

Title: The Computation of Scalar Implicatures: Pragmatic,
Lexical or Grammatical?
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The Computation of Scalar Implicatures Pragmatic, Lexical or Grammatical?

Abstract:

I provide an overview of current theories of scalar implicature: the pragmatic (or *Gricean*), the lexical and the grammatical theory. The empirical focus are global and local, but also intermediate implicatures. I argue that the grammatical theory is conceptually less well motivated than even a combination of the pragmatic and the lexical theory, and that the grammatical theory therefore requires strong empirical support. I then focus on a novel empirical phenomenon – intermediate implicatures – which provides empirical support for the grammatical theory. I conclude that it seems necessary to adopt the grammatical theory.

1 Introduction

When people engage in conversation, they aren't only paying attention to what the speaker says, but also to what is **not** said. This observation is widely shared in the field of linguistics and the intuition is also familiar to non-linguists: For example, the English idiom *reading between the lines* indicates that what is unsaid (or unwritten) contributes to what is communicated in a conversation. The role unsaid content plays in communication is hard to quantify, but the following observation illustrates its importance: The phrase *what Obama didn't say* is almost equally frequent as its positive counterpart *what Obama said* on the Google search engine: On November 11, 2010, my search found 214 000 occurrences for the negative and 277 000 for the positive phrase. The rough equality of the two counts is remarkable: For other transitive verbs like *eat*, *wear*, and *decide* positive forms are much more frequent than negative ones. The comparison shows that what a powerful person like U.S. president Obama leaves unsaid engenders just as much interest as what he says, while what Obama leaves uneaten, unworn or undecided is of little interest.

This article describes the state-of-art of linguistic accounts of how unsaid content is derived by people engaged in conversation. However, my review doesn't extend to all types of unsaid content. Instead I focus on the type where there has been most progress and also most debate: the case of *Scalar Implicature*. This type of implicature is characterized in the remainder of this introduction. In the following sections, I review three theories of scalar implicature that have been prominent in the recent literature. For reasons of space, I had to exclude a number of further proposals regarding scalar implicatures. In doing so, I chose to focus in the following discussion on the issue of the distinction of global or local computation of implicatures. For instance, I don't address game theoretic models (Benz, 2010; Franke, 2011) since they seem aligned on the global-local question with the pragmatic account, which I discuss in Section 2.

The concept of scalar implicature is most easily characterized by certain core phenomena since both the underlying mechanism and the full range of phenomena are a matter of debate. Two central cases of scalar

implicatures are associated with the words *some* and *or*. First consider example (1) with *some*. This example was used in experimental work by Bott and Noveck (2004), where almost 60% of participants judged it to be false.

(1) **Some** elephants are mammals.

Example (1) illustrates a scalar implicature triggered by the quantifier *some*. Specifically, the speakers who reject the example do so based on the scalar implicature of (2) that not all elephants are mammals.

The scalar implicatures triggered by disjunction *or* in (2) are a second central case. One important implicature of (2) is that not both Ernie and Bert, but only one of them were at the airport. Because this implicature strengthens an inclusive disjunction into an exclusive disjunction, it is called the *Exclusivity Implicature*.

(2) Ernie **or** Bert were at the airport.

Example (2) triggers two other implicatures: Namely, that the speaker is not sure that Ernie was at the airport and also not sure that Bert was. I refer to these two implicatures as the *Uncertainty Implicatures* in the following. The uncertainty implicatures are closely related to the following two inferences, which Gazdar's (1979) refers to as the *Conventional Implicatures of Disjunction*: the speaker thinks that it's possible that Ernie was at the airport and also possible that Bert was. Specifically, if the assertion (2) and the exclusivity implicature of (2) hold, the two inferences are equivalent to the uncertainty implicatures.

Scalar implicatures share several general properties with other implicatures, in particular their *Cancelability* (Grice, 1989). This refers to the fact that scalar implicatures can be explicitly contradicted by the speaker without the result being felt to be contradictory. For example, (1) can be continued by *... and maybe all of them are mammals*. With this continuation, the implicature noted above does not arise anymore – it is considered *cancelled*. The cancelability of implicatures distinguishes implicatures from inferences based on the lexical content of an utterance. For example, the disjunction example (2) shows an asymmetry between the continuations

... and maybe I saw both, which cancels the exclusivity implicature, and ... and maybe I saw neither, which contradicts the lexical content of the example – the latter is felt to be contradictory. Also the uncertainty implicatures of (2) are cancelable: When (2) is followed by ..., but I won't tell you which of the two, the implicatures disappear.

The exclusivity and uncertainty implicatures of disjunction illustrate an important difference concerning the epistemic status of implicatures – how certain the speaker is assumed to be of the implicature. The status of the uncertainty implicatures, as illustrated in (3a), is that the speaker is not certain about an alternative. The exclusivity implicatures, however, are generally agreed to have a stronger epistemic status: The speaker has to be certain that an alternative doesn't hold as in (3b).

- (3) a. The speaker is **not sure** that Ernie was at the airport.
b. The speaker is **sure** that Ernie and Bert were **not** at the airport.

For comparing the paraphrases in (3), note that I use *sure* here, rather than the verb *believe* because *believe* interacts with negation in a way that makes *S doesn't believe ϕ* and *S believes that not ϕ* difficult to distinguish, when forming intuitions about paraphrases (see Horn 1978). The use of *sure* circumvents this problem. Logically the epistemic status of (3b) is stronger than that of (3a) because if it's sure that a proposition P doesn't hold, it follows logically that it cannot be sure that P holds. As far as I know, it is still debatable whether the implicature in (1) and the exclusivity implicature in (2) have the strong epistemic status. However, the intuition is clear that someone saying (2) is more likely to have seen only one of Ernie and Bert rather than both of them. This intuition is captured by assigning to (3b) the strong epistemic status, though, it isn't the only way of doing so. In the following, I shall nevertheless assume the strong status of scalar implicatures as do all the participants in the debate I present in the following.

The three theories of scalar implicature I address in the following are 1) the *pragmatic theory* (Horn 1972; Atlas and Levinson 1981; Spector 2003; Sauerland 2004; Russell 2006; Geurts 2010, and others), 2) the *lexical theory* (Levinson 2000; Chierchia 2004), and 3) the *grammatical theory* (Chierchia 2006; Fox 2007; Chierchia et al. 2008). I draw a sharp distinction between

the lexical theory and the grammatical theory because I argue below that the motivation underlying the two approaches is very different. Geurts (2010) draws the same distinction, though he understates it in my opinion by using the terms *strict* and *weak conventionalism* for the two theories. Proponents of the grammatical theory usually see a continuity between the lexical and grammatical theory, which I argue against below.

2 The Pragmatic Theory

First consider the pragmatic theory. The general intuitions underlying this theory are due to the seminal work of Grice (1989). Specifically, common sense reasoning about the intentions of the speaker plays the central role in the derivation of scalar implicatures. The hearer seeks an explanation for the utterance choice of the speaker: Why did the speaker make a specific utterance rather than an alternative one? In answering this question, the hearer uses the same general cognitive strategies as in answering other questions of the type *Why did she/he do that?* But, there are components specific to language: Two basic questions about the hearer's reasoning are: 1) What are the alternative utterances the hearer considers and 2) what are potential reasons the hearer considers to explain the speaker's choice?

Consider our first example of a scalar implicature from the pragmatic perspective: *Some elephants are mammals*. With respect to question 1), the pragmatic theory assumes that *All elephants are mammals* is one of the alternative utterances the hearer considers. This special status is encapsulated in the claim that *some* and *all* are members of the same *Scale* (Horn, 1972). Scales are also assumed by the other two theories that we discuss below. Because the sentence with *all* is an alternative, the hearer therefore asks why the speaker didn't say *All elephants are mammals*. Following Grice, we restrict our attention to circumstances where the speaker is collaborative and rational. Still a large number of potential reasons for the speaker's choice exist – as Geurts (2010) emphasizes, finding a cause is an instance of abductive inference. The pragmatic approach assumes that some potential explanations of the speaker's choice are preferred by the hearer. Specifically, Grice presents rationales that may underlie the speaker's choice as

maxims. Of these, Grice's second maxim of quality in (4) can explain why the speaker didn't say *All elephants are mammals*: The speaker lacks evidence that all elephants are mammals.

- (4) *The second maxim of quality*: Do not say that for which you lack evidence. (Grice, 1989)

The implicature predicted by (4) is essentially saying that the speaker is not sure that all elephants are mammals – i.e. an implicature with weak epistemic status, not the strong one discussed in (3). Several proponents of the pragmatic approach (Soames, 1982; Horn, 1989; Sauerland, 2004; Spector, 2003; van Rooij and Schulz, 2004) have therefore amended it with an additional assumption that predicts a stronger epistemic status for most scalar implicatures. This *Competence Assumption* is that when the speaker isn't sure that α holds, the speaker actually must be sure that α doesn't hold, where α is an alternative of the utterance the speaker made. In conjunction with the weak implicature in (4), the epistemically strong implicature follows from this assumption.

The pragmatic approach is sometimes incorrectly claimed to rely on the competence assumption (Chierchia et al., 2008). But this is only true of the popular version of account I discuss here. A different version of the pragmatic theory would make use of Grice's first maxim of quality, *Do not say what you believe to be false* rather than the second one. This approach directly predicts the epistemically stronger implicature that the speaker believes that the alternative with *all* is false. The competence assumption is not necessary. At present, however, I am not aware of any work that explores this approach in more detail.

Scales, however, play an important role in the pragmatic approach, and also the other approaches. To appreciate their role, consider the following reasoning: The speaker uttering (1) also shunned the alternative *Only some elephants are mammals*. By maxim (4), the hearer would then be predicted to deduce the following wrong implicature: the speaker isn't certain that only some elephants are mammals. This result is wrong because it contradicts the actual implicature of (4). So some aspect of the derivation leading to the wrong implicature must be wrong. The notion of scale excludes the

alternative with *only some* from consideration: Only *some* and *all* stand in a special lexical relationship such that when one of them is uttered, the other is automatically activated as an alternative.

Now consider a case where implicatures are absent: Suppose the speaker says *All elephants are mammals*. Then the pragmatic approach predicts that the hearer wonders why the speaker didn't say *Some elephants are mammals*. In this case, maxim (4) cannot be the reason since the alternative must also be true: Logically the statement with *all* entails the one with *some* as long as the existence of elephants is presupposed. Therefore, the pragmatic theory doesn't offer an explanation of the speaker's choice in this case yet. But, another of Grice's maxims, the maxim of quantity in (5), provides an account: The sentence with *all* is more informative since it entails the one with *some*. For this reason, maxim (5) is also part of the pragmatic approach.

- (5) *The first maxim of quantity*: Make your contribution as informative as is required (for the current purposes of the exchange). (Grice, 1989)

To conclude the presentation of the pragmatic account, consider example (2). To generate the exclusivity implicature, we need to assume that *or* and *and* form a scale. It follows that the hearer wonders why the speaker didn't say *Ernie and Bert were at the airport* instead of (2). The hearer is predicted to assume that the second maxim of quality is the reason: The speaker is not certain that both Ernie and Bert were at the airport. Furthermore, the hearer would attribute competence to the speaker regarding whether both Ernie and Bert were at the airport. Therefore the hearer deduces the exclusivity implicature that the speaker is sure that not both Ernie and Bert were at the airport. Furthermore, the pragmatic approach can derive the uncertainty implicatures noted above (Sauerland, 2004). But for this, it must be assumed that two additional alternatives are considered: the sentences *Ernie was at the airport* and *Bert was at the airport*. The presence of such alternatives is difficult to reconcile with the idea that only lexical scales determine the set of alternatives. Partially for this reason, Katzir (2007) proposes that the alternatives can also be sentence

structures derived via a deletion operation from the structure of the original sentence. For example, deletion of *or Bert* derives the alternative *Ernie was at the airport* from (2). So, the hearer should wonder why the speaker didn't say *Ernie was at the airport*. From the second maxim of quality (4), the hearer infers that the speaker isn't sure that he saw Ernie at the airport, which is one of the uncertainty implicatures. The other uncertainty implicature follows in the same fashion from the alternative *Bert was at the airport*. Note though that in this case, the hearer cannot make the competence assumptions that the speaker knows whether Ernie was at the airport and whether Bert was there: The competence assumptions together with the uncertainty implicatures would entail that neither Ernie nor Bert were at the airport. In other words, by asserting a disjunction the speaker indicates lack of full competence.

In sum, the pragmatic account assumes that scalar implicatures arise because the hearer reasons about why the speaker chose a particular utterance. This reasoning process is viewed as structured by a restriction to alternative utterances and by making one potential explanation (the second maxim of quality (4)) a default. Combined with a competence assumption, this derives scalar implicatures. Important for the following is that the pragmatic reasoning is necessarily *global*: it can only apply to entire speech acts. This follows because the maxims of quality cannot generally apply to embedded sentences: For example, the sentence *P* cannot be subject to either maxim of quality when it occurs embedded under *I don't think that P*: the speaker cannot have any evidence for *P*, since the speaker believes *P* to be false. Therefore, the pragmatic approach predicts that implicatures essentially should be restricted to the level of whole sentences (I return below to the issue of embedded speech acts).

3 The Lexical Theory

The lexical theory is motivated conceptually by Levinson (2000) in the following way: The pragmatic theory assumes that essentially all occurrences of the words *some*, *or* and several other scalar terms require the hearer to execute several steps of reasoning. And in all cases the reason-

ing leads to the same implicatures: for example, from *some* to *some but not all*. It seems inefficient for the hearer to always go through the same reasoning. Instead, it would be more efficient for the hearer to store the result of this reasoning once and for all and apply it whenever it is needed.

Empirically, the lexical theory was supported by Levinson (2000) and Chierchia (2004) with examples that show that scalar implicatures are not always global. Consider the examples in (6): (6a) has an interpretation where it's tautologically true. This reading can be described, as having the implicature of *some* as part of the premise of the conditional: *If you ate some and not all of the cookies, then there must still be some left*. For (6b), the premise of the conditional must have the exclusivity implicature of *or* as part of its content for the sequence to be coherent. And in (6c), finally, Chierchia et al. (2008) argue that the disjunction *the first problem or the second problem* must also have the exclusivity implicature as part of its content. Specifically, they argue that otherwise (6c) would violate Hurford's constraint that the second disjunct must never entail the first disjunct in a disjunction (cf. Hurford 1974; Singh 2008).

- (6) a. If you ate **some** of the cookies and no one else ate any, then there must still be some left. (Levinson, 2000)
- b. If you take salad **or** dessert, you pay \$20; but if you take both, there is a surcharge. (Chierchia et al., 2008)
- c. Mary solved the first problem **or** the second problem or Mary solved both problems. (after Chierchia et al. 2008)

The pragmatic theory, however, cannot predict non-global implicatures as I pointed out at the end of the previous section. One way out might be to assume that speech acts can be embedded – a possibility raised by Krifka (1995) and, in a more limited way, by the notion of meta-linguistic negation of Horn (1989). However, Krifka (2011) assumes that embedding of speech acts in conditionals and disjunctions to be impossible. Also, the pragmatic theory as discussed in the previous section requires that the second maxim of quality (4) apply to the domain for which implicatures are computed. But the speaker typically lacks evidence for both the content of a conditional clause and individual disjuncts, so would violate (4) if it

applied at the level of embedding in (6) where implicatures are present. Therefore, the data in (6) present a problem for the pragmatic theory and motivate the lexical theory.

The basic assumption of the lexical theory is the intuition that scalar implicatures are stored in the lexicon and retrieved whenever a scalar term is used. In Levinson's (2000) account, implicatures are added to the lexical meaning of a scalar term, such that, for example, *some* means *some and not all*. However, in order to allow for implicature cancellation Levinson furthermore proposes that scalar implicatures are marked as defeasible in the lexical representation. Chierchia's (2004) proposal is a variant of Levinson's where scalar terms enter the sentence meaning both with their 'weak' (implicature-free) meaning and also with a 'strong' (implicature-laden) meaning. Implicature cancellation then involves the weak meaning, while otherwise the strong meaning is used.

The lexical theory in either version straightforwardly predicts all the data we considered up to now. For the examples (1) and (2), the scalar implicature is part of the lexical meaning of the scalar terms. For example, (2) therefore means the same as *Ernie or Bert and not both were at the airport*. Nothing but the appeal to the enriched lexical meaning is necessary to explain the exclusivity implicature in this case. The uncertainty implicatures can also be added to the lexical meaning of *or*, though this hasn't been proposed by either Levinson or Chierchia. The lexical theory furthermore accounts for the data in (6): Because the scalar terms *some* and *or* contain the scalar implicatures as part of their lexical meaning, the interpretations predicted are exactly the ones where the implicature is part of the content of the premise of the conditionals in (6a) and (6b) and the first two disjuncts in (6c).

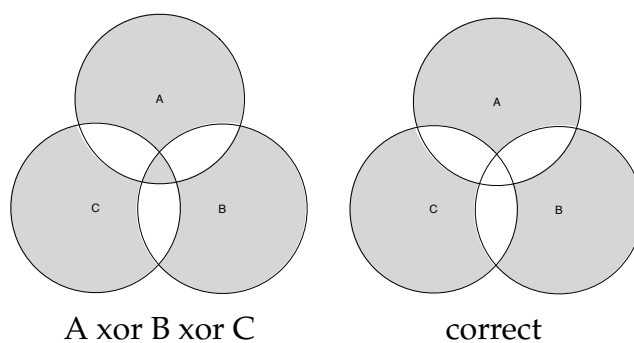
But, the lexical theory also faces problems because it always predicts implicatures to be local. It is easy to come up with examples where a global reading is prominent. Consider the two cases in (7):

- (7) a. Mika doesn't like all of Beethoven's symphonies.
b. A or B or C.

The lexical theory doesn't predict any implicatures for (7a): *all* as the most informative term of a scale doesn't trigger implicatures. In fact, though,

all embedded under negation triggers what is called an *Indirect Implicature*: *Mika likes some of Beethoven's symphonies*. Note that this implicature is a straightforward consequence of the pragmatic theory: Because *some* and *all* are members of a scale, *Mika doesn't like some/any of Beethoven's symphonies* is an alternative raised by (7a), and leads to the indirect implicature. More generally, the pragmatic approach predicts a reversal of implicatures when scalar expressions are embedded under in an environment that reverses entailment relations. The lexical theory can only emulate this behavior by introducing a repair mechanism (Chierchia 2004).

For (7b), I give an abstract sentence template where I assume that A, B, and C are three logically unrelated propositions. In this case, the situation of the lexical theory is even more dire: While it does predict a scalar implicature, the one it predicts is wrong. The correct implicature is that the speaker believes that only one out of A, B and C is true. The lexical approach predicts, however, that the speaker could believe that also all three of A, B and C hold. This prediction is easy to see by inspecting the Venn-diagram for (7b) in figure 1: Since the lexical theory predicts that *or* should have the meaning of the exclusive disjunction (*xor* in logic), the left diagram below represents the prediction of the lexical theory: the intersection of A, B, and C belongs to the set $A \text{ xor } B \text{ xor } C$ because $A \text{ xor } B$ is false in that case, so combining it with C yields true. Only this wrong interpretation is predicted by the lexical approach.



Chierchia (2004) points out that a similar problem similar arises for the lexical theory with any other weak scalar term in the scope of disjunction. The pragmatic theory, however, makes the right predictions for (7b) and all similar cases as Sauerland (2004) shows.

In sum, the lexical theory proposes that scalar implicatures are attached to lexical items. It is conceptually motivated as a memorization of implicatures. This assumption predicts that in some cases scalar implicatures can be local, which the pragmatic approach cannot. The problem of the lexical theory is that there are also cases where scalar implicatures must be global. In these cases, implicature computation needs to take into account larger parts of a sentence structure, not just lexical items: individual cases of global implicatures such as *not ... all ...* and *or ... or ...* could be accounted for as larger, partially lexicalized meanings, but this approach wouldn't predict the general availability of global implicatures.

4 The Grammatical Theory vs. the Pragmatic+Lexical Theory

The previous two sections showed that neither the pragmatic nor the lexical theory on their own can account for all the data on scalar implicatures. In this section, I consider two new theories: the pragmatic+lexical theory and the grammatical theory. The pragmatic+lexical theory combines the pragmatic and lexical theories discussed above to avoid the problems either theory individually faces. The grammatical theory, however, provides an entirely different approach. It allows implicature computation at both the lexical level and at the level of bigger parts of structure and thereby can predict both local and global implicatures. In this section, I first introduce the grammatical theory, then the pragmatic+lexical theory, and then present suggestions for how to distinguish between the two. I argue that the burden of proof rests on the grammatical theory, and show that none of the evidence discussed in the literature supports the grammatical theory. However, based on novel evidence from intermediate implicatures I conclude that the grammatical theory nevertheless seems preferable to the pragmatic+lexical theory.

The grammatical theory was developed by Chierchia (2006) and Fox (2007) to solve the problems just noted for the lexical theory. It attributes implicature computation to a silent grammatical operator which is written

as either *Exh* or *O* as abbreviations for *Exhaustify* and *Only* respectively. Since I follow Fox (2007) on the specific definition of the operator, I write *Exh* in the following. The abbreviation *Exh* is though used in earlier work by Groenendijk and Stokhof (1984) and others with a different interpretation. For the definition of *Exh*, Fox adopts parts of the pragmatic theories reasoning about which alternatives to exclude to yield the right predictions for the case of multiple disjunction (7b). Because my main concern is the local-global question, I won't present Fox's definition and account in detail. Instead, the following understanding of *Exh* is sufficient for this paper: the meaning, $\llbracket Exh(P) \rrbracket$ is defined as the conjunction of $\llbracket P \rrbracket$ and the epistemically strong implicatures the pragmatic approach of section 2 predicts when *P* is asserted. In this definition, *P* can be any constituent with a propositional meaning. With one exception, the grammatical theory provides a straightforward account for examples such as (1), (2), and (7), where implicatures were only global: the grammatical approach assumes that *Exh* is applied to the entire sentence. The uncertainty implicatures of (2) are the one exception: the grammatical approach does not account for these, and therefore must assume that for these a weak version of the pragmatic theory – perhaps without the competence assumption – explains the uncertainty implicatures.

The grammatical approach's primary difference to the pragmatic approach is that it divorces scalar implicature computation from reasoning about the speaker choice of a speech act: *Exh* is free to apply to embedded propositions. This provides an account, for the examples in (6) where implicatures are part of the meaning of an embedded constituent. The structure in (8) exemplifies the account for the third example from (6).

- (8) *Exh*(*Exh*(Mary solved the first problem or the second problem) or she solved both problems.)

The application of *Exh* to the first disjunct *Mary solved the first problem or the second problem* predicts the local implicature we observed above. For the other examples in (6), an embedded occurrence of *Exh* accounts for the example in a similar way. At the time of Fox's writing, an advantage of the grammatical theory was that it accounts for *Free Choice Inferences* of

disjunction, however, now it's known to be possible to modify the pragmatic theory to accommodate these inferences (e.g. Geurts 2010), hence, I do not discuss them here.

The account in (8), raises the question whether a similar representation, namely (9), is available for the multiple disjunction example ((7b)).

(9) *Exh(Exh(A or B) or C)*

Since (9) is equivalent to the unavailable *A-xor-B-xor-C*-interpretation discussed above, this representation must be unavailable. Chierchia et al. (2008) discuss a principle that blocks construal (9); namely, the *Strongest Meaning Hypothesis* (SMH, Dalrymple et al. 1998). One version of the SMH states that a representation ϕ is dispreferred if a representation ψ that differs only with respect to the placement of *Exh*-operators asymmetrically entails ϕ . (9) is predicted to be dispreferred by the SMH because omitting the lower occurrence of *Exh* results in a stronger reading – one where it is also excluded that A, B, and C were all three at the airport. Note that there is no such asymmetric entailment in (8).

The SMH seems initially problematic for the grammatical account for the examples in (6). For example, representation (10) for the b-example violates the SMH because omitting *Exh* results in a stronger interpretation (unless the SMH was apply to just the conditional clause, cf. Sauerland (2011)). Note however that adding an *Exh*-operator with global scope to (10) also results in a stronger interpretation, namely one that can be paraphrased as *Only if you take salad or dessert and not both, you pay \$20*. In this way, the grammatical approach provides an account for all the examples discussed until now.

(10) If *Exh*(you take salad or dessert), you pay \$20.

Now consider a second viable theoretical option, which I call the *Pragmatic+Lexical Theory* (*P+L Theory*). Though the term *Pragmatic+Lexical* is new, versions of this account can be traced back at least to Horn's (1972) discussion of numerals, and can also be attributed to Levinson (2000) and Geurts (2010). The P+L theory assumes that any non-maximal scalar word

is lexically ambiguous between two interpretations (cf. Chierchia 2004 mentioned above): without and with implicature. For example, *some* is ambiguous between $some_W$ without implicature and $some_S$ with the implicature as part of the lexical meaning. *Or* is ambiguous between or_W and or_S , where or_S entails exclusive disjunction *xor* and the uncertainty inferences discussed for example (2). Only the maximal scalar items such as *all* and *and* are not ambiguous. In addition to the lexical ambiguity, the pragmatic+lexical account assumes that the pragmatic account applies exactly as stated in section 2.

The predictions of the P+L account match those of the grammatical account for the most part. Basic examples of implicature such as (1) and (2) can be explained either by appeal to the weak meanings combined with the pragmatic account or directly by the strong meanings $some_S$ and or_S . For the examples in (6) that were problematic for the pragmatic account, the pragmatic+lexical account appeals to the strong lexical meanings, which directly result in the desired interpretations. For the examples in (7), the pragmatic+lexical account appeals to the weak lexical meanings. Specifically for ((7b)), $(A or_W B) or_S C$ with its pragmatic implicatures that $A or_S C$ and $B or_S C$ yields the correct interpretation. But, one remaining question concerns the absence of an *A-xor-B-xor-C*-interpretation for example ((7b)): this interpretation would be predicted by representation (11), but isn't available as we have seen.

(11) $(A or_S B) or_S C$.

As far as I know, the problem of (11) hasn't been addressed systematically in the literature on the P+L account. One suggestion is to also apply the SMH in the pragmatic+lexical account. Specifically, the following version of the SMH is viable for this case: The strong lexical entry of a scalar item cannot be used in a sentence ϕ if ψ asymmetrically entails ϕ where ψ uses the weak instead of the strong lexical entry. This rules out (11) because $(A or_W B) or_S C$ asymmetrically entails (11).

Both the grammatical and the pragmatic+lexical account predict all the data discussed up to now. Before reviewing further empirical evidence to decide between the two, I argue that conceptually the pragmatic+lexical

should be preferred – in other words, the burden of proof is on the grammatical account. Such conceptual arguments are often contentious, but in this case I think is interesting for two reasons: 1) the conceptual argument is widely shared, and 2) the empirical facts in the end don't accord with the result of the conceptual argument. The conceptual preference for the P+L is justified as follows: The pragmatic account is an outgrowth of common sense reasoning. That such common sense reasoning takes place, however, is not denied by proponents of the grammatical theory, who see it to be responsible for the uncertainty implicatures (Fox, 2007). The lexical theory too has solid conceptual appeal based on this common sense reasoning – committing implicatures to lexical memory saves mental effort. Therefore, both the pragmatic and lexical theory can be essentially motivated from common sense. The grammatical theory, however, denies a relationship between scalar implicatures and common sense reasoning. So, the account is not motivated in this way. Chierchia et al. (2008) present two other arguments that they claim provide two independent justifications for the grammatical theory, however, neither of them convinces me: 1) they claim that *Exh* is a silent version of *only*. But, on the one hand, this cannot be correct since *only* often licenses negative polarity items, while *Exh* never does, and on the other hand, the presence of overt lexical items doesn't generally predict silent ones to exist – for example, there is an overt, but no silent negation in English. 2) Chierchia et al. (2008) point to data from question-answer pairs originally discussed by Groenendijk and Stokhof (1984) to support a version of *Exh*-operator. But, work by Hirschberg (1985) and others has seen these viewed such data as instances of scalar implicature while introducing the notion of *ad hoc* scale. I conclude that it is healthy to approach the grammatical theory with scepticism. In some other cases of silent operators, I think there is empirical evidence to motivate them (see e.g. Beck and Sauerland (2000) on a silent cumulativity operator). Similarly, the grammatical theory requires empirical evidence in its favor – otherwise, the P+L theory is preferable.

There is at this point a growing amount of empirical work trying to decide the debate between the two theories. However, the results up to this point aren't decisive. The data Chierchia et al. (2008) discuss are pre-

sented in (6) and are predicted by the P+L theory as well. More recently, there is a growing body of experimental literature on examples illustrated by (12) (Geurts and Pouscoulous, 2009; Chemla and Spector, 2011; Clifton and Dube, 2010).

- (12) a. **All** the squares are connected with **some** of the circles. (Geurts and Pouscoulous, 2009)
b. **Exactly one** letter is connected with **some** of its circles. (Chemla and Spector, 2011)

But, the two theories as I've developed them don't make different predictions for these two examples in (12): The examples have a general structure where one logical operator Q (bold-faced) takes scope over a weak scalar item I (also bold-faced). The pragmatic+lexical theory predicts a reading where I is interpreted as the strong version I_S . The same interpretation arises on the grammatical approach by positing an *Exh*-operator in the scope of Q . Furthermore, on the grammatical theory an outer, second *Exh*-operator can apply with scope over Q – in fact, the outer *Exh* is preferred by the SMH. But, on the pragmatic+lexical theory the corresponding effect derives from the application of the pragmatic theory. Therefore the examples in (12) and other examples with only a single logical operator Q cannot be used to distinguish between the pragmatic+lexical and the grammatical theories. At this point, I conclude that the current literature doesn't provide the type of strong empirical argument that would justify adoption of the grammatical theory.

However, the preceding discussion makes clear what examples to draw the distinction between the PL and the grammatical theory would look like: the relevant test is whether structures with two logical operators Q_1 and Q_2 scoping above a scalar item allow implicature triggered by an *Exh*-operator scoping between Q_1 and Q_2 . Such implicatures we could call *intermediate implicatures*. There is a clear difference in prediction: While the grammatical theory predicts such scalar implicatures, the pragmatic+lexical theory does not. Furthermore, it is presently difficult to see any extension or modification of the pragmatic+lexical theory that would account for intermediate implicatures.

The following examples show that only the grammatical theory makes the correct predictions: intermediate implicatures are possible. Example (13a) was constructed with the help of Benjamin Spector (p.c.). (13b) is from an unpublished handout of Fox and Spector (2008), but they use it to make a different point than my current concern. Finally, (13c) is the most straightforward test for intermediate implicatures – an indirect implicature within a disjunction –, but its empirical status is unclear.

- (13) a. Either she must read at least **three** of the books **or** she must read at least **four** of them.
 b. Either every student solved **most** of the problems, or every student solved **all** of them. (Fox and Spector, 2008)
 c. ??Either Joe didn't read every book or he read no book.

All three examples utilize Hurford's constraint – the condition mentioned in section 3 above that *B* mustn't entail *A* in a disjunction *A or B*. They each test whether a representation where *Exh* takes scope over the entire first disjunct is available. I now discuss each of the three in detail, starting with (13c). (13c) is the first test for an intermediate implicature that comes to mind: Can the indirect implicature of *not every* be embedded under disjunction? Only if this is possible the second disjunct of (13c) doesn't entail the first. The result, however, is equivocal. However, it seems to be generally the case that indirect implicatures are not as easily available as other scalar implicatures – in unpublished pilot experiments on sentences like *Letter C isn't connected to every dot* Clemens Mayr and I did not observe indirect implicatures. The slight degradedness of indirect implicatures might also explain the questionable status of (13c).

Example (13b) provides direct evidence for intermediate implicatures because the sentence is acceptable even if it is already established that many students solved all of the problems. In principle, (13b) is predicted to satisfy Hurford's constraint either if *Exh* is applied in the scope of *every student* or with wide scope over *every student*, but only the latter representation is compatible with a scenario where many students solved all the problems. Therefore an intermediate implicature must be available for (13b).

Example (13c) provides the most striking evidence for the grammatical theory: it is actually predicted to be unacceptable in any scenario unless an intermediate implicature was available. First consider (14) without a modal: the quantifier *at least three* cannot occur in the immediate scope of *Exh* (Fox and Hackl, 2006), and hence doesn't have an implicature that she didn't read more than three books. Therefore (14) violates Hurford's constraint – the second disjunct entails the first. In (13a), however, the grammatical approach predicts that the first disjunct can have the representation *Exh* (*she must read at least three books*). This representation yields the implicature that she is allowed to read exactly three books, though she is also allowed to read more. Hurford's constraint is predicted to be violated by (13a) unless the intermediate implicature is available for the first disjunct. But if the intermediate implicature is available, the second disjunct doesn't entail the first. The fact that there is a contrast in acceptability between (13a) and (14), therefore, shows that (13a) permits an intermediate implicature.

(14) #Either she read at least three of the books or she read at least four of them.

The intermediate implicature data in (13) provide novel evidence for the grammatical theory of implicatures, and to me the evidence they provide is decisive. I still believe that scepticism of the grammatical approach is in order as I may have made a mistake, but it seems difficult to reconcile the data in (13) with any of the other three approaches to implicatures I discussed. One possibility to account for intermediate implicatures on the pragmatic+lexical theory that seems initially possible is an appeal to speech-act embedding as was already mentioned in the discussion of the examples in (6). However, as I already mentioned above, such an approach is incompatible with the normal concept of assertion. Specifically, assertion is crucially tied to Grice's maxims like the maxim (4) above. But, (4) is typically not satisfied by a single disjunct – this is predicted by the uncertainty implicatures of disjunction discussed following (2) above. If this is correct, the P+L theory even with speech-act embedding cannot provide an account of the intermediate implicatures in (13).

5 Conclusion

In this paper, I reviewed and extended what is known about the computation of scalar implicatures. In particular, four different theories of scalar implicatures were discussed. The first two, the pragmatic theory and the lexical theory were relatively straightforward to disprove. The pragmatic theory cannot explain local implicatures as in (6) while the lexical theory cannot explain global implicature as in (7). In section 4, I introduced two current theories of scalar implicature: the grammatical theory and the pragmatic+lexical theory. As I showed, both of these theories account for all the data introduced in the first three sections, especially (6) and (7).

I then set out to compare the grammatical with the P+L (pragmatic+lexical) theory, ultimately siding with the grammatical theory. I argued that a clear difference in prediction between the two theories exists: Only the grammatical theory predicts *intermediate implicatures*. Intermediate implicatures involve implicature computation between two quantificational operators. They can be derived on the grammatical theory by computing implicatures at a point of structure that scopes in-between the two quantificational operators, but not on the pragmatic+lexical theory. The examples in (13) show that intermediate implicatures really exist. These examples provide as far as I am aware the strong empirical support for the grammatical theory.

The outcome that favors the grammatical theory is unsettling from a conceptual point of view: I argued that the P+L theory is conceptually preferable to the grammatical one since only the former is rooted in Grice's natural explanation of scalar implicature derived from common-sense reasoning. Nevertheless, the P+L theory is falsified by intermediate implicature data in (13), and only the grammatical theory makes the correct prediction. I conclude that, after discovering strong evidence in favor of the grammatical theory, it may now be time to question the assumptions that made the P+L theory look so attractive.

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