worlds, i.e. some $[\![A \wedge P]\!]$-worlds, in the context; every $[\![A \wedge P]\!]$-world in the context must be a $[\![B]\!]$-world; and every $[\![\neg P]\!]$-world in the context must

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40 Also called 'Middle Kleene.'

41 See Fox 2012 for related discussion of trivalent approaches to the presuppositions of quantifiers.

be a $[\![B]\!]$-world (so that no matter how we assign a classical value to A_p at that world, we are sure that the material conditional $A_p \to B$ remains true at that world). For (33) to be false no matter how we fill in non-classical values, there must be some world in the context where A_p is true and B false; i.e. there must be some $[\![A \wedge P \wedge \neg B]\!]$-world in the context. The disjunction of these conditions is as follows:

(34) $[\exists w \in C : [\![A \wedge P]\!]^w = 1 \wedge \forall w \in C(([\![A \wedge P]\!]^w = 1 \vee [\![P]\!]^w = 0) \to [\![B]\!]^w = 1)] \vee \exists w \in C([\![A \wedge P \wedge \neg B]\!]^w = 1)$

This is logically equivalent to the simpler:[42]

(35) $[\exists w \in C : [\![A \wedge P]\!]^w = 1 \wedge \forall w \in C([\![P]\!]^w = 0 \to [\![B]\!]^w = 1)] \vee \exists w \in C([\![A \wedge P \wedge \neg B]\!]^w = 1)$

But this is no help. It predicts that our crucial example

(36) John isn't in Paris, if he regrets being in France.

presupposes that either it is compatible with the context that John is in France and regrets he is in France, and that if John isn't in France, he's not in Paris; or that it is compatible with the context that John is in France, that he regrets that he is in France, and that he is in Paris. Because it is trivially true that John isn't in Paris if he isn't in France, this simplifies to the presupposition that it is *compatible with the context* that John is in France and regrets that he is in France. But this is different from the observed presupposition of (36), which, again, is that John is in France.

Thus the parsing-based trivalent approach, even combined with a pre-suppositional semantics for the conditional, fails to predict that (36) presupposes that John is in France. Our proposed solution to the puzzles raised by antecedent-final conditionals therefore does not extend to trivalent parsing-based accounts. We leave open whether there is a different solution within this framework.

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42 We arrive at (35) by dropping from the left disjunct of (34) the material conditional $\forall w \in C([\![A \wedge P]\!]^w = 1 \to [\![B]\!]^w = 1)$, which is entailed by the negation of the second disjunct of (34), $\neg \exists w \in C([\![A \wedge P \wedge \neg B]\!]^w = 1)$.

5 Conclusion

We have used antecedent-final conditionals to formulate a problem for parsing-based theories of local contexts and its application to presupposition projection and triviality. We laid out a solution which allows us to maintain a parsing-based pragmatic approach with the caveat that, in calculating local contexts, we take into account material presupposed by the surrounding strings. This requires a substantial shift in the formulation of the symmetric algorithm for calculating local contexts. We sketched one possible reformulation, leaving many details for further work. We then discussed some alternative approaches and showed that our proposed solution does not extend to trivalent parsing-based approaches.

Our discussion has been an attempt to make progress in addressing the question of what kind of semantic and pragmatic information is taken into account in the calculation of local contexts. We have suggested that presuppositions, but not implicatures, should be taken into account; this allows us to distinguish the projection behavior of presuppositions triggered in antecedents of antecedent-final conditionals from the behavior of presuppositions triggered in right disjuncts. But this leaves open many other questions about what other kinds of semantic and pragmatic inferences can or can't be seen by the algorithm which calculates local contexts. Our broader methodological point has been that antecedent-final conditionals provide an ideal testing ground for these questions in a parsing-based framework.

We do not claim that our solution is the only possible one to these puzzles. But it is the best one we know of at present. Insofar as this solution raises a number of new theoretical and technical questions, these puzzles may also be taken to motivate abandoning parsing-based approaches altogether in favor of structural approaches of the kind advocated in traditional dynamic semantic accounts along the lines of Heim 1983. On an account like that, local contexts are determined by compositional structure. Under the assumption that antecedent-final conditionals have the same compositional structure as antecedent-initial ones, the local context for the antecedent is predicted to be the global context. As we discussed at the outset, this style of dynamic semantics has come under attack for being insufficiently explanatory. In recent years, however, more explanatory theories have been proposed which, like dynamic semantics, base the calculation of local con-

texts on compositional structure, and thus avoid the puzzles we have raised (see Chierchia 2009, George 2008, Rothschild 2011).[43]

We conclude by briefly surveying some further data which are related to those we have discussed here. We have taken the data discussed above from antecedent-final conditionals to show that any adequate algorithm for deriving local contexts must predict that the local context for the antecedent of a conditional, *whether preposed or postposed*, is the global context set. This generalization seems correct for the data we have seen so far, as well as close variants: for instance, data involving *unless* appear to mirror the data involving antecedent-final conditionals given above. As discussed by Schlenker (2009), Chemla & Schlenker (2012), the predictions of Schlenker 2009 for a sentence of the form *B, unless A_p* are the same as those of *B, if not A_p*: the local context of A_p in C is $C \cap \llbracket \neg B \rrbracket$, and so the predicted presupposition is $\neg B \rightarrow P$. But, as for antecedent-final conditionals, this doesn't seem correct: (37) is predicted to be presuppositionless, but intuitively gives rise to the inference that John is in France. Similarly, (38) appears felicitous, despite the fact that it is predicted to have a part that is redundant in its local context.[44]

(37)   John isn't in Paris, unless he's happy that he is in France.

(38)   John isn't in Paris, unless he is in France and Mary is with him.

We can capture these data by extending our presuppositional account in the obvious way to *unless*.

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43 Another, intermediate option one could explore is whether antecedent-final conditionals are to be derived from the corresponding antecedent-initial ones: that is, whether a conditional of the form *B, if A* would underlyingly have a structure identical to the corresponding antecedent-initial version, *[[if A] B]*. The questions for this move would be whether such an LF is motivated independently and whether a parsing-based approach could somehow access the LF rather than surface structures. See Bhatt & Pancheva 2006 and Barker 2008 for relevant discussion on these two points.

44 By contrast, though, Philippe Schlenker has pointed out that examples like (i) may have less strong of a suggestion that John lives in a big city. We are not sure about judgments here. The minimal variant in (ii) does seem to us to suggest that John lives in a big city, though.

(i)   John doesn't live in Moscow, unless he regrets living in a big city.

(ii)   John doesn't live in Moscow, unless he is unhappy that he lives in a big city.

But other data, in particular involving the behavior of additive particles, seem to make trouble for this generalization.[45] Consider cases like (39) and (40).

(39) Anne won't decide to study abroad, if her brother doesn't also decide to study abroad. [modified slightly and translated from the French in Chemla & Schlenker 2012]

(40) Every individual who wasn't present again during the March attack didn't take part in the January attack.   (Chemla & Schlenker 2009)

While (39) and (40) are not impeccable, they strike us as acceptable.[46] But on standard accounts, in order for *also* to be licensed in the antecedent of (39), the local context should entail that Anne will decide to study abroad; for *again* to be licensed in (40), the local context for the restrictor clause should entail $\lambda x.x$ *took part in a prior attack*. These are precisely the predictions which follow from the generalization which we have argued is problematic and that our proposal is designed to avoid: namely, that the local context for the antecedent of a conditional (or, essentially equivalently, restrictor of a quantifier) entails the negation of the consequent (nuclear scope) — either when using a symmetric algorithm, or when the antecedent (restrictor) is postposed and an incremental algorithm is used.[47]

These data thus constitute a challenge to the accounts that we have argued solve the puzzles we presented above, a challenge that we will leave open

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45 We are grateful to Philippe Schlenker (p.c.) for drawing our attention to the issues these data raise for our account.

46 Chemla & Schlenker (2012) present experimental evidence that French sentences similar to (39) are indeed acceptable, if not perfect.

47 A more thorough exploration of quantificational sentences like (i) may also help us make progress here. Insofar as conditionals and quantified sentences have structural and semantic similarities, as many have claimed, these promise to raise the same issue as the antecedent-final conditionals considered above, if one can create a corresponding sentence in which the restrictor appears sentence final.

(i) Every student of mine who is happy that he is in France isn't in Paris.

In English, restrictor-final quantificational sentences do not seem possible: both (iia) and (iib) sound ungrammatical. In Italian, however, the corresponding case of (iia) is possible (in (iii)), and a similar construction to (iib) is possible in German in (iv) (thanks to Vera Flocke and Matthias Jenny for German judgments):

(ii) a. *He isn't in Paris, every student of mine who is happy that he is in France.
      b. *Every student isn't in Paris who is happy that he is in France.

here. However, as discussed by Chemla & Schlenker (2012), it is not entirely clear that the source of the puzzles has to do with the way we calculate local contexts. Consider (41), which is, surprisingly, felicitous.

(41)   Nixon is guilty, if Haldeman is guilty too.   (Soames 1982)

According to standard theories of additive particles, the local context for *too* must entail that someone else is guilty besides Haldeman — in particular, it looks like it should entail that Nixon is guilty. But this is not predicted by any theory of presupposition projection (see Romoli 2012 for discussion). Analogously, for the modification of (40) in (42), which we find acceptable to the same extent, we would need the local context of the restrictor to entail $\lambda x.x$ *took part in a prior attack*. But, as for (41), this is again not predicted by any theory.

(42)   Every individual who was present again during the March attack took part in the January attack.

Given these conflicting data, we think it may be the case that additive particles simply do not work as they are standardly thought to, and thus that the present data should not be taken to point towards any conclusion about the calculation of local contexts in the first place.

A   Appendix

We prove the result alluded to in Section 4.1.2:

(iii)   Non è a Parigi, ogni mio   studente che è contento di essere in Francia.
         Not is in Paris, every mine student   that is happy   of being in France.
         'Every student who is happy that he is in France isn't in Paris.'

(iv)   Keiner meiner Studierenden war in Paris, der bedauert in Frankreich zu sein.
         None   of+my students   was in Paris, who regrets   in France   to be.
         'No one who regrets being in France was in Paris.'

Schlenker's algorithm (unless it takes a non-emptiness presupposition into account) predicts that the presupposition of the nuclear scope in these sentences is filtered by the negation of the restrictor. Therefore, (iii) and (iv) constitute other test cases for such algorithm. These cases bring added complexity, however, since it is generally unclear what the projection from the restrictor of quantifiers is empirically, regardless of whether it appears sentence-initial or sentence-final; see Schlenker 2008b and Chemla 2009 for discussion and experimental data.

Proposition 1. *In context C, C is the strongest substitution instance of Y that makes (43) and (44) contextually equivalent for any D, given the truth-conditions for 'If...then' in Definition 4.2.*

(43)   If Y $\wedge$ D then B.

(44)   If D then B.

Proof. REMARKS:

- In what follows we distinguish *presupposition failure* from *falsity*. In a bivalent theory like Schlenker's, these amount to the same thing. As the reader can verify, uniformly substituting the latter for the former in the proof that follows weakens our proof slightly: if presupposition failure is just falsity, then Proposition 1 holds only if $C \cap [\![B]\!] \neq \varnothing$, which is what our modified proof would show. For our purposes this weaker result suffices, since conditionals with the form *If A then B* or *B, if A* will not typically be asserted in contexts which entail $[\![\neg B]\!]$; the bivalent interpretation of the present proof thus shows that the local context for a conditional *in any reasonable global context C* will just be *C* itself. That said, we demonstrate the stronger result here since it is of independent interest. Issues about bivalence are orthogonal to our main interests here, and, as we have suggested, the bivalent, unidimensional conceptualization of presuppositions advocated by Schlenker may in any case be inconsistent with the data we have given in this paper.[48]

- We continue to assume that the accessibility relation for the strict conditional g_c obeys the constraint that $\forall w \in C: g_c(w) = C$.

PROOF:

- Suppose first that $[\![Y]\!] \cap C = \varnothing$; then (43) will be presupposition failure. If $C \cap [\![B]\!] \neq \varnothing$, then let D=B; (44) will be true. Otherwise let D=C; then (44) will be either true or false.

- Suppose next that $[\![Y]\!] \cap C \neq \varnothing$ and $([\![Y]\!] \cap C) \subsetneq C$.

  i. First, suppose that $[\![B]\!] \cap C = \varnothing$. Then choose $[\![D]\!] = C \setminus [\![Y]\!]$. Then (43) will be presupposition failure, (44) false.

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48 Thanks to anonymous reviewer for pushing us to clarify these points.

ii. Next suppose that $\llbracket B \rrbracket \cap C \neq \varnothing$.

- First, suppose that $\llbracket B \rrbracket$ and $\llbracket Y \rrbracket$ do not overlap in C. Then let $D = B$. Then (43) is presupposition failure, (44) true.

- Next, suppose that $\llbracket B \rrbracket$ and $\llbracket Y \rrbracket$ do overlap in C. We distinguish four cases: (a) they overlap in exactly the same region; (b) the overlap of the latter with C is a proper subset of the overlap of the former with C; (c) vice versa; and (d) none of the above:

  a. $\llbracket B \rrbracket \cap C = \llbracket Y \rrbracket \cap C$. Then let $D = \top$; then (43) will be true, (44) false.

  b. $\llbracket Y \rrbracket \cap C \subsetneq \llbracket B \rrbracket \cap C$. Then let $\llbracket D \rrbracket = (C \cap \llbracket B \rrbracket) \setminus \llbracket Y \rrbracket$, then (43) is presupposition failure, (44) is true.

  c. $\llbracket B \rrbracket \cap C \subsetneq \llbracket Y \rrbracket \cap C$. Then let $\llbracket D \rrbracket = C \setminus (\llbracket Y \rrbracket \setminus \llbracket B \rrbracket)$. Then (43) is true, (44) is false.

  d. $C \cap \llbracket Y \rrbracket \cap \llbracket B \rrbracket \neq \varnothing$ and $(C \cap \llbracket Y \rrbracket) \nsubseteq (C \cap \llbracket B \rrbracket)$ and $(C \cap \llbracket Y \rrbracket) \nsupseteq (C \cap \llbracket B \rrbracket)$. Then let $\llbracket D \rrbracket = (C \cap \llbracket B \rrbracket) \setminus \llbracket Y \rrbracket$. Then (43) is presupposition failure, (44) true.

- By contrast, if $\llbracket Y \rrbracket \supseteq C$, then it is easy to confirm from the truth conditions for the conditional in Definition 4.2 that (43) and (44) always have the same truth value. Thus C is the value of the strongest substitution instance for Y which guarantees that (43) and (44) have the same truth value.

□

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