Similarity: towards a unified account of scalar implicatures, free choice permission and presupposition projection*

Emmanuel Chemla

Abstract I propose a new theory of scalar implicatures: the speaker should be in the same epistemic status with respect to alternatives obtained via similar transformations (e.g., replacements of a scalar items with various stronger items). This theory extends naturally to explain presupposition projection. Cases where scalar items and presupposition triggers co-occur are straightforwardly accounted for. The main focus is the unification between various phenomena: scalar implicatures, free choice effects and presupposition projection. Yet, the system can be split into independent proposals for each of these issues.

Contents

* I am indebted to an embarrassing number of embarrassingly bright people, every mistake remains my own so that none should not be embarrassed with my acknowledgments: Marta Abrusan, Gennaro Chierchia, Paul Egre, Kai von Fintel, Danny Fox, Bart Geurts, Irene Heim, Roni Katzir, Nathan Klinedinst, Giorgio Magri, Alejandro Perez Carballo, Daniel Rothschild, Philippe Schlenker, Raj Singh, Benjamin Spector and audiences at the MIT-France Workshop, the MIT-Linglunch, Sinn und Bedeutung 2007, the Amsterdam Colloquium 2007. Special thanks to Bart, Benjamin, Danny, Nathan and Philippe who noticed important generalizations, suggested millions of test sentences and...

1 Introduction

The main claim of this paper is that the projection behaviors of presuppositions and scalar implicatures can be accounted for in a unified fashion. To this end, I propose a new theory of scalar implicatures, and show that the system extends straightforwardly to presupposition, and cases of interaction between scalar implicatures and presuppositions. Let me first illustrate what the beasts are.

1.1 Scalar implicatures

From the sentence in (1), we naturally understand that it is not the case that Mary read all the books.

(1) Mary read some of the books.
Alternative: Mary read all the books.
Scalar implicature: she didn't read all of them.

The most standard account of scalar implicatures relies on the following general maxims (freely adapted from Grice 1967):

(2) Maxim of Quality: Believe what you say.

(3) Maxim of Quantity: Use the stronger statement, within a set of candidates.

The explanation of the inference goes as follows. The words 'some' and 'all' belong to a common scale, they produce various "candidates" which are in competition with each other. In the present environment, i.e. Mary read __ the books, the word 'all' produces the stronger statement. Nonetheless, the speaker decided to utter the other candidate. This is a violation of the maxim of quantity given in (3). A plausible justification for violating this maxim is that using the alternative with 'all' would have violated the other maxim, the maxim of quality (2). This reasoning leads to the inference that it is not the case that the speaker believes that Mary read all the books, $\neg B_s[\text{ ALL }]$.

As noticed since Soames (1982) and Horn (1989), this inference is weaker than the actual inference: the speaker believes that the alternative is false, $B_s[\neg\text{ALL}]$. This is a desirable result for two reasons: (i) it accounts for contextual variations of the inference, and (ii) it is empirically hopeless to defend the idea that stronger alternatives are systematically believed to be false by speakers. Multiple disjunctions clearly illustrate this second point:

(4) John ate an apple, a banana or a coconut.
  a. Schematically: $(a \vee b) \vee c$
  b. Alternatives:

i. $(a\wedge b)\vee c$
ii. $(a\vee b)\wedge c$
iii. $(a\wedge b)\wedge c$ [if we can replace several scalar items at once]

The alternatives in (4b) are derived assuming that the conjunction $\wedge$ is an alternative to the disjunction $\vee$: each $\vee$ is replaced with a $\wedge$. The problem arises with the first alternative (4b-i). This alternative is stronger than the original sentence. However, the utterance does not imply that this alternative is false (i.e. $\neg(a\wedge b)\wedge\neg c)$). In particular, (4) does not imply that John did not eat a coconut.

Sauerland (2004) proposes a system which handles alternatives in two steps. At each step alternatives are treated independently from each other. The first round derives inferences of the form $\neg B_s[\text{ alternative }]$ for each alternative, provided that this inference is consistent with the sentence itself, i.e. for non-weaker alternatives.[1] These inferences are called primary implicatures. In the second round, each of these inferences is strengthened into $B_s[\neg\text{alternative }]$, provided that this stronger inference is consistent with the sentence and the first round of inferences. These inferences are the secondary implicatures.

The strengthening of primary implicatures into secondary implicatures is called the epistemic step. Notice that if the speaker is competent about an alternative, i.e. roughly if she knows whether the alternative is true or false, both versions of the inference $\neg B_s[\text{ alternative }]$ and $B_s[\neg\text{alternative }]$ are equivalent. For this reason, it is natural to assume that the epistemic step is subject to contextual assumptions about the speaker's state of beliefs.

Sauerland also assumes that both disjuncts are alternatives to a disjunction. Hence, (4) has additional alternatives: $a\vee b$, c, and optionally a, b, $a\vee c$, $b\vee c$, $a\wedge b$, $a\wedge c$, and $b\wedge c$. With these two refinements (i.e. the two rounds of inferences and the specific alternatives chosen), multiple disjunctions are not problematic anymore. The problematic inference $B_s[\neg[(a\wedge b)\vee c]]$ is a potential secondary implicature, but it is blocked by primary implicatures (the reader can check that $\neg B_s[a\vee b]$ and $B_s[(4)]$ block this inference).

Unfortunately, these new alternatives create other conflicts in modal contexts, and this happens as early as the first round of implicatures:

(5) John may eat an apple or a banana.
  a. Schematically: $\Diamond(a\vee b)$
  b. Alternatives: $\Diamond a$, $\Diamond b$, $\Diamond(a\wedge b)$

1 Alternatively, one could apply this first round of inferences only to stronger alternatives, and not to every non-weaker alternative. The decision is not made explicitly in Sauerland (2004). The dilemma is the following: (i) the maxim of quantity apparently concerns only the *stronger* alternatives, but (ii) to account for scalar implicatures in non-monotonic environments, it is empirically more adequate to deny *non-weaker* alternatives as well. This dilemma does not arise in the present framework.

c. Primary implicatures: $\neg B_s[\Diamond a]$, $\neg B_s[\Diamond b]$, $\neg B_s[\Diamond(a \wedge b)]$
d. Free choice inferences: $B_s[\Diamond a]$, $B_s[\Diamond b]$

The alternatives in (5b) are stronger than the original sentence. Hence, they give rise to primary implicatures of the form $\neg B_s$[alternative]. Among these primary implicatures, there are $\neg B_s$[John may eat an apple] and $\neg B_s$[John may eat a banana]. These inferences are in conflict with so-called free choice inferences associated with the sentence: B_s[John may eat an apple] and B_s[John may eat a banana], see Kamp (1973). Moreover, Kratzer & Shimoyama (2002) and Alonso-Ovalle (2005) provide arguments that these free choice inferences are actually scalar implicatures themselves. Hence, the conflict described above is a conflict between inferences of the same kind. This conflict justifies important changes in the theory of scalar implicatures.

Importantly, Schulz (2003) shows that if we admit different alternatives to (5) (and in particular if these alternatives include $\Box\neg$A and $\Box\neg$B), free choice inferences would follow from a neo-Gricean system. Hence, neo-Gricean systems seem compatible with free choice effects. However, Schulz' result is more precise, she shows that the price for this compatibility is not negotiable: the alternatives $\Box\neg$A and $\Box\neg$B are *necessary* to save the neo-Gricean enterprise. Neo-Gricean theories face the following dilemma: if we want to defend our beloved procedure to deal with alternatives, we need to postulate ad hoc alternatives to begin with.

These considerations have led several researchers to propose radical departures from the neo-Gricean procedure. Various proposals show that free choice inferences are compatible with a local theory of scalar implicatures.[2] Klinedinst (2006) relies on a strictly local theory *à la* Landman (1998) or Chierchia (2004). Fox (2007) develops a syntactic version of pragmatic exhaustivity operators *à la* van Rooij (2002) and van Rooij & Schulz (2004) or Spector (2003, 2006). I exhibit here a new globalist system to derive scalar implicatures, which accounts for free choice effects: inferences follow from comparisons between whole alternatives. One of the very new virtue of my proposal is that it extends to presupposition projection.

1.2 Presupposition

From each sentence in (6), we naturally infer that Bill has an elephant. The proposition that Bill has an elephant is called a presupposition of these sentences because of the following primary intuition: these sentences are felicitous only when this fact is agreed upon among the participants to the conversation prior to the utterance, see Stalnaker (1970, 1973, 1974).

2 Interestingly, even neo-Gricean authors proposed a somewhat localist approach to solve this problem: Geurts (2006) suggested that pragmatic workings may apply at some specific sub-sentential level, at the point where all discourse referents are introduced and settled.

(6) a. Mary knows that Bill has an elephant.
b. Mary doesn't know that Bill has an elephant.
c. It's possible that Mary knows that Bill has an elephant.
d. Does Mary know that Bill has an elephant?
Presupposition: Bill has an elephant.

The exact status of presupposition has been disputed and refined in various ways (see for instance Stalnaker 1998, 2002, Gauker 1998, von Fintel 2004, Schlenker 2006, and also Geurts 1999b and Abbott 2000). These criticisms originate from the observation that presuppositions may systematically convey new information and give rise to inferences, as I first described. Notice also that the usual diagnosis for presupposition is that a set of sentences such as the sentences in (6) trigger the inference that the alleged presupposition is true (this is sometimes called the P-family test, see Chierchia & McConnell-Ginet 2000 for a general introduction). In other words, presuppositions are primarily diagnosed via inferences. I will assume here that presuppositions are inferences. I discuss the minor role of this hypothesis in section 4.2.

A major issue for presupposition is the projection problem:

> The projection problem is the problem of predicting the presuppositions of complex sentences in a compositional fashion from the presuppositions of their parts. (Heim 1983)

For instance, if we take for granted that (6a) presupposes that Bill has an elephant, we want to predict that utterances in which this same sentence appears under various linguistic operators (e.g., negation as in (6b), modal as in (6c), some question operator as in (6d)) also trigger this same inference. The most influential solutions merely add a layer to the lexical contribution of linguistic operators. This layer explicitly indicates how they interact with presuppositional pieces (as in Karttunen & Peters 1979, but also in Heim 1983 as argued by Soames 1989 for instance). This line of lexical explanations has been criticized for its lack of explanatory power, recent investigations attempt to motivate these claims: Beaver & Krahmer (2001); George (2007, 2008); LaCasse (2008); Rothschild (2008). Other works argue for a more radical departure, e.g., Schlenker (2007).

The strategy I adopt to avoid lexical stipulations for each linguistic operator is to proceed just as scalar implicatures (this is close to the original program of Gazdar 1979). Accounts of scalar implicatures rely on two ingredients: (i) alternatives and (ii) the nature of the competition between alternatives. Presumably, the nature of the competition does not depend on the complexity of the original utterance. Hence, any account of scalar implicatures applies to complex sentences as soon as the procedure to compute alternatives does, which is most often unproblematic. In other words, alternatives reduce the projection problem for scalar implicatures to a mechanism which applies similarly across environments. My proposal will export this appealing feature to the projection problem of presupposition.

1.3 Interaction

As I said, I propose to account for the projection properties of presuppositions and scalar implicatures at once. One motivation to do so is that scalar implicatures and presuppositions interact. Sentences with a scalar item embedded under a presupposition trigger raise inferences which have received important attention recently (see Geurts 2006, Russell 2006, Simons 2006 and Sharvit & Gajewski 2007).

In (7), the scalar item ‘some’ is embedded under the presupposition trigger ‘know’, the resulting inference is difficult to account for by independent theories of scalar implicatures and presupposition:

(7) George knows that some of his advisors are crooks.
Inference: Some but not all of George’s advisors are crooks.

A unified theory of scalar implicatures and presupposition should straightforwardly explain this interaction. I come back to these cases in section 4.7 when my proposal is in place.

1.4 Program

I propose a mechanism to solve the projection problem for presupposition together with scalar implicatures and the puzzle of free choice permission. This involves two steps. First, I propose a new theory of alternatives and scalar implicatures. This new theory merely relies on one new principle: similarity. It provides a straightforward account of free choice effects.

Second, I will associate alternatives to presupposition triggers. Abusch (2002, 2005) and Simons (2001a,b) already suggested that presuppositions may come from alternatives. However, the focus of these works is the triggering problem for presupposition, and their accounts do not extend to a solution to the projection problem. Of course, their motivations to propose an account of presupposition in terms of alternatives carry over to my proposal.

The main virtue of my proposal is that a single principle solves a huge range of puzzles which are often thought to be independent.

1.5 Plan of the paper

- In section 2, I introduce the general details of my proposal. The core hypothesis is the similarity principle: alternatives obtained through various similar transformations (e.g., replacements of a scalar item by various stronger items) ought to produce similar global effects.

- In section 3, I show how similarity accounts for scalar implicatures, and in particular how it captures free choice effects.
- In section 4, I develop a notion of alternatives for presupposition triggers and show that presupposition projection follows from these new assumptions.

2 The projection proposal: Similarity

In this section, I set up the details of my proposal. The principal hypothesis is that alternatives obtained similarly (e.g., via replacements of a given scalar item with various stronger items in its scale) are indistinguishable by the speaker. In this whole section and the following, I focus on usual scalar implicatures and free choice effects.

Some parts of this section are very formal so that the proposal is as explicit as possible. However, there are very few new ingredients. For instance, I introduce a new formalism to derive alternatives, but overall the resulting alternatives are standard, except for two things: (i) super weak and strong items play a technical role, (ii) alternatives are clustered in sets of alternatives.

In section 2.1, I present a first pass at the proposal. I give very few explicit details, but I try to give a sense of the various achievements that we can expect. I present the details as explicitly as possible in section 2.2. Section 2.3 summarizes the proposal by repeating the main steps involved in the derivation of scalar implicatures.

2.1 Informally

Two phrases A and B must be somewhat similar to be conjoined felicitously. Of course: they should have the same semantic type for instance. I propose to add a pragmatic layer to this constraint: the speaker should be in the same epistemic state with respect to each disjunct of a disjunctive sentence.

More precisely, let $\varphi(\text{A}\vee\text{B})$ represent a sentence containing a disjunction $\text{A}\vee\text{B}$ embedded in the linguistic environment φ (e.g., negation, modals). The linguistic environment could also simply be something like John read__, as in the semi-formal (8). If we split the disjunction in two, we obtain two sentences: $\varphi(\text{A})$ and $\varphi(\text{B})$ (e.g., (9a) and (9b)). The claim is that these two sentences should be similar: the speaker believes one of them if she believes the other one as well.

(8) John read A or B.

(9) a. John read A.
   b. John read B.

Similarity yields unsurprising results for such simple examples. Imagine that someone believes only one of (9a) and (9b). Then she should simply utter the one she believes to be true and leave out the other superfluous disjunct.

The principle is more explicitly formulated in (10) – a very similar condition was explored in Klinedinst (2005).

(10) Epistemic similarity principle for disjunctions:
$\varphi(\text{A}\vee\text{B})$ is felicitous only if $B_s[\ \varphi(\text{A})\ ] \longleftrightarrow B_s[\ \varphi(\text{B})\ ]$

The following sections informally review a few other simple applications of this principle.

2.1.1 Violations of Similarity

The constraint in (10) suggests that disjunctive sentences should be somewhat inappropriate in situations where the speaker is known to be in a different epistemic attitude towards each disjunct. In this section, I briefly show that this prediction is empirically correct.

Similarity and world knowledge

Consider the sentence in (11), its use is marked if it is well-known that it never rains in Antarctica.[3,4] Assuming that the speaker is well aware of this state of affair, she does not believe the first disjunct (12a) to be true. The speaker certainly believes the sentence itself to be true, thus she believes the other disjunct (12b) to be true. Overall, the similarity advocated in (10) is broken since the speaker plainly believes one of the disjunct and not the other one, hence the deviance.

(11) *Context: It is well-known that it never rains in Antarctica.*
? It is raining in Antarctica or in London.

(12) a. It is raining in Antarctica.
b. It is raining in London.

3 Even though (11) is normally marked, there are plausible uses of sentences of the form “x or contradiction”, where intuitively the speaker wants to convey that x has to be true, since the second disjunct does not help the disjunction to become true. Interestingly, this effect flips for sentences of the form “x and contradiction” (e.g., Sure, you’re going to get an A and I am the Pope) which seem to convey that x is just as false as the contradiction. This can be seen as an effect of Similarity for conjunction (both conjuncts are just as true or false), which seems to apply even when the sentence itself is doomed to be false.

4 It hardly rains in Antarctica. Not only because the temperature is so low that it could only snow, Antarctica is considered a desert, see Nordenskjöld (1928).

I do not claim that this first piece of data is deeply mysterious, but it illustrates well how the similarity principle applies.[5] My goal is to show that there is a unusually large range of facts which follows from this single principle.

Similarity against exclusive disjunction

Consider now example (13). Without special intonation, an utterance of (13) is odd. This is a well-studied instance of a violation of Hurford's constraint: the first disjunct (14a) entails the second disjunct (14b), see Hurford (1974) and Gazdar (1979).[6]

(13) *Context: France is in Europe...*
? It's raining in France or in Europe.

(14) a. It's raining in France.
b. It's raining in Europe.

The Similarity Principle (10) captures this generalization as follows. The sentence (13) is overall equivalent to one of the disjunct (the weaker one, (14b)), and the speaker therefore believes it to be true. The Similarity Principle requires that the speaker believe that the other disjunct is true as well. However, this conflicts with the exclusive reading of the disjunction, hence the deviance: the inferences in (15) are incompatible.[7]

(15) Inferences of (13):

---

5 Note however that an explicit Gricean account is not so obvious to spell out. In the given context, (11) and (12b) convey exactly the same information, hence the maxim of Quantity cannot possibly help resolve the competition between the two sentences. So, presumably, the maxim of Manner would have to be recruited, and this would involve setting up the alternatives that enter in competition in the application of the maxim of Manner.

6 Notice that (11) can also be seen as a special violation of Hurford Generalization: if one of the disjuncts is a contradiction, it certainly entails the other one.

7 For the moment, it does not matter what gives rise to the additional inference (15b) which corresponds to the exclusive reading of the disjunction: the two inferences are incompatible. Notice in particular that if the exclusive reading is more tied to the meaning of the sentence, the utterance becomes even worse:

(i) *Context: France is in Europe...*
?? It's raining either in Europe or in France.

(ii) *Context: France is in Europe...*
?? It's raining in Europe or in France and not both.

a. Inference predicted by the similarity principle in (10):
   – B_s[It's raining in Europe];
   – B_s[It's raining in France].

b. Independent exclusive inference:
   $\neg B_s$[It's raining in Europe and in France.]

There is much more to say about examples involving Hurford Generalization, in particular because there seem to be systematic violations of the constraint. I will shortly come back to these questions in section B.1. The goal of this section was to illustrate simple applications of the similarity principle (10) to the oddness of some utterances.

Of course, there are also utterances that do not violate similarity a priori on the hearer's side. The expectation that Similarity is respected should then prompt new inferences. I illustrate this in the following section.

2.1.2 Inferences predicted by the constraint

In the previous section, I illustrated how the Similarity Principle (10) may explain the deviance of some utterances. In this section, I present the other side of the same coin: it also accurately predicts usual inferences that we draw from natural sounding utterances.

Ignorance implicatures

Let's first look at a basic disjunction:

(16) Mary ate an apple or a banana.

Again, grant me that the sentence (16) carries an exclusive reading for the disjunction (at least an epistemically weak one as in (17)), or consider example (18) where the disjunction is somewhat more explicitly exclusive.

(17) Independent inference of (16):
     It's not the case that the speaker believes that Mary ate both fruits.
     i.e. $\neg B_s$[(19a) and (19b)]

(18) Mary ate either an apple or a banana.

The Similarity Principle (10) applied to these examples (16) and (18) requires that the speaker believe one of the disjuncts (19a-19b) only if she believes the other one as well, see (20). Given the exclusive reading of the disjunction, the speaker does not believe both disjuncts to be true, therefore, the speaker believes none of them:

$\neg B_s[$ (19a) $]$ and $\neg B_s[$ (19b) $]$. These inferences correspond to the usual ignorance implicatures, which are also derived in various neo-Gricean frameworks.[8]

(19) a. Mary ate an apple.
b. Mary ate a banana.

(20) Similarity inference for (16/18): $B_s[$ (19a) $] \longleftrightarrow B_s[$ (19b) $]$
i.e. there are two options:
a. $\neg B_s[$ (19a) $]$ and $\neg B_s[$ (19b) $]$ (ignorance)
b. $B_s[$ (19a) $]$ and $B_s[$ (19b) $]$ (incompatible with (17))

Free choice permission

We can now move to cases at the basis of the main criticism of previous accounts: free choice effects. Consider sentence (21) where the disjunction is embedded under an existential modal. As before, the similarity principle in (10) predicts that the speaker is in the same epistemic status with respect to the alternatives with only one disjunct left: (22a) and (22b).

(21) You may eat an apple or a banana.

(22) a. You may eat an apple
b. You may eat a banana

(23) Similarity inference for (21): $B_s[$ (22a) $] \longleftrightarrow B_s[$ (22b) $]$
i.e. there are two options:
a. $\neg B_s[$ (22a) $]$ and $\neg B_s[$ (22b) $]$ (ignorance)
b. $B_s[$ (22a) $]$ and $B_s[$ (22b) $]$ (free choice)

For (16), the (b) option is blocked because it is incompatible with the independent inference (17). The corresponding inference for (21) is in (24). It is not incompatible with (23b), as the following situation illustrates: you may eat an apple, you may eat a banana, but you cannot eat both at the same time. Hence, if we assume that the speaker is opinionated about the disjuncts, the (a) option is out and we derive the expected free choice inferences.

(24) Independent inference of (21):
It's not the case that the speaker believes that 'you' may eat both fruits (together).

8 Plain ignorance also requires that $\neg B_s[\neg$(19a) $]$ and $\neg B_s[\neg$(19b) $]$, the reader can check that these follow from: $\neg B_s[$ (19a) $]$, $\neg B_s[$ (19b) $]$ and $B_s[$ (16) $]$=$B_s[$ (19a) or (19b) $]$.

To sum up: Classical neo-Gricean frameworks predict accurate ignorance implicatures for bare disjunctions, but are incompatible with free choice effects. The present proposal captures both phenomena at once. I come back to this issue in section 3.3 where I discuss more explicitly the interaction of free choice and ignorance with independent inferences.

2.1.3 Extension to other items and scales

So far, I quickly showed that Similarity is compatible with various empirical observations about disjunctive sentences: the deviance of some utterances, and inferences derived from others. The ambition of this paper is to explain the full range of scalar inferences by extending this constraint to usual scales such as $\langle$some, all$\rangle$. Eventually, the goal is to extend the account to presupposition projection. This is yet another independent piece of the proposal, I come to presupposition in section 4.

For sentences containing a disjunction, Similarity says that the speaker should be in the same epistemic status with regard to the sentences obtained by keeping only one or the other of the disjuncts. For usual scalar items, the idea is going to be that the speaker is in the same epistemic status with respect to alternatives obtained via parallel replacements, e.g., replacements of an item by various stronger items. Neo-Gricean systems model the statement that stronger alternatives are strong, so strong that they are false. My objective is to model the statement that stronger alternative *items* are strong. Similarity models this simple intuition by saying that stronger items have the same (global) effects as super strong items.

Example

Let me explain with an example:

(25) John read some of the books.

The sentence in (26a) is an alternative to (25): an alternative obtained by a replacement of ‘some’ with the stronger item ‘all’. My hypothesis is that as far as the speaker can tell, this replacement has the same (semantic) consequences as replacing the item with other stronger items, even a super strong item that would produce a contradictory phrase as in (26b). This idea simply models that the alternative item ‘all’ is strong, as far as the speaker can tell it is not different from a super strong item.

(26) Alternatives obtained by replacing ‘some of’ with stronger items:
   a. John read all the books.
   b. John read [none and some of] the books.
      i.e. a contradiction: $\perp$

So, the inference has the same form as similarity inferences for disjunctions: as far as the speaker can tell, two similar transformations yield the same effects. If we apply this to the alternatives above, we obtain the usual scalar alternatives of (25):

(27) Similarity Inference:
B_s[(26a)] $\longleftrightarrow$ B_s[(26b)]
i.e. B_s[(26a)] $\longleftrightarrow$ B_s[$\perp$]
i.e.$\neg B_s$[(26a)] (I assume that no one overtly believes the contradiction)
i.e.$\neg B_s$[John read all the books]

In other words

The Gricean intuition is that, as far as the speaker can tell, asserting a stronger alternative would be super strong, as strong as asserting a contradiction. The present system transposes this idea to the items themselves: stronger items and super strong items produce indistinguishable alternatives. In appendix A, I express the gricean intuition within the present formalism so that the comparison is easier (and the notations less suspicious). The result in (69) shows that the predictions are exactly the same in most standard monotonic environments.

Let me put it differently, somewhat more visually. The Gricean approach provides guidelines as to which items are optimal in a given scale: the items that produce maximally strong sentences. The similarity principle provides different guidelines: the optimal items split the scale in two so that their scale-mates behave on a par with the pathological items at their end of the scale. This is schematized in (28). Consider a scale of items linearly ordered by logical strength, as is represented in (28a). Super weak and strong items are added at both ends of the scale for convenience. A sentence with one of the scalar items, e.g., the k^{th} item, in some linguistic environment φ has several alternatives which are derived by replacing the item by its scale-mates in the very same environment φ, see (28b). This is the standard way to obtain alternatives. Similarity then requires that the item chosen split the set of alternatives in two as shown in (28b): the weaker items that would behave on a par with the tautology, and the stronger items that would behave on a par with the contradiction.

(28) Scales for similarity:
a. $\langle \top,\ item_1,\ ...,\ item_{k-1},\ item_k\ ,item_{k+1},\ ...,\ item_n,\ \perp\ \rangle$
b. $\{ \boxed{\varphi(\top), \varphi(item_1), ..., \varphi(item_{k-1})}, \varphi(item_k), \boxed{\varphi(item_{k+1}), ..., \varphi(item_n), \varphi(\perp)} \}$

Deviant examples

As before, Similarity predicts that certain uses of scalar items should be deviant. Consider the examples in (29).

(29) Context: everyone knows that every teacher assigned the same grade to each of his students.

a. John assigned an A to all his students.

b. ? John assigned an A to some of his students.

Although (29a) and (29b) are contextually equivalent, (29b) is not appropriate. In fact, it violates Similarity because 'all' is different from a super strong item which would produce a contradiction. Again, such cases are difficult for more standard Gricean views because both examples are contextually equivalent, and yet, only one of them is felicitous. (see discussion in Magri (2007)).

2.2 The proposal: explicit details

In the previous section, I informally illustrated the application of a Similarity Principle with a variety of simple examples. In essence, the proposal is to rely on a general constraint of the following form: similar transformations yield epistemically similar alternatives. In this section, I provide the formal definitions of what count as 'similar transformations', and what is required for two alternatives to count as 'epistemicallly similar'.

2.2.1 Ingredient 1: Similar transformations

In this section, I define the alternatives which come into play for the computation of scalar implicatures. I introduce a new formalism which mimics the standard procedure to obtain alternatives, except that (i) alternatives are clustered into sets of similar alternatives, and (ii) super weak and strong items play a (technical) role.

Alternatives are minor transformations of the original sentence, and I assume for the moment that there are two independent sources of transformations: scales and connectives. I introduce the relevant alternatives and transformations for presupposition triggers later in section 4.1.

Scales and replacements

The first type of transformations comes from usual scales: sets of items ordered by logical strength which enter in competition, (30) is such a scale in its usual guise. For present purposes, scales are enriched with super weak and strong endpoints (more precisely, items which would produce tautologies or contradictions at the first landsite of the appropriate type $\langle s,t\rangle$ in the derivation).

(30) $\langle$some of, many of, all$\rangle$

(31) $\langle\top$, some of, many of, all, $\perp\rangle$

As usual, these scales generate alternatives by replacement of an item with one of its scale-mates. The possible replacements generated by the scale in (31) are schematized in (32-33): $\{ x \to y \}$ stands for the replacement of the item 'x' with its stronger scale-mate 'y', and the other way round for $\{ x \leftarrow y \}$. Replacements involving super weak and strong elements are given separately in the (b) items of examples (32-33).[9]

(32) Stronger replacements:
(moving from left to right in the scale)
  a. $\{$ *some of* $\to$ *many of* $\}$, $\{$ *some of* $\to$ *all* $\}$, $\{$ *many of* $\to$ *all* $\}$,
  b. $\{$ *some of* $\to \perp \}$, $\{$ *many of* $\to \perp \}$, $\{$ *all* $\to \perp \}$

(33) Weaker replacements:
(moving from right to left in the scale)
  a. $\{$ *some of* $\leftarrow$ *many of* $\}$, $\{$ *some of* $\leftarrow$ *all* $\}$, $\{$ *many of* $\leftarrow$ *all* $\}$,
  b. $\{ \top \leftarrow$ *some of* $\}$, $\{ \top \leftarrow$ *many of* $\}$, $\{ \top \leftarrow$ *all* $\}$

The present theory relies on sets of alternatives. A set of alternatives is derived from a sentence by applying similar replacements over the same item or phrase. Two replacements are similar if they go in the same direction in the scale. For example, the replacements in (32) are all similar, they are replacements of an item with a stronger one in the same scale, the alternatives they produce should be clustered together as similar alternatives. The same applies to the replacements in (33).

Consider (34). Three similar replacements may apply to the sentence in (34a), they are given in (34b). In words: the item 'some' may be replaced with three stronger items: 'many', 'all' and $\perp$, a super strong item. Hence the set of three similar alternatives in (34c).

(34) a. Mary read some of her books.
Schematically: Mary is an x, such that x read some of x's books.
  b. Applicable stronger replacements:
  $\{$ *some of* $\to$ *many of* $\}$, $\{$ *some of* $\to$ *all* $\}$, $\{$ *some of* $\to \perp \}$
  c. Similar alternatives obtained via the replacements above:
    i. Mary is an x, such that x read *many of* x's books.
    i.e. Mary read many of her books
    ii. Mary is an x, such that x read *all of* x's books.
    i.e. Mary read all her books
    iii. Mary is an x, such that $\perp$. i.e. $\perp$

9 I removed from the list the replacements of super weak and strong items $\{ \top \to$ *item* $\}$ and $\{$ *item* $\leftarrow \perp \}$, because they do not play any role in the theory.

I laid out as explicitly as possible how scales may produce similar alternatives to a given sentence. The only two additions at this point are that (i) super weak and strong items play a role (at least a technical role), and (ii) alternatives come in sets of similar alternatives, two alternatives are clustered together if they are derived via similar transformations.

Connective split

Connectives also generate similar alternatives to the sentences in which they appear. Given the formalism above, it is sufficient to say that a sentence containing a phrase A$\otimes$B with a connective $\otimes$ may undergo two similar transformations which correspond to keeping one or the other side of the connective. This is schematized in (35), and applied to two examples in (36-37).

(35) The connective split (parallel transformations for connectives):

a. $\{$ A$\otimes$B $\rightarrow$ A $\}$

b. $\{$ A$\otimes$B $\rightarrow$ B $\}$

(36) a. Mary ate an apple and a banana.

b. Set of similar alternatives obtained by splitting the connective ‘and’:
$\{$ Mary ate an apple., Mary ate a banana. $\}$

c. These alternatives correspond to the following substitutions:
$\{$ *an apple and a banana* $\rightarrow$ *an apple* $\}$, $\{$ *an apple and a banana* $\rightarrow$ *a banana* $\}$

(37) a. You may eat an apple or a banana.

b. Set of similar alternatives obtained by splitting the connective ‘or’:
$\{$ You may eat an apple., You may eat a banana. $\}$

c. These alternatives correspond to the following substitutions:
$\{$ *an apple or a banana* $\rightarrow$ *an apple* $\}$, $\{$ *an apple or a banana* $\rightarrow$ *a banana* $\}$

On top of these transformations, the basic connectives also belong to their usual linear scale $\langle\top$, or, and, $\perp\rangle$, and this produces independent sets of similar alternatives.

Summary

Let’s wrap up. Sentences may undergo various transformations coming from two main sources (i.e. scales and connective split). These transformations produce alternatives in a rather standard way: by substitutions of some pieces of the sentence with other related pieces. Some of these transformations are similar, and so the alternatives they produce ought to pattern similarly, in the sense to be defined in the following section.

2.2.2 Ingredient 2: Epistemic Similarity

In the previous section, I explained how sentences produce 'similar alternatives': by undergoing various similar transformations (e.g., replacements of a given item with various stronger items). The present proposal is that there is a general constraint on assertability: similar alternatives are understood as having a similar status in the speaker's mind (see section 2.1 for discussion). So, the speaker should not prefer one alternative over the other, that leaves open two options: she believes that all alternatives are true, or there is no alternative that she believes to be true. This similarity relation, an epistemic similarity relation that I will refer to as e-similarity, is defined in (38):

(38) Epistemic Similarity (weak):
Two propositions X and Y are epistemically similar (in short: e-similar) if:

the speaker believes one to be true
if and only if
she believes the other one to be true as well.

Schematically: $B_s[\,X\,] \longleftrightarrow B_s[\,Y\,]$

This technical definition allows the formulation of the Similarity Principle (39) which is at the core of the present proposal:

(39) Similarity Principle:
An utterance is felicitous only if its similar alternatives are e-similar.

Remember that two alternatives are similar if they are derived via similar transformations, this notion relies on the very low level way by which alternatives are calculated in the first place. Two alternatives are e-similar if they have the same status in the speaker's mind, this second notion depends on the state of belief of the speaker. The Similarity Principle (39) requires that these two notions collapse.

Strengthening e-similarity

The Similarity Principle (39) requires a weak e-similarity between alternatives. As in neo-Gricean accounts the inferences derived from this constraint might be supplemented with contextual assumptions about the speaker's state of knowledge, at least when it is possible to do so consistently (see Spector 2003; van Rooij & Schulz 2004; Sauerland 2004). Here is the standard version of this contextual enrichment:

(40) Usual Epistemic Step:

a. Primary implicatures:
Derive every possible inference of the form: $\neg B_s[\text{ alternative }]$,
(except when the result conflicts with the assertion).[10]

b. Secondary implicatures:
Strengthen every inference of the form $\neg B_s[\text{ alternative }]$ into $B_s[\neg\text{alternative }]$
(except when the result conflicts with the assertion and the primary implicatures of the form $\neg B_s[\ldots]$).

The rationale for moving from primary to secondary implicatures is that by default, hearers assume that the speaker is competent about each alternative: the speaker believes either that the alternative is true or she believes that it is false (i.e. $B_s[\text{ alternative }]$ or $B_s[\neg\text{alternative }]$, written: $C_s[\text{alternative}]$).[11] In (41), I formulate explicitly the strengthening mechanism that I assume. It is entirely parallel to the epistemic step: inferences are strengthened, provided that this enrichment is consistent with primary inferences.

(41) Strengthening Epistemic Similarity:

a. Primary implicatures:
Derive weak e-similarity inferences of the form $B_s[X] \longleftrightarrow B_s[Y]$.

b. Secondary implicatures:
Strengthen every inference of the form $B_s[X] \longleftrightarrow B_s[Y]$ into strong e-similarity inferences of the form $B_s[X \longleftrightarrow Y]$
(except when the result conflicts with previous weak e-similarity inferences of the form $B_s[\ldots] \longleftrightarrow B_s[\ldots]$).

This enrichment relies on the idea that a speaker might be in the same epistemic status with regard to various alternatives, just because she believes that these alternatives are equivalent. As the following result shows, this is even weaker than assuming the kind of competence used for the standard epistemic step:

(42) Strengthening Similarity and Epistemic Step:
If the speaker is opinionated about X and Y (i.e. $C_s[X]$ and $C_s[Y]$), the following statements are equivalent:

a. $B_s[X] \longleftrightarrow B_s[Y]$ (weak e-similarity)

b. $B_s[X \longleftrightarrow Y]$ (strong e-similarity)

10 In other words, this applies to “non-weaker alternatives”. This departs a bit from the bare Maxim of Quantity which would require here “stronger alternatives”. In fact, without this assumption, non-monotonic environments would be implicature-less. See also footnote 1.

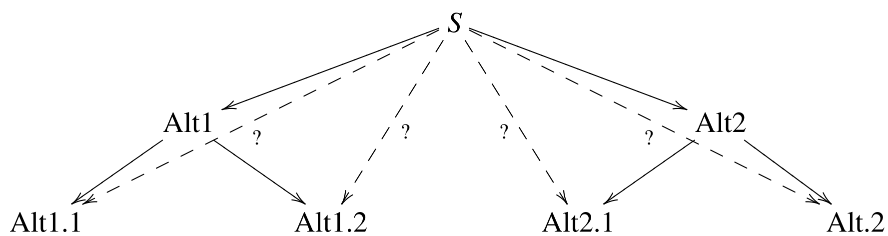
11 Alternatively, one could say that whenever there is reason to doubt that the speaker is competent about one of the alternatives, there is good reason to doubt that she is competent about all of them. This is in essence what Geurts (2007a) argues for, on the basis of the apparent fragility of the exclusive inference of disjunctive sentences. The same could be applied mutatis mutandis to the present proposal.

2.2.3 One more step ahead: Multiple replacements

Caution: This section is rather technical and the reader might want to come back to it when necessary. The explicit presentation of these details is necessary to ensure correct predictions for (i) fragile scalar implicatures (e.g., so-called embedded implicatures in the scope of universal quantifiers), and (ii) cases where a scalar item is embedded under a presupposition trigger.

What happens if a sentence contains multiple sources of alternatives? The standard neo-Gricean view postulates that all sources of alternatives should be explored simultaneously. In other words, alternative sets are closed under transitive closure. It is unclear what would be the equivalent move in the present framework: should the similarity constraint apply to similar alternatives of similar alternatives? There is no reason why it should be so. In the diagram (43), the transformations from S to Alt1.1 and from S to Alt2.2 for instance may not be comparable at all, in what sense should Alt1.1 and Alt2.2 be similar then?[12]

(43) Are similar alternatives (Alt1.1, Alt1.2, Alt2.1, Alt2.2) of similar alternatives (Alt1, Alt2) similar alternatives to the original sentence?



If we want several sources of alternatives to produce higher order sources of alternatives, we need to consider which combination of possible transformations are permissible. I suggest that a higher order version of the Similarity principle should be the following: similar alternatives should be so similar that if you modify them in exactly the same way (i.e. by applying to each of them the exact same transformation), the similarity constraint applies to the sets of alternatives you obtain. This is illustrated in (44b), and exemplified in (45).

(44) Similar alternatives which undergo the exact same transformation produce similar alternatives.
Constraints on the second transformation g:

a. The second transformation g should not apply at a more embedded level than the one at which lies the source of the f_1 and f_2 transformations.

12 Notice also that an alternative to the alternatives of S is S itself. There is no reason why S should be similar to anything.

b. To make sure that the second transformation g is indeed the exact same on both sides, i.e. it is a replacement of the same lexical item and *not* the same type of replacements applied to different tokens, one can check that the route (ii) leads to the same alternatives Alt1' and Alt2'.

i.
$$\begin{tikzcd} & S \arrow[dl, "f_1"'] \arrow[dr, "f_2"] & \\ \text{Alt1} \arrow[d, "g"] & & \text{Alt2} \arrow[d, "g"'] \\ \text{Alt1'} & & \text{Alt2'} \end{tikzcd}$$

ii.
$$\begin{tikzcd} & S \arrow[d, "g"'] & \\ & S' \arrow[dl, "f_1"'] \arrow[dr, "f_2"] & \\ \text{Alt1'} & & \text{Alt2'} \end{tikzcd}$$

Hopefully, the following example is simple enough to clarify the previous details.[13]

(45) All the students read some of the books.
Schematically: All the students are x's such that x read some of the books

a. Replacing the most embedded item first:
– All the students are x's such that x read all the books.,
– All the students are x's such that $\bot$.

b. We can then apply the same replacement { *some* $\leftarrow$ *all* } to the topmost item:
– Some students are x's such that x read all the books.,
– Some students are x's such that $\bot$.

c. Replacing the topmost item alone:
– Some students are x's such that x read some of the books.,
– $\top$

It seems to me that the move I propose is the most natural given the present framework. This choice is also empirically motivated by two relatively independent types of cases: scalar items embedded under another scalar item, or under a presupposition trigger. In this last type of cases, the present theory makes a new range of predictions which are empirically correct, see section 4.7.

2.3 Outlook

Various transformations may be applied to derive the alternatives to a given sentence. Some of these transformations are similar: replacements of a given scalar item

13 I ignore useless sets of similar alternatives which contain a single element (e.g., $\{\top\}$) or the same element several times (e.g., $\{\top, \top\}$). I also do not show when some sets of alternatives may be derived via different sequences of replacements.

with various weaker scale-mates, replacements of a given scalar item with various stronger scale-mates, or replacements of a connected phrase with one or the other of the two connected phrases. The Similarity principle (39) requires that similar transformations yield e-similar alternatives, i.e. alternatives which have the same status in the speaker's mind: $B_s[X] \longleftrightarrow B_s[Y]$. Any of these relatively weak inferences may be enriched into $B_s[X \longleftrightarrow Y]$ if the result is consistent with all the weak inferences.

The three main steps of the derivation are repeated below:

Step 1: similar transformations and sets of alternatives

Identify first the similar transformations which apply to the sentence S. There are two sources of transformations (scales and connectives) and three sets of similar transformations:

(46) Similar transformations
   a. Stronger replacements (from a scale).
      (e.g., $\{\text{MANY} \rightarrow \text{ ALL }\}$, $\{\text{MANY} \rightarrow \bot\}$)
   b. Weaker replacements (from a scale).
      (e.g., $\{\text{SOME} \leftarrow \text{MANY}\}$, $\{\top \leftarrow \text{MANY}\}$)
   c. Each connective can be split in two.
      (schematically: $\{\text{A}\otimes\text{B}\rightarrow\text{A}\}$, $\{\text{A}\otimes\text{B}\rightarrow\text{B}\}$)

Each of these sets of transformations produce a set of similar alternatives. Optionally, any transformation τ that you can apply to each member of a set of similar alternatives produces a set of second order similar alternatives (see section 2.2.3 for details). Schematically, we end up with sets of alternatives as follows:

(47) Sets of similar alternatives:
   a. $\{\ X_1\ ,\ X_2\ \}$,
   b. $\{\ Y_1\ ,\ Y_2\ \}$,
   c. $\{\tau(X_1), \tau(X_2)\}$, ...

Step 2: weak e-similarity

The principle requires that similar alternatives should be e-similar. So for the sets of alternatives in (47) above, we would obtain:

(48) Weak e-similarity inferences:
   a. $B_s[\ X_1\ ] \longleftrightarrow B_s[\ X_2\ ]$,
   b. $B_s[\ Y_1\ ] \longleftrightarrow B_s[\ Y_2\ ]$,
   c. $B_s[\tau(X_1)] \longleftrightarrow B_s[\tau(X_2)]$, ...

Step 3: Strong e-similarity

The last step is to derive strong e-similarity inferences: Strengthen each of the inferences above that can be strengthened consistently with all of these inferences (and consistently with the assertion itself as well).

(49) Strong e-similarity inferences:

a. ✓ $B_s[\ X_1 \longleftrightarrow X_2\ ]$ consistent with the inferences in (48),

b. ⋆ $B_s[\ Y_1 \longleftrightarrow Y_2\ ]$ blocked because inconsistent with (48),

c. ✓ $B_s[\ \tau(X_1) \longleftrightarrow \tau(X_2)\ ]$ consistent with (48), hence, goes through, etc.

3 Application to scalar implicatures

The previous section set up the details of my proposal. In this section, I go over various examples to show the proposal at work. It is worth going through some computations for a number of examples because the form of the procedure is a bit unusual. Yet, I think the first examples show that the computations are fairly simple, even when the number of alternatives grows significantly (and this is very different from exhaustivity accounts à la van Rooij & Schulz 2004; Spector 2006; Fox 2007).

The predictions are spelled out as much as possible, but after a few examples, I restrict my explicit comments to the most relevant parts of the derivations. The steps of the derivation are recapitulated in (50) (more details can be found in the outlook above in section 2.3):

(50) Implicature Derivation:

a. Recognize the sources of alternatives, and derive the sets of similar alternatives,

b. Derive weak e-similarity inferences,

c. Strengthen previous inferences into strong e-similarity inferences, wherever it is consistent to do so.

Section 3.1 goes over three simple cases in detail: non-embedded scalar items, scalar items embedded under negation and a simple disjunctive sentence. Section 3.2 reports general results which the previous simple examples illustrate. In section 3.3, I explain how similarity accounts for free choice effects in various configurations. I discuss various secondary issues in section B.

3.1 Simple cases

In this section, I show similarity at work for simple cases: non-embedded scalar items, scalar items embedded under negation and a simple disjunctive sentence.

The first two examples use the scalar item 'many'. This might be a surprising choice since the implicatures associated with this item seem to be less robust than others, as if this item was not so firmly anchored in its scale. The reason for this choice is that 'many' has both weaker and stronger alternative items ('some' and 'all', respectively). Thus, it will illustrate at once the behavior of weak and strong items in a given scale.

As a result, the scalar item 'many' involves relatively many alternatives, and this might give the wrong impression that the computations are unusually complicated in rather simple cases. In fact, it seems to me that the computation load involved in the present framework is quite lower than in exhaustivity frameworks *à la* van Rooij & Schulz (2004), Spector (2006) or Fox (2007). Indeed, exhaustivity based mechanisms require one to keep track of all the alternatives at once and to decide how many of them you want to rule out on the basis of the consequences of ruling out one subset or the other.[14] In the present framework, alternatives are clustered together from the moment they are derived, and inferences follow straightforwardly from this clustering.[15]

3.1.1 A positive case in detail

Let's go through example (51) in detail.

(51) Mary read many of the books.
Schematically: MANY

The first step is to recognize the possible transformations that the sentence can undergo. There is only one scalar item in (51), it may be replaced by stronger or weaker items. Hence, we obtain two sets of similar alternatives given in (52a) and (52b).

(52) Sets of similar alternatives for (51):
   a. Stronger replacements: { ALL , $\perp$ }
   b. Weaker replacements: { SOME, $\top$ }

14 See de Jager (2007) for formal arguments to the conclusion that, despite its heavy computational load, the exhaustivity procedure is a "natural" operation.

15 These considerations by themselves do not constitute an argument in favor of one framework or another. Yet, these types of considerations may lead to distinguish the accounts. Quite generally, the computation load should increase with the number of alternatives involved. However, there is a case where the sets of alternatives involved are quite different in the various frameworks: free choice permission. Exhaustivity accounts predict free choice inferences to pattern as scalar implicatures involving multiple replacements, while similarity predicts them to behave as simple scalar implicatures. This would be worth investigating with psycholinguistics procedures.

Similarity requires that similar alternatives should be e-similar: the sets of similar alternatives obtained in (52) should feed statements of the form "$B_s[\,...\,] \longleftrightarrow B_s[\,...\,]$". At this stage, we obtain two inferences. The first inference in (53a) corresponds to the usual neo-Gricean primary implicature: it is not the case that the speaker believes that Mary read all the books, which is indeed a globally stronger alternative. The second inference (53b) is unproblematic: the speaker believes that Mary read some of the books (a globally weaker alternative), this is already entailed by the sentence.

(53) Weak Epistemic Similarity: (general form: $B_s[\,...\,] \longleftrightarrow B_s[\,...\,]$)

a. $B_s[\ \text{ALL}\ ] \longleftrightarrow B_s[\,\bot\,]$ i.e. $\neg B_s$[Mary read all the books.]

b. $B_s[\,\text{SOME}\,] \longleftrightarrow B_s[\,\top\,]$ i.e. B_s[Mary read some of the books.]

The next step is to enrich the previous inferences. In practice, this amounts to making the similar alternatives in (52) feed formulas of the form "$B_s[\,... \longleftrightarrow ...\,]$", and check whether the result is consistent with the speaker believing the sentence and the inferences previously derived in (53). No strengthening is blocked in this case. The (a) inference gets strengthened exactly as it would be through a standard epistemic step. Schematically, an inference about s not believing x to be true (i.e. $\neg B_s[\,x\,]$) gets enriched into the inference that s believes x to be plainly false (i.e. $B_s[\,\neg x\,]$). This illustrates the rather general pattern discussed in (42). The (b) inference remains the same, and this is not surprising since it is already epistemically strong (in the sense that it denotes an overt belief).

(54) Strong Epistemic Similarity: (general form: $B_s[\,... \longleftrightarrow ...\,]$)

a. $B_s[\ \text{ALL} \longleftrightarrow \bot\,]$ i.e. B_s[¬Mary read all the books.]

b. $B_s[\,\text{SOME} \longleftrightarrow \top\,]$ i.e. B_s[Mary read some of the books.]

Overall, we obtain the standard reading of the sentence which is paraphrased in (55): the stronger alternative where 'all' replaces 'many' is false. This result is obtained in two steps which are entirely standard. The weaker alternative obtained by replacing 'many' with 'some' did not add any inference, apart from inferences which are already entailed by the sentence.

(55) Overall meaning for (51):
Mary read many of the books, but not all the books.

3.1.2 The same thing under negation

What happens when the previous sentence is embedded under negation as in (56)? In the standard case, the status of the alternatives are reversed: the weaker items produce new implicatures while the stronger items become inactive. This is also what we see in the detailed steps in (57-59). One can check in particular that the epistemic step goes exactly as expected for the (b) inferences. Overall, we obtain the usual reading paraphrased in (60). Again, this amounts to rejecting stronger alternatives.

(56) Mary didn't read many of the books.
Schematically: $\neg$(MANY)

(57) Sets of similar alternatives for (56):
  a. Stronger replacements: $\{\neg($ ALL $), \neg(\ \bot\ )\}$ i.e. $\{\neg$ ALL $, \top\}$
  b. Weaker replacements: $\{\neg($SOME$), \neg(\ \top\ )\}$ i.e. $\{\neg$SOME$, \bot\}$

(58) Weak Epistemic Similarity: (general form: $B_s[\ ...\ ] \longleftrightarrow B_s[\ ...\ ]$)
  a. $B_s[\neg$ ALL $] \longleftrightarrow B_s[\top]$ i.e. $B_s[\neg$Mary read all the books.$]$
  b. $B_s[\neg$SOME$] \longleftrightarrow B_s[\bot]$ i.e. $\neg B_s[\neg$Mary read some of the books.$]$

(59) Strong Epistemic Similarity: (general form: $B_s[\ ... \longleftrightarrow ...\ ]$)
  a. $B_s[\neg$ ALL $\longleftrightarrow \top]$ i.e. $B_s[\neg$Mary read all the books.$]$
  b. $B_s[\neg$SOME $\longleftrightarrow \bot]$ i.e. $B_s[$ Mary read some of the books. $]$

(60) Overall meaning for (56):
Mary didn't read many of the books, but she read some of them.

Interestingly, notice that the strong versions of the implicatures obtained for (51) and its negation (56) are exactly the same: (54)=(59). This is a fairly general pattern discussed in (73). The reason why this pattern is expected is given in (61): if a sentence S entails one of its alternatives Alt, the negation of S implicates this alternative Alt, and the same holds the other way round. Hence, Alt is an inference of both the sentence S and its negation ¬S.

(61) a. S entails Alt.
  b. Therefore, ¬Alt entails ¬S (by contraposition)
  i.e. ¬Alt is stronger than ¬S.
  c. ¬S implicates the negation of its stronger alternatives.
  i.e. ¬S implicates ¬(¬Alt)=Alt.

This will provide more fruitful results for presupposition projection.

3.1.3 A bare disjunction

Let's move to a simple disjunctive sentence:

(62) Mary ate an apple or a banana.
Schematically: A $\vee$ B

One difference with examples (51) and (56) is that there are now two sources of alternatives: the scale $\langle \top, \text{OR}, \text{AND}, \bot \rangle$ and the fact that 'or' is a connective. This leads to the three sets of similar alternatives in (63) below. The set in (63c) contains only one sentence, so that similarity is vacuous and this set can be ignored.

(63) Sets of similar alternatives for (62):

a. Connective split: $\{\ \text{A}\ ,\ \text{B}\ \}$

b. Stronger replacements: $\{\ \text{A}\wedge\text{B}\ ,\ \bot\ \}$

c. Weaker replacements: $\{\top\}$ (but singletons can be ignored)

Similarity yields the expected primary implicatures. In particular, (64b) states that the speaker does not believe that the stronger alternative derived from the scale is true. This inference together with (64a) implies that the speaker is ignorant about each disjunct: (i) if she believed one of them to be true, she would have to believe both (because of (64a)) and this conflicts with (64b); and (ii) if she believed one of them to be false, the assertion would require that she believes the other one to be true, but this would now violate similarity.

(64) Weak Epistemic Similarity: (general form: $B_s[\ ...\ ] \longleftrightarrow B_s[\ ...\ ]$)

a. $B_s[\ \text{A}\ ] \longleftrightarrow B_s[\ \text{B}\ ]$

b. $B_s[\ \text{A}\wedge\text{B}\ ] \longleftrightarrow B_s[\ \bot\ ]$

i.e. $\neg B_s[$ Mary ate both an apple and a banana. $]$

The strengthening step does not go through as easily as before. In particular, (65a) is blocked. Indeed, given the assertion, (65a) would require that the speaker believe both disjuncts to be true, and this conflicts with the previous inference (64b). The other inference can be strengthened consistently, and again, it is a strengthening of the usual form: $\neg B_s[\ ...\ ]$ becomes $B_s[\ \neg ...\ ]$.[16]

(65) Strong Epistemic Similarity: (general form: $B_s[\ ... \longleftrightarrow ...\ ]$)

a. $*\ B_s[\ \text{A} \longleftrightarrow \text{B}\ ]$

b. $B_s[\ \text{A}\wedge\text{B} \longleftrightarrow \bot\ ]$

i.e. $B_s[\ \neg$Mary ate both an apple and a banana. $]$

(66) Overall meaning for (62):

Mary ate one of the fruits, not both, and I don't know which.

16 Alternatively, one could also say that the fact that one of the strengthening is blocked casts doubt on the necessary contextual assumptions needed for any strengthening to go through. In this case, we would stick to the inferences in (64). This seems to be the option that Geurts (2007a) argues for on the basis of the fragility of the exclusive inference of disjunctions. To simplify the presentation, I stick here to the more conservative version: strengthening is entertained for each alternative independently.

Overall, we obtain the usual meaning with an exclusive disjunction and ignorance implicatures. In appendix C, I extend this result: multiple disjunctions of the form $\text{A}_1 \vee \ldots \vee \text{A}_n$ have an exclusive reading ("only one of the disjunct is true"), and trigger ignorance implicatures ("the speaker does not know which disjunct is true"):

(67) Mary ate an apple, a banana, a coconut, ... or an orange.
Schematically: $\text{A}_1 \vee \ldots \vee \text{A}_n$

(68) Overall meaning derived for (67):
  a. The speaker believes that exactly one of the disjunct holds.
  b. The speaker does not know which disjunct holds.

The strengthening of the similarity inference prompted by the connective 'or' was blocked by an inference due to the fact that 'or' is also in competition with 'and'. If this parasitic inference gets out of the way, the strong version of the inference should become available. As we will see in section 3.3, this scenario happens for instance when the disjunction is embedded under an existential modal (see (77)). The strengthened version of (64a) is in (77a), it yields the desired free choice effects.

3.2 Intermediate general results

Before going on with the list of predictions derived from similarity, I explicitly state some general results which were already suggested in the previous sections. The reader who is not interested in the explicit formulation of such general results may skip this section.

3.2.1 Similarity and neo-Gricean predictions

I showed several examples where both the results and the various steps of the computations mirror pieces of neo-Gricean procedures. In fact, the present proposal encodes Gricean intuitions such as the idea that items stronger than the one uttered were too strong. The following result shows that this comparison is quite general:

(69) Gricean predictions in easy contexts:
For sentences containing a scalar item in a well-behaved monotonic environment, Similarity predicts that the speaker does not believe stronger alternatives to be true.
Well-behaved monotonic environments are:
  a. Upward entailing environments φ such that $\varphi(\bot) = \bot$;
  b. Downward entailing environments φ such that $\varphi(\top) = \bot$.

(70) Proof of (69):

a. In upward entailing environments, stronger alternatives are obtained by replacing the scalar item with a stronger scalar item. Similarity should thus apply as follows: $B_s[\,\varphi(\text{weaker-item})\,] \longleftrightarrow B_s[\,\varphi(\bot)\,]$, where φ(stronger-item) is overall stronger than the original sentence. If the environment $\varphi(...)$ satisfies the constraint (a) above, the result follows straightforwardly from the fact that the right-hand side of the inference is false.

b. In downward entailing environments, stronger alternatives are obtained by replacing the scalar item with a weaker scalar item. Similarity should thus apply as follows: $B_s[\,\varphi(\text{weaker-item})\,] \longleftrightarrow B_s[\,\varphi(\bot)\,]$, where φ(weaker-item) is overall stronger than the original sentence and the rest of the result follows as above.

The similarity proposal also seems to have a non-Gricean counterpart: many entailments come up as implicatures (e.g., (53b) and (58a)). Of course, these additional inferences are empirically unproblematic: if S entails x, S may or may not implicate x as well.

More interestingly, similarity straightforwardly derives what needs to be further added to the bare Gricean maxim of quantity in non-monotonic environments (see footnote 1, and (87) for an application):

(71) For sentences containing a scalar item in a well-behaved non-monotonic environment, Similarity predicts that the speaker does not believe the alternatives to be true. (Well-behaved non-monotonic environments being environments such that: $\varphi(\bot) = \varphi(\top) = \bot$).

The proof is straightforward: similarity requires that alternatives are equivalent to either $\varphi(\bot)$ or $\varphi(\top)$, and both are false. I briefly exemplify this below, see (87) for a similar example.

(72) Exactly five students did some of the readings.

a. Alternative: Exactly five students did all the readings.

b. Similarity prediction: The alternative above is e-similar to ‘Exactly five students satisfy the contradiction.’ This is false, hence the inference that among the five students who did any of the readings, not all of them did all the exercises.

c. Gricean situation: the alternative is not stronger than the sentence, hence the prediction does not follow from the bare maxim of quantity.

In the present framework, a natural property to classify environments is not their monotonicity but rather the effect they may have on super weak and strong items. I leave for future research a closer investigation of the role of this property in natural language, and its interaction with polarity items in particular.

3.2.2 Similarity and negation

(73) provides a general result about the comparison between the implicatures of a given sentence and the implicatures of its negation. This result will play an important role when we turn to presuppositions.

(73) Negation does not modify *strong* similarity implicatures, provided that:
  a. The sources of alternatives remain the same for the sentence and its negation;
  b. Nothing blocks strengthening in one case and not the other. (e.g., strong e-similarity is blocked for the sentence, but not for its negation)

(74) The proof of (73) relies on the basic equivalence between the statements in (a) below, which leads to the equivalence between the statements in (b):
  a. i. $\neg X \longleftrightarrow \neg Y$
     ii. $X \longleftrightarrow Y$
  b. i. $B_s[\neg X \longleftrightarrow \neg Y]$
     ii. $B_s[X \longleftrightarrow Y]$

The comparison of (51) with its negation (56) already shows that having the exact same implicatures ((54)=(59)) might have different consequences depending on how these implicatures combine with the bare meaning of the sentences. This is an important point which I illustrate again in (75) and (76) with question-answer scenarios.[17]

(75) a. – Which of John and Mary came to the party?
     – John.
  b. Inferences:
     i. $B_s[J \wedge M \longleftrightarrow \bot]$, i.e. both did not come, hence Mary did not come.
     ii. $B_s[J \vee M \longleftrightarrow \top]$, this is an entailment of the sentence.
  c. Overall: John came, and Mary did not.

(76) a. – Which of John and Mary came to the party?
     – Not John.
  b. Inferences (same as above):
     i. $B_s[J \wedge M \longleftrightarrow \bot]$, this is an entailment of the sentence.
     ii. $B_s[J \vee M \longleftrightarrow \top]$, i.e. one of the two came, hence Mary came.
  c. Overall: John did not come, and Mary did.

17 In this context, I assume that $J \wedge M$ and $J \vee M$ are alternatives to J. It is not entirely clear that $J \vee M$ should be an alternative (e.g., is it a positive answer to the question?). If it is not an alternative, nothing changes for the positive case (75), but then the additional implicature for (76) is lost. This might be an accurate prediction, see Spector (2006).

3.3 Free choice permission

A major problem for theories of scalar implicatures, and in particular for globalist theories, is to predict free choice effects (see discussion above about example (5)).

In the present framework, free choice inferences correspond to the strong e-similarity of alternatives obtained by splitting a connective in two. For bare disjunctions like (62), the strong version of this similarity inference is blocked by another inference: the exclusive reading of the disjunction. Free choice effects will arise exactly in these cases where this type of interferences is out of the way. In particular, Similarity predicts an alternation between free choice effects and potential blockers.

3.3.1 The basic effects

As discussed in the introduction, free choice effects constitute an important worry for current theories of scalar implicatures. The present framework was primarily designed to handle them, examples (77) and (78) show how this is achieved. Connectives carry a similarity assumption about the phrases they conjoin. When nothing blocks this assumption to wear its strong guise (i.e. the speaker believes both alternatives to be equivalent), free choice effects arise, and disjunctive sentences acquire a conjunctive meaning. This happens when a disjunction is embedded under an existential modal as in (77), or when a conjunction is embedded under the negation of a universal modal as in (78). Both cases are entirely parallel, I focus my comments on (77).

Example (77) reports the last step of the derivation: (77a) corresponds to the Similarity inferences coming from the split of the connective in two; (77b) is the Similarity inference coming from stronger replacements of 'or' in its scale. I present these inferences in their strong versions right away. It is clear that both weak inferences can be strengthened into these strong versions, simply because the overall result is consistent. We can check that free choice effects follow from (77a). The speaker believes that at least one among $\Diamond$A and $\Diamond$B is true (the assertion $\Diamond$(A$\vee$B) is equivalent to $\Diamond$A$\vee\Diamond$B). According to (77a), the speaker believes that both have the same-truth value, and we then conclude that the speaker believes that both are true.

(77) You may eat an apple or a banana.
Schematically: $\Diamond(\text{A}\vee\text{B})$
a. $\text{B}_\text{s}[\ \Diamond\text{A} \longleftrightarrow \Diamond\text{B}\ ]$, hence: $\text{B}_\text{s}[\ \Diamond\text{A}\ ]$ and $\text{B}_\text{s}[\ \Diamond\text{B}\ ]$
b. $\text{B}_\text{s}[\ \Diamond(\text{A}\wedge\text{B}) \longleftrightarrow \Diamond(\bot)\ ]$, i.e. $\text{B}_\text{s}[\ \neg\Diamond(\text{A}\wedge\text{B})\ ]$

(78) You are not required to eat an apple and a banana.
Schematically: $\neg\Box(\text{A}\wedge\text{B})$
a. $\text{B}_\text{s}[\ \neg\Box\text{A} \longleftrightarrow \neg\Box\text{B}\ ]$, hence: $\text{B}_\text{s}[\ \neg\Box\text{A}\ ]$ and $\text{B}_\text{s}[\ \neg\Box\text{B}\ ]$
b. $\text{B}_\text{s}[\neg\Box(\text{A}\vee\text{B})\longleftrightarrow \neg\Box(\top)\ ]$, i.e. $\text{B}_\text{s}[\ \Box(\text{A}\vee\text{B})\ ]$

How did it work? In cases of a bare disjunction such as (62) the exclusive inference corresponding to (77b) prevents the inference corresponding to the connective split to be strengthened. When the disjunction is embedded, this exclusive inference is weakened, it states that both options might not be possible *at the same time*. The inference from the connective split can thus be strengthened consistently with this weak inference, and deliver the free choice effect for (77).

In other words, free choice effects correspond to the natural tendency of the weak version of the similarity inferences coming from connective splits to be strengthened. This tendency is sometimes blocked for independent reasons such as the incompatibilities with other primary inferences of the sentence. In the next section, I review various configurations where no such intervention blocks free choice effects.

3.3.2 Quantification and free choice

In the previous section, I argued that free choice effects arise in configurations where nothing prevents the Similarity inference driven by the split of a connective to be strengthened into its strong version. This happens in modal environments, and in various quantificational configurations as well. For instance, (77) and (79) are entirely parallel: a disjunction is embedded under existential quantification, over possible worlds in (77), over individuals in the case of (79). As a result, the predictions are entirely parallel as well, nothing blocks the strengthening of the Similarity inference (check that the sentence and its inferences (79a) and (79b) are compatible). In short, the present theory predicts that the disjunctive sentence (79) should acquire a conjunctive meaning (a free choice effect), and this is an accurate result.

(79) Some students skipped exercise A or exercise B.
Schematically: $\exists x$, $A(x) \vee B(x)$

a. $B_s[\, \exists x, A(x) \longleftrightarrow \exists x, B(x) \,]$,
hence: $B_s[\, \exists x, A(x) \,]$ and $B_s[\, \exists x, B(x) \,]$
i.e. $B_s[$ Some students skipped A, and some skipped B $]$

b. $B_s[\, \exists x, A(x) \vee B(x) \longleftrightarrow \exists x, \perp \,]$,
i.e. $B_s[\, \neg \exists x, A(x) \wedge B(x) \,]$
i.e. $B_s[$ No student skipped both A and B $]$

The parallel between modals and quantifiers with respect to free choice effects was noticed independently by Fox (2005), Eckardt (2006) and Klinedinst (2006). Klinedinst noticed that free choice effects disappear in singular existential sentences such as (80-82). This generalization is natural in the present framework. Singular indefinites suggest that, as far as the speaker can tell, it is not the case that several individuals satisfy the property under discussion.[18] This weak uniqueness inference blocks free choice effects: if only one individual satisfies A or B, if no individual satisfies both A and B, it is not possible to find both an individual that satisfies A, and an individual that satisfies B.

(80) Some student skipped exercise A or exercise B.

(81) Somewhere in France, it is raining or snowing.

(82) At some point in the past, John ate an apple or a banana.

More precisely, the present framework predicts a correlation: free choice effects arise when conflicting factors (mainly other inferences) vanish. In particular, the conflicting uniqueness inferences above do not seem so robust to me, and it seems possible to recover free choice effects. I prefer to illustrate this type of situations with bare disjunctions. When the exclusive inference is implausible, for instance because it would lead to implausible ignorance implicatures, free choice effects should reappear.[19] This is illustrated in (83-84).

(83) There is beer in the fridge or the ice bucket.
Free choice inference: There is beer in both places. (e.g., Fox 2007)

(84) Hi John, make yourself at home, there is beer or wine.
Free choice inference: There is both beer and wine.

Finally, we can also reproduce this effect with a conjunction under negation. The inference in (85) can be accounted for by saying that conjunction takes wide-scope over negation, but it might very well be a kind of free choice inference parallel to (83-84): the two sides of the connectives are equivalent.[20]

(85) Mary and Sue didn't come.
? Free choice inference: Mary didn't come, and Sue didn't come.

3.3.3 Quantification and anti-free choice effects

Free choice effects arise in configurations where the strong version of the similarity inference due to the connective split is not blocked. Usually, this produces the inference that both resulting alternatives are true, but in some cases, we find the exact opposite inference: both alternatives are false. This happens for instance when

18 Spector (2007) argues that this uniqueness inference is itself an implicature.

19 This suggests that there is a hierarchy between the various similarity inferences involved.

20 This example raises a new issue: what is the relation between Similarity and the homogeneity presupposition advocated by Schwarzschild (1993), Löbner (1995) and Beck (2001) (see also recent cross-linguistic discussion in Szabolcsi & Haddican 2004)?

a disjunction is embedded under a universal quantifier as in (86). The exclusive reading of the disjunction (86a) does not block the strengthening of the other similarity inference into (86b). However, the consequence is not that both sides of the connective produce true alternatives, but false alternatives: not all students skipped exercise A, and not all skipped exercise B.

(86) Every student skipped exercise A or exercise B.
Schematically: $\forall x, \text{A}(x) \vee \text{B}(x)$
  a. $\text{B}_s[\forall x, \text{A}(x) \wedge \text{B}(x) \longleftrightarrow \forall x, \bot(x)]$
  b. $\text{B}_s[\quad \forall x, \text{A}(x) \quad \longleftrightarrow \forall x, \text{B}(x)]$, hence: $\text{B}_s[\, \neg\forall x, \text{A}(x)\,]$ and $\text{B}_s[\, \neg\forall x, \text{B}(x)\,]$

The following example illustrates the effect of this pattern in non-monotonic environments. The overall result is that (87) implicates that among the five students who did one of the two: (i) not all of them did both (see (87a)), i.e. some of the five did only one of the two; (ii) not all of the five did A and not all of the five did B (see (87b)), i.e. some did A and some did B.

(87) Exactly 5 students did exercise A or exercise B properly.
Schematically: $\textsc{Five}(\text{A} \vee \text{B})$
  a. $\text{B}_s[\textsc{Five}(\text{A} \wedge \text{B}) \longleftrightarrow \ \textsc{Five}(\bot)\ ]$
  b. $\text{B}_s[\ \ \textsc{Five}(\text{A}) \ \longleftrightarrow \ \ \textsc{Five}(\text{B})\ \ ]$, hence: $\text{B}_s[\, \neg\textsc{Five}(\text{A})\,]$ and $\text{B}_s[\, \neg\textsc{Five}(\text{B})\,]$

3.3.4 Simplification of disjunctive antecedents

Counterfactuals

It is well-known that disjunctions in antecedents of counterfactual conditionals also generate an overall conjunctive meaning (see Fine 1975; Nute 1975; Lewis 1977), although it is not validated by the usual semantics for counterfactuals (e.g., Lewis 1973):

(88) If John had studied hard or cheated, he would have passed.
Inference: If John had studied hard, he would have passed, and if he had cheated, he would have passed. (from Klinedinst 2006)

This inference is predicted just as other free choice effects in the present framework: it follows from the strong version of Similarity applied to the connective split, nothing blocks this strong version.

Desires and definite descriptions

The present analysis naturally extends to every environment which has a similar semantics. I shortly present two such non-monotonic environments which confirm this prediction: desire verbs and definite descriptions.

Stalnaker (1984) argues for a semantics of desire verbs based on conditionals (see Heim 1992 for a more explicit discussion). As a result, we expect free choice effects just as for the example above:

(89) John would be happy to go to the movies or to the theater.
Inference: John would be happy to go to the movies, and John would be happy to go the theater.

Lewis (1973) noticed a similar parallel between conditionals and definite descriptions (see Schlenker 2004 for a more explicit discussion). As before, the expected free choice effects do arise for definite descriptions:

(90) The students who went to the movies or to the theater are tired today.
Inference: The students who went to the movies and the students who went to the theater are tired today.

3.3.5 Two problems

Wide scope disjunctions

Zimmermann (2000) pointed out that free choice inferences are available even when the disjunction takes wide scope over the existential modal, at least on the surface, as in (91). (see Alonso-Ovalle 2005, Simons 2005, Fox 2007 and Klinedinst 2006 for discussion).

(91) You may eat an apple or you may eat a banana.

This is a problematic example for most accounts because free choice is incompatible with the exclusive reading of the disjunction. In the present framework, the competition between the two inferences is entirely explicit. Provided that the exclusive reading of the disjunction does not surface, free choice is expected. The puzzle then is to explain why the disjunction does not yield its exclusive reading as expected. I do not have a conclusive explanation for these facts, but I would like to notice add two more pieces to the discussion.

First, notice that the alternative (92) where the disjunction is replaced with a conjunction shows the same reverse scope reading and conveys that both options are possible at the same time: you may eat both an apple and a banana. Hence, the scope problem seems to be more general than disjunction.

(92) You may eat an apple and you may eat a banana.
(= You may eat both an apple and a banana.)

Again, the crucial bit for the present proposal is that there is a correlation between free choice and the absence of the wide scope exclusive reading of the disjunction. In (93-95), I show that changing the modal, or varying the overt material from one disjunct to the other strengthens the exclusive inference, and accordingly weakens free choice.

(93) Mary may eat an apple, or Mary may eat a banana.
(Wide scope exclusive reading, no FC)

(94) John is allowed to eat an apple, or Bill is allowed to eat a banana.
(possible wide scope exclusive reading, FC otherwise)

(95) You may eat an apple, or Bill is allowed to eat a banana.
(no wide scope exclusive reading, FC)

'An odd number'

Before concluding this section on free choice, I present a very different type of potential problem. Consider example (96). The weak e-similarity inference associated with the connective split is problematic.[21] If we want the total to be odd, it cannot be that there is an odd number of A-students and also an odd number of B-students, neither can it be that there is an even number of A-students and an even number of B-students. Hence, the similarity inference entails that the speaker is not sure about the number of A-students and B-students, and this might be too strong. I leave this question for future research, mainly because I am not sure that this prediction is problematic, and admittedly I am comfortable with the bold claim that these types of sentences do not give rise to pragmatic enrichments to begin with.

(96) Context: A math teacher reports on the results of his students at their last exam.
Utterance: For their last exam, an odd number of students got As or Bs.
Prediction: B_s[An odd number got As] $\longleftrightarrow$ B_s[An odd number got Bs]
i.e. the speaker does not know if an odd number got As, or Bs.
(N. Klinedinst, pc.)

3.3.6 Summary of free choice

Free choice is a natural Similarity tendency for sentences containing a connective. However, free choice effects surface only when there is no competing inference.

21 The exclusive inference is irrelevant for this case because each student got only one grade.

Importantly, free choice effects are not tied to the exclusive reading of the disjunction (as it is for Fox 2007),[22] quite the other way round.

3.4 Conclusion for scalar implicatures

In appendix B, I discuss a collection of minor phenomena but I already showed that similarity explains a wide variety of scalar implicatures. For most cases, the results are the same as those derived by the neo-Gricean mainstream. However, the present proposal also naturally accounts for scalar implicatures in non-monotonic environments and for free choice effects.

In the remaining of the paper, I show that the similarity principle can be extended with a handful of hypotheses to account for presupposition projection.

4 Application to presupposition

In this section, I show that the Similarity principle explains presupposition projection. There is only one additional theoretical ingredient to be added: the alternatives associated with presupposition triggers, see section 4.1. In section 4.2, I show that the present proposal is in principle compatible with a view of presupposition as common ground information. In section 4.3, I illustrate the proposal with easy cases, I provide general results in section 4.4. In section 4.5 and 4.6, I review some more environments involving connectives or quantifiers. In section 4.7, I show how similarity applies to cases where scalar items and presupposition triggers interact to produce inferences which would be hybrid if the systems for scalar implicatures and presuppositions were separated.

4.1 Similar alternatives for presupposition triggers

In the previous sections, I explained my solution to the projection problem for scalar implicatures: which inferences are produced by scalar items embedded in various linguistic environments. The solution relies on three ingredients: (i) the alternatives produced by scalar items (scales and connective split); (ii) the way these alternatives were treated (the Similarity principle); and (iii) the usual semantics of the embedding environments. To extend this solution to the projection problem for presuppositions, I define alternatives for presupposition triggers.

22 The "parsing" $\text{exh}(\text{exh}(\Diamond(\text{exh}(\textsc{a})\vee\text{exh}(\textsc{b}))))$ is supposed to explain free choice effects without the exclusive inference, at least in the easy case of a disjunction under an existential possibility modal. I am not at ease with this option, in particular because it requires that the alternatives of each disjunct include the other disjunct. So, to compute $\text{exh}(\textsc{a})$, we would need to compute $\text{exh}(\textsc{b})$ first, but to compute $\text{exh}(\textsc{b})$, we would first need to compute $\text{exh}(\textsc{a})$.

The main intuition is that presupposition triggers raise the question as to whether their presupposition holds. Consider the examples in (97) to (99). The question as to whether the presupposition holds arises naturally.

(97) a. John knows that there is an elephant in the garden.
b. Question: Is there an elephant in the garden?

(98) a. My elephant is sick.
b. Question: Does the speaker have an elephant?

(99) a. I stopped smoking tea.
b. Question: Did the speaker use to smoke tea?

The possible answers to these questions are: p and ¬p. I would like to argue that these are the main alternatives associated with a presupposition trigger S_p. I do not want to argue too much about these specific alternatives: they seem plausible, and they will derive the facts correctly. These are the main motivations for choosing alternatives to scalar items.

The similarity principle would then require that the positive answer pattern with the tautology, and that the negative answer pattern with the contradiction. This is illustrated below:

(100) a.

$$\begin{tikzcd} & p\ ,\ \top \\ S_p \arrow[ur] \arrow[dr] & \\ & \neg p\ ,\ \bot \end{tikzcd}$$

b.

$$\begin{tikzcd} & \text{It's raining}\ ,\ \top \\ \text{John knows that it's raining} \arrow[ur] \arrow[dr] & \\ & \text{It's not raining}\ ,\ \bot \end{tikzcd}$$

The pseudo-scale in (101) yields another representation of the same claim. It is not a plain scale for two reasons: (i) the items in this scale are not all alternatives to each others (S_p is not an alternative to p and ¬p), and (ii) it is not fully ordered. Nonetheless, it will provide a convenient way to represent that p should be similar to the tautology, and that its negation should be similar to the other end of the spectrum: the contradiction.

(101) $\langle \top, p, S_p, \neg p, \bot \rangle$

Notice that S_p may semantically entail p.[23] This would explain why p should pattern with the tautology for instance. To explain why $\neg$p is grouped with $\bot$, I would need to argue that the distinction is not between weaker and stronger alternatives, but rather between weaker and non-weaker alternatives (see also discussion of example (72)). Again, these details do not matter, the main motivation for these alternatives is the wide range of facts they explain.

Hence, a presupposition trigger raises two sets of similar alternatives: the positive alternatives (p and $\top$) and the negative alternatives ($\neg$p and $\bot$). So far, these alternatives are provided by the lexicon, I do not offer a solution to the triggering problem: why do certain lexical items (and not others) trigger these presuppositions? Yet, this is at least as good as standard accounts which stipulate that 'know' presupposes the truth of its complement, while 'believe' does not for instance. The difference lies in the way this claim is represented. The particular representation I propose accounts for the projection problem.

4.2 Where is the common ground?

Since Stalnaker (1970, 1973, 1974), presuppositions are standardly understood as pieces of information which ought to be common ground before the utterance. By definition, a proposition p is common ground (written: CG[p]) if every participant to the conversation believes p, every participant believes that every participant believes p, etc. So, presuppositional sentences should be infelicitous if their presuppositions are not common ground. This constraint is obviously too strong, and it has been refined in many ways (see for instance Stalnaker 1998, 2002, von Fintel 2004 and Schlenker 2006). Geurts (1999b) and Abbott (2000) argue in favor of an apparently different requirement: presupposition triggers convey background information. I do not believe that these various proposals are incompatible (see discussion in Chemla 2008).

Technically: why not?

Similarity is technically compatible with the common ground view of presupposition. The principle was phrased as a constraint on the speaker's state of belief as in (102). There is no difficulty to translate it into a requirement on the common ground as in (103):

(102) Usual similarity:

a. B_s[alternative 1] $\longleftrightarrow$ B_s[alternative 2]

b. B_s[alternative 1 $\longleftrightarrow$ alternative 2]

23 Schlenker (2007) makes use of this claim to motivate a whole theory of presupposition projection.

(103) The common ground version:

a. CG[alternative 1] $\longleftrightarrow$ CG[alternative 2]

b. CG[alternative 1 $\longleftrightarrow$ alternative 2]

Under this modification of Similarity, the projection systems for presuppositions and scalar implicatures would then be different, but both would be based on the same core mechanism: the assimilation of various alternatives.

Presupposition (or backgrounding) is post-hoc

Alternatively, one could argue that the common ground flavor comes from a later process. Consider for instance the sentence John knows that it's raining. We infer from this sentence that the speaker believes that it is raining. The content of this inference (a statements about the world) is rather different from the assertion (a statement about John's beliefs). The sentence thus conveys an uneven set of information, and some pieces of it must be backgrounded. This suggests an informal principle of the following form:

(104) Background principle:
Let S be a sentence such that:
– A is entailed
– B is implied
– A and B are "unrelated" (e.g., A is someone's belief, B is a fact about the world)
Then B gets backgrounded.

So, presuppositions and implicatures could be exactly the same kind of inferences, but some of these inferences become presupposition post-hoc. This type of explanations may even lead to an explanation of the difference between weak and strong triggers, or why the content plays a role for the robustness of scalar implicatures. I would need to develop a precise definition of what counts as "unrelated". The following very restricted and informal table may illustrate the intuition better:

(105)

Inference triggers	Factive verbs	Change of state	Scalar items
Assertion *Inference*	Someone's belief About the world	present facts past facts	Because of scales, both are close
'Relatedness'	low	medium	high
Status	strong trigger	weak trigger	implicature

I leave this suggestion at this intuitive stage. The main focus here is presupposition *projection*.

4.3 Easy cases

I would like to illustrate how the proposal works for the simplest cases. I assume that the verb 'know' triggers the presupposition that its complement p is true, i.e. that it raises two sets of alternatives: $\{\, p, \top \,\}$ and $\{\, \neg p, \bot \,\}$. Example (106) reports the relevant computations when 'know' is not embedded, and (107) spells out the derivation when 'know' occurs under negation.

(106) John knows that it's raining.
Schematically: S_p

a. Similar alternatives:
   i. $\{\ \ p\,,\top\,\}$
   ii. $\{\,\neg p\,,\bot\,\}$
b. Ep.-Similarity:
   $B_s[\ \ p\ \ ] \longleftrightarrow B_s[\ \ \top\ \ ]$
   $B_s[\ \ \neg p\ \ ] \longleftrightarrow B_s[\ \ \bot\ \ ]$
c. Strong Ep.-Similarity:
   $B_s[\ \ p\ \ \longleftrightarrow\ \ \top\ \ ]$
   $B_s[\ \ \neg p\ \ \longleftrightarrow\ \ \bot\ \ ]$
d. Overall: $B_s[\,p\,]$

(107) John doesn't know it's raining.
Schematically: $\neg(\ \ S_p\ \ )$

a. Similar alternatives:
   $\{\,\neg(\ \ p), \neg(\top)\,\}$: $\{\,\neg p, \bot\,\}$
   $\{\,\neg(\neg p), \neg(\bot)\,\}$: $\{\ \ p, \top\,\}$
b. Ep.-Similarity:
   $B_s[\ \ \neg p\ \ ] \longleftrightarrow B_s[\ \ \bot\ \ ]$
   $B_s[\ \ p\ \ ] \longleftrightarrow B_s[\ \ \top\ \ ]$
c. Strong Ep.-Similarity:
   $B_s[\ \ \neg p\ \ \longleftrightarrow\ \ \bot\ \ ]$
   $B_s[\ \ p\ \ \longleftrightarrow\ \ \top\ \ ]$
d. Overall: $B_s[\,p\,]$

The first inference in (106b) entails that the speaker believes that p, and there is no stronger statement anywhere else in the derivation. Hence, there is no need to apply the strong version of the similarity principle (i.e. there is no need to take the epistemic step) to reach the inference that the speaker plainly believes the presupposition. The same is true of the negative case (107), although it comes about through the other set of similar alternatives, the relevant inference is the second one in (107b).

4.4 General results

In this section, I present a few general results of the system. I state these results with very few comments, I come back to their important consequences in subsequent sections.

Negation

The first result in (108) was already discussed for scalar implicatures: strong similarity inferences are the same for a sentence and its negation. For implicatures, this result was not very important because for either the sentence or its negation, the predicted inference was already entailed by the sentence. This result is very welcome for presuppositions which project the same inference for a sentence and its negation, no matter whether these inferences are independently entailed.

(108) Negation:
The strong version of Similarity yields the same inferences for a sentence and its negation.

Propositional logic

There are a few general results which can be easily stated for a fragment of English which excludes any form of quantification.

(109) Propositional logic (proof: Chemla 2006)
a. The predictions are equivalent to the global version of Schlenker (2007).
b. Both sets of alternatives yield the same (strong) similarity inferences.
c. The epistemic step is vacuous in environments φ such that $\varphi(\top) = \top$ or $\varphi(\bot) = \top$.
(this is true for any combinations of disjunctions and negations, the result holds for many sentences with conjunctions and the quantifiers 'every' and 'no' as well).

The result in (a) states that, if we restrict our attention to propositional logic, the system is equivalent to the global version of the Transparency theory presented in Schlenker (2007). The predictions of this global version are strictly weaker than the predictions of dynamic semantics. The difference mainly concerns examples discussed below in section 4.5, I will show that these differences are not problematic.

The next result in (b) could be a bit surprising, it points at a redundancy in the system: both alternatives lead to the same inference. First, this applies only to a restricted fragment of English and the alternatives project different inferences in quantified cases. Second and more interestingly, each alternative induces different *weak* similarity inferences and in most cases, one set of alternatives will provide the full inference without enrichment to the strong version, as the result in (c) spells out.

Extension to other accounts

Eventually, I would like to mention that there is no obvious way to extend the present idea to another account of scalar implicatures. In particular, it is difficult to extract a definition of alternatives which would provide appropriate results for exhaustivity types of accounts:

(110) Export to other scalar implicatures accounts
The alternatives I argue for (p and ¬p) do not yield any results for other accounts of scalar implicatures.

I do not want to develop this negative result in great detail but here are three hints to demonstrate this result:

- The alternatives produced by p and ¬p would conflict with each other, and there is no reason a priori why one of them ends up being "innocently excludable", following the terminology of Fox (2007). (The relevant cases are non-monotonic environments where the assertion cannot help resolving the conflict).
- Keeping only the alternative p would basically amount to saying that presupposition project as scalar implicatures, and this is not true in the case of quantified sentences (see Chemla 2009 for discussion).
- The alternative ¬p alone would produce the wrong result for simple negations: p would be an alternative to $\neg(S_p)$ (because $p=\neg(\neg p)$), and $\neg(S_p)$ does not imply/presuppose the negation of p.

4.5 Proviso problems

For propositional logic, the present proposal is equivalent to the global version of Schlenker (2007). This means that conjunctive sentences, disjunctive sentences and conditionals lead to conditional presuppositions:

(111) It won't stop raining, and Mary will take her umbrella.
Predicted inference: It is not raining, or Mary will take her umbrella.
i.e. If 'Mary will take her umbrella', it is raining.

(112) It will stop raining, or Mary will take her umbrella.
Predicted inference: It is raining, or Mary will take her umbrella.
i.e. If it is not raining, 'Mary will take her umbrella'.

(113) If it stops raining, Mary won't take her umbrella.
Predicted inference: If It is not raining, Mary will take her umbrella.

(114) If Mary takes her umbrella, it will stop raining.
Predicted inference: If Mary does not take her umbrella, it is raining.

Although the case of conjunctions can be treated just as the other cases, I would like to mention independent reasons why it is not problematic. The sentence '$A \wedge S_p$' itself entails that A. It combines with the inference that '$\neg A \vee p$' to lead to the conclusion that p is true. Notice also that I do not believe that there is a linear asymmetry specific to presupposition (see (115)). It seems to me that the question as to why the presupposition trigger cannot be in the first conjunct as in (115b) is orthogonal to presupposition projection. The contrasts at issue can be reproduced with non-presuppositional content, as the parallel between (115) and (116) illustrates (see for discussion Schlenker 2007, and Singh 2007b for a similar asymmetry concerning scalar items and disjunctions).

(115) a. It is raining and it will stop raining.
b. ? It will stop raining and it is raining.

(116) a. It is an animal and a dog.
b. ? It is a dog and an animal.

The other three cases (112-114) are identical: the system predicts an inference of the form "If A, p" while in most standard cases we would like to derive that p. For conditional sentences such as (114), this is known as the proviso problem since Geurts (1994). I refer to Pérez Carballo (2006), Franke (2007) and van Rooij (2007) for discussion and solutions to these types of issues. The solutions proposed by these authors rely on considerations about the plausibility of the inference, and it is entirely independent from the way the inference is derived in the first place. In essence, the idea is that a belief of the form *if A, then p* is most likely to come from the stronger belief that p is true when A and p are 'independent'.[24]

Interestingly, the present system opens an alternative account as well. If we take multiple replacements into consideration, the present system derives further sets of similar alternatives which lead to the inference that p is true, this can be illustrated with a schematic version of (112):

(117) $S_p \vee A$.
a. i. Set of alternatives (first order): $\{ p \vee A, \top \vee A \}$
ii. If we keep the left-hand side of each alternative above: $\{ p, \top \}$
b. i. Set of alternatives (first order): $\{ \neg p \vee A, \bot \vee A \}$
ii. If we keep the left-hand side of each alternative above: $\{ \neg p, \bot \}$

If this line of investigation is correct, it might confirm the intuition that the connective split may apply to conditionals just as well as to disjunctions and conjunctions (see section B.3 for discussion).[25]

24 Admittedly, I do not know how the inference that p is true is favored over the inference that A is false.
25 Singh (2007a) argues for a better definition of the sets of candidate propositions that could be accommodated in cases of proviso problems. Singh proposes to rely on a formal definition of alternatives, it would be highly interesting to import this discussion in the present framework where alternatives already play a natural role: future research.

4.6 Quantification

In this section, I consider sentences with a presupposition trigger in the scope of a quantifier:

(118) Each of these students knows that he's lucky.
Schematically: Quant x, $S_{p(x)}$
  a. Existential presupposition: $\exists$x, p(x)
  b. Universal presupposition: $\forall$x, p(x)

Some theories (e.g., Beaver 1994, 2001) assume that these types of sentences carry an existential presupposition, as in (118a), others (e.g., Heim 1983) assume that they carry a universal presupposition, as in (118b). The formal aspect of this dispute is discussed in chapter 10 of Kadmon (2001).

Similarity makes several original predictions. First, similarity predicts that the quantifier matters: there are differences between universal, existential and numerical quantifiers. Second, the inferences may come with various epistemic flavors. In section 4.6.2, I show that for some quantifiers, the universal inference comes first in a weak version, as is usual for scalar implicature: $\neg B_s[\,\neg\forall x,\ p(x)\,]$.[26] Finally, I show that the predictions are more fine-grained than usual: the presupposition might be intermediate between existential and universal, see section 4.6.4.

All these predictions are in line with the experimental data collected in Chemla (2009).

4.6.1 Universal presuppositions

For universal quantifiers or universal modals, the present system predicts a universal presupposition. Consider the examples in (119). Both examples contain the presupposition trigger know embedded under an operator which has universal force (the universal quantifier Each or the universal modal certain). In (120) I show that the universal presupposition derives from the weak similarity principle applied to the set of alternatives $\{\,p, \top\,\}$. No other inference predicted by the system is stronger than this universal presupposition so this is also the overall prediction. Notice that it does not require the strong version of the Similarity principle.

(119) a. Each of these students knows that he is lucky.
  Universal presupposition: Each of these students is lucky.
  b. It is certain that John knows that it's raining.
  Universal presupposition: It is certain that it is raining.

26 If we follow the common ground view discussed in section 4.2 the inference becomes: $\neg CG[\,\neg\forall x,\ p(x)\,]$.

(120) Partial derivation of the presuppositions for (119a,b):

a. Schematically: $\forall x$, $S_{p(x)}$

b. Weak similarity: $B_s[\,\forall x, p(x)\,] \longleftrightarrow B_s[\,\forall x, \top\,]$ i.e. $B_s[\,\forall x, p(x)\,]$

4.6.2 Robust existential, fragile universal presuppositions

Interestingly, existential quantifiers show a different behavior. Let me give an informal description of the prediction. There should be an existential inference, which does not require strengthening (epistemic step), the universal version of this inference requires strengthening. In other words, the existential presupposition is robust and the universal presupposition is fragile. This seems accurate:

(121) It's possible that this guy stopped smoking.[27]

a. Robust: It is possible that this guy smoked.
(From: $B_s[\,\Diamond p\,] \longleftrightarrow B_s[\,\Diamond\top\,]$)

b. Weak epistemic status: This guy smoked.
(From: $B_s[\,\Diamond\neg p\,] \longleftrightarrow B_s[\,\Diamond\bot\,]$, i.e. $\neg B_s[\,\Diamond\neg p\,]$)

(122) Some of these students know that they are lucky.[28]

a. Robust: At least some of them are lucky.
(From: $B_s[\,\exists x, p(x)\,] \longleftrightarrow B_s[\,\exists x, \top\,]$)

b. Weak epistemic status: All of them are lucky.
(From: $B_s[\,\exists x, \neg p(x)\,] \longleftrightarrow B_s[\,\exists x, \bot\,]$, i.e. $\neg B_s[\,\exists x, \neg p(x)\,]$)

Sentences with a universal operator under negation lead to the same predictions, and to the same judgments as well:[29]

(123) Not all of my students know that they are lucky.

a. Robust: At least some of my students are lucky.

b. Weak epistemic status: All my students are lucky.

(124) It's not certain that this guy stopped smoking.

---

27 Adapted from Geurts (1999a). It seems that this type of examples are easier to construct with so-called weak presupposition triggers.

28 This sentence is ambiguous between the semi-formal paraphrases in (i) and (ii). The target reading for this example is (i).

(i) $\exists$x, x knows that x is lucky.

(ii) $\exists$x, x knows that all these students are lucky.

29 The difference between sentences with universal operators and their negations is at the level of the weak similarity principle. This is of course consistent with the general result on negation in (108).

a. Robust: It is possible that this guy smoked.
b. Weak epistemic status: This guy smoked.

So, existential and universal quantifiers are both expected to support existential presuppositions, the universal presupposition should be less robust for existential quantifiers.

4.6.3 No: robust universal presupposition, existential scalar implicature

The quantifier no is predicted to behave as universal quantifiers, see (125): there is no need for an epistemic step to obtain the universal inference.

(125) a. None of these students knows that he's lucky.
b. Universal presupposition: Each of these students is lucky.
c. Derivation of this inference (weak similarity applied to $\{\neg p, \bot\}$):
$B_s[\text{No x}, \neg p(x)] \longleftrightarrow B_s[\text{No x}, \bot]$
i.e. $B_s[\text{No x}, \neg p(x)] \longleftrightarrow B_s[\top]$
i.e. $B_s[\text{No x}, \neg p(x)]$
i.e. $B_s[\forall x, p(x)]$

The only difference with the case of a universal quantifier is that the universal inference now comes from the set of "negative" alternatives: $\{\neg p, \bot\}$. As a result, we can expect that scalar implicatures do not show the same pattern. In fact, similarity predicts that scalar implicatures project existentially, and this seems entirely satisfying, see (126).

(126) a. None of these students read many of the books.
b. Scalar implicature: At least one read some of the books.
This implicature comes from the following similarity inference:
$B_s[\text{No x, read some}] \longleftrightarrow B_s[\text{No x}, \top]$ i.e. $\neg B_s[\text{No x, read some}]$

These predictions are strongly supported by recent experimental data. In essence, Chemla (2009) shows that naive speakers believe that sentences similar to (125) imply their associated universal presupposition (as much as when the presupposition trigger is in the scope of a universal quantifier). In the same conditions, scalar items do not create universal inferences.

4.6.4 Numerical quantifiers: more fine-grained predictions

The data collected in Chemla (2009) show that the universal inferences are much less robust for other quantifiers such as exactly 3, more than 3 and at least 3.[30]

30 Or rather their French counterparts: exactement 3, plus de 3, and au moins 3.

In fact, the similarity predictions do not predict universal inferences. The exact predictions are described in appendix D. I restrict my comments to the predictions in (127) and (128):

(127) a. More than 10 of these 100 people know that they're lucky.
b. Predicted inference: More than 90 of them are lucky.

(128) a. More than 50 of these 100 people know that they're lucky.
b. Predicted inference: More than 50 of them are lucky.

These predictions are unusually numerically precise. In fact, the exact numbers involved may not matter for the presupposition, it is plausible that the exact quantities are blurred when it comes to pragmatic inferences. What remains crucial though is how the predictions vary when the numbers change. In particular, the sentence in (128) generates a weaker prediction, an almost vacuous one given the sentence, and this seems to be correct: the expectation on the number of lucky students is higher for (127) than for (128). Notice also that the prediction in (127) requires the application of *strong* e-similarity, and this may also explain why it is not very robust.

Finally, if we allow multiple substitutions of both presupposition triggers and numerals, the predictions become universal across the board. This is an entirely satisfying result, if we accept that multiple substitutions produce less robust inferences (see discussion in section B.2).

4.6.5 Conclusions for quantification

The predictions for numerical quantifiers are difficult to evaluate, although the way they depend on the number involved seems appropriate to me. Any stronger claim would require deeper investigations, ideally experimental investigations with naive subjects. This work falls out of the scope of this paper.

More generally, I would like to repeat the theoretical contribution of this discussion. The debate between existential and universal presuppositions is outdated, for two reasons. First, all quantifiers do not behave on a par, and we want to explain where this difference comes from. Second, for some quantifiers it seems that the inference is neither existential nor universal, and we want to understand what it is, potentially taking into account the epistemic status of the inference. The present proposal offers precise answers to all these issues.[31,32]

31 See also George (2007) for a discussion of these data in a trivalent framework.

32 There is another interesting range of facts I did not discuss at all: what happens if the presupposition trigger is in the restrictor of the quantifier? As discussed in section B.4, the corresponding situation is intricate for scalar implicatures, so I decided to set this issue aside for presupposition.

4.7 Interaction between presuppositions and scalar implicatures

One ambition of the present proposal is to unify the projection mechanisms underlying presuppositions and scalar implicatures. It becomes natural to consider cases with both presupposition triggers and scalar items:

(129) John knows that some of his advisors are crooks.

These cases have received a lot of attention recently. Some authors have argued that in these cases, the scalar implicature arises below the presupposition trigger and took it as an argument for treating (at least some) scalar implicatures as a semantic or syntactic phenomenon (see Chierchia 2004 and Sharvit & Gajewski 2007). Other authors showed that these facts can be reconciled with a pragmatic approach: Russell (2006) and Simons (2006) argued in essence that a generalization of the epistemic step mechanism may account for these facts; Geurts (2006) argued that there is no reason why presupposition should escape Gricean workings since it is (also) a device to convey new information.

The situation is much easier in the present system. Sentences with several sources of similarity inferences are expected. Here is the prediction for the most standard case:

(130) John knows that some of his advisors are crooks.

a. i. $B_s[$ Some of John's advisors are crooks $] \longleftrightarrow B_s[\top]$
   ii. $B_s[\neg$ Some of John's advisors are crooks $] \longleftrightarrow B_s[\bot]$

b. $B_s[$ John knows all his advisors are crooks. $] \longleftrightarrow B_s[$ John knows $\bot]$
   i. $B_s[$ All his advisors are crooks. $] \longleftrightarrow B_s[\bot]$
   ii. $B_s[\neg$ All his advisors are crooks. $] \longleftrightarrow B_s[\neg\bot]$

c. Overall: John knows that some of his advisors are crooks, not all of his advisors are crooks.

More generally, similarity can predict how scalar implicatures should project from the inside of a presupposition trigger. Let p^- and p^+ represent respectively weaker and stronger alternatives to p, when p is the presuppositional part of a presupposition trigger S_p. p^- projects just as the presupposition. p^+ projects exactly in the opposite direction ($\top$ and $\bot$ are inverted in (131a) and (131c)). This is exactly what we expect: the scalar implicature of p is the negation of p^+. In sum: scalar implicatures of the presupposition project just as the presupposition itself.

(131) Comparison between presupposition projection, and the projection of the scalar implicatures of the presupposition:

a. $B_s[\varphi(p) \longleftrightarrow \varphi(\top)]$ and $B_s[\varphi(\neg p) \longleftrightarrow \varphi(\bot)]$

b. $B_s[\varphi(p^-) \longleftrightarrow \varphi(\top)]$ and $B_s[\varphi(\neg p^-) \longleftrightarrow \varphi(\neg\top)]$

c. $B_s[\varphi(p^+) \longleftrightarrow \varphi(\bot)]$ and $B_s[\varphi(\neg p^+) \longleftrightarrow \varphi(\neg\bot)]$

4.8 Remaining environments: questions, exclamatives, orders...

How do presuppositions project from questions?

(132) Does Mary know that it's raining?

At this point, the projection system comes from a globalist theory of scalar implicatures, and it relies on an equivalence relation between utterances. The predicted inferences take the following forms which do not make any sense until we define an equivalence relation for questions:

(133) Similarity inferences for (132):
  a. B_s[Is it the case that p ? $\longleftrightarrow$ Is it the case that $\top$?]
  b. B_s[Is it the case that $\neg$p? $\longleftrightarrow$ Is it the case that $\perp$?]

There are various ways to define an appropriate equivalence relation, but I would like to set the technical details aside. Instead, I think it is important to mention that the same issue arises for scalar implicatures, and it seems to me that questions do produce scalar implicatures:[33]

(134) Did Mary read all the books?
Inference: She read some of them.

(135) Did Mary read any of the books?
Inference: She did not read them all.

4.9 Summary of presupposition

I proposed defining alternatives to presuppositional elements, and showed how it addresses the projection problem. Presuppositions now project through a system parallel to the system for scalar implicatures, this has several advantages. First, interactions between presupposition triggers and scalar items are immediately accounted for (see section 4.7). Second, the projection system is as demanding as usual accounts of scalar implicatures are: it merely relies on the bare semantics of the various pieces of the sentence, there is no need to use other layers of meaning as in dynamic accounts for instance (see Karttunen & Peters 1979; Heim 1983, and discussion in Soames 1989 and Schlenker 2007 for instance). Third, just as scalar implicatures, there are two flavors available to presuppositions: plain inference, and ignorance inference. However, weak inferences arise in fewer linguistic environments for presupposition.

33 Of course, these scalar implicatures may arise in their weak epistemic versions because the very fact that the speaker asked a question casts doubts on the competence assumption.

So, there is only one projection problem for presuppositions and scalar implicatures. This suggests that there is only one triggering problem as well. The question as to where presuppositions and scalar implicatures come from now boils down to the same question: where do alternatives come from?

5 Conclusions

I presented a unified theory of scalar implicatures, free choice permission and presupposition projection. This theory relies on two main assumptions: (i) there are three sources of alternatives: usual scales, connectives, and presupposition triggers, and (ii) the similarity principle which governs how alternatives should behave. The main virtue of this discussion is that it shows that a wide range of phenomena which are otherwise supposed to be very different can be brought together with a very few principles. However, the system can be split into independent accounts of these phenomena if some assumptions I use seem more plausible for one or the other phenomena.

Appendices

A Gricean intuitions, with the present notations

Let's define the following notation: X<Y is true iff X is stronger than Y.[34] Then, the following is a very close approximation of the Gricean intuition "stronger alternatives are false":

(136) Gricean intuition for φ(actual item):

a. Primary implicatures:
$B_s[\ \varphi(\text{alternative item})\ ] \longleftrightarrow B_s[\ \varphi(\text{alternative item}) < \varphi(\text{actual item})\ ]$

b. Secondary implicatures:
$B_s[\ \varphi(\text{alternative item}) \longleftrightarrow \varphi(\text{alternative item}) < \varphi(\text{actual item})\ ]$

Here is the corresponding subpart of the present system:

(137) The present system for φ(actual item):

a. Primary implicatures:
$B_s[\ \varphi(\text{alternative item})\ ] \longleftrightarrow B_s[\ \varphi(\text{alternative item} < \text{actual item})\ ]$

b. Secondary implicatures:
$B_s[\ \varphi(\text{alternative item}) \longleftrightarrow \varphi(\text{alternative item} < \text{actual item})\ ]$

34 I do not discuss whether it is logical or contextual strength.

B Issues for Similarity and scalar implicatures

In this appendix I discuss a collection of minor issues arising when one investigate further facts related to scalar implicatures: Hurford's constraint, local implicatures, connectives other than 'or' and 'and', and scalar items in restrictors of quantifiers.

B.1 Hurford's constraint

On the basis of examples such as (13), Hurford (1974) suggested the generalization in (138).

(138) Hurford (1974)'s generalization:
"A or B" is infelicitous if A entails B or the other way round.

There are systematic counterexamples to this generalization. In (139a) and (140a), the second disjunct entails the first disjunct and yet the sentences are perfectly natural. Presumably, the potential scalar implicatures of the first disjunct plays a role (Gazdar 1979).

(139) a. John or Mary or both came to the party.
b. (Exactly one of John and Mary) or both came to the party.

(140) a. John read some or all the books.
b. John read (some but not all) or all the books.

Finally, Singh (2007b) noticed that the situation is not symmetrical since the non-entailment constraint remains active if the scalar item is in the second disjunct as in (141) and (142).

(141) ? John and Mary or John or Mary came to the party.

(142) ? John read all or some of the books.

Let me discuss two types of accounts which have been proposed, I refer to Singh (2007b) for a more systematic review of the literature. Under the first type of account, we postulate a rather strong constraint on disjunction: later disjuncts cannot entail earlier disjuncts together with their implicatures (this is a simplification of the discussion in Singh 2007b). Under the second type of accounts, we stick to a weaker constraint on disjunction which states that disjuncts cannot entail one another. We then capitalize on local computation of scalar implicatures to explain why the constraint is not violated for examples like (139a). The last ingredient would be an independent constraint on the distribution of local implicatures so that examples (141) could not be saved (see Spector, Fox & Chierchia 2007).

I cannot do justice to these accounts here. My main point is that these two accounts need to postulate some version of the generalization (138), although it follows from Similarity. In (143), I lay out the consequences of similarity on a disjunctive sentence where one disjunct A^+ entails the other A. In short, Similarity predicts that sentences which violate the generalization (138) have conflicting implicatures.

(143) Sentence: $\text{A} \vee \text{A}^+$
Hence: $B_s[\,\text{A}\,]$
a. $B_s[\text{A}\wedge\text{A}^+] \longleftrightarrow B_s[\;\perp\;]$ i.e. $\neg B_s[\,\text{A}^+\,]$
b. $B_s[\;\text{A}\;] \longleftrightarrow B_s[\;\text{A}^+\;]$ hence: $B_s[\,\text{A}^+\,]$

Thus, the only issue for Similarity is to explain how scalar items can ever obviate this conflict. One route would be to say that a disjunct which generates conflicting implicatures is acceptable, if it helps avoid undesirable implicatures. We would need to specify how exactly the tension is set up and solved, let me just give an example: it would be fine to say *John read some or all the books* because without the second disjunct, *John read some of the books* triggers the potentially undesirable implicature that John didn't read all the books.

Alternatively, one could argue that this type of conflict among primary implicatures justifies extraordinary measures, such as local implicatures.[35,36] We would then need to specify how the rescue strategy works, and this would correspond to the restrictions on the distribution of local implicatures which is discussed in Spector et al. (2007). The reason why this option is worth mentioning is that their proposal accurately predicts a wide range of facts, which I do not have room to report in this paper.

Let me add a more pessimistic remark. Some version of the generalization in (138) seems to be active when the disjunction is embedded under negation as in (144), although Similarity does not produce any conflicting implicatures for these cases.

(144) a. ? It's not the case that John is French or European.
b. ? It's not the case that John is European or French.

35 It would be a very similar move to what proponents of local accommodation have argued for: when something goes wrong with the normal way of deriving presuppositions, there is an alternative route. Furthermore, it is exactly in special circumstances that local implicatures appear clearly (e.g., when focus comes into play REF). See Geurts (2007b) for a general discussion.

36 Of course, there is no technical impossibility to spell out a local version of similarity:

(i) If ψ is the first site of type $\langle s,t\rangle$ above "some" in the sentence $\varphi(\psi(\text{some}))$, a local application of similarity will yield: $\varphi(\,\psi(\text{some})$ and $(\psi(\text{all}) \longleftrightarrow \perp))$

In fact, the negation of a disjunctive sentence is equivalent to a conjunctive sentence and these examples suggest that there is a deeper generalization missing: (138) should be extended to conjunctions as well, as witness examples in (145).

(145) a. ? John lives in Paris and in France.
b. ? John lives in France and in Paris.

Interestingly, Schlenker (2007) uses similar examples to motivate a theory of presupposition projection.[37] I leave this as an open issue.

B.2 Local implicatures (and multiple replacements)

In this section, I present some consequences of the type of multiple replacements that I advocated.

Globalist accounts of local implicatures are superior

van Rooij & Schulz (2004) and Spector (2006) showed that so-called cases of local implicatures are straightforwardly accounted for by globalist accounts, provided that alternatives are calculated carefully. In particular, it has been claimed that (146) triggers the implicature in (146a). This is expected in a globalist framework since it is the negation of the alternative (146b), where 'some' replaces 'every', and 'all' replaces 'some'.

(146) Every student read some of the books.
a. Inference: No student read all the books.
b. Alternative: Some of the students read all the books.

In the present framework, these types of multiple replacements are constrained, but the results are exactly the same as the Gricean version I discussed above. The sets of alternatives derived for (146) is given in (45), (45b) leads to the result in (146a).

So, some so-called local implicatures are genuine global implicatures involving multiple replacements. Moreover, I believe that there are arguments in favor of the global derivation of these implicatures. The first argument is that these inferences

37 Some of the judgments reported in Schlenker (2007) may suggest a slightly different generalization than examples (145). At least in some cases, it could be okay for the second conjunct to entail the first one:

(i) a. John resides in France and he lives in Paris. (from Schlenker 2007)
b. ? John lives in Paris and he resides in France.

are not as robust as other implicatures which do not require multiple replacements (see Geurts & Pouscoulous 2008 for quantified data) and this easily makes sense in a globalist framework. In fact, if we consider alternatives obtained by multiple replacements, it has two consequences: (i) the derivation is somewhat 'costly' (more computations are needed), and (ii) the alternative gets very different from the original sentence. These two features point in the same direction: inferences due to multiple replacements may not be robust.

The second argument in favor of a globalist account of these so-called local implicatures comes from a weaker version of this implicature. To me, the sentence in (146/147) may implicate (146a) just as well as the weaker (147a). This inference is the negation of the alternative given in (147b). There is no local derivation of this inference.

(147) Every student read some of the books.
  a. Inference: Not many student read all the books.
  b. Alternative: Many of the students read all the books.

Similarity is superior to other global accounts

I discussed the examples above within a standard global neo-Gricean framework, but again, the results are entirely parallel in the present framework. Interestingly, there are cases with multiple scalar items, and where the predictions of the present proposal differ from the globalist mainstream.[38] For these cases, the present proposal is superior (compare the predictions for (148): (150) vs. (151)):

(148) Few boys did some of the readings.
Schematically: FEW (SOME)

(149) Similarity inferences:
  a. Replacing the most embedded item *some*:
  B_s[FEW (ALL) $\longleftrightarrow$ FEW ($\perp$)] already entailed by the sentence
  b. Further replace the less embedded item *few*:
  B_s[NO (ALL) $\longleftrightarrow$ NO ($\perp$)] i.e. No boys did all the readings.
  c. Replacing the less embedded item *few* alone:
  B_s[NO (SOME) $\longleftrightarrow$ $\perp$] i.e. Some boys did some of the readings.

(150) Overall (similarity): Some but few boys did some readings, none did all.

(151) Gricean prediction: Some but few boys did some readings, some did all.
(Negation of the alternative 'No boys did all the readings')

38 Fox (2007) discusses these cases. Although his proposal is not a strictly globalist system, his operator may apply globally and hence it runs into the same problem as globalist systems. Fox proposes a technical way to restrict multiple replacements to avoid the problematic prediction in (151).

Other local implicatures

Local implicatures also seem to arise when a scalar item is embedded under a verb of propositional attitude, as before the bare globalist prediction is apparently too weak:

(152) John believes that some of his students are waiting for him. (from Chierchia 2004)

a. Actual inference: John believes that not all his students are waiting for him. ($B_{John}[\neg\text{ALL}]$)

b. Globalist prediction: It's not the case that John believes that all his students are waiting for him. ($\neg B_{John}[\text{ALL}]$)

No multiple substitution derives this inference. Russell (2006) and Simons (2006) argued for a pragmatic solution which is roughly an extension of the epistemic step: if John has an opinion about each of his students, the statements in (a) and (b) are equivalent. These types of globalist accounts also make better predictions for more embedded cases:

(153) Each of my friends believes that some of his teachers are stupid.

a. Localist prediction: None believes that all his teachers are stupid.

b. Globalist prediction: Some believe that not all their teachers are stupid.

For each case of alleged local implicatures above, I showed that the stronger meaning derived with local implicatures can be obtained via additional alternatives which generate more inferences, or thanks to pragmatic enrichments. Example (154) is more challenging, because local implicatures are used to obtain a weaker meaning than the bare semantic meaning:

(154) If John read SOME of the books, he will fail his exam.

The bare denotation of the sentence entails that if John read all the books, he will fail his exam. Yet, this sentence can be consistently followed by the negation of this statement: but of course, if he read them all he will pass the exam. This is an "L-type" of inference, as classified in Geurts (2007b). These cases are always marked (e.g., via focus) and, as I argued in section B.1, there is no problem to say that in marked cases, the global algorithm I argue for applies locally.

B.3 Conditionals, and other connectives

Before moving away from scalar implicatures, I would like to spell out a few predictions when scalar items are embedded in antecedents or consequents of conditionals. There are two complications of quite different natures: (i) the semantics of conditionals makes it a bit difficult to compute the predictions, (ii) conditionals involve a connective, which may give rise to a connective split.

(155) If Mary ate the apple, John ate many of the bananas.
Schematically: If APPLE, MANY
a. B_s[If APPLE, SOME $\longleftrightarrow$ If APPLE, $\top$], already entailed by (155)
b. B_s[If APPLE, ALL $\longleftrightarrow$ If APPLE, $\perp$]

The second inference (155b) requires more thought. If we consider that the conditional is a strict conditional, the inference is equivalent to: the speaker does not believe that if Mary ate the apple, John ate all the bananas, or the speaker believes that Mary did not eat the apple. This merely says that the speaker is not ready to make a strong claim about the alternative sentence: if Mary ate the apple, John ate all the bananas.

The main reason why I wanted to introduce conditionals is that they are connectives. As such, they might be subject to the connective split.[39] In this case, we would obtain the following additional inferences:

(156) Additional inferences of (155) if *if* can be split as a connective:
a. Connective split:
B_s[Mary ate the apple $\longleftrightarrow$ John ate many of the bananas]
b. Extract the right-hand sides of the alternatives involved in (155a):
B_s[John ate some of the bananas $\longleftrightarrow$ $\top$]
i.e. John ate some of the bananas.
c. Extract the right-hand sides of the alternatives involved in (155b):
B_s[John ate all the bananas $\longleftrightarrow$ $\perp$] i.e. John did not eat all the bananas.

The first of the inferences above is interesting: it recovers the usual fallacy of the consequent which leads to interpret a conditional as an equivalence. The other two inferences (156b) and (156c) predict that (155) implies that John ate some of the bananas no matter what, and that he did not eat all the bananas, no matter what. These implicatures are plausible to me. They might not be very robust, but this is expected since they are obtained via multiple replacements.

The goal of this section was to mention that a priori there is no reason why the connective split should be restricted to disjunction and conjunction. In particular, it would have plausible effects if it is extended to conditionals. I leave for future research a more systematic investigation of this issue.

---

39 If the conditional is reconstructed as $\Box(A\rightarrow B)$, the connective split might lead to $\Box A$ and $\Box B$. The inferences in (156) would then incorporate some more modality.

B.4 Restrictors

Universal quantifiers

For scalar items in the restrictor of universal quantifiers, the similarity prediction is weaker than usual globalist predictions:

(157) Every student who did all the readings will come to the party.
Schematically: $\forall$x who ALL, party(x) (from B. Spector, p.c.)
  a. Similarity prediction: $B_s[\ \forall x \text{ who SOME, party}(x) \longleftrightarrow \forall x, \text{party}(x)\ ]$
  b. Globalist prediction: $B_s[\ \neg\forall x \text{ who SOME, party}(x)\ ]$

The difference between the two predictions is that $B_s[\ \neg\forall x, \text{party}(x)\ ]$. This might follow in the similarity framework as well if the sentence without the restrictor is also an alternative: Every student will come to the party. It is a bit difficult to see at which scope site we should consider this transformation, but if we proceed globally, we obtain exactly the missing inference: $B_s[\ \forall x, \text{party}(x) \longleftrightarrow \bot\ ]$.

More difficult cases

I would like to discuss a notoriously problematic example: (158). The similarity inference due to the scalar some in the restrictor of the existential quantifier states that no student who did all the readings will come to the party.

(158) Some students who did most of the readings will come to the party.
Schematically $\exists$x who MOST, party(x)
Inference: $B_s[\ \exists x \text{ who ALL, party}(x) \longleftrightarrow \exists x \text{ who } \bot, \text{party}(x)\ ]$
i.e. $B_s[\ \neg\exists(x) \text{ who ALL, party}(x)\ ]$

This prediction is common to any globalist account, roughly because some students who did all the reading will come to the party is a stronger alternative to (158).[40] At first sight, it seems to be a very strong inference. Admittedly, I find this prediction very difficult to evaluate. Consider the following examples:

(159) Some students who did most of the readings will fail their exam.
Globalist inference: No student who did all the readings will fail their exam.

40 I would like to mention a neo-neo-Gricean not-so-globalist account. Roughly, Geurts (2006) proposes that scalar implicatures could be taken into account after discourse referents are settled. This proposal is not spelled out for the cases we are interested in here, and it is a bit difficult to see how it is going to work for non existential quantifiers:

(i) No student who did most of the readings will come to the party.

(160) Some students who did most of the readings will pass their exam easily.
Globalist inference: No student who did all the readings will pass their exam easily.

(161) Some students who did only most of the readings will pass their exam easily.

Informally, I find (159) more natural than (160). To me, (160) is more natural if most is replaced with only most as in (161). This contrast is expected if the globalist prediction is right: the globalist inference is more plausible for (159) than for (160).

I will leave the analysis of these cases as an open issue, mainly because the judgments are very difficult and I am not in a position to make strong empirical claims.

C Multiple disjunctions - general results

C.1 Unembedded multiple disjunctions

(162) Mary ate an apple, a banana, a coconut, or...
Schematically: $A_1 \vee ... \vee A_n$

(163) Similar alternatives raised by the x^{th} disjunction:

a. Connective split:
$\{ [((\cancel{A_1 \vee ... \vee A_x) \vee} A_{x+1}) \vee A_{x+2} \vee ... \vee A_n],$
$[((A_1 \vee ... \vee A_x) \cancel{\vee A_{x+1}}) \vee A_{x+2} \vee ... \vee A_n] \}$

b. Stronger replacements:
$\{ [((A_1 \vee ... \vee A_x) \wedge A_{x+1}) \vee A_{x+2} \vee ... \vee A_n],$
$[(\quad \perp \quad) \vee A_{x+2} \vee ... \vee A_n] \}$

(164) Inferences:

a. Similarity applied to "splitting" the disjunction:
Similarity applied to the last disjunct is enough to yield the ignorance implicature: $B_s[A_1 \vee ... \vee A_{n-1}] \longleftrightarrow B_s[A_n]$, and the speaker cannot believe both because of what follows. Since the speaker believes that one of the two is true, s/he is ignorant.
The strong e-similarity does not apply.

b. Similarity applied to "stronger replacements":
Applied to the last disjunction, similarity requires that the last A_n does not co-occur with any other A_x; and one can check that if A_x and A_y are true, similarity applied to the y^{th} connective requires that one of the A_z with z>y is also true, and this is going to be blocked by the inferences due to the $(z-1)^{th}$ disjunct...

C.2 Multiple disjunctions under an existential modal

(165) You may eat an apple, a banana, a coconut, or...
Schematically: $\Diamond(A_1 \vee ... \vee A_n)$

(166) Similar alternatives:

a. Connective split:
$\{ \Diamond[\ (A_1 \vee ... \vee A_x) \vee (A_{x+2} \vee ... \vee A_n)\ ],$
$\Diamond[\ (\quad A_{x+1} \quad) \vee (A_{x+2} \vee ... \vee A_n)\ ]\ \}$

b. Further replacement, keep the left-hand side of the main disjunction for each of the alternatives above:
$\{ \Diamond\ (A_1 \vee ... \vee A_x)\ ,$
$\Diamond\ (\quad A_{x+1} \quad)\ \}$

c. Stronger replacements:
$\{ \Diamond[\ ((A_1 \vee ... \vee A_x) \wedge A_{x+1}) \vee (A_{x+2} \vee ... \vee A_n)\ ],$
$\Diamond[\ (\qquad \bot \qquad) \vee (A_{x+2} \vee ... \vee A_n)\ ]\ \}$

d. Further replacement, keep the left-hand side of the main disjunction for each of the alternatives above:
$\{ \Diamond\ ((A_1 \vee ... \vee A_x) \wedge A_{x+1}),$
$\Diamond\ (\qquad \bot \qquad)\ \}$

(167) Inferences:

a. Free choice inferences: from the sets in (a) above, we derive that $\Diamond(A_1 \vee ... \vee A_x)$ for any x. From the sets in (b), we then derive $\Diamond(A_{x+1})$ for any x.

b. The exclusive reading follows straightforwardly from the sets of alternatives in (d): there is no possible world in which A_{x+1} and some A_y are true, with $y \leq x$. This guarantees that there is no possible world in which two A_x and A_y are true.

D Presupposition and numerical quantifiers

I report here the main steps to compute the predictions discussed in section 4.6.4.

(168) More than n of these N individuals, S_p

a. B_s[More than n, $\quad$ p $\longleftrightarrow$ More than n, $\top$]i.e. B_s[More than n, p] (universal pres if we then replace n with N-1)

b. B_s[More than n, $\neg$p $\longleftrightarrow$ More than n, $\bot$]i.e. B_s[More than (N-n), p] (weak)

(169) Less than n of these N individuals, S_p

a. B_s[Less than n, $\quad$ p $\longleftrightarrow$ Less than n, $\top$] i.e. B_s[At least n, p] (weak)

b. B_s[Less than n, $\neg$p $\longleftrightarrow$ Less than n, $\bot$] i.e. B_s[At least N-n, p] (universal pres if we then replace n with 0)

(170) Exactly n of these N individuals, S_p

a. $B_s[\,\text{Ex n},\quad p \longleftrightarrow \text{Ex n}, \top\,]$ i.e. $B_s[\,\neg\text{Ex n}, p\,]$ (weak)
(universal pres if we then replace n with N)

b. $B_s[\,\text{Ex n}, \neg p \longleftrightarrow \text{Ex n}, \bot\,]$ i.e. $B_s[\,\neg\text{Ex N-n}, p\,]$ (weak)

References

Abbott, Barbara. 2000. Presuppositions as nonassertions. *Journal of Pragmatics* 32(10). 1419–1437.

Abusch, Dorit. 2002. Lexical alternatives as a source of pragmatic presuppositions. In Brendan Jackson (ed.), *Proceedings of salt xii*. Ithaca, NY: CLC Publications.

Abusch, Dorit. 2005. Triggering from Alternative Sets and Projection of Pragmatic Presuppositions. Ms., Cornell University. Available at http://semanticsarchive.net/Archive/jJkYjM3O/Abusch-Triggering.pdf.

Alonso-Ovalle, Luis. 2005. Distributing the disjuncts over the modal space. In Leah Bateman & Cherlon Ussery (eds.), *North east linguistics society (glsa)*, vol. 35. Amherst, MA. URL http://www.alonso-ovalle.net/papers/alonso-ovalle_NELS2005.pdf.

Beaver, David I. 1994. When variables don't vary enough. In Mandy Harvey & Lynn Santelmann (eds.), *Semantics and linguistic theory 4*, 35–60. Cornell: CLC Publications.

Beaver, David I. 2001. *Presupposition and assertion in dynamic semantics*. CSLI Publications.

Beaver, David I. & Emiel Krahmer. 2001. A partial account of presupposition projection. *Journal of Logic, Language and Information* 10. 147–182.

Beck, Sigrid. 2001. Reciprocals are Definites. *Natural Language Semantics* 9(1). 69–138.

Chemla, Emmanuel. 2006. Aren't Dummy Alternatives only Technical Shortcuts? Ms., ENS & MIT.

Chemla, Emmanuel. 2008. An Epistemic Step for Anti-Presupposition. *Journal of Semantics* 25(2). 141–173. doi:10.1093/jos/ffm017.

Chemla, Emmanuel. 2009. Presuppositions of quantified sentences: experimental data. *Natural Language Semantics* 17(4). 299–340. doi:10.1007/s11050-009-9043-9.

Chierchia, Gennaro. 2004. Scalar implicatures, polarity phenomena, and the syntax/pragmatics interface. In A. Belletti (ed.), *Structures and beyond*. Oxford University Press.

Chierchia, Gennaro & Sally McConnell-Ginet. 2000. *Meaning and grammar: an introduction to semantics*. MIT Press Cambridge, MA, USA.

Eckardt, Regine. 2006. Licensing 'or'. In Penka Stateva Uli Sauerland (ed.), *Presuppositions and Implicatures in Compositional Semantics*, 34–70. Palgrave Macmillan New York.

Fine, Kit. 1975. Critical notice of Lewis, D., *Counterfactuals*. *Mind* (84). 451–458.

von Fintel, Kai. 2004. Would you believe it? The King of France is back! (Presuppositions and truth-value intuitions.) In Anne Bezuidenhout and Marga Reimer, eds. *Descriptions and beyond: an interdisciplinary collection of essays on definite and indefinite descriptions and other related phenomena* 315–341.

Fox, Danny. 2005. Scalar implicatures and the organization of grammar. Class given at the LSA.

Fox, Danny. 2007. Free Choice and the theory of Scalar Implicatures. In Uli Sauerland & P. Stateva (eds.), *Presupposition and Implicature in Compositional Semantics*, 537–586. New York, Palgrave Macmillan.

Franke, Michael. 2007. The pragmatics of biscuit conditionals. In *Proceedings of the 16th amsterdam colloquium*.

Gauker, Christopher. 1998. What Is a Context of Utterance? *Philosophical Studies* 91(2). 149–172.

Gazdar, Gerald. 1979. *Pragmatics: Implicature, Presupposition and Logical Form*. Academic Press, New York.

George, Benjamin R. 2007. Variable presupposition strength in quantifiers. In *Xprag in berlin*. ZAS, Berlin.

George, Benjamin R. 2008. *Presupposition repairs: a static, trivalent approach to predict projection*. Master's thesis, UCLA.

Geurts, Bart. 1994. *Presupposing*. Ph.D. thesis, University of Osnabrück.

Geurts, Bart. 1999a. *Presuppositions and pronouns*. Elsevier New York.

Geurts, Bart. 1999b. Specifics. In Bart Geurts, Manfred Krifka & Robert van der Sandt (eds.), *Focus and presupposition in multi-speaker discourse*, 99–129.

Geurts, Bart. 2006. Implicatures without propositions. In Estela Puig-Waldmüller (ed.), *Proceedings of sinn und bedeuting 11. universitat pompeu fabra, barcelona*, 261–275.

Geurts, Bart. 2007a. Exclusive disjunction without implicature. Ms. University of Nijmegen.

Geurts, Bart. 2007b. Quasi-local implicatures or local quasi-implicatures? Ms., University of Nijmegen.

Geurts, Bart & Nausicaa Pouscoulous. 2008. No scalar inferences under embedding. In Paul Egré & Giorgio Magri (eds.), *Presuppositions and implicatures.* MIT Working Papers in Linguistics.

Grice, H. P. 1967. Logic and conversation. *the William James Lectures, delivered at Harvard University. Republished in* **?** .

Heim, Irene. 1983. On the projection problem for presuppositions. *Proceedings of WCCFL* 2. 114–125. doi:10.1002/9780470758335.ch10.

Heim, Irene. 1992. Presupposition Projection and the Semantics of Attitude Verbs. *Journal of Semantics* 9. 183–221.

Horn, Laurence R. 1989. *A natural history of negation*. University of Chicago Press Chicago.

Hurford, James. 1974. Exclusive or Inclusive Disjunction. *Foundations of Language* 11. 409–411.

de Jager, Robert, Tikituandvan Rooij. 2007. Explaining quantity implicatures. In Dov Samet (ed.), *Theoretical aspects of rationality and knowledge: Proceedings of the eleventh conference (tark 2007)*, 193–202. Brussels: Presses universitaires de Louvain.

Kadmon, Nirit. 2001. *Formal Pragmatics: Semantics, Pragmatics, Presupposition, and Focus*. Blackwell Publishers.

Kamp, Hans. 1973. Free choice permission. *Proceedings of the Aristotelian Society* 74. 57–74.

Karttunen, Lauri & Stanley Peters. 1979. Conventional implicature. In Choon-Kyu Oh & David A. Dinneen (eds.), *Syntax and semantics*, vol. 11: Presupposition, 1–56. New York: Academic Press.

Klinedinst, Nathan. 2005. Freedom from Authority. Ms. ucla.

Klinedinst, Nathan. 2006. *Plurality and possibility*. Ph.D. thesis, UCLA.

Kratzer, Angelika & Junko Shimoyama. 2002. Indeterminate pronouns: The view from Japanese. *The Proceedings of the Third Tokyo Conference on Psycholinguistics* 1–25.

LaCasse, Nicolas. 2008. Constraints on connectives and quantifiers. Ms. UCLA.

Landman, Fred. 1998. Plurals and Maximalization. In S. Rothstein (ed.), *Events and grammar*, 237–271. Kluwer, Dordrecht.

Lewis, David. 1973. *Counterfactuals*. Harvard University Press.

Lewis, David. 1977. Possible-world semantics for counterfactual logics: A rejoinder. *Journal of Philosophical Logic* 6(3). 359–363.

Löbner, Sebastian. 1995. On One-eyed and Two-Eyed Semantics: Outlines of a Theory of Natural Language Negation and Predication. *Blaubeuren Papers: Proceedings of the Symposium "Recent Developments in Natural Language Semantics". SfS-report (working papers of the Seminar für Sprachwissenschaft, Universität Tübingen)* .

Magri, Giorgio. 2007. Sketch of a theory of oddness. Ms. MIT.

Nordenskjöld, O. 1928. *The Geography of the Polar Regions*. American Geographical Society.

Nute, Donald. 1975. Counterfactuals and the similarity of worlds. *Journal of Philosophy* (72). 773–778.

Pérez Carballo, Alejandro. 2006. A first shot at the proviso problem. Ms. MIT.

van Rooij, Robert. 2002. Relevance implicatures. Ms. Amsterdam, available at http://semanticsarchive.net/Archive/WIyOWUyO/Implicfinal.pdf.

van Rooij, Robert. 2007. Strengthening Conditional Presuppositions. *Journal of Semantics* 24(3). 289.

van Rooij, Robert & Katrin Schulz. 2004. Exhaustive Interpretation of Complex Sentences. *Journal of Logic, Language and Information* 13(4). 491–519. doi:10.1007/s10849-004-2118-6.

Rothschild, Daniel. 2008. Making dynamics semantics explanatory. Ms. Columbia University.

Russell, Benjamin. 2006. Against Grammatical Computation of Scalar Implicatures. *Journal of Semantics* 23(4). 361.

Sauerland, Uli. 2004. Scalar Implicatures in Complex Sentences. *Linguistics and Philosophy* 27(3). 367–391. doi:10.1023/B:LING.0000023378.71748.db.

Schlenker, Philippe. 2004. Conditionals as Definite Descriptions. *Research on Language & Computation* 2(3). 417–462.

Schlenker, Philippe. 2006. 'Maximize Presupposition'and Gricean Reasoning. Ms. UCLA and IJN.

Schlenker, Philippe. 2007. Anti-dynamics: presupposition projection without dynamic semantics. *Journal of Logic, Language and Information* 16(3). 325–356.

Schulz, Katrin. 2003. *You may read it now or later. A case study on the paradox of free choice permission*. Master's thesis, University of Amsterdam.

Schwarzschild, Roger. 1993. Plurals, presuppositions and the sources of distributivity. *Natural Language Semantics* 2(3). 201–248.

Sharvit, Yael & Jon Gajewski. 2007. On the calculation of local implicatures. Talk given at the Journées Sémantique et Modélisation, Paris.

Simons, Mandy. 2001a. On the conversational basis of some presuppositions. *Semantics and Linguistic Theory, 11* .

Simons, Mandy. 2001b. Why Some Presuppositions are Conversational Implicatures. Ms., Carnegie Mellon University.

Simons, Mandy. 2005. Dividing things up: The semantics of *or* and the modal/*or* interaction. *Natural Language Semantics* 13. 271–316.

Simons, Mandy. 2006. Notes on Embedded Implicatures. Ms. Carnegie Mellon.

Singh, Raj. 2007a. Formal Alternatives as a Solution to the Proviso Problem. In *Proceedings of semantics and linguistic theory 17*.

Singh, Raj. 2007b. On the Interpretation of Disjunction: Asymmetric, Incremental, and Eager for Inconsistency. Ms., MIT.

Soames, Scott. 1982. How presuppositions are inherited: A solution to the projection problem. *Linguistic Inquiry* 13(3). 483–545.

Soames, Scott. 1989. Presupposition. In Dov Gabbay & Franz Guenther (eds.), *Handbook of philosophical logic*, vol. IV, 553–616. Dordrecht: Reidel.

Spector, Benjamin. 2003. Scalar implicatures: Exhaustivity and Gricean reasoning. In Balder ten Cate (ed.), *Proceedings of the eigth esslli student session*. Vienna, Austria. Revised version in **?**.

Spector, Benjamin. 2006. *Aspects de la pragmatique des opérateurs logiques*. Ph.D. thesis, Université Paris 7.

Spector, Benjamin. 2007. Aspects of the Pragmatics of Plural Morphology: On Higher-order Implicatures. In Uli Sauerland & Penka Stateva (eds.), *Presuppositions and Implicatures in Compositional Semantics*, 243–281. Palgrave Macmillan New York.

Spector, Benjamin, Danny Fox & Gennaro Chierchia. 2007. Hurford's Constraint and the Theory of Scalar Implicatures. Ms., Harvard and MIT.

Stalnaker, Robert C. 1970. Pragmatics. *Synthese* 22(1). 272–289.

Stalnaker, Robert C. 1973. Presuppositions. *Journal of Philosophical Logic* 2(4). 447–457.

Stalnaker, Robert C. 1974. Pragmatic presuppositions. *Semantics and Philosophy*

197–214.

Stalnaker, Robert C. 1984. *Inquiry*. MIT Press Cambridge, Mass.

Stalnaker, Robert C. 1998. On the Representation of Context. *Journal of Logic, Language and Information* 7(1). 3–19.

Stalnaker, Robert C. 2002. Common Ground. *Linguistics and Philosophy* 25(5). 701–721.

Szabolcsi, Anna & Bill Haddican. 2004. Conjunction Meets Negation: A Study in Cross-linguistic Variation. *Journal of Semantics* 21(3). 219–249.

Zimmermann, Thomas Ede. 2000. Free Choice Disjunction and Epistemic Possibility. *Natural Language Semantics* 8(4). 255–290.