Matrix and Embedded Presuppositions

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1 The presuppositions of complex sentences: a brief introduction

This chapter is concerned with the projection problem for presuppositions and related issues that arise in the course of addressing it like presupposition accommodation. The projection problem is the problem of predicting the presuppositions

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of complex sentences based on their form and the presuppositions of their parts. At first blush, it might be unclear why presupposition projection is a "problem." Suppose that the semantic system has some way of assigning presuppositions to atomic sentences. We might then expect the presuppositions of complex sentences to be derivable from the run-of-the-mill compositional semantics that we are used to. The problem, of course, is that classical assumptions do not suffice to adequately describe the presuppositions of complex sentences.

To see this, suppose that *The King of France is bald* presupposes that there is a unique King of France and asserts that this individual is bald. We will say more about what this means later, but for the moment, note that the sentence entails both its assertion and its presupposition (presuppositions of atomic sentences are also entailments). From the perspective of classical logic, it is a surprising discovery that when the sentence is negated, for example, the asserted content is denied but the presupposition survives: *The King of France is not bald* "inherits" the presupposition that there is a unique King of France and denies only that this individual is bald.

(1) The King of France is bald.
   a. Presupposition: that there is a (unique) King of France, x.
   b. Assertion: that x is bald.

(2) The King of France is not bald.
   a. Presupposition: that there is a unique King of France, x (= same as (1a)).
   b. Assertion: that x is not bald (= negation of (1b)).

Under Karttunen's (1973) terminology, negation is a "hole" for presuppositions because it lets the presupposition of its complement through unnegated. But what is it about negation that makes it negate (1b) and not the conjunction of (1b) and (1a)? The classical analysis does not answer the question. At the same time, it would be surprising if the classical analysis had nothing to say about this. One would expect a connection between the classical treatment of negation and its interaction with presuppositions – but what is that connection?

The problem with negation is just a special case of a more general problem. Let S_p^q be a sentence that presupposes p and asserts q, and assume for the moment that it can be analyzed as the conjunction of p and q. If we assume classical entries for operators like disjunction, conditionals, attitude predicates, and questions, we fail to predict the fact that the complex sentences in (3) all presuppose that Sandy has a dog. (By $A \rightsquigarrow p$ we mean that sentence A presupposes proposition p.)[1]

(3) Sandy loves her dog $\rightsquigarrow$ Sandy has a dog.
   a. Either John is lazy or Sandy loves her dog $\rightsquigarrow$ Sandy has a dog.
   b. If John gets run over by a bull, Sandy loves her dog $\rightsquigarrow$ Sandy has a dog.
   c. Sue believes that Sandy loves her dog $\rightsquigarrow$ Sandy has a dog.
   d. Does Sandy love her dog? $\rightsquigarrow$ Sandy has a dog.

In essence, the problem is that – as with negation – the operators contained in the larger sentence appear to interact with the embedded sentence S_p^q's asserted content q but not with its presupposed content p. On the face of it, then, classical

semantics appears to offer no help with figuring out how, or why, the presuppositions of complex sentences come to be what they are.

Perhaps the problem is with the assumption that S_p^q ought to be analyzed as the classical conjunction of p and q. Note, however, that things do not become any clearer if we assume a three-valued or partial semantics to incorporate presuppositions. It is sometimes assumed that to make sense of the "squeamish" feeling we get when a sentence is uttered whose presupposition is not true, such as *The King of France is bald*, we need a semantics that fails to assign true or false to the sentence (see von Fintel 2004a for discussion). In some views the sentence is assumed to not have a truth value (the semantics is partial), and in some approaches the sentence receives a third value that is neither true nor false (sometimes interpreted as uncertainty).[2] Assume the latter three-valued approach for the moment: suppose that sentences can have the value 0 (false), 1 (true), or # (don't know which). If the sentence's presupposition is true, then if the assertion is also true the sentence is true, and if the assertion is false the sentence is false. However, if the presupposition is not true, the whole sentence receives the third value: it is neither true nor false. Granting this, what should be the value of $\neg S$, for example, when S receives the value #? There is a choice here: the value could be taken from anywhere in the set of truth values {0,1,#}, and nothing in the logic itself forces one answer over the other. The fact that the value is #, that is, that the presupposition of S is inherited by $\neg S$, is as mysterious as it was from the classical perspective.[3]

As we hope to clarify, observations like this seem to call for a dedicated theory of presupposition projection. In all the cases we have seen so far, the presuppositions of embedded constituents – henceforth "embedded presuppositions" – have been inherited at the matrix level. That embedded presuppositions tend to percolate to larger containing structures was first brought to light in Morgan (1969) and Langendoen and Savin (1971), where the following simple descriptive generalization was proposed:

(4) *The cumulative hypothesis*
Operators are "holes" for presuppositions. Let Op be an operator, S_p a sentence that presupposes p, and $Op(S_p)$ a sentence containing S_p as (a possibly deeply) embedded constituent. Then $Op(S_p)$ presupposes p.

These earliest works were also aware, however, that (4) is not descriptively adequate, and Karttunen (1973) provided a detailed classification of operators into those that are "plugs" for embedded presuppositions (preventing them from projecting), filters (passing them up in modified form), or holes (passing them up as they are). A persistent challenge for classifying operators as plugs, holes, or filters is the fact that they often seem to fall into multiple categories. For example, presuppositions do not always project out of the consequent of a conditional (compare with (3b)):

(5) a. If Sandy has a dog, she loves her dog $\not\rightarrow$ Sandy has a dog.
b. If Sandy is a scuba diver, she will bring her wetsuit $\not\rightarrow$ Sandy has a wetsuit.

The sentence in (5a) has no presupposition at all, and thus *if* appears to be a plug here. At the same time, (5b) presupposes that if Sandy is a scuba diver she has a wetsuit, showing that conditionals sometimes behave like filters. Thus, conditionals can be holes (3b), plugs (5a), and filters (5b).

This multiplicity is not unique to conditionals. It has been known since Russell that negation can interact with embedded presuppositions in more than one way. For example, (2) can be understood as denying the conjunction of (1a) and (1b), rather than denying just (1b).

(6) The King of France is not bald … there is no King of France!

The text in (6) is consistent, which means that negation in this case does not act like a hole for presupposition. Instead, it appears to be a plug.

Once we see that conditionals and negation need not be holes, we can readily find cases where other operators that appear to be holes (see (3)) can also behave otherwise:

(7) a. Either Sandy is not a scuba diver or she will bring her wetsuit. $\not\rightarrow$ Sandy has a wetsuit.
b. Mary believes that Sandy has a wetsuit, and she believes that Sandy will bring her wetsuit. $\not\rightarrow$ Sandy has a wetsuit.

Disjunction, for example, appears to be a filter in (7a): the sentence presupposes that if Sandy is a scuba diver she has a wetsuit, just as (5b) does. This is perhaps not surprising, given the close connection classically assumed between disjunctions and (the material implication analysis of) conditionals. We might also expect, then, that disjunctions should sometimes behave like plugs, an expectation that is confirmed by sentences like (8).

(8) Either Sandy has no dog or she loves her dog.

It was immediately clear that it would be no easy task formulating a mechanism that adequately describes these kinds of observations while also having claims to explanatory adequacy (in the sense of Chomsky 1965). It was perhaps this realization that led some philosophers to predict (correctly, it turns out) that the study of presupposition would become quite specialized (Hacking 1975). How do we account for the variability in each operator's projection profile? What determines when an operator acts like a hole, or a plug, or a filter, for its embedded presuppositions? What is the division of labor between syntax, semantics, and pragmatics in accounting for this determination? How do presuppositional components of meaning relate to other semantic/pragmatic components, such as truth conditions, anaphora, and implicatures, among others? We do not have introspective access to the inner workings of the mind, and thus the only thing to do is to build theories and hope that the effort leads to insight and understanding. The decade after Karttunen (1973) witnessed several proposals for how to best answer these questions (e.g., Karttunen 1974; Stalnaker 1974; Karttunen and Peters 1979; Gazdar 1979; Soames 1979; 1982; Heim 1983). That amazing decade laid the foundations for continued developments in the decades since.

I will not be able to do justice here to all of that work. To keep the discussion focused, I will highlight one central observation that quite neatly divides different approaches to projection, namely, the observation that although the cumulative hypothesis in (4) is not true as an absolute generalization, it appears to be correct when stated as a tendency. Specifically, although there appears to be optionality in what an operator projects, complex sentences tend to inherit the presuppositions of their embedded constituents. Roughly speaking:

(9) *The cumulative tendency (to be revised and clarified)*
Operators tend to be "holes" for presuppositions. An utterance $Op(S_p)$ in context c will normally be understood with presupposition p unless there is a good reason to not presuppose p in c.

This tendency has been noted extensively in the literature across otherwise different approaches to presupposition projection (e.g., Soames 1979; 1982; Gazdar 1979; Heim 1983; 1992; Horton and Hirst 1988; Mercer 1992; van der Sandt 1992; Zeevat 1992; Geurts 1999b; 2000; Blutner 2000). Experimental evidence has recently been produced that also supports the privileged status held by hole-like interpretations (e.g., Chemla and Bott 2013).[4] Of course, it remains to be explained why the tendency should be true, as well as what the good reasons are that prevent the projection of p to the root.

Different approaches to presupposition projection provide different resources for describing and explaining this (and related) generalizations. An important architectural distinction that divides frameworks is whether the projection mechanism can filter presuppositions such that embedded presuppositions appear in modified form at the root. Theories that can filter a presupposition need a mechanism for "unfiltering" it to account for the generalization that embedded presuppositions tend to be inherited at the root. Theories that cannot filter a presupposition can account for the generalization but not for the observation that presuppositions can be filtered. In sections 2 and 3 I will summarize the way this architectural difference is realized in competing approaches, and in section 4 I will articulate an emerging synthesis that generally allows embedded presuppositions to become filtered as part of the projection component and that connects apparent unfiltering with accommodation inferences that keep track of the presuppositions of sentences bounded by the matrix sentence and the embedded triggering sentence. The synthesis raises many new questions, some of which are discussed in section 4, such as whether the facts have been properly described (for example, whether (9) is a true generalization), as well as about the division of labor between syntax, semantics, pragmatics, and domain-general reasoning when the hearer tries to figure out what the speaker wants them to presuppose as background to the complex sentence they just uttered.

2 Paths to the cumulative tendency: projection, accommodation, cancellation, and ambiguities

We have seen that (propositional) operators tend to be holes for their embedded presuppositions, but that they can also behave like plugs and in some cases they

can behave like filters. Let us agree to refer to this as a "presuppositional ambiguity." Any given theory has to answer three central questions:

(10) *Presuppositional ambiguity*
   a. How does the ambiguity arise?
   b. How is the ambiguity resolved? In particular, what makes the disambiguation favor the hole-like interpretation, when it's available?
   c. What is presupposed, and what is asserted, under the different readings?

I will now build up just enough theoretical machinery so that we can state how competing theories provide answers to these questions. I will not be concerned with stating the presuppositions of atomic sentences correctly. If I am wrong about those, so be it. My interest here is more with what happens to a presupposition – whatever it may be – as the larger sentence in which it is contained is parsed and interpreted in the context in which it is uttered.

2.1 Atomic sentences

We begin with the presuppositions of atomic sentences and work our way to sentences of greater complexity. Following Beaver and Zeevat (2007), we will distinguish between "semantic presuppositions," which are assigned by the linguistic system as the projected presupposition of the sentence, and "pragmatic presuppositions," the presuppositions of speakers and hearers who use linguistic objects that have semantic presuppositions.[5] Semantic presuppositions are commonly assumed to be triggered by certain lexical items, called presupposition triggers (though see, e.g., Abusch 2010; Abrusan 2011 and references therein). The definite article *the* is one such item: under one textbook treatment (Heim and Kratzer 1998), *the* presupposes that its nominal argument has a contextually unique satisfying element (e.g., a unique King of France in *the King of France*). If the context furnishes such an element *a*, we say that the presupposition is satisfied, in which case *the N* denotes *a*.[6] This individual *a* then saturates the predicate *is bald*, and the sentence is true if *a* is bald and is false is *a* is not bald. If there is no unique King of France available in the context, the presupposition is not satisfied and the sentence is said to suffer from "presupposition failure." In a partial semantics like the one in Heim and Kratzer (1998), this means that the sentence receives no denotation.[7] We will assume for concreteness that we are working with a partial/multivalued semantics such that sentences receive a classical denotation in the world of evaluation only if the sentence's presupposition is true in that world.[8]

The set of presupposition triggers includes elements of various semantic types: the definite article is one, but there are also complement-taking verbs such as *know* and *realize* (e.g., *John knows that he made a mistake* presupposes that John made a mistake), aspectual verbs like *stop* (e.g., *it stopped raining* presupposes that it was raining at some (salient) time interval before the utterance), anaphoric discourse particles like *too* and *also* (e.g., *JOHN built a garden bed, too* presupposes that some (salient) individual other than John built a garden bed), and many more (see e.g., Karttunen 1973; Gazdar 1979; Soames 1989; Beaver 2001; Beaver and Zeevat 2007).

Semantic presuppositions are commonly assumed to impose special pragmatic constraints. Intuitively, a speaker who utters a sentence like *The King of France is bald* is taken to be pragmatically presupposing that there is a (unique) King of France. By this we mean that the speaker assumes that the context in which the sentence is uttered entails its semantic presupposition. Following terminology introduced in von Fintel (2008), we refer to this as "Stalnaker's Bridge":[9]

(11) *Stalnaker's Bridge*
If sentence S semantically presupposes p, S_p, then a speaker can appropriately utter S_p in context c only if c entails p.

Certainly no cooperative speaker would utter *The King of France is bald* if they had reason to doubt the existence of a King of France. Such an utterance strikes me as ruder than an outright lie. Assertions can and sometimes should be challenged (*no, that's false!*), but it's harder to directly challenge a presupposition. That is not to say that there are no mechanisms available to challenge presuppositions. However, the mechanisms for challenging presuppositions differ from those for challenging assertions, and tend to be more involved. For example, von Fintel (2004a) notes that the hearer can object *Hey wait a minute! I didn't know there's a King of France!* but cannot object #*Hey wait a minute! I didn't know the King of France is bald!* The objection to the presupposition is appropriate because the speaker has incorrectly assumed that the hearer shared the presupposition with them (note the past tense marking and the verb *to know*: *I didn't know that*). Assertions are intended to be new to the listener, so objecting that you didn't know what the speaker said before they said it would be senseless.[10]

It is of course well known that speakers can sometimes utter a sentence S_p in a context c that appears to violate (11) without giving rise to any sensation of presupposition failure. For example, I can say (12) in just about any context that is consistent with my having a brother:

(12) I'm sorry I'm late. I had to call my brother.

This sentence presupposes that I have a brother, and I can typically get away with uttering this sentence even if it is common ground that you know nothing about the makeup of my family. In such cases, it would typically be uncooperative for a hearer to object: *Hey wait a minute! I didn't know you have a brother!* Instead, they would simply accommodate the presupposition that the speaker clearly intends for them to accept as background.[11] There is much to say about accommodation in this general framework (see, e.g., Karttunen 1974; Stalnaker 1974; Lewis 1979; Heim 1982; 1983; Beaver 2001; and much work since); we will return to accommodation after we discuss the way presuppositions project in complex sentences.

We will sometimes omit the qualifiers "semantic" and "pragmatic" presupposition and will talk of presuppositions *simpliciter* when the distinction is not relevant. But, as we will see, semantic and pragmatic presuppositions can differ, and this has consequences for the overall theory of presupposition. In particular, various operations – accommodation and cancellation – can tamper with semantic

presuppositions so that what gets pragmatically presupposed in context is different than the projected presupposition. Thus, as we proceed to discuss the presuppositions of complex sentences, it might be useful to keep in mind that intuitions about what a complex sentence presupposes may well involve the interaction of multiple underlying mechanisms. We will try to clarify how different theories make different choices about what these mechanisms are, and how their labor is divided, in computing the semantic and pragmatic presuppositions of complex sentences.

2.2 Complex sentences: a first attempt

Consider now what happens when S_p occurs in a complex sentence $\phi(S_p)$. Take negative embedding to start, which, recall, generates a two-way ambiguity:

(13) The King of France isn't bald.
   a. Hole reading: <u>There is a King of France</u> x and it's not the case that x is bald.
   b. Plug reading: It is not the case that (there is a King of France x and x is bald).

I have underlined the part of the meaning that is presupposed: in (13b) there is no presupposition at all but in (13a) the embedded presupposition projects to the root and is treated as a presupposition in the discourse. For example, a listener who understands (13) under its reading in (13a) could respond *Hey wait a minute! I didn't know France has a King!* Furthermore, as we noted earlier, the reading in (13b) is hard to get but nevertheless *is* available. However, it is so marked that it typically can be recovered only with contextual help:

(14) a. The King of France isn't bald … there is no King of France!
   b. There is no King of France. Therefore, the King of France isn't bald.

We want an account of how the string in (13) is assigned the meanings in (13a) and (13b) as well as an answer to why (13a) is preferred to (13b).

As a first attempt at a systematic account of these facts, consider the proposal in Karttunen and Peters (1979). They proposed that the presuppositional ambiguity generated by negation might be due to a *lexical* ambiguity. Under their analysis, operators encode not only a normal truth-conditional component of meaning, intended to specify the projection of asserted content, but also a "heritage" function that specifies how presuppositions of embedded constituents affect higher clauses. As above, let S_p^q be a sentence that presupposes p and asserts q. In Karttunen and Peters' (1979) treatment of negation, the word *not* is ambiguous. Under one of the entries, the one in (13a), *not* S_p^q asserts $\neg q$ ($\neg$ is classical negation) and presupposes p: $[\,\textit{not}\,[S_p^q]]_p^{\neg q}$. Under the other entry, the one in (13b), *not* S_p^q presupposes nothing at all and asserts $\neg(p \wedge q)$: $[\textit{not}\,[S_p^q]]_{\mathscr{W}}^{\neg(p\wedge q)}$ (here $\mathscr{W}$ is the set of all worlds, and thus the presupposition has no information). Karttunen and Peters (1979) note that this second negation is typically associated with the prosody of metalinguistic negation, which may suggest why that reading is dispreferred (see also Horn 1985).

There are several reasons to doubt an analysis in terms of lexical ambiguity as the source of ambiguity and metalinguistic negation as the source of preference rankings. First, as far as I know, these two negations are not realized by different

morphemes in any language. Second, there need not be marked accent in generating the reading in (13b); there is none in (14b), for example. Third, as noted earlier, we find a similar pattern with other embedding operators: the presupposition of an embedded constituent typically projects to the root (see the (a) sentences in (15)–(17)), but can be prevented from doing so in certain contexts (see the (b) sentences in (15)–(17)):

(15) a. If John is from Toronto, the King of France is bald.
b. If there is a King of France, the King of France is bald.

(16) a. John is from Toronto and the King of France is bald.
b. There is a King of France and the King of France is bald.

(17) a. Either John is from Toronto or the King of France is bald.
b. Either there is no King of France or the King of France is bald.

We would not wish to multiply ambiguities in the lexically specified heritage functions of operators, and we would prefer to have an explanation that connects an operator's heritage function with other aspects of its meaning. A list of (possibly ambiguous) lexical specifications does not provide the required explanation. Clearly, a more general account would be preferable.

A hint in this direction comes from the observation that when the embedded presupposition does not project, there are clear interfering factors that could provide independent motivation for why hole-like readings would be suppressed in those contexts (see especially Gazdar 1979; van der Sandt 1988). In (15b) and (17b) there is a constituent that suggests that the speaker is ignorant about whether there is a King of France: *if there is a King of France* in (15b) and *either there is no King of France* in (17b). And in (16b) the first conjunct *there is a King of France* plainly asserts that there is one. In the negative sentences in (14), the existence of a King of France is asserted to be false. These considerations might be reason enough to cancel the presupposition; that is, to select a non-hole interpretation if one happens to be available. Asserting that something is true at the same time as presupposing it seems self-defeating. So is asserting that something is false and presupposing that it is true. And so is presupposing that something is true and implying that you don't know whether it is true. It is unclear why presuppositions give way to these other inferences when they come into tension, but it seems clear that in the absence of such self-defeating acts, the embedded presupposition seems to want to be inherited globally by the entire sentence (see (15a), (16a), (17a)).

These considerations suggest a certain refinement to the cumulative tendency stated in (9): presuppositions project through operators by default, but this default can be overridden under threat of pragmatic inappropriateness.

(18) *Cumulative tendency, revised (see (9))*
a. Heritage functions are holes. The heritage functions of operators are generally holes for presuppositions.
b. Pragmatically motivated cancellation: presuppositions of embedded constituents get canceled to avoid self-defeating or otherwise inappropriate

speech acts, such as the ones enumerated above. In such contexts, the presupposition is assimilated into the asserted component of its triggering constituent.

3 Capturing the cumulative tendency with different theories of projection

This section summarizes different theories of presupposition in light of the generalization in (18).

3.1 Filtering + accommodation mechanisms

The Karttunen and Peters (1979) approach was criticized largely for not being explanatory (e.g., Gazdar 1979; Heim 1983). However, several approaches to projection nevertheless largely agree with Karttunen and Peters' (1979) descriptive account, even while replacing stipulated heritage functions by deriving them from independent principles, such as those motivated by donkey anaphora (e.g., Heim 1982; 1983), by pragmatic redundancy principles (e.g., Schlenker 2008), by principles of epistemic reasoning (e.g., Chemla 2009a), by principles of computational efficiency (e.g., Schlenker 2009), by reasoning about relevance and uncertainty (e.g., Fox 2008; 2012), by constraints on rewrite rules (e.g., Rothschild 2011), and by constraints on the lexicalization of logical operators (e.g., Katzir and Singh 2012; 2013a). Thus, I am inclined to think that the explanatory problem for deriving projection properties is not a serious objection for such approaches.

What ties these approaches together? I will call them all "filtering" theories for reasons that I hope will become clear as we proceed. For current purposes, the following two assumptions are central:

(19) *Presupposition projection and satisfaction*
   a. Projection function: There is a function, π, which assigns a *unique* projected presupposition to complex sentences (hence no ambiguity as far as presupposition projection goes).
   b. Context satisfaction: When $\pi(S) = q$, S_q may be used in context c only if $c \subseteq q$. When this condition is met, we say that the context *satisfies* the sentence's presupposition.

Clearly, the commitment in (19a) is inconsistent with the apparent multiplicity of operators' projection characteristics. To account for multiplicity, filtering approaches connect it with accommodation inferences that apply when (19b) is at risk of not being satisfied.

Conditionals, for example, are predicted to unambiguously be filters: $\pi(\textit{if } A, \textit{ then } S_p) = A \rightarrow p$. This makes sense of the fact that a sentence like (20) is understood with a conditional presupposition that if Paul is a devout Catholic, he has a Bible.

(20) If Paul is a devout Catholic, he will read his Bible tonight.

At the same time, conditionals do not invariably get interpreted with conditional presuppositions. Recall from (15), repeated here as (21), that *if* can behave like a hole for presuppositions (21a) and can behave like a plug as well (21b).

(21) a. If John is from Toronto, the King of France is bald.
b. If there is a King of France, the King of France is bald.

The case in (21b) is actually unproblematic. Intuitively, (21b) has no presupposition, and this is in fact predicted by the filtering approach: π in this case outputs the tautologous proposition that if there is a King of France, then there is a King of France. This imposes no special requirements on the context. The proposition is satisfied in every context and hence no presupposition is ever sensed. More generally, filtering theories predict that *if* will behave like a plug – generating no detectable matrix presupposition – in any construction *If* A, S_p where A entails p, because in such constructions the conditional presupposition $A \rightarrow p$ will be satisfied in all contexts.

The case in (21a) is more problematic. Here, the sentence is predicted to project that there is a King of France if John is from Toronto ($A \rightarrow p$). However, what we spontaneously conclude is p = that there is a King of France *whether or not John is from Toronto*. Thus, there is a mismatch between the semantically projected conditional presupposition $A \rightarrow p$ and the intuitive, unfiltered, pragmatic presupposition p.

Proponents of the filtering approach make sense of this mismatch by tying it to contexts in which the conditional presupposition is not satisfied (see (19b)). The listener recognizes the speaker's intention that they be in a context that entails the projected presupposition $A \rightarrow p$. This recognition follows from the observation that the speaker used a sentence with this projected presupposition and the assumption that (19b) governs speech (see note 9). The listener's task in response to this recognition – if they're willing to along with it – is to amend the context c to a context c' that entails $A \rightarrow p$. Recall from section 2.1 that this amendment is called presupposition accommodation. (It is sometimes called "global accommodation," where "global" is intended to capture the idea that the reasoning occurs pragmatically at matrix level.)

To see how accommodation can resolve the mismatch between semantically projected and intuitive pragmatic presuppositions, suppose (21a) is used in a context c that does not entail that if John is from Toronto, there is a King of France. For the speech act to be successful, the participants need to move to a new context c' that entails this proposition. What cases like (21a) teach us is that the amendment need not involve merely conjoining c with the output of π; in this case, you accommodate not the conditional presupposition, but rather the stronger proposition that there is a King of France (the presupposition of the consequent). The general idea is that accommodation is governed by plausibility considerations, and it is more plausible that the speaker expects you to accommodate that there is a King of France rather than to accommodate that there is a conditional connection between the antecedent and this proposition.[12] I will return to this matter shortly, but for now the important architectural point is that when the conditional presupposition *is* satisfied, as in

(21b), or in a text like (22), there is no need to accommodate and hence no inference that there is a King of France:[13]

(22) If John flies to Toronto, there is a King of France. Moreover, if John flies to Toronto, the King of France is bald.

Thus, under filtering approaches, what a sentence pragmatically presupposes will be a combination of what it projects and the accommodation inferences it licenses. In particular, if an operator behaves like a hole, this need not indicate that it is a hole for projection; rather, its hole-like behavior may be due to presupposition accommodation.

At the same time, some operators – like negation – are assumed to be holes in the projection component; that is, $\pi(\neg S_p) = p$. Thus, the approach needs to find a way to account for the fact that negation is sometimes a plug.[14] Recall that the Karttunen and Peters (1979) strategy for multiplying lexical ambiguities is undesirable. It turns out, however, that lexical stipulations can be eliminated in favor of a general mechanism for assimilating presuppositions into assertions. That is, several mechanisms in the filtering framework have been proposed for "shutting off" presupposition projection and treating embedded presuppositions as though they were part of the asserted content of their triggering constituent. These include the "local accommodation" operation of Heim (1983) and the "floating-*A*" operator of Beaver and Krahmer (2001). In Schlenker (2008) and Chemla (2009a), the relevant pragmatic principles responsible for projection are deactivated, leaving the presupposition as an entailment of the asserted component in its local clause.

Let me illustrate cancellation here with the floating-*A* operator. Suppose that sentence S_p^q is embedded in sentence ϕ, $\phi(S_p^q)$. This sentence will normally be associated with some presupposition, based on the heritage functions present in ϕ. However, if the embedded sentence S_p^q is parsed with Beaver and Krahmer's (2001) floating-*A* operator, the operator wipes out p as a presupposition and adds it to the asserted component: $(A(S_p^q))_{\mathscr{W}}^{p \wedge q}$. For example, a sentence like *The King of France isn't bald* can be parsed without any *A*, and this gives the meaning in (13a). However, with an *A* embedded below negation, *not* (*A(The King of France is bald)*), the sentence gets the reading in (13b). Thus, filtering theories have a general mechanism for canceling presuppositions, and thus can avoid a lexical stipulation in negation itself. Moreover, filtering frameworks can recapture the idea that presupposition cancellation is generally dispreferred with the (not unnatural) assumption that *A*-insertion is marked. Note that, typically, cancellation occurs only to rescue the sentence from potential communicative failure. For example, both of the sentences in (14) would be contradictions if the embedded presupposition had projected to the root. Since these are contexts in which the projected presupposition is not satisfied, cancellation – like global accommodation – is a response to potential violations of (19b). For this reason, cancellation is often called "local accommodation" (though see von Fintel 2008 for concerns about this terminology).

Given the above discussion, how close are we to explaining why, as a default, embedded presuppositions project to the root (see (18))? For operators that are

holes by virtue of projection, like negation, the answer appears straightforward: all else being equal, the actual semantic output is preferred to mechanisms that might tamper with it. The theory allows room for presupposition cancellation when projection would lead to a bad conversational outcome, such as with negation. At the same time, it reanalyzes several cases of apparent cancellation as cases where the projected presupposition just happens to be tautologous (e.g., *If there is a King of France, the King of France is bald*).

The problem for this approach in connection with (18) is that it is totally mysterious that presuppositions of constituents embedded under filters do, as a default, become pragmatic presuppositions of the sentences in which they are contained. Recall that filtering approaches allow a semantic filter to become a pragmatic hole by appealing to presupposition accommodation: when the need to accommodate $A \rightarrow p$ (for example) arises in context c, hearers will often amend c such that it entails not only $A \rightarrow p$ but also p. And this pragmatic reasoning typically takes into account the speaker's epistemic state, information in the common ground, the output of the linguistic system, and whatever else might be available to central systems (in the sense of Fodor 1983; see section 4.2.1). I think this move is not entirely innocent. To see the nature of the problem, consider the fact that the following sentences all pragmatically presuppose that there is a cow in the barn:

(23) a. If Mary moved the hay bales, then I doubt that John thinks that the cow in the barn is hungry.
b. Does Jan ever wonder whether Sue hopes that the cow in the barn is hungry?
c. Tell Luke that I'll steal his chickens if he ever reminds me about how Sue thinks the cow in the barn might go hungry!

Consider (23a). Here, *the cow in the barn* is deeply embedded under several operators that under the filtering approach would be classified as presupposition filters (*if*, *doubt*, *believe*). Under common assumptions (e.g., Heim 1992), the sentence semantically presupposes that if Mary moved the hay bales, then the speaker believes that John believes that there is a cow in the barn. Nevertheless, we come away from the sentence learning that there is in fact a cow in the barn, and we furthermore are expected to treat this inference as a presupposition. For example, the listener may respond to (23a) with (24):

(24) A: If Mary moved the hay bales, then I doubt that John thinks that the cow in the barn is hungry.
B: Hey wait a minute! I didn't know there's a cow in the barn!

The puzzle is this: why is the pragmatic inference that there is a cow in the barn so much more salient and accessible than the semantic presupposition that if Mary moved the hay bales, then the speaker believes that John believes that there is a cow in the barn? I am not concerned with why there are pragmatic presuppositions that are different from semantic presuppositions. Let us grant that pragmatic presuppositions are a function of semantic presuppositions but need not be identified with them. My concern is that there seems to be no rationale for concluding that there is a cow in the barn if the only input to the inference process is (i) the

semantic presupposition of the sentence, and (ii) propositional information in the context.

First, there seems to be nothing in the semantic presupposition itself *qua* proposition that invites this inference. For example, a sentence that paraphrases the semantic presupposition does not invite the inference that there is in fact a cow in the barn:

(25) If Mary moved the hay bales, then I believe that John believes that there is a cow in the barn.

Upon processing this information and trying to make rational sense of it, I am in no way compelled to conclude that there is a cow in the barn.

Second, one has to do some mental work to realize that the semantic presupposition is available at all. This itself is somewhat surprising: why should the output of the linguistic system – which is context invariant – be harder to retrieve than a presumably malleable, context-dependent pragmatic inference? This challenge is exacerbated by the fact that under common assumptions about the semantics–pragmatics interface the embedded presupposition should be unavailable at the root. A (filtered) semantic presupposition q *is* available in matrix position, but this is just a proposition, a mere set of words. Of course, q has been derived from the embedded presupposition p in some fashion: $q = f(p)$, where f is shorthand for a possibly complex sequence of semantic operations. But this derivational history is lost at the root: here we only have access to q, and not to $f(p)$. This follows from the assumption that at each node in the tree, meaning is computed only locally (on the basis of immediate constituents), and that what gets delivered to the pragmatics is the proposition denoted by the sentence, rather than its derivational history. Why, then, should this inaccessible proposition – the presupposition of an embedded constituent – be so salient? And why should it be the *preferred* reading? The challenge is to explain how a proposition that has been "filtered away" by the linguistic system can be recovered and subsequently made the preferred interpretation of the sentence.

I will return to this challenge in section 4 after discussing approaches that perhaps more directly allow presuppositions of embedded constituents to surface as global pragmatic presuppositions (i.e., as pragmatic presuppositions at matrix position).

3.2 Default projection

3.2.1 Potential presuppositions

Gazdar (1979) proposed that embedded presuppositions are always *potential* presuppositions of the complex sentences in which they are contained.[15] That is, the system that computes the pragmatic presuppositions of a complex sentence goes through a stage of computation in which it collects the presuppositions of all atomic constituents contained in the sentence.[16] This set of "potential presuppositions" then undergoes a series of tests to determine which of these survive to become actual presuppositions of the sentence. These tests involve consistency checks with the context, and with other inferences the sentence generates, such as its entailments and other conversational implicatures. We saw earlier that when

an inconsistency with one of these inferences arises, the potential presuppositions of embedded constituents typically get canceled. It is an important question why this should be, but what is important for current purposes is that this approach, unlike filtering approaches, allows the matrix position to access presuppositions of embedded constituents, and hence to state a preference for default global projection.

For example, consider conditionals again:

(26) a. If Sandy is from Toronto, the King of France is bald.
b. If there is a King of France, the King of France is bald.

In (26a) the embedded presupposition that there is a King of France is a potential presupposition of the whole sentence. It faces no barriers to becoming an actual presupposition, and hence by default it becomes a presupposition of the larger sentence. In (26b), on the other hand, that same potential presupposition conflicts with an ignorance implicature generated by the antecedent, and hence is prevented from becoming actual.

What we have, then, is a direct encoding of the idea that embedded presuppositions will prefer to become actual matrix presuppositions so long as no pragmatic cancellation prevents this. The system also brings some other welcome simplifications that lend it some explanatory force. The semantics is classical and there are no heritage functions. Hence, there is no question of relating heritage functions to other semantic properties of operators. Furthermore, the attempt to explain cancellation as a consequence of consistency requirements is appealing. We have seen that there is support for the general idea. For example, we saw in (15b), (16b), and (17b) that if p is a potential presupposition of a sentence, and if p is entailed by the asserted component of the sentence, or if the speaker suggests that they are ignorant about whether p is true, this is enough to prevent p from becoming an actual presupposition of the sentence. If this were a true description of the data, we would want to know why potential presuppositions get canceled by assertions and implicatures. However, there are reasons to doubt that default projection of p is generally modulated by interfering inferences like ignorance implicatures about p.

To see this, consider conditionals like the following (modified from Soames 1982; 1989; Heim 1990):

(27) a. If Mary (the job candidate) graduated from MIT, the search committee will appreciate the fact that she graduated from an American university.
b. # If Mary (the job candidate) graduated from an American university, the search committee will appreciate the fact that she graduated from MIT.

Gazdar (1979) predicts that (27a) should presuppose that Mary graduated from an American university, and he predicts that there should be no presupposition at all in (27b). Both predictions have been argued to be incorrect. In (27a), Gazdar predicts that the antecedent should trigger an ignorance implicature to the effect that the speaker does not know whether Mary graduated from MIT. This

is consistent with the presupposition of the consequent that Mary graduated from an American university, and thus the presupposition should project uncanceled. This prediction is incorrect; the sentence presupposes nothing at all (e.g., Soames 1982; 1989). For example, further embedding shows that the presupposition does not project (e.g., *Do you think that if Mary graduated from MIT, the search committee will appreciate the fact that she graduated from an American university?*). Furthermore, the *Hey wait a minute!* diagnostic fails: it is odd to respond to (27a) with # *Hey wait a minute! I didn't know Mary graduated from an American university!*

In (27b), the antecedent triggers the implicature that the speaker is ignorant about whether Mary graduated from an American university. Assuming that the speaker knows that MIT is an American university, they cannot possibly know that Mary graduated from MIT; the ignorance implicature thus cancels this potential presupposition. But then we are left without an explanation of the strangeness of the utterance. Heim (1990) points out that a plausible account of the strangeness is that the sentence suggests by way of presupposition that if Mary graduated from an American university, then it is a matter of course that she graduated from MIT.[17] It is difficult to imagine what kind of evidence one would have for being in such an epistemic state. To furthermore presuppose such an odd proposition is conversationally inappropriate. Note that the strangeness persists under embedding: # *Do you think that if Mary graduated from an American university, the search committee will appreciate the fact that she graduated from MIT?* It is noteworthy that the strangeness reduces significantly if a speaker asserts the strange conditional instead of presupposing it: *If Mary graduated from an American university, she graduated from MIT and the committee will appreciate it* is nowhere near as bad as (27b).[18]

Thus, Gazdar's (1979) attempt to replace a set of heritage functions with a general cancellation principle must be deemed unsuccessful. Sentences like (27) are hard to reconcile with the basic predictions of his system (though see van der Sandt 1988; Odón 2012): he predicts hole-like behavior when the operator in question behaves like a plug (27a), and he predicts plug-like behavior when the operator behaves like a filter (27b). Filtering theories, which predict that sentences *If* A,B_p project filtered conditional presuppositions $A \rightarrow p$, do not suffer from these difficulties. Furthermore, as pointed out in Heim (1983), Gazdar's (1979) proposal is limited to potential presuppositions that are propositions; it is this assumption that allows consistency checks with other propositions. The proposal thus does not extend to subsentential constituents. For example, the proposal is silent on the presuppositions of quantified sentences, which contain within them formulas with free variables and which the global context does not access (e.g., Heim 1983). Consider a sentence like (28), which contains a constituent *x loves x's dog* (presupposition that x has a dog). The proposal has nothing to say about why (28) presupposes that every woman in that room has a dog.

(28) No woman in that room loves her dog $\rightsquigarrow$ every woman in that room has a dog.

In fact, it doesn't even get this wrong; it simply doesn't say anything at all about such sentences. Something more general is needed.

3.2.2 Displacement

3.2.2.1 Scope ambiguity

It is common in linguistics to see an element appear overtly in one position but to assume that the element is interpreted in a position different from where it appears on the surface. Suppose with Russell that *the King of France* is one such element. For example, instead of denoting an individual, we might assume that *the King of France* is a quantificational noun phrase and that it can therefore undergo Quantifier Raising or some other scope-shifting operation.[19] Then, when we see a complex sentence in which *the King of France* appears to be deeply embedded but is interpreted as if it were at the root, it might be that some covert displacement operation has moved the element from its surface position to matrix position, where it is ultimately interpreted.

This would have welcome consequences for the theory of projection. First, it would immediately solve the problem faced by filtering approaches: the matrix position would have access to the presupposition that appears to be embedded because at the relevant level of representation it is not embedded at all. Second, it would reduce the explanatory burden on the theory of presupposition projection, for projection would reduce to scoping mechanisms for which there is ample independent motivation.

However, this move has little else going for it. First, it remains to be explained why presuppositions should prefer to take wide scope, given that there is little evidence for a wide scope preference in general. Second, we would need to say why matrix scope is interpreted with a pragmatic presupposition while narrow scope is interpreted as part of the asserted component. Third, the fact that presuppositions scope out of islands would need an explanation (though see Geurts 1999a); for example, both of the sentences in (29) presuppose that there is a King of France, even though *the King of France* sits inside a scope-island in each case.

(29) a. If the King of France is bald, I'll mow your lawn.
b. Every leader who meets the King of France is always amazed at how much wine he consumes.

Finally, it is not only definite descriptions, but *all* presupposition triggers that have this profile: wide scope readings are presupposed while narrow scope readings are asserted, and there is a preference for the former. However, it is not clear that a scope analysis would be appropriate for other presupposition triggers. For example, *stop* behaves just like *the King of France* in all relevant respects, as the following sample should illustrate:[20]

(30) a. It hasn't rained all day. Therefore, it didn't stop raining. (↛ it was raining)
b. If John is from Toronto, it has stopped raining. (⇝ it was raining)
c. A: If Mary moved the hay bales, then I doubt that John thinks that it stopped raining. (⇝ it was raining)
B: Hey wait a minute! I didn't know it was raining!

These difficulties seem hard to overcome. Nevertheless, the displacement idea is appealing, and a very influential approach to presupposition projection has taken

syntactic displacement to be the core mechanism for projection. The approach gives up the idea that displacement happens on Logical Forms (LFs) as commonly construed, and concomitantly gives up the assumption that Quantifier Raising is responsible for displacement of presupposition-bearing elements.

3.2.2.2 A new representation: Discourse Representation Structures

Building on Kamp (1981), a line of inquiry suggests positing a new level of representation, so-called Discourse Representation Structures (DRSs), different from the LFs created by the syntactic system and thus freed from the usual constraints on displacement (van der Sandt 1992; see also Zeevat 1992; Geurts 1999b). This framework, Discourse Representation Theory (DRT), provides new possibilities for what gets moved where. A guiding motivation for the approach is that presupposition projection has much in common with anaphora resolution. Specifically, presuppositions (of embedded constituents) appear to be "canceled" in many of the environments in which pronouns find their antecedents, and they appear to "project" to the root in many of the environments in which pronouns need to look outside of the sentence for their referent/binder. For example, the presuppositions in (31a) and (31b) are "canceled," and the pronoun in (31c) finds its antecedent in the sentence itself.

(31) a. If there is a King of France, the King of France is bald $\not\rightsquigarrow$ that there is a King of France.
b. If it was raining, it has stopped raining $\not\rightsquigarrow$ that it was raining.
c. If there is [a King of France]$_i$, he$_i$ is bald.

And when there is no antecedent for the pronoun within the sentence, as in (32c) (assuming that *he* is not one of Mary's pronouns), it needs us to look to the global context to find one; and in (32a) and (32b) the presuppositions project outside of the (rest of the) sentence, to the root.

(32) a. If Mary brought in the hay bales, the King of France is bald $\rightsquigarrow$ that there is a King of France.
b. If Mary brought in the hay bales, it has stopped raining $\rightsquigarrow$ that it was raining.
c. If Mary$_j$ brought in [the hay bales]$_k$, he$_i$ is bald.

What connects run-of-the-mill presuppositions and pronouns? The guiding intuition is that presuppositions and anaphoric elements both require antecedents. Taking pronoun resolution as independent motivation, there are clearly defined paths in the search for an antecedent. The search procedure looks not only to c-commanding positions, but also "sideways"; for example, an element in the consequent of a conditional can find its referent in the antecedent.[21] Indeed, this is motivated by donkey anaphora:

(33) a. If John owns [a donkey]$_i$, I bet he beats it$_i$.
b. Every farmer who owns [a donkey]$_i$ beats it$_i$.

The general prediction is that wherever pronouns can find antecedents, presuppositions can too. The key difference between them, under this approach, is

that presuppositions typically have more content than pronouns, and thus (it is argued) this allows them to sometimes be accommodated in the positions where an antecedent was sought but not found. To accommodate a presupposition at some position is to conjoin p with the material at that position. Consider $[S_0 \ldots [S_1 \ldots T_p^q \ldots]]$. Accommodating p in S_1 means understanding the sentence with p conjoined with S_1, that is, as $[S_0 \ldots [S_1, p \wedge [S_1 \ldots q \ldots]]]$. And accommodating p into S_0 involves conjoining p with S_0: $[S_0, p \wedge [S_0 \ldots [S_1 \ldots q \ldots]]]$.

This notion of accommodation, like the one assumed in filtering approaches, is a response to a presuppositional element's need to find information furnished by the context. However, they are very different kinds of operation. In filtering approaches, accommodation is an amendment to the common ground made to satisfy the sentence's projected presupposition. In DRT approaches, accommodation operates on the sentence's DRS, rather than on the broader common ground, by adding the presupposed element's meaning to a particular scope site.

The set of possible scope sites is determined by the positions where an antecedent is sought. For example, with conditionals *if A, then* B_p^q, antecedents may be found within B itself (e.g., *if John is from Toronto, there is a King of France and the King of France is bald*), or in A (e.g., *If there is a King of France, the King of France is bald*), or outside of A (e.g., *There is a King of France. If John is from Toronto, the King of France is bald*).[22] If no antecedent is found, then these sites on the search path are possible landing sites for accommodation, and among them there is a stipulated anti-locality preference: wide scope ("global accommodation") > within A ("intermediate accommodation") > within B ("local accommodation").

DRT overcomes the problem faced by filtering approaches: it clearly captures the idea that embedded presuppositions are accessible at the root (because they are sometimes literally displaced there), and it captures the preference for wide scope by postulating a preference for anti-locality in accommodation decisions. Of course, the anti-locality preference remains stipulated (Geurts 2000), but an important architectural problem is resolved by taking a more representational approach to presuppositions. It also overcomes one of the limitations of Gazdar's (1979) approach: *any* presupposition can be displaced, including sub-formulas in quantificational expressions. For example, in *every man in that room loves his son*, the presupposition of the nuclear scope *x loves x's son* can be accommodated either within the scope ('every man in that room has a son and loves him') or in the restrictor ('every man in that room who has a son loves him'). Nevertheless, important problems remain.

First, so far as I know, there is no attested "intermediate accommodation" reading of conditionals: that is, there is no attested sentence *if A, then* B_p^q that is interpreted as "if A and p, then q." This possibility is clearly predicted (see the donkey pronoun facts in (33a)), and is in fact predicted to be preferred to the narrow scope local accommodation possibility. We have already seen cases of global accommodation (e.g., (32a)), and we have also seen what might be argued to be examples of local accommodation (e.g., (27b)).[23] But there is no known case of intermediate accommodation in the antecedent. Thus, it is precisely the nonstandard "sideways movement" possibility that seems banned.[24]

It has been argued that intermediate accommodation *is* attested in quantified sentences. For example, *Every man loves his children* is predicted to have a reading

'Every man who has children loves them.' The sentence clearly admits of this reading, but this reading could also be generated if the domain of the quantifier were restricted to only those men who have children (e.g., Beaver 2001; 2004; von Fintel 2004b; 2008; Beaver and Zeevat 2007; Fox 2012; though see Geurts and van der Sandt 1999). The availability of a restricted domain can (for some reason) be reduced by making the restrictor more heavy. When we do this, the purported intermediate accommodation reading disappears: *every one of these fifteen men loves his children* cannot be true if eight of the fifteen men have children, all of whom love their children. To be true, all fifteen men must have children and must love them.

Quantified sentences are generally problematic for DRT. For example, the reader can readily confirm that the system fails to predict that a sentence like (28), repeated here as (34), presupposes that every woman in that room has a dog (on a bound variable construal of *her*).[25]

(34) No woman in that room loves her dog.
   a. Intermediate accommodation (into the restrictor): No woman in that room who has a dog loves it.
   b. Local accommodation (within the nuclear scope): No woman in that room has a dog and loves it.

Clearly, something other than scope is responsible for the universal presupposition here, which, I should add, has been found to be robust in experimental settings (Chemla 2009b; Sudo et al. 2012).

There are further difficulties with reducing presupposition projection to scoping, even if we consider cases where intermediate accommodation is irrelevant. Consider again negative sentences like *The King of France is not bald*, which, recall, generates the readings in (13), repeated here as (35).

(35) The King of France isn't bald.
   a. Hole reading: There is a King of France x and it's not the case that x is bald.
   b. Plug reading: It is not the case that (there is a King of France x and x is bald).

DRT generates something close to the two readings in (35a) and (35b), and in fact predicts the desired preference for the global reading in (36a).

(36) The King of France isn't bald.
   a. Hole reading (global accommodation): There is a King of France x and it's not the case that x is bald.
   b. Plug reading (local accommodation): It is not the case that (there is a King of France x and x is bald).

The problem here is that the reading in (36a) is interpreted as entailing without presupposing that there is a King of France. DRT systems fail to account for the observation that the wide scope reading comes with a presupposition while the narrow scope reading does not. DRT provides a theory of displacement that is motivated by anaphora, but the approach does not admit a presupposition/assertion distinction at all.[26]

This leads the approach into difficulties elsewhere. Specifically, it means the system is unable to generate "filtered" presuppositions. But the availability of such presuppositions is readily demonstrated, as discussed earlier with respect to (27b) (see also note 23 and Beaver 2001; Schlenker 2011a; among others).

Finally, there are examples where an embedded presupposition appears to occupy multiple scope positions. Presuppositions under attitude predicates are well-known cases (e.g., Heim 1992; Geurts 1999b; Beaver and Geurts 2011; Sudo 2014).

(37) John believes Mary's car is blue.

Sentence (37) presupposes both that Mary has a car and that John believes it. Thus, the presupposition that Mary has a car appears to sit below *believes* and above it. Zeevat (1992) suggests an amendment to DRT under which apparent displacement of presuppositions actually involves copying, so that the element occupies multiple sites simultaneously. This might relate in potentially interesting ways to the copy theory of movement assumed in some of the syntactic literature (e.g., Chomsky 1995), but as a generalization about presupposition projection it seems incorrect. For example, recall that quantified sentences project universal presuppositions: *No woman in that room loves her dog* presupposes that every woman in that room has a dog. Now consider the following sentence, modified from Schlenker (2011a):

(38) John believes that no woman in that room loves her dog.
   a. that every woman in that room has a dog
   b. that John believes that every woman in that room has a dog

Schlenker (2011a) points out that this sentence presupposes (38a) and (38b). The pattern is exactly like (37): the sentence inherits the presupposition p of the complement of *believe*, and it presupposes that the subject believes p. Unlike (37), however, multiple copying will not help here: the embedded presupposition "x has a dog" can be copied into the restrictor and/or the nuclear scope, but there is no way to get either (38a) or (38b) out of these operations. Thus, multiple copying does not provide a general solution to the way presuppositions project out of attitude predicates. The source of the problem is by now familiar: embedded presuppositions sometimes appear in higher sentences in modified form, but default projection theories are unable to make sense of this.

3.3 Brief summary

Filtering theories are able to generate filtered presuppositions, but their attempt to explain presuppositional ambiguities by appeal to accommodation does not explain why embedded presuppositions often seem to appear unfiltered at the root. Default projection theories overcome this problem by manipulating embedded presuppositions in such a way that they can be interpreted at the root without losing their integrity. However, this structural integrity means that default projection theories are unable to generate filtered presuppositions. In the next section I will summarize an emerging synthesis of these two approaches, in the spirit of Soames

(1982), that might contribute to resolving this tension. However, we will also see that the synthesis raises several nontrivial questions, ones that I nevertheless believe are worth pursuing and hope will animate future studies of presupposition.

4 An emerging synthesis

4.1 Filtering and potential accommodation

Default projection approaches treat presuppositions of embedded constituents as formal objects that are in principle accessible in matrix position. This information access has tended to come at a cost: they are unable to derive modified presuppositions at the root. Filtering approaches, on the other hand, assign a unique semantic presupposition to any given LF, and this is often a presupposition that results from filtering an embedded presupposition. However, the presuppositions of embedded constituents, and the ways in which they may be modified as the sentence is constructed, are lost at the root. At matrix level you have a proposition, not the derivational history that produced that proposition. Thus, the fact that embedded presuppositions often do project, are salient to speakers and hearers, and often are more accessible than the filtered projected presupposition itself, is puzzling.

I would like to suggest a possible way out of this tension (building on Heim 2006; Singh 2007; 2008; 2009; Schlenker 2011b; Fox 2012): maintain with filtering approaches the association of each LF with a unique semantic presupposition, but allow the global accommodation mechanism to access a set of potential pragmatic presuppositions, among which it will find the presuppositions of embedded constituents. Specifically, suppose that filtering approaches provide the correct semantic presuppositions of sentences (the function π from section 3.1), and suppose that the decision about what to accommodate and hence pragmatically presuppose is made by choosing from a set of potential accommodations generated by considering the semantic presuppositions of various alternative sentences that weren't uttered (henceforth simply "alternatives"). In order to account for the fact that embedded presuppositions, even when filtered semantically, often become pragmatic presuppositions, this set of potential presuppositions – call it $\mathscr{H}$ – should include the semantic presuppositions of atomic sub-constituents of the sentence (see note 16). This possibility was the centerpiece of default projection theories like Gazdar (1979). However, given the existence of filtered presuppositions, the set should also contain the semantic presuppositions of more complex constituents. Which constituents are those? A reasonable starting point is to assume that the LF of the sentence gives us everything we need.[27] For the moment, we identify the set of constituents relevant to generating potential accommodations with the sentence's sub-constituents. Specifically, let π be identified with the projection component of one of the filtering theories, and let S be a sentence. Then:

(39) *Subsentences and potential accommodations*
   a. The set of potential accommodations of S is $\mathscr{H}(S) = \{\pi(S') : S' \text{ an alternative of } S\}$. (We sometimes write $\mathscr{H}$ instead of the more accurate $\mathscr{H}(S)$ to reduce clutter.)
   b. S' is an alternative of S if and only if S' is a sentence contained in S.[28]

Recall that the difficulty I identified for filtering approaches was that there was no rationale for the pragmatic system inferring an unfiltered embedded presupposition when the system only has access to a filtered presupposition and the propositional information in the context. However, what we may have missed is that there are more resources available in the context than merely the propositional information in it. In particular, what is salient is presumably part of the conversational score (Lewis 1979), and when a speaker utters a sentence they change this part of the score by making a set of constituents salient. Example (39) is motivated by this idea: it suggests that the decision about what to pragmatically presuppose in context is made by consulting this resource of salient constituents, which for the moment we identify with the set of sentences contained in the uttered sentence. Presumably, a speaker's decision about which *form* to use in a given context takes into account the set of potential accommodations the form would generate. The hearer in turn takes this form as a guide to generating a nontrivial set of candidate pragmatic presuppositions, hence making it possible to enrich the common ground with more information than semantically presupposed by the sentence. At the same time, the form helps the hearer constrain the set of candidate accommodations, hence making it easier for speaker and hearer to coordinate on the next common ground without running into the combinatorial explosion of potential new common grounds that could follow once you allow for accommodation of more than the semantic presupposition itself. We thus borrow from default projection theories the idea that syntactic structure is relevant to governing presuppositional inferences, but we implement the idea differently by computing (possibly filtered) projected presuppositions for *all* constituents in the sentence and using these as input to accommodation decisions.

Let me work through a concrete example. Consider again presuppositions in attitude contexts, which are problematic for both filtering and default projection approaches (e.g., Beaver and Geurts 2011). I provide an illustrative sentence – together with its bracketing – in (40).

(40) [$_{S_0}$ John believes [$_{S_1}$ it stopped raining]].
   a. It stopped raining.
   b. John believes it stopped raining.

There are two sentences contained in (40): (40a) and (40b). In deciding what (40) presupposes, default projection approaches consider the presupposition of (40a), r = that it was raining, and decide whether or not to project r to the root. They stipulate a preference for projection to the root, but what is important is that r is the only potential presupposition that the projection mechanism considers. Thus, default projection approaches derive the inference that it was raining, but fail to derive the presupposition that John believes it. Filtering approaches, on the other hand, compute a filtered presupposition for (40), $B_j r$ = that John believes it was raining. However, at matrix level there is no access to the presupposition of the embedded constituent (40a). There *is* a stage of computation at which the embedded presupposition r is generated, namely, when (40a) is processed, but there is no trace of this at the root: here, only the semantic presupposition $B_j r$ is available, and it is only this proposition that the pragmatics gets to see.

Clearly, the semantic presuppositions of *both* constituents are needed to generate the intuitively correct pragmatic presuppositions (40) has. Further embedding of (40) continues to generate these inferences: *If John believes it stopped raining, I'll give you five dollars* pragmatically presupposes r and B_j. I believe (39) provides a natural way to derive both r and $B_j r$ as potential accommodations: it allows the root position to recover its computational history, and to use this history to generate a set of potential accommodations that may become actual pragmatic presuppositions of the complex sentence. To illustrate but one way to compute (39), suppose that the set of potential pragmatic presuppositions $\mathcal{H}$ of a complex sentence is computed "bottom up" by extracting the semantic presuppositions of sentences that are encountered along the way. In such an architecture, the semantic presuppositions of more deeply embedded constituents will be computed before the semantic presuppositions of higher sentences. Starting with an empty set $\mathcal{H}$, suppose that the semantic presupposition of each sentence encountered in the computation is added to $\mathcal{H}$, and suppose that these semantic presuppositions are computed in the way suggested by filtering approaches. By the time the root is reached, $\mathcal{H}$ will be the set of potential pragmatic presuppositions that get assigned to the sentence.

To see how this works, return to (40) and initialize the set of potential presuppositions to $\mathcal{H} = \emptyset$. The most deeply embedded constituent is (40a), and at this stage the set of potential presuppositions gets modified by adding r to it: $\mathcal{H} \cup \{r\} \leftarrow \mathcal{H}$. The next sentence that gets encountered is (40b). The semantic presupposition of this sentence gets added to $\mathcal{H} = \{r\}$: $\mathcal{H} \cup \{B_j r\} \leftarrow \mathcal{H}$. This is the root, and the output is $\mathcal{H} = \{r, B_j r\}$. More generally, we can give the following inductive method for generating $\mathcal{H}(S)$ for any sentence S:[29]

(41) *Generating $\mathcal{H}$ for any sentence*
   a. If S is atomic and presupposes p, then $\mathcal{H}(S_p) = \{p\}$.[30]
   b. If $S = Op(S_1, \ldots, S_k)$, then: $\mathcal{H}(S) = \mathcal{H}(S_1) \cup \ldots \mathcal{H}(S_k) \cup \{\pi(Op(S_1, \ldots, S_k))\}$.

We can think of $\mathcal{H}$ as the grammar's contribution to helping speakers and hearers decide what to presuppose in context. Note that, unlike default projection approaches, this gives us the filtered presupposition $B_j r$ as a formal object. And unlike filtering approaches, this makes available the embedded presupposition r without having to "unfilter" anything; instead, the computation simply keeps track of work it has already done and reuses that in later stages when needed. I leave it to the reader to confirm that the system extends to the example in (38) in exactly the same way as it applies to (40). Note that we also readily account for why the hearer does not accommodate that it was raining in response to the following sentence from Geurts (1999b) even though, like (40), it semantically presupposes $B_j r$ = that John believes it was raining:

(42) Mary knows that John believes it was raining.

The solution to this, essentially following Singh (2007), is that $B_j r$ is the only potential accommodation (given the form of the sentence). There is no constituent in (42) that semantically presupposes that it was raining, and hence that is not a

possible accommodation. Thus, formal restrictions on alternatives (derived from the LF of the sentence) are an integral part of a solution to the proviso problem (Geurts 1996; 1999b):

(43) *The proviso problem*
Why do pragmatic presuppositions differ from semantic presuppositions, and in particular why do some sentences that have the same semantic presupposition have different pragmatic presuppositions (like (40) and (42))?

Once a set of potential accommodations is derived, what determines which of these potential pragmatic presuppositions become actual pragmatic presuppositions? Recall that $\mathcal{H}$ will be relevant only when the context c does not satisfy the sentence's projected presupposition (though see note 13). Thus, $\mathcal{H}$ must (at a minimum) contain the projected presupposition of the sentence. In a sentence like (40), this would be $B_j r$. It seems clear, however, that the default interpretation is that we pragmatically presuppose $B_j r$ and r. Thus, there appears to be a default to pragmatically presuppose *each* proposition in $\mathcal{H}$. This is different than the standard way of stating the preference, which suggests that there is a preference for global accommodation of embedded presuppositions like r. Instead, we suggest that global accommodation is governed by a preference for accommodating *all* the potential pragmatic presuppositions that are available, among which are the semantic presuppositions of atomic sub-constituents.

(44) *Accommodation in response to $\phi(S_p)$ in context c when c does not satisfy $q = \pi(\phi(S_p))$*
a. Generate a set $\mathcal{H}$ of potential accommodations. This set will as a rule include q and p, and possibly other propositions.
b. Select a set $\mathcal{H}' \in \mathcal{P}(\mathcal{H})$ such that $q \in \mathcal{H}'$ (so that (19b) will be satisfied), and accommodate $\wedge\mathcal{H}'$.[31]
c. Preference: Select $\mathcal{H}$ unless there is a good reason not to.

In (44), we not only recover the generalization (18) that embedded presuppositions are preferably interpreted at the root (when accommodation is needed), but also extend it to cases where filtered presuppositions are inferred by default, such as $B_j r$ in (40). Conditionals typically obey this pattern as well, but since the filtered presupposition $A \rightarrow p$ is entailed by p, it is harder to tell whether p alone is being accommodated or the entire set $\{A \rightarrow p, p\}$; attitude predicates teach us that it must be (conjunctions of elements in) sets of propositions that are being accommodated.

The preference for accommodating $\mathcal{H}$ itself is quite natural. First, it is a nonarbitrary subset. Second, accommodation of $\mathcal{H}$ allows participants to generate stronger common grounds than would be made available by any other subset of $\mathcal{H}$. Suppose we order the subsets of $\mathcal{H}$ that satisfy (44b) by the subset relation: $\mathcal{H}_1 \leq \mathcal{H}_2$ iff $\mathcal{H}_1 \subseteq \mathcal{H}_2$. In the typical case, the higher a set is the stronger the accommodation will be, but independent of the particular properties of $\mathcal{H}$ there are two non-arbitrary subsets of it that are always available: *max* ($\mathcal{H}$ itself) and *min* (the set $\{q\}$ containing only the projected presupposition of the uttered sentence). The maximal choice corresponds to the default preference for accommodating everything,

and the minimal choice corresponds to the marked but available option to accommodate only the projected presupposition of the sentence.

To see the difference, consider conditionals:

(45) a. If John flies to Toronto, he'll bring his wetsuit.
b. If John is a scuba diver, he'll bring his wetsuit.
c. If Gugu is a palwan, he'll bring his chappal.

In (45a) you accommodate *max*, in (45b) you accommodate *min*, and in (45c) you are confused about what to accommodate because you don't know what the words mean. But intuitively, it is clear that you have two options: either you accommodate *max*, in which case you conclude that Gugu has a chappal, or you accommodate *min*, which in turn appears to be connected to an assumption that palwans in general have chappals (see section 4.2.1).

Of course, sometimes neither *max* nor *min* is selected. Consider again the case of negative sentences like *The King of France isn't bald*. Let p be the proposition that there is a King of France. Then the set of potential presuppositions is $\mathscr{H} = \{p\}$: the embedded constituent semantically presupposes p, and negation is a hole and thus doesn't contribute any new presupposition to $\mathscr{H}$. In this case, there are no subsets of $\mathscr{H}$ that would be available for accommodation. The only other subset of $\mathscr{H}$ is the empty set, but this set does not satisfy (44b). Thus, the only option for global accommodation is to accommodate p. However, recall that there is another parse of the sentence, one with A embedded under $\neg$. This parse cancels the presupposition, and hence provides a different way to understand the sentence without suffering from presupposition failure. As long noted in the literature (since Heim 1983), it is preferable to globally accommodate p than to cancel the presupposition when $\neg S_p$ is uttered in a context that does not entail p.

Taking the above discussion into account, we can state accommodation preferences in terms of preferences over subsets of $\mathscr{H}$ ordered by $\geq$:

(46) *Accommodation preferences*
Suppose that S_p is a (possibly complex) sentence uttered in context c and that $c \not\subseteq p$. Then, all else being equal, there is a preference for accommodating $max(\mathscr{H}(S_p), \geq)$.

Under this view, other choices will be marked, such as accommodating $min(\mathscr{H}(S_p), \geq)$ or accommodating $\emptyset$ (i.e., parsing the sentence with A so that the sentence presupposes only $\mathscr{W}$).

4.2 Challenges

The previous section explored a synthesis between filtering and default projection approaches that hopefully retains the benefits of each and avoids some of the unwelcome consequences of each. I leave it to future work to explore the direction in greater detail. Here I end with some challenges for the synthesis, with the hope of identifying data points that might guide future explorations.

4.2.1 Plausibility and defaults

The synthesis assumes that *max* is accommodated as a default. What are the pressures that lead a listener to accommodate something other than the default (see (18))? As noted earlier, the threat of contradiction can naturally lead to cancellation (where no pragmatic presuppositions are made). But the more difficult case arises when there is no threat of inconsistency but you nevertheless accommodate something other than *max* anyway. For example, consider sentences *If A, then* S_p. These give rise to the following accommodation possibilities: $\mathscr{H} = \{A \rightarrow p, p\}$. In this case, $min = \{A \rightarrow p\}$ (this is the smallest set containing the projected presupposition of the uttered sentence), and $max = \mathscr{H}$. We have seen cases where *min* is selected for accommodation:

(47) *Accommodation of* $A \rightarrow p$ *in response to If A, then* S_p
   a. If John is a scuba diver, he'll bring his wetsuit.
   b. If John is a devout Catholic, he'll bring his Bible.

In (47a), for example, we accommodate only that if John is a scuba diver he has a wetsuit. We don't accommodate that he has a wetsuit, even though such an accommodation would not give rise to any incoherence or pragmatic infelicity. For example, the following paraphrase of the resulting meaning is just fine:

(48) John has a wetsuit, and if he's a scuba diver he'll bring it.

So what makes us go against the default in this case? Stating a default preference for *max* doesn't answer this question.

Given the context satisfaction requirement, you have to accommodate $A \rightarrow p$ anyway (unless you cancel). So your task is to decide whether or not to also accommodate p. Various proposals have been put forth arguing that the decision is made not by default, but by plausibility considerations (e.g., Beaver 2001; 2006; Heim 2006; Singh 2007; von Fintel 2008; Pérez Carballo 2009; Schlenker 2011b; Fox 2012; 2018). Here is a proposal due to Heim (2006) and Singh (2007) modified to fit our discussion. Let "$\Box q$" stand for something like "the speaker expects you to accommodate q," or "the speaker takes for granted that q," or some such modal force (see, e.g., the references in note 9). The use of the sentence implies at least $\Box(A \rightarrow p)$. The listener then asks which of $\Box p$ and $\neg\Box p$ is more likely: if $\Box p$, they accommodate p (hence *max*), and if $\neg\Box p$, they do not accommodate p and hence stick with *min*.[32]

A somewhat different approach rests the accommodation decision on judgments of independence, where independence is spelled out as "orthogonality" (van Rooij 2007, building on Lewis 1988) or probabilistic irrelevance (Singh 2006; Schlenker 2011b; Lassiter 2012). On the probabilistic account, for example, if A and p are independent – that is, the probability that p does not change upon learning A in context c ($Pr(p|A,c) = Pr(p|c)$) – you accommodate p.[33] If A makes p more likely – that is if A is "positively relevant" to p in c ($Pr(p|A,c) > Pr(p|c)$; see Carnap 1950) – you accommodate $A \rightarrow p$ and you do not accommodate p.[34]

Under either of the plausibility systems discussed here, there is no default inference – plausibility reasoning pushes you one way or the other. In cases like (47)

you're pushed to a conditional presupposition $A \rightarrow p$, and when there is no obvious connection between A and p, you accommodate p. Under this view, the appearance of a "default" is a consequence of something else, namely, that the examples purporting to show this default happen to be ones in which A and p have little connection. Indeed, experimental investigations (see n. 4) manipulating the connection between A and p show that it is a relevant factor in governing the decision between $A \rightarrow p$ (= consequence of *min*) and p (= consequence of *max*).

There are some challenges for the plausibility view. First, it is not obvious how to extend it to other constructions like attitude predicates:

(49) Mary believes it stopped raining.

Here we have to accommodate $B_j r$ (given context satisfaction), and we ask whether we should also accommodate r. In this case, it is not clear that $\Box r$ is significantly more likely than $\neg\Box r$: just because the speaker takes it for granted or wants me to take for granted that Mary believes that it's raining, that provides no obvious rationale for thinking that the speaker takes for granted or wants me to take for granted that it is in fact raining (though see Heim 1992). It's also not clear what statistical independence assumptions would need to be made to decide whether to accommodate r. Nevertheless, the inference to r is strong and robust here.

Second, returning to conditionals, it appears that *max* is sometimes accommodated even when A is positively relevant to p in the given context. For example, Mandelkern (2016) produces (50) as an example where p (= that Smith was murdered) is accommodated even though the antecedent A provides information that significantly increases the probability that Smith was murdered, namely, that Smith's blood was found on the butler.

(50) [It is common ground that Smith has gone missing, and we don't know whether he is still alive. A detective enters and says:] If the butler's clothes contain traces of Smith's blood, then it was the butler who killed Smith.

This is arguably a case where $Pr(p|A, c) \gg Pr(p|c)$ but we nevertheless accommodate p instead of just $A \rightarrow p$. This is clearly a challenge for the independence reasoning approach.[35]

The proposal in Heim (2006) and Singh (2007) does not fare any better here. The listener needs to accommodate $A \rightarrow p$, and they have to decide whether to also accommodate p (= that Smith was murdered). This decision, recall, is based on deciding which of the following is more probable: $\Box p$ or $\neg\Box p$ (given $\Box(A \rightarrow p)$). Suppose we understand "$\Box q$" to mean "the speaker takes for granted that q." Then $\Box(A \rightarrow p)$ means that the speaker takes for granted that if the butler's clothes contain traces of Smith's blood, then Smith was murdered. Grant this. Now we ask which of the following is more likely: that the speaker takes for granted that Smith was murdered, or that the speaker does not take for granted that Smith was murdered? It's not clear (to me) that there's any obvious pressure one way or the other. Nevertheless, the pressure to accommodate that Smith was murdered is real.

The above considerations suggest that we sometimes accommodate an embedded presupposition p even when this is not supported by plausibility reasoning, at least of the kinds that have been explored so far. With the special case of conditional presuppositions $A \rightarrow p$ of conditional sentences *If A, then* B_p, it appears that conditional presuppositions are accommodated not merely when A is positively relevant to p, but when the conditional $A \rightarrow p$ is supported by a universal inductive generalization (e.g., that scuba divers (in general) have wetsuits). If we can ignore exceptions to these generalizations in accommodation decisions, then that might provide a rationale for sticking to the semantic presupposition itself (it is "satisfied enough"). Clearly, much more would need to be said about when it is proper to ignore such exceptions, lest the move become devoid of content (see Lewis 1996 for relevant discussion).

What we have, then, is evidence for a default principle that selects *max* unless contextual considerations pressure the listener to accommodate something else instead (or to accommodate nothing at all by parsing with A so that the sentence makes no presuppositional demands on the context). Clarifying the relative contributions of default principles and context-sensitive reasoning remains a challenge for future work on this topic. It might be instructive to examine other areas where similar interactions seem to be active, such as with the "Strongest Meaning Hypothesis" (SMH) originally proposed to account for puzzles in the interpretation of reciprocal expressions (Dalrymple et al. 1998). The SMH guides listeners to select the strongest meaning compatible with world knowledge. For example, *The soccer players I coach love each other* means that each player loves each other player. However, this is not demanded by *each other*: a sentence like *The soccer players I coach are sitting next to each other* means that they are sitting in a row such that it's not the case that each player is sitting next to each other player. Aside from their shared pressure to maximize informativity, a curious property shared by both the SMH and the pressure to accommodate *max* is that when they select a particular meaning, the other potential meanings are nearly impossible to access.[36] For example, it is hard to imagine any other interpretation of the reciprocal expressions above. Similarly, consider the sentence *If John flies to Toronto, his sister will pick him up from the airport*. If uttered out of the blue in a context that requires accommodation, it is hard to understand it with just a conditional presupposition that if John flies to Toronto he has a sister, even though this is the projected presupposition of the sentence.

It does not appear to be a general feature of language interpretation that selection of one meaning makes the other candidate meanings inaccessible. For example, the different readings produced by PP-attachment ambiguities are easily detected in sentences like *The student saw the professor with binoculars*. One difference between these cases is that *max* and the SMH provide a nonarbitrary, order-theoretic, context-invariant, meaning-based selection principle that helps choose among alternative interpretations when world knowledge considerations do not. I leave the matter here and hope that future work will clarify the interaction between default principles and plausibility reasoning in accommodation and other decisions that need to get made when the grammar itself does not uniquely determine the sentence's interpretation.[37]

4.2.2 Non-constituents

It appears that presuppositions of non-constituents are sometimes accommodated. Consider the following example from Schlenker (2011b):

(51) Among my ten best friends, everyone who is smart has stopped smoking.

Several filtering theories assume that (51) projects the universal presupposition that each of the speaker's ten best friends who is smart used to smoke.[38] However, what we readily accommodate out of the blue is that each of the speaker's ten best friends used to smoke (whether or not they are smart). But this is not the presupposition of any constituent in the sentence.

For reasons like this, Schlenker (2011b) suggests expanding the set of alternatives to include those that can be generated by "ignoring" certain constituents, such as the relative clause *who is smart* (see also Singh 2008; 2009; Fox 2012 for related ideas). The resulting sentence *Among my ten best friends, everyone has stopped smoking* projects the presupposition p = that each of the speaker's ten best friends used to smoke, making p available as a potential accommodation in $\mathscr{H}$ (51). The choice of accommodating *max* would then lead to p becoming the pragmatic presupposition of the sentence (note that p entails the projected presupposition of (51)). Thus, it is desirable to generate the sentence *Everyone has stopped smoking* out of (51). However, as Schlenker (2011b) notes, his proposal about alternatives runs into difficulties with attitude predicates such as in (49).

One way to deal with the challenge in (51) in the more restricted framework assumed here is to note that the restriction to sub-constituents (39) can be dissociated from the restriction to constituents computed in the derivational history of the sentence (41), even though these often coincide. For example, it has sometimes been proposed that relative clauses are merged late into the clause (e.g., Lebeaux 1990 and much work since). If that is correct, then there was a stage of computation in the construction of (51) at which *Everyone has stopped smoking* was created, and hence the presupposition of this sentence could be available for accommodation if the fundamental restriction on alternatives references the derivational history, rather than sub-constituents as such.

Unfortunately, it's not obvious how either (39) or (41) would help with what Schlenker (2011a) refers to as the "Singh/Geurts problem":

(52) If John is a scuba diver and wants to impress his girlfriend, he'll bring his wetsuit.

This sentence is naturally understood as presupposing that if John is a scuba diver he has a wetsuit. This is not the presupposition of any constituent of (52), nor do I see a natural way to make *If John is a scuba diver, he'll bring his wetsuit* a sentence in the derivational history of (52), at least not within our current set of assumptions. But which assumptions do we give up, and what do we replace them with? Here I briefly hint at some directions for addressing this problem.

If we wish to maintain that alternatives must be sub-constituents of a given sentence, we might consider – against convention – allowing more sentences to qualify as sources of sub-constituents than the LF of the uttered sentence. We want

to get S' = *If A, then* C_p to be an alternative of S = *If A and B, then* C_p. To do this, we might try converting S to semantically equivalent forms that distort the structure of S in such ways that they end up having S' as a subconstituent. Specifically, suppose that we expand the set of alternatives of S to include any sentence T' that is a constituent of any sentence T such that (i) T is semantically equivalent to S, and (ii) T reuses the nonlogical symbols in S without increasing propositional complexity; that is, the complexity of T is no greater than the complexity of S. Assume that S and T are semantically equivalent if they have the same semantic presupposition and the same asserted meaning, and suppose (following Feldman 2000) that we identify a formula's propositional complexity with the number of literals in it (propositions or their negation). For example, the sentence *If A and B, then* C_p is semantically equivalent to *If A, then (If B, then* C_p*)* and to *If B, then (If A, then* C_p*)*. These equivalent sentences use the same nonlogical symbols A, B, and C_p, and they have the same propositional complexity (= 3).[39] With these alternatives, the desired presupposition $A \rightarrow p$ could be derived because it is the semantic presupposition of *If A, then* C_p, a sub-constituent of *If B, then (If A, then* C_p*)*.

The general idea behind the tentative proposal above is to use meaning-preserving and complexity-preserving transformations of the sentence that alter the structure in ways that increase the space of possible sub-constituents (and hence potential accommodations). An alternative implementation of this general idea, again somewhat unconventional, would be to convert the sentence into a *normal form equivalent*. For example, suppose that the accommodation system converts the LF of the sentence into semantically equivalent formulas with the same complexity but in disjunctive normal form (DNF).[40] Suppose further that the system uses the semantic presuppositions of all sub-constituents of all normal form equivalents as potential accommodations. For example, $(A \wedge B) \supset C_p$ would have $\neg B \vee (\neg A \vee C_p)$ as one of its alternatives (by rebracketing and reordering); this would suffice to generate the desired sub-constituent $\neg A \vee C_p$.[41]

Less radical modifications have been proposed in the prior literature but these give up the restriction to sub-constituents. As with (51), sentences like (52) have motivated the assumption that the set of alternatives includes sentences that can be derived by deleting/ignoring material (e.g., Singh 2007; 2008; 2009; Schlenker 2011b; Fox 2012). For a sentence like *If A and B, then* S_p, we could derive the following alternatives by ignoring/deleting material in the sentence: (i) *If A,* S_p, (ii) *If B,* S_p, and (iii) S_p. These alternative sentences would in turn yield the following set of potential accommodations: $\mathscr{K}$ ((51)) = $\{(A \wedge B) \rightarrow p, A \rightarrow p, B \rightarrow p, p\}$. From this set, the desired subset $\{A \rightarrow p, (A \wedge B) \rightarrow p\}$ could be selected (note that this is neither *max* nor *min*).

We run into familiar problems with this approach, such as how to properly restrict the alternatives. For example, you would need restrictions on alternatives to prevent, say, a sentence like *Mary knows that if John flies to Toronto he has a sister* from having *Mary knows that John has a sister* as an alternative; if it were an alternative, its presupposition that John has a sister would become available for accommodation, giving rise to Geurts' (1996) proviso problem again. Alternatively, we could allow these alternatives but then would need to block the

offending inferences in some other way (say, as a clash with other inferences). For relevant discussion, see Singh (2008; 2009) and Schlenker (2011b).

The challenge, then, is to find a natural way to extract presuppositions of sentences that are not sub-constituents of the uttered sentence S, but are in some way derivable from it by reusing the material in S. The alternatives should be bounded in complexity by the utterance itself (like the alternatives for implicature; see Katzir 2007), and should not introduce any new, undesirable potential accommodations (or should be coupled by a selection mechanism that would filter out undesirable potential accommodations).

4.2.3 Presupposition cancellation

Recall that (27b), repeated here as (53), is odd:

(53) # If Mary (the job candidate) graduated from an American university, the search committee will appreciate the fact that she graduated from MIT.

Symbolizing (53) as S = *If A, then* B_p, we have $\mathscr{H}(S) = \{A \rightarrow p, p\}$. In this case, the listener appears to be stuck with a bad conversational outcome no matter what they do. If they accommodate $max = \mathscr{H}(S)$, the result is odd because it is incoherent and hence uncooperative for a speaker to presuppose that Mary graduated from MIT while being ignorant about whether she graduated from an American university (generated by the antecedent). If the hearer accommodates $min = \{A \rightarrow p\}$ = {that if Mary graduated from an American university she graduated from MIT}, the result would be odd because it is uncooperative to make your listener accommodate information that is somehow noteworthy, at least without any supporting context. Since both options lead to the conclusion that the speaker has been uncooperative, the oddness of (53) can be accounted for.

A question for this framework, however, is why the listener cannot avoid this oddness simply by canceling the presupposition. Depending on the particular theory, cancellation can be effected in many ways: local accommodation in dynamic semantics (Heim 1983), insertion of A-operators (Beaver and Krahmer 2001; Fox 2012), or deactivation of pragmatic principles (Schlenker 2008; Chemla 2009a). Be that as it may, the effect is the same: the presupposition is incorporated into the asserted component of the minimal sentence in which it occurs. To the extent that overt paraphrases of the resulting meaning are telling, the oddness compared with (53) is lessened:

(54) If Mary (the job candidate) graduated from an American university, she graduated from MIT and the search committee will appreciate that.

Asserting something noteworthy like this at least grants your listener the opportunity to ask about the conditional connection between Mary's graduating from an American university and graduating from MIT. Presupposing it doesn't. Given this, why not simply cancel the presupposition to avoid the inevitable oddness that would result from accommodating either *max* or *min*? More generally, what are the conditions under which presupposition cancellation is licensed?

A clear answer to this question has yet to be produced. Cancellation is typically licensed under threat of inconsistency, but this is not necessary. For example, consider a context in which you arrive at the counter to check in at your hotel. The person helping you can easily say:

(55) If you brought your car, please give us the license plate number.

This can readily be understood as 'if you have a car and brought it, please give us the license plate number', even though (if you had a car) global accommodation that you have a car could naturally be incorporated into the common ground.

The difficulty of predicting when cancellation is available, as well as how to make sense of cancellation in a principled way, has led some to question its place in the theory of presupposition (e.g., Chierchia 1995; von Fintel 2008; Schlenker 2008). Singh (2014) goes one step further and tries to eliminate cancellation entirely, a move that obviously necessitates a change in what is assumed about projection and global accommodation.[42] At the same time, there is evidence suggesting that cancellation is an important factor in accounting for presuppositional inferences in quantified sentences (e.g., Sudo et al. 2012; Fox 2012). The challenge is to explain the conditions under which cancellation mechanisms apply and why they tend to be marked, so much so that they do not come to the rescue of sentences like (53).

5 Concluding remarks

We began with a tension: filtering approaches fail to provide access to presuppositions of constituents, and hence have a hard time making sense of the observation that those often become pragmatic presuppositions even when they have been filtered away by the projection component. Default projection theories provide direct access to embedded presuppositions and project them by default, but fail to provide filtered presuppositions at the root. We articulated a possible synthesis: filtered presuppositions are delivered for all constituents, but accommodation inferences are made relative to sets of alternatives derived from the LF of the sentence, and among these there is always the presupposition of atomic constituents, the matrix sentence, and other sentences somehow bounded by these two. What these alternative sentences are, and how selection works from the alternative accommodations they generate, remains an open challenge. But I hope that the challenge has been clarified, and that it has become clear that the study of presupposition requires explicit – and ideally principled – assumptions about projection, accommodation, cancellation, and inference mechanisms that decide what to do in the face of presuppositional ambiguities generated by the language faculty.

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SEE ALSO: Ambiguity; Context and Conversation; Pragmatic Accommodation; Presuppositional Binding; Quantity Implicatures; Semantics vs Pragmatics

Notes

1. We will sometimes not distinguish sentences from propositions; we hope that no confusion arises from our occasional abuse of notation.
2. Specifically, the system is sometimes assumed to be underlyingly bivalent, and "#" is interpreted as uncertainty about which of the two classical values the sentence receives (see, e.g., Fox 2008; 2012; George 2008 for discussion). This intuition then allows the three-valued tables motivated by empirical considerations (e.g., Peters 1979; Beaver and Krahmer 2001) to be explained in terms of (incremental) reasoning about uncertainty. It's not clear that this interpretation is consistent with Kleene's (1952) interpretation of the third value. He imagined a computing device mechanically carrying out a procedure with the aim of answering a question. At any given moment, when asked it could give the answer "yes" (true), "no" (false), or "don't know." Because the problem under consideration might be undecidable, it's not clear that the assumption of underlying bivalence is warranted. See Katzir and Singh (2012) for a different perspective on deriving the basic Kleene (1952) truth tables, one that employs constraints on lexicalization (Katzir and Singh 2013a) instead of reasoning about uncertainty.
3. This is not to say that the choice of # is unnatural. However, different motivations for extending bivalent logic to a many-valued logic will lead to different entries for the many-valued extensions of various operators. Indeed, the earliest works on many-valued logics in the 1920s and 1930s had competing motivations, such as future contingency (Łukasiewicz 1920), functional completeness (Post 1921), recursive function theory (Kleene 1938), meaningfulness (e.g., Bochvar 1939), and others. The truth tables developed in these pioneering studies (as well as in the literature since) correspondingly sometimes disagree about how the third value projects in complex sentences. See also note 2.
4. For observations that might be relevant to characterizing this tendency, see, e.g. Romoli, Sudo, and Snedeker (2011); Romoli and Schwarz (2013); and Schwarz and Tiemann (2017), as well as sections 4.1 and 4.2.1.
5. Some theories derive projected presuppositions pragmatically (e.g., Schlenker 2008; Chemla 2009a). For such theories, I would restate "semantic presuppositions" as context-invariant pragmatic presuppositions, and "pragmatic presuppositions" as context-sensitive pragmatic presuppositions that take the projected presuppositions and the context as input and return additional presuppositions. For our purposes, these theories are sufficiently like some other approaches that produce semantically projected presuppositions that I will treat them in a similar way (see section 3.1).
6. $[\![\textit{the}]\!] = \lambda f_{et} : \exists!xf(x).\tau y(f(y))$. Here, we use "$\exists!x$" to mean "there is a unique x such that" and we use "τy" to mean "the unique y such that." We can read this in English as denoting a partial function that (i) takes elements of type *et* as input (or, equivalently,

predicates); (ii) is defined only if there is a unique individual in the context that satisfies the input predicate; and (iii) when defined, returns as output the unique individual that satisfies the predicate.

7. In this system, if any node fails to have a semantic value, so does any node dominating it; that is, undefinedness projects all the way up the tree. Thus, when the DP *the King of France* fails to get a semantic value, so does the sentence containing it.
8. In a dynamic semantics, such as in Heim (1983), sentence meanings are partial functions (context-change potentials) from context to contexts; presupposition failure occurs when the input context does not entail the sentence's presupposition. In a three-valued system, if the sentence's presupposition is not true in the world of evaluation, the sentence receives a nonclassical truth value (e.g., Beaver and Krahmer 2001). There are also theories of presupposition that assume a classical semantics but nevertheless incorporate presuppositions in other ways. See, e.g., Gazdar (1979); van der Sandt (1992); Schlenker (2008); Chemla (2009a).
9. Our treatment here is slightly different from von Fintel's (2008). We are ignoring for current purposes important questions about the intricate contextual dynamics concerning the point at which the context needs to entail the uttered sentence's presupposition, as well as questions about the relation between the speaker's epistemic state, their intentions, and the information in the common ground. For relevant discussion, see Stalnaker (1998; 2002), as well as von Fintel (2008); Simons (2003); and Beaver and Zeevat (2007).
10. Matthewson (2006) provides evidence for crosslinguistic variation concerning the way presuppositions are challenged in discourse. For example, St'at'imcets speakers were more accepting of inappropriate presuppositions than English speakers.
11. That is, unless the presupposition is somehow noteworthy or controversial. For relevant discussion, see, e.g., Soames (1989); Heim (1992); Beaver (2001); von Fintel (2008); and see Singh et al. (2016a) for experimental results.
12. I am temporarily sweeping aside many nuances that enter into the statement of the relevant principles. For detailed discussion, see section 4.2.1, as well as Beaver (2001; 2006); Heim (2006); van Rooij (2007); Singh (2007; 2008); von Fintel (2008); Pérez Carballo (2009); Romoli, Sudo, and Snedeker (2011); Schlenker (2011b); Fox (2012; 2018); Lassiter (2012); Mandelkern (2016).
13. For explorations of this connection between accommodation and mismatches between semantic and pragmatic presuppositions, see, e.g., Heim (1992; 2006); Geurts (1999b); van Rooij (2007); Katzir and Singh (2013b).
14. Singh (2014) develops a proposal under which negation is a plug as far as projection goes, and its hole-like properties are due to accommodation. More generally, downward-entailing operators are predicted to be plugs, upward-entailing operators are predicted to be filters, and hole interpretations are always due to accommodation.
15. Soames (1979) developed a proposal that was similar in spirit. I focus here on Gazdar's (1979), partly because it is more detailed. See also Mercer (1992) and Marcu (1994) for computational implementations of default projection systems.
16. I use the term "atomic" here, but the restriction is to constituents that are the *smallest* constituents containing a presupposition trigger. Often these are atomic constituents, but they need not be. For example, in *If John flies to Toronto, Mary knows that Sue is happy*, the presupposition of the sentence *Mary knows that Sue is happy* would be a potential presupposition. This sentence is not atomic, but it is minimal in the sense required.
17. Heim (1990) used a different example but one that makes the same point: *If John has children, he will bring along his 4-year-old daughter*.

18. Under an assumed presupposition/assertion distinction, it is expected that implausible presuppositions should be more inappropriate than implausible assertions (see n. 11).
19. E.g., $[\![the]\!] = \lambda P_{et}.\lambda Q_{et}.\exists x((P(x) \wedge \forall y(P(y) \rightarrow y = x)) \wedge Q(x))$.
20. Though see Heim (1992) for an attempt to give a scope analysis of *stop*.
21. By "referent" I mean "discourse referent," for reasons discussed elsewhere (e.g., Karttunen 1976; Heim 1982).
22. Schwarz and Tiemann (2015) present evidence that the cost of processing a presupposition-carrying element varies with the distance of its antecedent; DRT projection paths provide a straightforward measure of distance.
23. Local accommodation in the consequent leads to a sentence that entails $A \rightarrow p$. Global accommodation of $A \rightarrow p$ would also produce this entailment. Global accommodation of $A \rightarrow p$ is possible in filtering frameworks (as a presupposition) but not in DRT systems. This distinction has consequences that we discuss in section 4.2.3.
24. Schlenker's (2011a) modification of DRT explicitly bans such problematic movement.
25. The global accommodation reading that DRT normally provides is unavailable in quantified sentences because that would involve unbinding a variable, which is ruled out by the so-called "trapping constraint" of van der Sandt (1992).
26. I believe this could be remedied with the proposal in Singh (2014) if the projection mechanism proposed there applied to the post-displacement structures predicted by DRT, but I will not try to establish this here.
27. Heim (2006) assumed a set of alternatives for a handful of cases, and Singh (2007) presented an intensional characterization using descriptions of Heim's (1983) context change potentials. Later works aimed to generate alternatives from the logical forms of sentences instead (e.g., Singh 2008; 2009; Schlenker 2011b; Fox 2012). See Singh (2007; 2008) and Fox (2012; 2018) for arguments that the mechanism that generates potential accommodations is encapsulated from common knowledge. Specifically, the set of potential accommodations is limited to propositions that can be extracted from the LF of the sentence without considering how these propositions relate to information in the common ground.
28. We assume a reflexive notion of containment (a sentence contains itself).
29. We have stated a somewhat simplified version here that only adds the projected presupposition of $S_{k+1} = Op(S_1, \ldots, S_k\}$ to $\mathscr{H}_k = \mathscr{H}(S_1) \cup \ldots \mathscr{H}(S_k)$. However, there is evidence that we need to allow higher operators Op to interact with presuppositions in the alternative sets of embedded constituents as well. For example, as noted in Schlenker (2011a), a sentence like *Mary is convinced that if Obama agrees to meet with me, I will realize that he is a genius* licenses the inference that Mary is convinced that Obama is a genius. Such cases have been argued to support "intermediate accommodation" in DRT (e.g., Geurts 1999b), but in our approach we would amend the inductive step in (41b): where Op is an operator and its argument S semantically projects p and has alternative set $\mathscr{H}(S)$, then $\mathscr{H}(Op(S_p)) = \mathscr{H}(S) \cup \{\pi(Op(S_q)) : q \in \mathscr{H}(S)\}$. In essence, higher operators not only look at the projected presuppositions of their arguments, but also apply point-wise to all the presuppositions in the alternatives of their arguments as well. Thus, *convince* would produce two new semantic presuppositions: one with $A \rightarrow p$ as the presupposition of its argument, and one with p, hence allowing that Mary is convinced that p to become an inference. The extension to operators with greater arity would follow similar lines.
30. When S intuitively has no presupposition, $p = \mathscr{W}$ (the set of all worlds). We will sometimes omit $\mathscr{W}$ to reduce clutter.

31. By $\mathscr{P}(A)$ we mean the power set of set A (i.e., the set of subsets of A), and by $\wedge A$ we mean the conjunction of elements in A.
32. The general idea is that the modalized alternatives are exhaustified in order to create a partition so that probability comparisons would be meaningful. For example, by comparing $exh(\mathscr{H})(\Box(A \rightarrow p))$ $(= \Box(A \rightarrow p) \wedge \neg\Box p)$ with $exh(\mathscr{H})(\Box p)$ $(= \Box p)$, you create independent propositions that can guide your decision about whether to only accommodate $A \rightarrow p$ or to accommodate p as well.
33. This notion of independence or irrelevance is standard in modern probability theory. See Keynes (1921) for an extended early discussion in the context of difficulties surrounding the classic "principle of indifference," which provides a guide on how to assign probabilities when you have no (relevant) information that would support some alternatives over others.
34. See Lassiter (2012) for the case where A is negatively relevant to p.
35. See Mandelkern and Rothschild (2018) for additional challenges for the independence reasoning approach. I am afraid I learned of this paper too late to incorporate discussion here.
36. I thank Mary Dalrymple (p.c.) for discussion of this connection between the SMH and principles like *max*.
37. For related discussion in the context of decisions about whether or not to compute implicatures, where default principles about strength/complexity interact with context-sensitive reasoning, see, e.g., Levinson (1983); Ippolito (2010); Chemla and Spector (2011); Chierchia, Fox, and Spector (2012); and Singh et al. (2016b) (among others), and see Chemla and Singh (2014a; 2014b) and Singh (2019) for more general discussion.
38. Projection out of quantified sentences is a matter of considerable controversy. For just a small sample of diverging predictions, see, e.g., Heim (1983); Chierchia (1995); Beaver (2001); Schlenker (2008); Chemla (2009a); Fox (2012). For our purposes, we will follow Heim (1983) and assume that $[[\forall x : Ax][Bx_{Px}]]$ semantically presupposes $[[\forall x : Ax][Px]]$.
39. What is important in the complexity measure is the number of occurrences of literals. Thus, $S = p \vee q$ and $T = (p \vee q) \vee (p \wedge q)$ are semantically equivalent and use the same nonlogical symbols $\{p, q\}$, but S is strictly simpler than T (two versus four).
40. A formula is in DNF if it is a disjunction of conjunctive clauses. A conjunctive clause is a conjunction of literals such that no propositional variable is repeated in the conjunction.
41. Note that if implicature computation operates on this kind of normal form, we would immediately generate both the desired ignorance inferences of *If A, B* and conditional strengthening as a scalar implicature. To see this, note that $A \rightarrow B$ would have $\neg A \vee B$ as its normal form. If Katzir's (2007) alternatives applied to this normal form, rather than to the LF itself, the alternatives would be $\{\neg A, B, (\neg A \wedge B)\}$. From this set, only $\neg A \wedge B$ is innocently excludable (Fox 2007), generating $\neg B \vee A$, i.e., $B \rightarrow A$, as a scalar implicature. Ignorance implicatures about each of $\neg A$ (hence A) and B would follow from the "pure" maxim of quantity (Fox 2007). Without distorting the LF like this, it is less clear how to generate the desired inferences (though see Singh 2008; 2009).
42. As discussed in note 14, the system predicts that upward-entailing operators are filters ($\pi(Op_{UE}(S_p)) = Op(p)$) and downward-entailing operators are plugs ($\pi(Op_{DE}(S_p)) = \mathscr{W}$). Thus, for (54) there is no option for cancellation: there is only *max* or *min*, and both lead to oddness. For $\neg S_p$, we continue to have $max = \{p\}$ and $min = \emptyset$, but no cancellation is needed because $\pi(\neg(S_p)) = \mathscr{W}$.

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