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Scalar Implicatures, Polarity Phenomena, and the Syntax/Pragmatics Interface

1. Introduction

Negative polarity phenomena, as exemplified in the behavior of English *any*, and scalar implicatures, as exemplified by, say, the interpretations of *some* (i.e., "at least one and possibly all" vs. "at least one but not all"), have often been felt to be closely related.[1] However, the exact nature of such a relationship remains as of now not fully understood, insofar as I can tell. And in fact, some important empirical generalizations pertaining to it, if not altogether missed, have perhaps not been properly appreciated. In this chapter, I address the issue of what are the relevant factual connections between scalar implicature and negative polarity and what we can learn from this about the grammatical mechanisms at the basis of these phenomena. One of the features that makes the analysis of negative polarity items (NPIs) and scalar implicatures (SIs) particularly interesting is that they raise a number of key questions concerning how syntax, semantics, and pragmatics interact with each other. We will mostly focus on the interface of pragmatics with syntax and semantics. More specifically, here is a widespread view of the latter. Grammar (which includes syntax and semantics) is a computational system that delivers, say, pairs of phonetic representations and interpreted logical forms. The output of the computational system is passed onto the conceptual/pragmatic system that employs it for concrete communication. The computational system of grammar and the conceptual/pragmatic system are separate units and work in a modular way: each unit is blind to the inner workings of the other. Things like agreement or c-command belong to grammar; things like relevance or conversational maxims belong to the conceptual/pragmatic system. This view is very plausible and has been quite successful in explaining things. Yet, I would like to make a case that, in certain important respects, it is actually wrong.

Let me try to give, in broad outline, the structure of the main claims to be developed. An influential account of scalar implicatures stems from Grice (1989) and the work more or less directly inspired by it (e.g., Horn 1972, 1989; Atlas & Levinson 1981). I will take the (neo)Gricean view as our starting point. I will then try to establish a factual generalization relating scalar implicatures to polarity phenomena. The generalization, in rough terms, is the following: ordinary scalar implicatures are systematically suspended in the very contexts that license elements like *any*. This seems to entail that the two phenomena in question must be based on a device governed by uniform principles. At the same time, scalar implicature computation and NPI licensing are influenced by structural (i.e., locality) considerations in very different ways—so much so that it is hard not to draw the conclusion that they are driven by very different mechanisms after all. This is, then, the problem: SIs and NPIs are so similar in certain respects and so different in others. Why? How come? After discussing the limits within which current approaches manage to provide an account of this puzzle, I will make a specific proposal on how SIs are computed and on how NPIs are licensed. I will try to make a case that the interaction of these two proposals actually takes us some way to a better understanding of the relevant phenomena. As we will see, my proposal has interesting (though not uncontroversial) consequences for the overall architecture of grammar at the above mentioned interfaces. In particular, I will argue that pragmatic computations and grammar-driven ones are "interspersed." Implicatures are not computed *after* truth conditions of (root) sentences have been figured out; they are computed phrase by phrase in tandem with truth conditions (or whatever compositional semantics computes).

The structure of the chapter is the following. In section 2 I discuss the main empirical properties of SIs. Then in section 3, I will put forth a theory of SIs that hopefully sheds some light on such properties. I will argue that, contrary to the dominant view, SIs are introduced locally and projected upward in a way that mirrors the standard semantic recursion. In section 4 I turn to NPIs. In this area, recent proposals have been developed, which make us understand *why* NPIs are licensed in negative context (Kadmond & Landman 1993; Krifka 1995; Lahiri 1998). All such proposals are based on the idea that the semantics of NPIs involves a comparison among relevant alternatives (much as SI implicature computation involves a comparison with scalar alternatives). I will propose a modification of such views in order to overcome some difficulties they run into. The two proposals (on SIs and NPIs) will have an unexpected kind of interaction having to do with the so-called intervention effect that has been observed in connection with NPIs.

In the rest of this introduction, in order to set our baseline, I summarize (a version of) the neo-Gricean stand on implicatures. The phenomenon is well known. The truth conditional content of a sentence like (1a) is taken to be (1b). Yet, such a sentence typically implicates (1c) conversationally and similarly for the sentences in (2):

(1) a. John is singing or screaming
b. $\text{singing}(j) \vee (\text{screaming}(j))$
c. $\neg (\text{singing}(j) \wedge (\text{screaming}(j))$

(2) a. Some student did well
b. $\exists x[\text{student}(x) \wedge (\text{did well}(x)]$ (Some and possibly all students did well)
c. $\neg \forall x\ [\text{student}(x) \rightarrow (\text{did well}(x)]$ (Not every student did well)

Implicatures of this sort arise whenever expressions that may be viewed as partaking in an informational scale are involved. For example, the (positive) quantifiers can be thought of as being ordered along a scale of informativeness as follows:

(3) The (positive) quantifier scale: some < many < most < every

The reason why this is so is that, for example, a sentence like (4a) asymmetrically entails (and hence is informationally stronger than) a sentence like (4b):[2]

(4) a. Every man smokes
b. Some man smokes

More generally, whenever a determiner D occurs to the right of a determiner D^+ in the scale in (3), a sentence of the form D N V will entail a sentence of the form D^+ N V. Similarly, *and* and *or* can be thought of as part of an informational scale, as *p and q* (asymetrically) entails *p or q*, and hence the former is inherently more informative than the latter. The centrality of the notion of scale for implicatures has been especially motivated in Horn's (1972, 1989) work; what can constitute a natural scale is somewhat controversial and need not concern us here.[3] Typical scales, besides < or, and> and the positive quantifiers in (3), are the following:

(5) Examples of Horn scales:
a. Negative quantifiers: not all < few < none
b. Predicates: *cute* < *beautiful* < *stupendous*
discrete < *good* < *excellent*
...
c. Numerals: 1 < . . . n < . . . .
d. The modals: possibly < necessarily
may < must
where $\alpha < \beta$ ("α is informationally weaker than β") $=_{df}$ β (asymmetrically) entails α.[4]

SIs derive from the systematic exploitation of Grice's (1989) conversational maxims (especially relevance and quantity). The way in which they come about may be schematically illustrated by an example (inspired most directly by Landman 1998). Consider

(6) a. Who is in that room?
b. John or Bill
c. John and Bill

Suppose a hearer gets (6b) as an answer to question (6a); s/he will then typically come to conclude that the answer in (6b) implies that (6c) does not hold (i.e., that John and Bill are not both in the room) in the following (idealized) way:

(7) i. The speaker said (6b) and not (6c), which would have been also relevant
ii. (6c) entails (6b) [*or* and *and* are part of a scale]
iii. If the speaker had the info that (6c), she/he would have said so [quantity]
iv. The speaker has no evidence that (6c) holds
v. The speaker is well informed
Therefore,
vi. It is unlikely/not the case that (6c) holds

Whether one goes for the stronger or the weaker version of the conclusion in (8vi) will depend on various pragmatic factors. It is important to notice that in the view just sketched, SIs are computed "globally," that is, after grammar has done its job. One first computes the (plain) meaning of the sentences; then, taking into account the relevant alternatives, one strengthens that meaning by adding the implicature.

It might be useful to have a more explicit model of how SIs are computed. An interesting proposal in this sense may be found in Krifka (1995). Following recent discussions of the semantics of focus, Krifka argues that a sentence S is generally considered against the background of a relevant set of alternatives, that is, other statements that might have been made in place of S. When scalar items are involved, the relevant set of alternatives is constituted by propositions built up by using the other items on the scale. Consider, for example, a sentence like (8a). Its truth conditional content is given in (8b).

(8) a. John earns $200 an hour
b. earn (j, $200) (in the "at least" sense)

The relevant set of alternatives are the following:

(9) Relevant alternatives:
{ . . . earn (j, $100), ___, earn(j, $300), earn (j, $400) . . }
entailment : ←

The members of the relevant alternatives in (9) are presented in their natural order, going from the weakest to the strongest. That is, every item in (9) entails the items to its left. For example, if it is the case that John earns $400 an hour, it must also be the case that he earns $300 an hour, and so on. The arrow beneath (9) indicates the direction of entailment. The slash indicates where the assertion would fit (for simplicity I am assuming only multiples of $100 to be relevant). According to Krifka, the recursive part of the semantics is set up in such a way as to compute, next to the truth-conditional content of a sentence $\|S\|$, also its relevant set of alternatives $\|S\|^{ALT}$ (along lines similar to those proposed by Rooth 1985 for focus). Thus, we keep track simultaneously of truth conditions and alternative sets, which is tantamount to saying that what we call "meaning" is in fact a multidimensional phenomenon. At some point,

we choose to assert our sentence. That is, we add it to a context c, which will include a shared body of information (the conversational background). It is at this point that SIs are factored in because to choose a proposition from a given set of alternatives will, reasonably, carry along the weaker ones (i.e., the entailed alternatives) and exclude the stronger ones (i.e., the entailing alternatives)—by something like the Gricean reasoning sketched above in (7). Krifka formalizes this by defining a notion of scalar context incrementation whereby adding (8a) to a context c amounts to adding to c the following:

(10) [earn (j, $200) $\wedge \neg$ earn (j, $n)] ($200 < n)

Thus, there are two parts to this process: the recursive computation of meaning (truth-conditional content plus alternative set) and context incrementation (where SIs are added in). The second part necessarily follows the first in time. I refer to Krifka's (1995) article for details.

I have sketched a neo-Gricean model of how implicatures are computed that to the best of my knowledge pretty much represents the level of our current understanding of the phenomenon. (The existing variants of it, to the extent they are or can be made equally explicit, share the basic architecture of Krifka's 1995 proposal). To be sure, I have offered no arguments in favor of the neo-Gricean view. And, in fact, to do so would take us too far afield. However, I believe that there are a number of things that that approach explains reasonably well.

(11) What the (neo-)Gricean approach explains:
a. Defeasability of scalar implicature
b. Sistematicity and cross-linguistic stability of the phenomenon
c. Lack of lexical ambiguity of scalar items
d. Metalinguistic/echoic uses of negation (and other operators)

Let us briefly review how a neo-Gricean account of the properties of SIs listed in (11) would go. Scalar implicatures are defeasable for a number of reasons. Perhaps the most straightforward one is that something in the context may make the stronger alternatives irrelevant, thereby undermining the canonical reasons for assuming that they do not hold. [Imagine, e.g., uttering (8a) in a situation in which our explicit concern is to find out who earns *at least* $200 an hour]. Moreover, the neo-Gricean reasoning applies in an equal manner to every item that may be construed as belonging to a scale of the type illustrated in (6); hence, whenever we find a set of items in any language that naturally forms a Horn scale, we will expect them to display similar behavior. And the reason that one does not find distinct lexical entries for the alternative interpretations of scalar items is also clear: the two interpretations of, for example, *some* can be derived by means of a fully general mechanism. Finally, the neo-Gricean view meshes well with the independent observation that negation (and, possibly, other connectives) may be used in a "echoic" or "metalinguistic" way (again see Horn 1989). I think it is desirable to hold on to these results. However, some further empirical generalizations relevant to SIs will lead us to change rather radically certain aspects of the picture I have just sketched. To these I now turn.

2. Empirical properties of scalar implicatures

In this section I will first present data that cast some doubts on the traditional, strictly modular view of how SIs come about. Such data will suggest that implicatures are (or, at the very least, can be) introduced locally (i.e., in the scope domain of the scalar term) and then projected to (i. e., inherited by) larger embedding structures. The main empirical generalizations that characterize implicature projection will be discussed.

2.1. Are there embedded implicatures?

As mentioned in the introduction, the dominant view maintains that implicatures are computed globally, that is, after the semantics of the whole root sentence has been computed. In this section I will present some preliminary evidence that goes against this idea. If this proves to be true, we then need a way of thinking about implicature computation differently from the standard neo-Gricean one.

Let us begin by pointing out that, according to the standard view, embedded implicatures should not exist. Consider, for example, a sentence like (12):

(12) John believes that some students are waiting for him.

If implicatures are factored in at the embedded level, this sentence should implicate this one:

(13) John believes that not every student is waiting for him.

If, on the other hand, implicatures are computed at the root level, sentence (12)'s relevant alternative would be (14a). And the implicature should be its negation, (14b).

(14) a. John believes that every student is waiting for him.
b. It is not the case that John believes that every student is waiting for him.

Sentence (14b) is much weaker than (13). The former merely says that it is *compatible* with John's beliefs that not every student is waiting. But this doesn't mean he excludes such a possibility, as (13) does. So, if (12) implicates (14a) [as opposed to (13)], the implicature normally associated with *some* is weakened to the point of being virtually suspended.

What are our intuitions like about these facts? Perhaps intuitions in this domain are not sharp enough to settle the issue. Let me add, then, some further relevant observations. Suppose John comes to us and utters sentence (15a). General conversational dynamics authorizes us to claim on the basis of John's utterance that (15b) holds:

(15) a. John: "Some students are waiting for me."
b. John believes that some students are waiting for him.

Uncontroversially, the "not all" implicature will normally be present in interpreting (15a), which will be taken to convey "Some, though not all sutdents are waiting for him." But if implicatures are computed globally, such implicature is absent from (15b). This seems odd, for after all we were just reporting what (15a) gives us grounds for. The same holds for numerals:

(16) a. John: "My colleague makes $100 an hour."
b. John believes that his colleague makes $100 an hour.

If the standard neo-Gricean view of numerals is correct, the phrase "$100 an hour" in (16a), via the scalar implicature, comes to have an "exactly" interpretation. But in sentence (16b), the same numerical phrase loses such an interpretation. In fact, if implicatures are global, there is no way for unmodified numerals in embedded clauses to get an "exactly" interpretation. To put it in slightly different terms, a sentence like (15b) or (16b) certainly can be understood as if it had an embedded implicature. For example, (16b) certainly can be understood as imputing to John the belief that his colleague makes exactly $100 an hour. If this attribution doesn't come about via a local implicature, then how does it come about?

A related set of problems comes from factive verbs, that is, verbs that are taken to presuppose the truth of their complement. As we know, presuppositions can normally be accommodated. Take a sentence such as "My bike is outside." If you didn't already know that I have a bike, you can accommodate such information without any problem. By the same token, suppose someone tells us,

(17) John knows that some students are waiting for him.

If we didn't know the relevant facts (namely, that some students are waiting for John), we would typically accommodate them. I think that, in fact, we will typically accommodate also the implicature generally associated with the embedded clause. That is, we interpret (17) as

(18) Some though not all students are waiting for John and he is aware of it.

This interpretation (and the way in which we accommodate) does not come for free at all if implicatures are computed globally, whereas it does if they are computed locally. In the local approach to implicatures, (17) is interpreted as

(19) John knows that some though not all students are waiting for him.

So we have right there the fact to be accommodated. The global mechanism, instead, would only authorize one to conclude, on the basis of (17),

(20) It is not the case that John knows that every student is waiting for him.

We obviously need some extra assumption to get from here to (18), and such assumptions are not so straightforward to state. The usual assumptions that the speaker (the speaker, not John, i.e., the knower) is well informed, cooperative, and so on do not straightforwardly enable us to arrive at (18). This does not mean, of course, that it cannot be done. But I'll let the globalists tell us exactly how.

Further evidence against global computation of implicatures comes from the interaction with sentential connectives. Consider the following sentences:

(21) a. (Right now) Mary is either working at her paper or seeing some of her students.
b. Mary is either working at her paper or seeing some (though not all) of her students.

Putting for the moment aside the implicature associated with *or*, sentence (21a) is typically understood as in (21b). That is, the implicature "not all" associated with *some* is clearly present. The question is how it comes about in the view that implicatures are computed globally. The relevant alternative would be as in (22a). Notice that (22a) is stronger than (21a). Hence, such alternatives should be understood as being implicitly negated, as in (22b):

(22) a. Mary is either working at her paper or seeing all of her students.
b. It is not the case that [Mary is either working at her paper or seeing all of her students].
c. Mary is not working at her paper.

So the expected relevant implicature should be (22b). But such an implicature entails (22c), that is, the negation of the first disjunct. This cannot be. It is not obvious how to fix this problem (without loosing the implicature). To put it differently, negation, in the globalist view, seems to wind up in the wrong place: it is expected to take scope over the whole disjunction, whereas we would want it to negate just the second disjunct of the alternative. This seems to constitute a problem.[5]

Difficulties of a similar sort arise for the standard view also from the interaction of implicature triggers and quantifiers.

Consider the following sentences:

(23) a. How did students satisfy the course requirement?
b. Some made a presentation or wrote a paper. Some took the final test.

The globalist predicts that (b) implies that no students whatsoever both wrote a paper and presented it. Again, this is so because negation always winds up having the widest scope in the globalist view. In this case, such a prediction appears to be exceedingly strong. Intuitions become even shaper if we put the scalar term in the restriction of *some*. So, for example, in the globalist's view, (24a) ought to implicate (24b).

(24) Who will get a good grade in that class?
a. Some students who read some J. D. Salinger stories will get a good grade.
b. No student who read all J. D. Salinger stories will get a good grade.

Again, this seems quite unwarranted by our intuitions. The problem with existential terms parallels the one with disjunction. In both cases, the globalist predicts implicatures that are exceedingly strong (to be expected, given that existential quantification can be defined as a generalized disjunction (or join) operator).[6]

A further argument is based on nonmonotone quantifiers. Consider the following sentence:

(25) Exactly two students wrote a term paper or made a class presentation.

Sentence (25) can certainly be construed exclusively (as much as it can be construed inclusively). That is, we can intend it to mean that the number of students who did one or the other (but not both) equals two. Or we can intend it to mean that the number of students who did one or the other or both equals two. The question is, how is this possible? In particular, how did this sentence get its exclusive interpretation? In the globalist's view, the relevant alternative would be

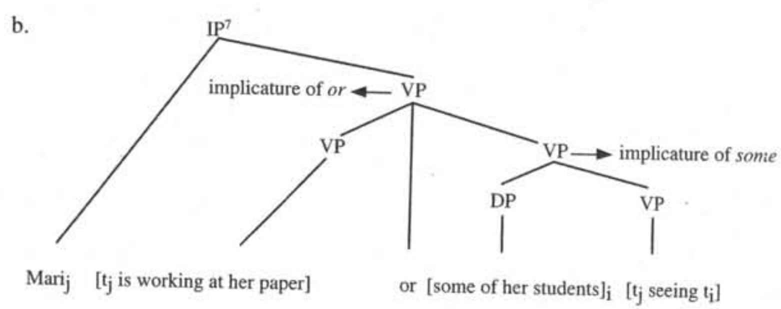
(26) Exactly two students wrote a term paper and made a class presentation.

But clearly, (26) does not entail (25). That is, because of the nonmonotonicity of the quantifier, the relevant alternatives are not ordered on a scale of informational strength. And the implicature cannot be computed. The engine that generates implicatures has nothing to work on. For the localist, per contra, this would be no problem. The implicature would be generated locally, before the subject comes in.

What emerges from these considerations is that if we look at it more closely, the idea that implicatures are computed globally (after the root sentence has been assigned its basic meaning by grammar) seems to face empirical difficulties. Hence, it seems wrong to take such an idea as the null hypothesis, in spite of its many prima facie desirable features. In all of the cases we have discussed above, one can try various moves, if one feels that the globalist view ought to be preserved. But we need theories of implicature more articulated than those currently available in order to assess the actual viability of the globalist view, rather than simply taking it for granted.

On the other hand, the facts under discussion also constitute preliminary evidence that justifies exploring an altogether different approach. Its guiding idea is that implicatures are introduced locally as soon as possible in the same order in which their trigger (the scalar terms) are introduced in the syntactic tree. Consider, for example, a sentence like (21a) above, repeated here as (27a). Its logical form would be roughly as (27b). The implicatures associated with the scalar terms would be introduced roughly at the points shown (imagining a bottom-up semantic computation):

(27) a. Mary is either working at her paper or seeing some of her students.
b.



Once introduced, implicatures are projected upward and filtered out or adjusted, as the case may be, much like that which occurs with presuppositions.[8] As a matter of fact, the history of the problem of presuppositions offers a good analogy. In that case, too, it was thought early on that presuppositions constituted a purely pragmatic phenomenon, not amenable to a grammar-driven compositional treatment (see, e.g., Kempson 1975). But eventually it turned out that such a compositional, grammar-driven treatment is, in fact, the one that allows us a better understanding of the phenomenon. In what follows, we shall thus sketch a projection algorithm for scalar implicatures. To do so, we first need to have an idea of which contexts affect implicature projection. It is in this connection that the relation with NPIs becomes central. Let us see how.

2.2. *Any* licensing and contexts of scalar implicature suspension

If implicatures are introduced in the embedded position, which contexts affect them? It is useful to go back to one of the first attempts at developing a formal theory of implicatures, namely, Gazdar's (1979), who observes that SIs appear to be suspended under negation. It's worth going through the facts, as this will serve the purpose of illustrating the empirical methodology I will adopt. Take a sentence like (28a). If the implicature normally associated with *some* was added locally, together with its meaning, the result ought to be (28b). Hence, (28a) should be consistent with the continuation in (28c).

(28) Negation
  a. It's false that Sue harassed some students.
  b. It's false that Sue harassed some though not all the students.
  c. #Sue harassed all the students.

However, such a continuation is generally not possible, banning heavy metalinguistic uses of negation (I use the "#" sign to indicate the peculiar character of (28c) as a continuation of (28a)). Hence, we conclude that the implicature normally associated with *some* is absent under negation. The same happens with other scalar items. Consider, for example, disjunction under negation:

(29) a. Sue didn't meet Hugo or Theo.
  b. It is not the case that Sue met Hugo or Theo but not both.
  c. #She met both.

Here, too, the infelicity (apart from metalinguistic uses) of (29c) as a continuation for (29a) is, I take it, evidence that the implicature of exclusiveness is missing in (29a).[9] Now, in commenting on Gazdar's proposal, Horn (1989, 233–234) suggests that SIs are suspended not just under negation but more generally in downward-entailing (DE) contexts. Horn mentions only negation-like DE contexts (like *doubt*) and doesn't actually support his comment further. He gives away the culprit without presenting

the evidence, so to say. For our present purposes it is important to see whether such a claim is actually empirically supported. In doing so, it is useful to depart slightly from Horn's suggestion and check whether SIs are affected by the contexts that license *any* (rather than in DE contexts). The DE-ness is a theoretical characterization of the relevant contexts, *any* licensing an empirical one. Since the seminal work of Ladusaw (1979), DE-ness has been identified as a key property in the licensing of NPIs. A function f is DE iff it licenses inferences from a set to its subsets [i.e., if f(A) entails f(B), whenever $B \subseteq A$]. Thus, for example, negation is DE because a sentence like (30a) entails (30b):

(30) a. John doesn't smoke.
  b. John doesn't smoke Muratti.

However, it is controversial whether DE-ness suffices in characterizing NPIs. In trying to establish the basic empirical generalizations, it is thus useful to keep *any* licensing and DE-ness separate (even though I do believe that DE-ness is, at present, our best bet). In my discussion, I will be using mostly the implicature associated with *or*. But I believe that things work in parallel ways for all scalar items.

Let us start with negative determiners like *no*. I will adopt here the classical relational analysis of determiners whereby a sentence like (31a) is analyzed as a relation between, roughly, the denotation of the noun and the verb as shown in (31b):

(31) a. No man smokes
  b. NO (MAN, SMOKES) = MAN $\cap$ smokes = $\emptyset$

Any is acceptable with *no* both within the VP and in the NP part.

(32) a. No italian eats any raw fish.
  b. No Italian who eats any fish will eat it raw.
  c. No more than *n*, at most *n*, few . . .

Following standard practice, I will refer to the NP part as the restriction of the determiner *no* and to the VP-part as the scope [as this generalizes to the cases in which a Determiner Phrase (DP) is assigned scope—say, via Quantifier Raising (QR)]. Other DE determiners such as those listed in (32c) behave exactly like *no* with respect to *any* licensing. Now, the observation that interests us in the present connection is that all such determiners, just like negation, also systematically suspend SIs. Relevant data are given in (33):

(33) Scope and restriction of DE quantifiers:
  a. No student with an incomplete or a failing grade is in good standing.
  b. #While/in fact a student with both is
  c. No student who missed class will take the exam or contact the advisor.
  d. #They will do both.

It may be useful to contrast the sentences in (33) with other non-DE determiners:

(34) a. There was some student who had an incomplete or a failing grade
b. Some student who missed class wanted to take the exam or contact the advisor

Here there is no expectation that the students mentioned in (34a) may have both an incomplete and a failing grade or that the student mentioned in (34b) wants to both take the exam and contact the advisor. That is, within the restriction and scope of *some*, the exclusiveness implicature of *or* is (or typically can be) assumed.

Another interesting contrast concerns the restriction versus the scope of the determiner *every*. As is well known, *any* is licensed in the restriction (which is DE) but not in the scope (which is not DE) of *every*. And, in fact, SIs behave accordingly.

(35) Restriction of *every*
a. Every student who wrote a squib or made a classroom presentation got extra credit.
b. #But not every student who did both got extra credit.
c. Every student wrote a squib or made a classroom presentation.

Sentence (35c) suggests that students didn't do both, although in sentence (35a) the implicature appears to be suspended, as witnessed by the oddity of (35b). In assessing their intuitions on cases such as this, readers should keep some caveats in mind. In particular, the defeasability of implicatures and the effect of shared contextual knowledge have to be taken into due consideration. Consider, for example, sentence (35c). If implicatures are introduced locally, such a sentence ought to be understood as "Every student wrote either a paper or made a presentation but not both." I think that this is what in fact happens in neutral contexts (i.e., contexts in which little is known about the relevant facts). Suppose, however, that we are considering a class where it is known beforehand that besides students that have done only one of the two chores there are also students that did both of them. We would still describe such a situation by means of (35c). The reason for this is fairly clear. We immediately see that the implicature is incompatible with the context, so we throw it out. Yet using *or* remains the best way to describe the relevant state of affairs. The same goes, mutatis mutandis, for implicature removal. Sentences like (35a) appear to favor an inclusive interpretation. But an exclusiveness condition may be *independently* present in the conversational background. For example, we may be talking about a school where you are actually penalized if you satisfy a course requirement in two ways. Or, to give another example, consider a sentence like:

(36) It was a two course meal. But everyone who skipped the first or the second course enjoyed it more, for he wasn't too full to appreciate it.

With a sentence like this, we don't mean to include among the most satisfied customers people who skipped both courses. We are told that the first and the second course cover, essentially, the whole meal. So under an inclusive construal, (36) winds up saying that also those who skipped the whole meal enjoyed it. But this is a contradiction. [Notice, incidentally, that the existence of cases like (36) seem to constitute further evidence against globalism. We seem to be in the presence here of an embedded scalar implicature.]

So what is being exactly claimed about SIs? The claim is that there are situations in which (standard) implicatures are by default present and situations in which they are by default absent, and such situations are determined by structural factors. By default interpretation, I simply mean the one that most people would give in circumstances in which the context is unbiased one way or the other. So the way in which you want to test your intuitions in assessing the above (and the following) claims is by resorting to situations that are as much as possible "neutral." Sometimes this may be hard to do, but by and large I think it is possible. At any rate, this is certainly an area of study where psycholinguistic experimentation can usefully supplement intuitions.

Let us move on to other relevant linguistic contexts and let us consider antecedents versus consequents of conditionals. *Any* is licensed in the former but not in the latter, and again SIs pattern accordingly.

(37) Antecedents of conditionals
a. If Paul or Bill come, Mary will be upset.
b. #But if Paul and Bill both come, Mary won't be.
c. If Paul comes, Mary or Sue will be upset.

In (37c) the unmarked expectation is that Mary and Sue typically won't both be upset. There is a clear contrast with (37a), where the expectation is that if Paul and Bill both come, Mary will be upset all the more.

The next class of cases concerns clause-embedding verbs that have a negative coloring of some sort.

(38) Negative embedding predicates
a. Dubitatives: doubt, deny
i. John doubts that Paul or Bill are in that room.
ii. # He doesn't doubt that Paul and Bill both are.
b. Negative factives: regret, be sorry
iii. John regrets that Paul or Bill are in that room.
iv. #He doesn't regret that Paul and Bill both are.
c. Negative propositional attitudes: fear, complain
v. John fears that Paul or Bill might not come.
vi. #John doesn't fear that Paul and Bill might both come.
d. Predicates of minimum requirement: be enough, suffice
vii. It's enough to know Italian or French (to be admitted to the program).
viii. #It's not enough to know both Italian and French.

This list is by no means exhaustive. It is interesting to note that the verbs in (38) do not pattern wholly uniformly with respect to *any* licensing. The verbs in (38a) do license *any*. Those in (38b) typically do not. But they can be argued to have something close enough to the relevant property. For example, suppose I smoke and, in fact, I smoke only Muratti or Malboro. If I regret smoking, it must, then, be the case that I also regret smoking Muratti. Finally, there is a lot of debate in the literature on the distinction between negative polarity *any* versus free choice *any* (for insightful discussion and references, see, e.g., Dayal 1998). Now, the verbs in (38c and d) do not license negative polarity *any*, but they are very happy with the free choice one:

(39) It is sufficient to know any Romance language

Thus, here, too, there is an intriguing connection between the licensing of *any* and the suspension of SIs.

The next case is that of generic statements (on this plus the two that follow, cf. Higginbotham 1991). Generics express habits or regularities that involve generalizations across cases, in contrast with episodic sentences that describe a single event. Compare in this light the two sentences in (40):

(40) a. Tomorrow, a linguist or a philosopher will come to see me.
b. A linguist or a philosopher doesn't easily give in.

Sentence (40a) is episodic, sentence (40b) generic. Sentence (40a) appears to have the familiar exclusiveness implicature. In contrast, (40b) clearly has a reading according to which if you are a linguist or a philosopher, you don't give in. In this reading, *both* linguists and philosophers are claimed to be stubborn. Clearly, the exclusiveness of *or* is suspended.

In assessing (40b), it should be noticed that such a sentence is ambiguous. It also has a reading that can be brought out by the continuation in (41a), which is equivalent to (41b):

(41) a. I know you claimed that a linguist or a philosopher never gives in. But I don't remember which.
b. I know you claimed either that a philosopher never gives in or that a linguist never gives in, but I don't remember which.

In the construal brought out in (41a and b), *or* has wide scope with respect to the generic operator. In such a case, exclusiveness will typically be present, although in the reading we were considering before, the opposite is arguably the case: the generic operator has scope over disjunction. It is in this reading that *or* cannot, typically, be construed exclusively. I am assuming here, in line with much current work, that the generic operator is essentially a (modalized) universal quantifier whose restriction is partly supplied by the context and partly constructed out of the material structurally present in the sentence. What I mean, then, by "narrow scope" construal of disjunction is that the disjunction winds up in the restriction of the generic quantifier. In rough terms the Logical Form (and the corresponding interpretation) of (40b) can be spelled out as follows (where Gn is the generic quantifier—see, e.g., Chierchia 1995 and Krifka et al. 1995, for discussion):

(42) a. Gn x [x is a philosopher or x is a linguist][x doesn't give in easily]
b. For every x (in every "normal" circumstance), if x is a linguist or a philosopher, x does not give in easily.

If this is so, then the behavior of generics can be reduced to that of the universal quantifier (and of conditionals): in the restriction, exclusiveness is suspended.

Something related to this occurs in *before* clauses and *without* clauses, which are also known to be *any*-licensing contexts.

(43) Before/After
a. John arrived before Paul or Bill.
a'. John arrived before anybody else.
b. John arrived after Paul or Bill.
b'. *John arrived after anybody else.

(44) *Without* versus *with*
a. John will come without pen or notepads.
a'. John arrived without anything.
b. John will come with pens or notepads.
b'. *John came with anything.

I give in parallel, for comparison, sentences with scalar items and with *any*. Consider the paradigm in (44). Sentence (44b) tends to suggest that John will not come with both pens and notepads. On the other hand, sentence (44a) clearly has a reading suggesting that John will come without both (again, one must avoid getting interference with "wide scope" construals of *or*). The same, mutatis mutandis, seems to be going on in (43).

Here are further *any*-licensing contexts that also appear to inhibit SIs.

(45) Comparatives
a. Theo is taller than anybody else.
b. Theo is taller than Bill or John.

(46) Prefer (i.e., verbs of comparison)
a. I prefer Theo to any other linguist.
b. I prefer Theo to John or Bill.

These structures too appear to naturally admit a reading that may be paraphrased as follows:

(47) a. If x is Bill or John, then Theo is taller than x.
b. If x is Bill or John, then I prefer Theo to x.

(To be sure, (45b) and (46b) also admit the "but I don't remember which" reading, where exclusiveness pops out again).

An important set of constructions that are known to license NPIs are questions. And it seems clear that scalar items in questions typically get an inclusive interpretation. For example:

(48) Questions
Did John or Paul arrive?
a. #No; they both did.
b. Yes, they both did.

If the question was interpreted as "Did John or Paul but not both arrive?" the answer in (48a) would sound more natural than it does. The fact that, if they both arrived, the natural answer is yes suggests that *or* is being interpreted inclusively.

Consider next the case of modalities of permission:

(49) Modality of permission.
a. It is permitted/legal to smoke or drink.
(Expectation: it is permitted/legal to do both)
b. You may smoke or drink.

If we see posted something like (49a), we don't expect to be fined if we do both. Something similar happens with (49b). However, this also readily admits of a reading in which *or* is construed as having wide scope with respect to the modal ("You may smoke or you may drink"), in which case we get a (strong) exclusiveness implicature. Intonation matters. It favors the "inclusive" reading if "smoke or drink" form an intonational phrase of their own. Speakers seem to be a little less clear about imperatives, which nonetheless ought to be mentioned in this context because they, like the modals, are known to be licensors of (free choice) *any*.

(50) Imperatives (?)
Get me Paul or Bill.

The question is, If I get you both do I fulfill the order? It seems to me that there is a sense in which the answer is yes.

The final case I'd like to mention is the irrealis mood, which has also been identified as relevant to NPI licensing (see, e.g., the discussion in Giannakidou 1997) in interaction with suitable embedding predicates. To check the relevant facts, we have to go to a language that is a bit richer in its morphology than English. Italian will do. Consider the examples in (51):

(51) a. ??Ci sara' qualcuno che ha mai sentito nominare Pavarotti.[10]
There will be somebody who ever heard of Pavarotti.
b. Ci sara' qualcuno che abbia mai sentito nominare Pavarotti!
(I hope) there will be somebody who has-SUBJ heard of Pavarotti.

In (51a) we have a presentational construction, "there will be," with an embedded indicative future. The embedded clause contains the NPI *mai* 'ever,' and the result is marginal. If one switches to subjunctive, as in (51b), the presentational sentence acquires an optative meaning (I hope/wish that there will be . . .) and the sentence becomes grammatical. Thus the presentational future *plus* the subjunctive can license NPIs. Now, if we embed a scalar item in the construction in (51b), the interpretation one gets is the inclusive one:

(52) Irrealis constructions
a. Lì ci sarà qualcuno che sa inglese o francese.
In-that-place there will be somebody who knows English or French.
b. Ci sara' qualcuno che sappia inglese o francese!
(I hope) there will be somebody who knows English or French.
c. #I don't hope that there will be somebody who knows both English and French.

Sentence (52a), with the indicative embedded under the future, is a (plain) prediction and it has a prominent exclusive construal (if in the relevant place we find only people who speak both languages, it is unclear whether the prediction we made was accurate). With the subjunctive embedded under the future, the favorite construal of *or* becomes inclusive, as witnessed by the oddity of the continuation in (52c).

In conclusion, a rather solid generalization seems to emerge from these considerations:

(53) Generalization on SIs
(Ordinary) scalar implicatures are suspended in the contexts that license *any*
(as a Neg Pol or Free-Choice Item).

So, we have, on the one hand, a class of specialized items (identified by a specific morphological makeup) whose distribution appears to be sensitive to contexts with a common semantic coloring (an extensively studied fact, which happens with remarkable cross-linguistic stability). We now also see that a certain well-established pragmatic phenomenon, the calculation of scalar implicatures, is also systematically sensitive to those very contexts (or to some closely related ones). Perhaps the extent to which generalization (53) holds hasn't been fully appreciated in the literature on these topics. One would like to understand exactly why this is case. In addressing this question, I am going to stick to Downward Entailingness as the property that comes closest to providing a characterization of the relevant contexts (while being aware of its problems).

2.3. Implicatures of negative contexts

Taking stock, we have gathered preliminary evidence in favor of the following two ideas: (a) implicatures are (or, at least, can be) added locally and (b) once an implicature has been added, upon being embedded within a DE element, it typically gets removed. Now a more careful consideration of the facts shows, I think, that what actually goes on in DE contexts is not simple cancellation of implicatures. What actually happens is that implicatures are in a way "recalibrated." Consider, for example, sentences like the following:

(54) a. In this class, no one read three papers (from the reading list).
b. In this class, no one read many papers (from the reading list).

Now intuitions tell us fairly firmly that these sentences have, respectively, the following implicature:

(55) a. No one read three papers ⇒ Someone read two papers.
b. No one read many papers ⇒ Someone read some papers.

Notice, for instance, the oddity of continuations that deny such implicatures, unless the typical means through which implicature cancellation is signaled are overtly present (i.e., interjections like *in fact* or *actually*):

(56) No students read many papers. *(In fact/actually) no student read any paper.

What is going on? As a first approximation, it looks as if in these cases (besides removing embedded implicatures), we add new ones created by the interaction of the embedding negative element and the embedded scalar terms. In the case of, for example, (54b), it is intuitively clear that the relevant alternative set will look as follows:

(57) { no student read some paper, no student read many papers, no student read every paper }
→

(Let's put aside the fact that for many speakers *some* is infelicitous under negation, as the issues this raises are related but orthogonal to our present concerns.) The direction of entailment is shown by the arrow. By the familiar reasoning, uttering (54b) will implicate the negation of the stronger alternatives. This corresponds to (58a), which is equivalent to (58b):

(58) a. ¬ no student read some paper.
b. Some student read some paper.

Clearly, this result would be (presumably) predicted if implicatures are computed globally. But we have seen that the globalist approach runs into problems (independent of those under consideration). So rather than computing them globally, we want to try to compute them at each step of the derivation (or, say, at each scope site or perhaps at each "phase"—cf. Chomsky 1999—or something of the sort). If we get it right, that should give us the good results of the globalist approach while avoiding its problems.

Let us see that facts of this sort are indeed quite general. An interesting case is that of the restriction of *every*. Since it creates (in its first argument) a DE context, it should not only remove implicatures when present but also induce new ones. And it does. A sentence like (59a) implicates (59b):

(59) a. Everyone who read two papers passed the exam.
b. Not everyone who read one paper passed the exam.

Fully parallel to these are cases concerning the antecedent of conditionals:

(60) a. If Bill has done two assignments, he will pass the exam.
b. It is not (necessarily) the case that if Bill has done one assignment, he will pass the exam.

By the same token, the sentences in (61a)–(63a) appear to convey the implicatures in (61b)–(63b), respectively:

(61) a. I doubt that most students will show up.
b. I think that some student will show up.

(62) a. It won't happen that every student will complain.
b. Some student will complain.

(63) a. Not every friend of mine has a car.
b. Some friend of mine has a car.

In (61)–(63), negation or a negative verb have scope over a quantifier like *most* or *every* and we get a positive implicature that typically involves *some*. Also *and*, embedded under negation, gives rise to an implicature:

(64) a. John doesn't eat and smoke.
b. John either eats or smokes.

(65) a. It never is the case that John drinks and drives.
b. John typically either drinks or drives.

The reasoning that justifies implicatures of this sort is, yet again, the same.

The role of scales in DE contexts (especially in connection with numerals) deserves perhaps some further discussion. According to the line we are taking, we expect that, for example, (66a) implicates (66b) and (67a) implicates (67b):

(66) a. John isn't 21 years old.
b. John is of an age pretty close to 20.

(67) a. John doesn't make $80,000 a year.
b. John makes something close to $80,000 a year.

In general, the predicted implicature of a sentence containing a numeral under negation is that the corresponding positive sentence containing the immediately lower numeral holds. Before commenting on whether this is indeed so, let me show briefly how these implicatures come about. Consider the alternative set for, say, (91). It will be something like

(68) { . . . ¬ **20Y(j)**, ¬ 21Y(j), ¬ 22Y(j) . . . }
→

The informational strength (i.e., entailment) goes the way indicated by the arrow. The strongest alternative to the assertion is the one in boldface. Hence, this is the one that, according to our Gricean procedure, gets negated. Is this expectation supported by our intuitions? The facts are not so clear. A sentence like (66a) seems to carry the expected implicature in most contexts; a sentence like (66a), less clearly so. This is part of a more general issue. Although there is systematicity in how implicatures get associated with negative sentences, such implicatures appear to be generally somewhat weaker and flimsier than their positive counterparts. For example, a sentence like (62a), repeated here rarely has the implicature "most students will complain," which is the one we would expect, given the mechanism we are assuming:

(62) a. It won't happen that every student will complain.
b. Some student will complain.

I believe that the reasons for this phenomenon have to be sought in two factors. The first is the "granularity" of the scale, that is, the intervals between the scale members that are taken to be contextually relevant. Clearly, not all the alternatives in a scale are always relevant. For example, in talking of age, we do not typically consider months (except for babies), and sometimes we talk in terms of decades. When we talk about money, we also tend to select a particular range of values (tenths of dollars in talking about restaurant prices, thousands in talking about yearly salaries, etc.), rounding off intermediate ones.[11] This interacts with the second factor, namely, the polarity under which the scalar term is embedded. If it's positive, the relevant alternative will be higher on the scale. Hence, no matter what granularity is chosen, one will get an "exactly" effect (relative to that granularity). But if the scale is embedded negatively, the relevant alternatives (i.e., those that can potentially yield stronger statements) have to be sought at the low end. This is schematized as follows:

(69) ...

three ← next strongest element in positive embedding

target → two
(i.e., uttered element)

one ← next strongest element in negative embedding

Now, it may happen that in a context, the only relevant element is the lowest on the scale. If that happens, one gets a very weak implicature, which may be tantamount to cancelling it. To give a concrete example, in talking about whether one can buy alcohol, the year immediately before the legal age will normally be relevant. In talking about money, it depends. But notice that if, in the latter case, we were to pick some small amount at the low end the scale, the implicature would be effectively cancelled, for having very little money is like having no money. That's why our intuitions are shakier in cases like (66) and (67). We will come back to this in section 3.3, after having put forth the specifics of our proposal.

In this section, I have first argued against adding implicatures all at once at the end, after the semantic computation. Then, on the assumption that implicatures get

introduced locally, I have discussed the interaction of negative contexts with scalar term. Such contexts not only remove implicatures that may have been added in before. They also induce new ones by activating new alternatives. It may be useful to introduce an appropriate terminology to talk about this. Let us call the ordinary implicatures associated with a scalar term just in virtue of its position on a scale the *direct* implicatures (e.g., the direct implicature of "John read many linguistics books" would be that he didn't read all the linguistics books). We will instead call *indirect implicatures* those introduced by a scalar term in interaction with a higher negative element (such as "I doubt that John read many linguistics books" ⇒ "I believe he read some," discussed in this section).

3. Scalar implicatures revisited

If we take the evidence we've gathered at face value, we are led to conclude that some of the Grice-inspired pragmatics is probably part of the computational system of grammar. We figure out SIs in tandem with "core" meaning, as facets of a parallel recursion. Or, an equivalent way of thinking about it is that intermediate phrases (maximal projections that are also scope sites or, possibly, just any maximal projections[12]), rather than root clauses, are shipped to the pragmatic module and that higher semantic components have access to the results of that. In what follows, I am going to formulate a hypothesis on the mechanism at the basis of such a process.

3.1. The proposal

I will assume that Logical Forms of the type familiar from the generative tradition are interpreted compositionally (bottom up) in the usual way, say, by translating them into a suitable logical language.[13] If α is any English expression, $\|\alpha\|$ will be its (plain) value, computed in the way familiar from your favorite semantic textbook. (I will sometimes abbreviate $\|\alpha\|$ as α'). Next to its plain value, each expression also has a "scalar" or "strengthened" value $\|\alpha\|^{\mathbf{s}}$, also recursively assigned. (I will sometimes abbreviate $\|\alpha\|^{\mathbf{s}}$ as $\alpha^{\mathbf{s}}$) Such a scalar value is computed (as in Krifka's 1995 proposal) by exploiting its alternatives, through a rather simple variant of the standard recursion. But rather than introducing implicatures at the end of the computation (or at some other arbitrarily stipulated site), I introduce them as soon as possible after a scalar term enters the computation. The strengthened value is thus provided by grammar. It is defeasible in the sense that whenever its addition to a given context results in inconsistency, one falls back on the plain value. In this section, I'll try to guide the reader through the characterization of strengthened meaning as informally as possible (without being exceedingly imprecise); all of the complete formal definitions necessary to the task are to be found in the appendix to this chapter.

The first step in defining strengthened values is identifying the relevant alternatives that enter into it. In the same spirit as Krifka's (1995) proposal, I assume that for any expression α, its alternatives $\|\alpha\|^{ALT}$ are a set of expressions of the same type as α (which I will abbreviate as α^{ALT}). Defining α^{ALT} is easy if α contains just one scalar term but might become quite complex if α contains more than one scalar term.

Now, since the plan is to deal with each implicature as soon as possible, I will define α^{ALT} in such a way that it yields the alternatives induced solely by the last scalar element in the tree (i.e., the highest or topmost one). The rationale for this is that scalar terms below the topmost (if present) will have been already taken care of (by the time we process the topmost). This is a locality constraint driven by the guiding idea of our attempt (namely, that implicatures are processed locally in the order in which their triggers appear). Let me illustrate how the intended definition works with a simple example. In the example below, I provide a sentence with two scalar terms, its simplified LF, and its alternative sets (throughout, I use logical formulas as stand-ins for the corresponding propositions):

(70) Some student smokes or drinks.

(71) a. LF: [some student$_i$ [t_i smokes or t_i drinks]]
b. [t_i smokes or t_i drinks]^{ALT} = { [smoke'(x_i) $\vee$ drink'(x_i)], [smoke'(x_i) $\wedge$ drink'(x_i)]}
c. [some student$_i$ [t_i smokes or t_i drinks]]^{ALT} = {some'(student')(smoke' $\vee$ drink'), many'(student')(smoke' $\vee$ (drink'), every'(student')(smoke' $\vee$ drink')}

In (71b) we have the scalar alternatives of the embedded constituent; in (71c), those of the root. In the latter, the lower scalar term is ignored. Further examples (and a formal definition of $\| \|^{ALT}$) can be found in the appendix.[14]

Now, out of a given set of alternatives, we want to be able to pick the one that is immediately stronger than our target. For instance, if we have {some'(student')(smoke' $\vee$ drink'), many'(student')(smoke' $\vee$ drink'), every'(student')(smoke' $\vee$ drink')} as the alternatives for "some students smoke or drink," we will want to pick out "many students smoke or drink" (which is what will be denied when the implicature is factored in). Let us introduce some notation for this. Given a set of alternatives A and a member of such set β, $S_\beta(A)$ will be the weakest member of A that asymmetrically entails β (and if A does not contain anything that asymmetrically entails β, we let $S_\beta(A)$ be the contradiction, $\perp$). Let me illustrate:

(72) a. $S_{\text{some students smoke or drink}}$ (some student smoke or drink ^{ALT}) = many students smoke or drink'.
b. $S_{\text{every students smoke or drink'}}$ (every student smokes or drinks^{ALT}) = $\perp$

When the target is understood and no confusion arises, I will omit the subscript and write simply, for instance, S(some students smoke or drink ^{ALT}).

Let us see now how strong values are defined. The format is that of a recursive definition that parallels the standard one. The starting point is trivial. The strong meaning of a lexical item is simply identical to its plain one; and functional application (the core rule of any type of driven translation) is defined in the familiar way:

(73) a. For α lexical, $\|\alpha\|^s = \|\alpha\|$.
b. Functional application (first version): , $\|[\ \beta\gamma\ ]\|^s = \|\ \beta\ \|^s (\|\ \gamma\ \|^s)$.

The effect of this is that ordinary meanings wind up qualifying as strong meanings, albeit as totally uninteresting ones. For example,

(74) a. John saw some students.
b. LF: [some student$_i$ [John saw t_i]]
c. $\|$[some student$_i$ [John saw t_i]]$\|^s$ = some'(student')(λx saw'(j,x)).

The next step is the "canonical" introduction of implicatures, which hopefully will make things more interesting. Let's assume that this is done at any scope site, through the following rule:

(75) If ϕ is a scope site (of type t), then $\|\phi\|^s = \|\phi\|^s \wedge \neg S(\phi^{ALT})$.[15]

This is simply a (slightly modified version of) Krifka's (1995) rule. Here is a simple computation that illustrates how it works:

(76) a. $\|$[some student$_i$ [John saw t_i]]$\|^s$ = $\|$[some student$_i$ [John saw t_i]]$\|^s$ $\wedge$ $\neg$ S([some student$_i$ [John saw t_i]](^{ALT}), by (75)
b. $\|$[some student$_i$ [John saw t_i]]$\|^s$ = some'(student')(λx saw'(j,x)) $\wedge$ $\neg$ S([some student$_i$ [John saw t_i]](^{ALT}), from (a) in virtue of (73b)
c. $\|$[some student$_i$ (John saw t_i]]$\|^s$ = some'(student')(λx saw'(j,x)) $\wedge$ $\neg$ every'(student')(λx saw'(j,x)), by definition of ALT and S[16]

Setting things up in this way entails regarding interpretation as, in essence, a relation rather than as a function (i.e., for any expression α, $\|\alpha\|^s$ will be the *set* of its strong meanings, some of which will be innocuously trivial; see the appendix for details). The interaction between the canonical rules (73) with Krifka's rule lets us happily pile up implicatures in embedded contexts. Thus, in particular, a sentence like (77a) will wind up with the strong meanings listed in (77b):

(77) a. Someone smokes or drinks.
b. i. someone'(λx smoke'(x) $\vee$ drink'(x))
ii. someone'(λx smoke'(x) $\vee$ drink'(x) $\wedge$ $\neg$ smoke'(x) $\wedge$ (drink'(x))])
iii. someone'(λx smoke'(x) $\vee$ drink'(x) $\wedge$ $\neg$ smoke'(x) $\wedge$ (drink'(x))]) $\wedge$ $\neg$ everyone'(λx smoke'(x) $\vee$ drink'(x))

Of these, the strongest one is (iii); if nothing in the context blocks it, this is the one we'll tend to use. But we also have suitably weaker ones (all the way to the plain one), which will come in handy if the strongest meaning turns out to be inappropriate (e.g., inconsistent with contextually available information).

So far so good. We have a basis for our recursion and a way to introduce canonical implicatures locally. Now we have to make sure implicatures are filtered out or recalibrated, as the case may be, in accordance with our observations. The burden of this falls on functional application. Clearly, we cannot adopt it as is, for that would be tantamount to *always* keeping in the implicatures that have been introduced, whereas we have seen that they are removed in DE contexts. So DE functions must be treated differently from the others. When we hit a DE function, we must remove the implicature from the argument. In other words, the computation of strong values must be subject to an overall constraint (or, if you wish, presupposition): the strong value cannot become weaker than the plain value. This constraint (let us call it "the Strength Condition") is checked at each step of the derivation and involves a local comparison of potentially strong values with the corresponding plain value. Let me illustrate with a simple example. Imagine embedding (76c) under *believe*, as in "I believe that John saw some students." Focus on the interpretation of the VP and assume, just for the sake of explicitness, the classical possible worlds analysis of *believe*. Now, (78a) is the plain interpretation of the VP, whereas (78b) is the strong one:

(78) a. $\|\text{believe}\|(\|\text{that [some student}_i \text{ [John saw } t_i \text{]]}\|) =$
$\text{believe}'({}^\wedge\text{some}'(\text{student}')(\lambda x\ \text{saw}'(j,x)))$
b. $\|\text{believe}\|^S(\|\text{that (some student}_i \text{ (John saw } t_i \text{]]}\|^S) =$
$\text{believe}'(\text{some}'(\text{student}')(\lambda x\ \text{saw}'(j,x)) \wedge \neg\ \text{every}'(\text{students})(\lambda x\ \text{saw}'(j,x)))$

Since (78b) is indeed stronger than (78a), the strength condition is satisfied and it is possible to keep (78b) as the strong value of the VP. For comparison, let us imagine embedding, instead, the same sentence under *doubt*. Analyzing *doubt* as *not believe* (again, just for the sake of explicitness), we now get the following as candidate values for the plain and strong interpretations, respectively:

(79) a. $\|\text{doubt}\|(\|\text{that [some student}_i \text{ [John saw } t_i \text{]]}\|) =$
$\neg\ \text{believe}'({}^\wedge\text{some}'(\text{student}')(\lambda x\ \text{saw}'(j,x)))$.
b. $\|\text{doubt}\|^S(\|\text{that [some student}_i \text{ [John saw } t_i \text{]]}\|^S) =$
$= \neg\ \text{believe}'(\text{some}'(\text{student}')(\lambda x\ \text{saw}'(j,x)) \wedge \neg\ \text{every}'(\text{student})(\lambda x\ \text{saw}'(j,x)))$

Given the DE character of *doubt*, logical relations are inverted: (79a) is stronger than (i.e., it entails) (79b). So, if we took (79b) as the final strong value, the Strength Condition would be violated. In this case, we simply remove the implicature from the argument (i.e., we make the strong value of the argument identical to its weak value). Here is the modified general schema for application that formalizes the process we have informally described:

(80) Strong application (second version):
Suppose $\alpha = [\beta\ \gamma]$, where β is of type <a,b> type and γ of type a. Then

$$\|[\beta\ \gamma]\|^S = \begin{cases} \|\beta\|^S(\|\gamma\|^S), \text{ if } \|\beta\| \text{ is not DE} \\ \\ \|\beta\|^S(\|\gamma\|), \text{ otherwise} \end{cases}$$

We have now the beginning of a global picture of how strong values may be computed. Essentially, there are two modifications of the canonical interpretive rules.

First, we introduce implicatures at any scope site (including embedded ones). Second, we impose a general condition on application that filters out implicatures whenever they lead to a weakening of information content (by local comparison with plain meanings). The recursion through which we compute strong values is an arguably straightforward modification of the standard one. Having two interpretive procedures does not lead to loss of generality since one is a predictable variant of the other (somewhat in the same spirit of the way type shifting is used in much work since Partee 1987).

One last step: we have seen that DE operators are responsible for novel implicatures *in interaction with* the alternatives of their arguments (the indirect ones). We need to modify (80) in order to get this effect. Here is one way of doing so. When the Strength Condition fails, we do not merely remove implicatures; we also check the alternatives associated with the argument in the new context, making sure that new possible quantity implicatures are added. Again, let me resort to an example to illustrate what I have in mind. Consider a sentence like (81a) and its meaning in (81b) (ignoring irrelevant factors, e.g., genericity):

(81) a. John drinks and drives.
b. $[\text{drink}'(j) \wedge \text{drive}'(j)]$

Sentence (81a) won't have any implicature by itself. This follows from the fact that *and* is the strong element of its scale. But now embed (81a) under *doubt*, as in "I doubt that John drinks and drives," and again focus on the interpretation of the VP. What we want to do is reconsider the scale associated with the argument in the new context, and if there is now an element stronger than our target, we want to add the corresponding scalar assertion. The alternative set corresponding to (81a) is (82a). Combining this with *doubt* we get (82b):

(82) a. $\{\ [\text{drink}'(j) \wedge \text{drive}'(j)],\ [\text{drink}'(j) \vee \text{drive}'(j)]\ \}$
$\rightarrow$
b. $\text{doubt} + \{\ [\text{drink}'(j) \wedge \text{drive}'(j)],\ [\text{drink}'(j) \vee \text{drive}'(j)]\ \} =$
$= \{\ \text{doubt}'({}^\wedge[\text{drink}'(j) \wedge \text{drive}'(j)]),\ \text{doubt}'({}^\wedge[\text{drink}'(j) \vee \text{drive}'(j)])\ \}$
$\leftarrow$

Now, as indicated by the arrows below the alternative sets, *doubt* inverts the strength of the relevant alternatives. So when we combine *doubt* with its complement, we must add the relevant scalar term, thereby obtaining (83a), which is equivalent to (83b):

(83) a. $\text{doubt}'({}^\wedge[\text{drink}'(j) \wedge \text{drive}'(j)]) \wedge \neg\ \text{doubt}'({}^\wedge[\text{drink}'(j) \vee \text{drive}'(j)])$
b. $\text{doubt}'({}^\wedge[\text{drink}'(j) \wedge \text{drive}'(j)]) \wedge \text{believe}'({}^\wedge[\text{drink}'(j) \vee \text{drive}'(j)])$

This is what we want. We must make it part of our definition of Strong Application, so that whenever a function combines with an argument, novel possible interactions between the two (with respect to scales already introduced) are duly taken into account. This takes us to the following definition:

(84) Strong Application (final version):
Suppose $\alpha = [\beta\ \gamma]$, where β is of type <a,b> type and γ of type a. Then

$$\|[\beta\gamma]\|^S = \begin{cases} \|\beta\|^S(\|\gamma\|^S), \text{ if } \|\beta\| \text{ is not DE} \\ \\ \|\beta\|^S(\|\gamma\|) \wedge \neg S(\|\beta\|(\gamma^{ALT})), \text{ otherwise} \end{cases}$$

So, in our final proposal on Strong Application, we simply enrich our previous definition with a novel scalar statement (i.e., $\|\beta\|(\gamma^{ALT})$), which corresponds to (83b) in our example).

Let us summarize so far. Grammar provides us with two related interpretive procedures that assigns two types of values to each expression: the plain value and its strengthened alternates. Plain values are defined in the usual way. The strengthened ones are defined in terms of the plain ones and the set of (local) relevant alternative values. The recursion through which strong values are defined is a simple modification of the standard one. Through this recursion, implicatures come in two ways, in correspondence with the two types of implicatures we have identified in the previous section. Direct implicatures come in at the first scope site of a scalar term, through Krifka's (1995) rule. Indirect implicatures come in through the interaction of a DE operator with an embedded scalar term, through Strong Application. The proper introduction of indirect implicatures is monitored at each step, as part of making sure that the strengthened value remains indeed stronger. The crucial thing is that, in this view, the level at which implicatures are added in (or removed) must not and cannot be freely set, but it simply is the most local relevant environment. Contrary to the dominant view (but consistently with our observations), implicatures, like core meaning, are computed compositionally bottom-up, off LF structures.[17]

One would expect that speakers will use the values grammar provides them with cooperatively. This means that they will tend to use the strongest interpretation (*consistent with the context*) for which they have evidence. So the default interpretation in a concrete communicative situation will be the one provided by strengthened values.[18] The idea that sentences have multiple values is what this proposal has in common with the semantics of focus. But unlike the focus value of a sentence, its scalar value is not accessible to operators. It is used for local comparison with the plain value.

Let us now turn to a more thorough discussion of some empirical consequences of the present approach.

3.2. Discussion

Insofar as I can see, the observations made in section 2 now follow and the relevant readings can be appropriately derived. Implicatures, introduced locally, appear to be projected by the theory according to intuition, through propositional connectives, quantifiers, modal operators, and embedding verbs. The reader can look up in the appendix some of the basic derivations, to get a better feel for how

the proposal works. In the present section I will illustrate, informally, some more complicated cases.

3.2.1. Some complex DE contexts

Consider the following sentence:

(85) No one (here) lives to be 80.

Such a sentence implies that someone, however, lives to be 79 (or some other lesser age, according to the context). This implicature is indirect, as it arises from the interaction between the DE contexts and the scalar term in its argument. This is correctly predicted by our approach. Now insert another implicature trigger in the restriction of *no* in (85), as in the following example:

(86) No one who smokes and drinks lives to be 80.

We expect a novel indirect implicature to compound with the first one, so that (86) implies

(87) a. Someone who smokes and drinks lives to be 79 (or some other age fairly close to 80).
b. Someone who smokes or drinks lives to be 80.

Again, this seems to be in accordance with our intuitions. [See the appendix for a complete derivation of (87)].

Now change *no* to *few* in (86). Here are the results.

(87) Few people that smoke and drink live to be 80.
Expected implicatures:
a. Some people that smoke and drink live to be 80.
b. It is not the case that few people that smoke and drink live to be 79.
(≈ some people who smoke and drink live to be 79)
c. It is not the case that few people who smoke or drink live to be 80.
(≈ some people who smoke or drink live to be 80).

With respect to *no*, the sentence with *few* adds a new direct implicature, namely (88a). This is due to the fact that *few* is part of a (negative) scale with *no*; since *no* is stronger, it gets negated (by Krifka's 1995 rule). Moreover, *few* also essentially retains the same indirect implicatures as *no* because it is DE. Notice that such implicatures are, strictly speaking, of the form "not few," as in (88b and c). But this must be taken as the expression of the abstract content of the implicature and should not be confused with the actual content of the corresponding natural language expression. In particular, in no way should *not few* here be taken to suggest *many* (and that's why the paraphrasis in parenthesis with *some* is a better rendering of the implicature). Suppose, for example, we change the ambiguous *few* in (88) to *at most two* (i.e., one or two). The implicature then is that more than two (i.e., possibly three) people who smoke and drink live to the relevant lesser age. This seems right.

3.2.2. *Default override*

As we observed, the default is usually the strong meaning. However, implicatures can be cancelled. Under the present view, cancellation amounts to a simple kind of backtracking. Let me illustrate with a few examples. (In what follows, c + S stands for the incrementation of context c by S.)

(89) a. John or Theo are there. Maybe/in fact, they both are.
b. (c + there'(sue') $\vee^{s}$ there' (theo'))
c. (c + there'(sue') $\vee^{s}$ there' (theo')) + there' (sue') $\wedge$ (there'(theo')

Here is what one expects. One first processes the first sentence in (89a) and adds it to the context, as in (89b). At the point where the first sentence is processed, the hearer will hypothesize that the strong interpretation of (89a) is being intended (as that is the default). Then, the second sentence is processed and added to the context, as in (89c). But this results in a contradiction because the exclusive interpretation of *or* is incompatible with the second sentence. At that point, the hearer throws away the strong interpretation of the first sentence and switches to the plain one (in accordance with Stalnaker's 1978 felicity conditions). Items like *in fact* or *maybe* are markers to signal that some backtracking must take place.

We also noticed in section 2.2 that sometimes implicatures are not cancelled when one would expect them to be. The example we discussed there was

(90) It was a two course meal. But everyone who skipped the first or the second course enjoyed it more.

The point is that *or* in this sentence is not construed inclusively, because otherwise a contradiction would ensue (at least in "normal" contexts). Now in cases such as (90), my theory predicts that the strong interpretation and the plain interpretation are one and the same. So, how does such a sentence come to have the reading it seems to have ("Everyone who skipped the first or the second course but not both enjoyed the meal more")? How come we see what looks like an implicature in a context where we wouldn't expect one? A simple way of thinking about this is in terms of accommodation. We know that quantificational domains are subject quite generally to such phenomena. The interpretation of (90) requires a domain of people who don't skip both courses. This yields the same effect that we would obtain by not removing the locally added implicature.

Cases of a similar sort are also pointed out in Levinson (2000), who discusses, for example,

(91) If John has two cars, the third one parked outside must be somebody else's.

Notice how this sentence becomes a blatant non-sequitur if we introduce an overt "at least" in the antecedent:

(92) If John has at least two cars, the third one parked outside must be somebody else's.

Clearly, here too we want to accommodate in the antecedent of (92) an "and no more" proviso. I.e., we want to restrict our consideration to sets of worlds from which people with more than two cars are excluded. The effect of this accommodation is the same as the computation of an implicature. But if we are right, the mechanism through which this happens is very different from how implicatures come about normally. In (92) the implicature is not added locally. It is accommodated at some point to avoid a near contradiction.

A first consequence of this view is that we would expect phenomena like those exemplified in (90) and (91) to be hard to obtain in contexts where accommodation is hard. In particular, we know that accommodation with antecedents of conditional or quantificational domains is relatively common. But, for instance, it is quite hard in the scope of negation or of a negative quantifier (as in the famous "no one ate with the king because there is no king"), and indeed in such contexts it is much harder to have the appearance of implicature preservation.

(93) No one skipped the first or second course.

It is hard or impossible to construe (93) as equivalent to "no one skipped the first or second course but not both." To the extent that this happens, immediately the sentence gets a very strong metalinguistic flavor.

A second consequence is that if something prevents us from reintroducing a removed implicature, we should be in trouble (i.e., the sentence should sound awkward). Something like (94) might be a case in point:

(94) ?? No one who earns $40,000 a year can afford this house

I believe that this sentence out of the blue is strange (we need to add an understood "or less"). The reason is the following. First you remove the "exactly" implicature in the DE context of *no*. At that point we would get a sentence such as "No one who earns $40,000 a year or more can afford this house," which (given what *afford* means) is a contradiction (or a near contradiction). At that point, we try to introduce the implicature. But the result is not much better (why should it be that no one who earns exactly $40 a year should not be able to afford this house). So in the end we are left with a pragmatically odd sentence.

I should conclude this discussion by pointing out that the case of nonmonotone quantifiers like (95) now also follows.

(95) a. Exactly two students smoke or drink.
b. exactly two (student') (smoke' $\vee^{s}$ drink')
c. exactly two (student') (smoke' $\vee$ drink')

The scalar interpretation of (95a) is (95b), and the plain one is, of course, (95c), despite the fact that the strong and the weak interpretation are, in this case, informationally independent of each other (i.e., neither entails the other). The reason we expect the implicature to be kept in this case is the following. Implicatures are removed only when the plain meaning becomes stronger than the (candidate) strengthened one. In the case at hand, this doesn't happen, and the Strength Condition is thus satisfied. Of the interpretations made available in this case, none is stronger than the other. Hence, neither constitutes the default. That is, the hearer will need contextual clues to figure out which one is being intended by the speaker. Only in these cases do we get the effects we would get if *or* was ambiguous.

On the whole, the theory predicts that sentences have certain default interpretations. Defaults (when incompatible with the context) can be overridden in two ways. First, if a scalar implicature is absent in a positive context, backtracking takes place. We first try to increment the context with the strong meaning, and when that fails we revert to the plain one. Second, if a (direct) scalar implicature seems to be maintained in a negative context, accommodation takes place. That is, the implicature is not added at the first pass but accommodated at some point. Besides the purely linguistic evidence we have considered, these expectations might be (dis)confirmed through psycholinguistic experimentation.

3.3. Axioms on scales

We have noticed that indirect implicatures are somehow felt to be weaker than direct ones. We have suggested that this may be due, at least in part, to an interaction between scales and the context. Now that we have a precise device for implicature computation, it may be worth being more explicit about such an interaction. The question may be put in the following terms. Knowledge of scales is part of our knowledge of the lexicon. But when a scale has more than two elements (and possibly, as with numerals, a potential infinity of elements), the context may select some subset of such elements. That is, not every element of a scale needs to be salient (and hence in consideration) in any given context. Now, the choice of which elements of a scale may be disregarded cannot be totally free; otherwise, we would always be able to void the effects of scales. Consider, for example, the following sentence:

(96) I have many matches left.

Sentence (96) needs to be considered relatively to some total amount, say, a contextually salient matchbox. In this context, it implies that I don't have all of the matches originally left in the box or possibly that I don't have most of the matches left. These two options arise from the following scales:

(97) a. <many, most>
b. <many, every>

Those in (78) are the minimal scales that give the desired effect. "Smaller" amounts (e.g., the scale <some, many, every>) may also be salient. But in this case, the salience of such smaller amounts would remain without effect. Crucially, what we want to rule out is adopting the scale

(98) <some, many>

In the scale in (98), *many* is the strongest element. Under such a choice, the implicature would simply disappear, for sentence (96) would come out as the strongest of the relevant alternatives. And, by the usual scalar reasoning, no implicature would come about. But then we would no longer have any secure way of predicting any implicature. So, evidently, a choice such as (98) must be excluded. Accordingly, we might adopt the following simple axioms:

(99) In any given context where we utter a sentence S, containing a scalar term α,
a. A subset of the lexical scale associated with α may be selected.
b. The chosen scale must contain at least two elements.
c. If possible, α must not be the strongest element of the chosen scale.

The proviso in (99c) is due to the fact that if α is itself the strongest element of the scale, we have no choice. For example, if we utter "I have all of the matches," *all* is necessarily the strongest member of its lexical scale, and thus the only kind of scale we can choose in the context has to be of the form <x, all>, with *all* as the strongest member.

Now the axioms in (99) have an interesting consequence once indirect implicature enters the picture. Imagine, in particular, embedding sentence (96) under negation:

(100) I don't have many matches left.

As we have noticed, our intuitions concerning the implicature of sentences like (100) are somewhat shaky. In particular, such a sentence may or may not imply that I have some matches left. Now we can be more precise about why. If "smaller" amounts are taken as relevant (i.e., if we choose the scale <some, many, every>), the implicature that I have some matches left, will be triggered. But if "small" amounts are irrelevant (because, say, having few matches is functionally equivalent, for the purpose at hand, to having none), then we might well select the scale <many, every>, as that is allowed by the axioms in (99). This is so because such axioms only constrain the scales associated with the lexical entry *many* (without having to consider how such a lexical entry winds up embedded). So, we can select in the case at hand <many, every>. In such a case the potential implicature of (100) will be absent, and the sentence will be fully compatible with having no matches. This is, I take it, the reason that sentence (100) sometimes can be used to convey that I have *no* matches (or, e.g., "I don't have much time" may wind up saying that I have *no* time): it is the combined action of the removal of the positive implicature plus small amounts not reaching the threshold of relevance.

This effect is also possible with numerals but is expected to be less easy to obtain. The reasons we may have for embedding a precise numeral under negation can be quite diverse and complex. What enables us to truncate a scale at the low end, as in the previous example, is that small amounts may be functionally equivalent to nothing. But when we use a numeral, precise amounts (even if small) are likely to be relevant. However, sometimes effects similar to those observed with *many* are also clearly visible with numerals. Suppose that, for example, classes are usually made up of twenty students. Take the following sentence uttered against such a background:

(101) Today, I won't address twenty lethargic students.

Clearly, B's utterance does not suggest "but I intend to address a smaller audience of students." In fact, it even suggests that I will simply not teach.

I think that this explains in principled terms the different intuitions we have on direct versus indirect implicatures and the "now you see it, now you don't" effect we observe with the latter (but not with the former). Intermediate quantifiers and numerals under negation typically give rise to a positive implicature. This is the default expectation. However, they may loose it because of scale truncation. This loss of the indirect (positive) implicature is perhaps harder with numerals (with respect to vague quantifiers). In general, it depends on which scale one selects; this in turn depends on the common ground and the particular aspects of the conversational dynamics.

3.4. Interim conclusions

Summing up, our theory of SIs is based on the idea of adding them in as soon as possible, as part of the computational system of grammar rather than as part of the interaction of such system with other extragrammatical modules. This addition is governed by one simple constraint: implicatures must lead to strengthening. The strength condition is checked at each step, and it leads to removal of implicatures as soon as their addition would wind up weakening what is said. The implementation of this idea, through the definition of the notion of strengthened values, is quite simple (maybe too much so to withstand closer scrutiny), and it leads to a number of detailed predictions, some of which have been discussed here.[19]

4. NPIs: Domain comparison versus scales

In this section, I will discuss how this approach to SIs and the theory of NPIs may be related. First, I will present some general issues that seem to arise in this area. Second, I will sketch a theory of NPIs that builds on recent semantic proposals. Finally, I will explore the consequences that such a theory has, once embedded in the general approach to scalar implicatures outlined in section 3.

4.1. Semantics of NPIs: The status of the debate

How is the sensitivity to the same type of contexts of such diverse phenomena to be explained? In the case of SIs, the line of explanation is fairly clear. The SIs are added in because they lead to strengthening (i.e., they constitute a gain in information). But strengthening is a context-dependent notion. More specifically, something that leads to a gain of information in a positive context turns into a loss once it gets embedded within a negative operator (as the latter reverses the monotonicity of its arguments).

Thus canonical SIs associated with certain terms (e.g., the strengthening of *some* to *some and not all*) are in general absent from DE contexts.

How about NPIs? Here is where recent semantic proposals have important new insights to offer. I am thinking, in particular, of such work as Kadmon and Landman (1993), Krifka (1995), and Lahiri (1998). Although quite different in many respects, these proposals have a common thread, which I'll briefly expose through a (much simplified) review of Kadmon and Landman's approach (K&L, henceforth).

Generally, quantifiers are associated with a certain quantificational domain, which the context supplies. For example, if I say, "Everyone was late," I typically don't mean everyone in the world but everyone in a salient domain of individuals. Following Westertahl (1988), let us assume that quantifiers are indexed to a domain (which is left for the context to specify). Accordingly, we will write "$every_D$(one')(was late')" for (the meaning of) *everyone* (*in D*) *was late* or "$\exists_D$ x [donkey (y)]" for *there is a donkey* (*in D*).[20] Now, K&L propose that *any* is an existential quantifier that "widens" the domain of quantification that would otherwise be assumed. For example, if in using *potatoes* we have a certain domain in mind, which, say, excludes frozen ones, in saying, *I don't have any potato* we may enlarge that domain to include also frozen potatoes. But now the question immediately becomes, Why is domain extension limited to *negative* contexts? Consider a sentence with an existential quantifier in a positive context, say (102a):

(102) a There is a student who doesn't know me.
b. *There is any student who doesn't know me.

In uttering (102a), we will typically have some domain in mind, for if we meant some student or other in the world, then (102a) would hardly be news. In positive contexts, the more specifically constrained the quantificational domain of an existential will be, the more informative a sentence we get. To put it differently, domain widening in a positive context leads to a loss of information. That is why we don't do it in such contexts. The formal underpinning of this lies in the following elementary logical fact:

(103) Let g be an increasing function from sets into sets [i.e., for any set D, g(D) $\supseteq$ (D.]
Then
$\exists_D$ x [ϕ] entails $\exists_{g(D)}$ x [ϕ], where D is a quantificational domain.

So, in particular, the reason that (102b) is bad is the following: given a choice, we go for the most informative, relevant piece of information. Sentences (102a) and (102b) are semantically identical except for domain widening. Hence, we must go for (102a).

Under negation, things, of course, change. Since negation reverses entailments, we get the opposite of (103):

(104) $\neg \exists_{g(D)}$ x [ϕ] entails $\neg \exists_D$ x [ϕ]

This means that under negation, an *any* statement becomes stronger, and hence more informative, than its plain existential counterpart. That is, (105a) is stronger than (105b):

(105) a. There isn't any student that doesn't know me.
b. There isn't a student that doesn't know me.

What using *any* contributes is the information that there are no students of the relevant type in a domain larger than that one would otherwise assume. This looks like a sensible conversational move.

The explanatory potential of this approach is the following. It was discovered that NPI licensing takes place in contexts that have a certain abstract semantic property in common (idealizing a bit, DE-ness). This was an important breakthrough, but it remained an essentially descriptive statement; we didn't know why exactly such elements were so picky in their distribution. Now we have a fairly natural hypothesis on the meaning of the relevant lexical items (according to which, NPIs are simple modifications of the meaning of standard indefinites) that, given elementary considerations on how we communicate, makes us see why they should appear only in DE contexts. Of course many problems remain open, much needs to be worked out further, and so on. But what emerges is a line of argumentation one would wish to maintain (and Krifka 1995 or Lahiri 1998, e.g., constitute alternative accounts that do so).

On the basis of proposals on NPIs of this sort, we immediately also see the connection with SIs. In both cases, we are driven by a search for maximal information. And what is maximal in a positive context becomes minimal once embedded under negation-like operators—whence the sensitivity to the same structural semantic properties. So far we seem to have a success story, one that is largely independent of the localist view of implicatures I have been advocating.

However, there are things that don't quite work out so well, and this will force us to revise the picture we have so far. Let us consider some of the problems.

First, domain widening doesn't *have* to take place when we use *any*. Imagine a situation in which one is willing to utter (106a); in such a situation one might equally well utter (106b):

(106) a. Everybody in that class did poorly on the exam.
b. There isn't anybody in that class who did well.

The domains we implicitly refer to with (106a) versus (106b) seem to be just the same. In fact it is quite hard to imagine in exactly what way the intended domain might be expanded by using (106b). One might be led to conclude that whereas NPIs are good devices to widen a quantificational domain, domain widening can't be their only semantic function, for it doesn't always take place when we use them.

A second issue is the following. How are we to understand the condition that domain widening must lead to strengthening? The intuition is that domain widening and pragmatic strengthening are part and parcel of the lexical meaning of *any*. Yet it is not obvious how to exactly encode such an information in a lexical entry (in a way that is compatible with what is usually assumed on lexical meanings). To put it in different terms, it is not clear how we arrive at a compositional implementation of K&L's idea (see Lahiri 1998 for an elaboration on this criticism).

The two problems we just discussed are specific to K&L's proposal and do not apply to other proposals in the same spirit, such as Lahiri's (1998) or Krifka's (1995).

The next points, however, apply to them as well. They have to do with locality. Let me illustrate with examples. With K&L's proposal in mind, consider the sentence in (107a):

(107) a. It is not true that there aren't any potatoes.
b. Value on standard domain $\neg\neg\,\exists_D x\,[\text{potatoes}(x)]$
c. Value on widened domain $\neg\neg\,\exists_{g(D)} x\,[\text{potatoes}(x)]$

Here the two negations cancel each other out; the informational content of (107a) is the same as that of "there are potatoes." Hence, widening in (107a) cannot lead to strengthening, and we wouldn't expect *any* to be grammatical. But it is. The problem can be put in the following terms. The semantics of *any* is domain widening. This semantics naturally goes together with a pragmatic condition that domain widening must lead to strengthening. If this is truly a pragmatic condition and if the semantics/pragmatics interface is modular, pragmatic strengthening should be checked globally, after the computational system has done its job. But then we wouldn't expect the result in (107a). The grammaticality of (107a) shows that the condition that licenses *any* is, instead, checked locally; that is, what counts is the *first* DE operator that c-commands the NPI (which might be quite far from the NPI). This kind of locality (a "roofing" effect) is unexpected. Of course, one can always build locality into the theory, which is what, in essence, K&L or Krifka (1995) in different ways do.[21] But the point is that the logic of the theory is compatible with a variety of different ways of settling the locality issue. This can hardly be viewed as an asset of this family of approaches.

The presence of locality conditions on NPI licensing resonates well with my claim that implicatures are introduced (or removed) locally. Still one would like to understand better the exact relationships between the two kinds of locality. For example, how do implicatures behave with respect to roofing? If they worked like NPIs, we should expect that the first DE operator removes (or recalibrates) the implicature and whatever happens next has no further impact. But in fact, things do not seem to work this way. Consider, for example, the following sentences:

(108) a. It is warm outside.
b. I doubt that it isn't warm outside.
c. It's not boiling hot outside.

Sentence (108a) implicates (108c). Does (108b) have the same implicature? Whereas the double negation is hard to process, it seems that in one way of understanding (108b) it is just equivalent to (108a). In that interpretation, (108b) does implicate (108c). In other ways of understanding (108b), metalinguistic uses slide readily in. Such uses may remove the implicature. But that is no news, as metalinguistic uses can be construed as an objection to any aspect whatsoever of an utterance. So there is no roofing on implicature projection; we have rather a flip-flop effect: first implicatures are introduced, then they are removed or recalibrated at the first DE operator, then they are restored again at the next DE operator, and so on. This effect, which is predicted by my approach, sets implicatures aside from NPIs. This constitutes a serious problem for approaches that try to reduce NPIs and SIs to identical phenomena.[22]

The second problem is related to the first but adds, possibly, an extra twist. Since the work of Linebarger (1981), it has been known that NPI licensing is subject to an "intervention" or "minimality" effect. The problem is illustrated by paradigms of the following sort:

(109) a. I doubt that Sue has potatoes.
b. I doubt that Sue has any potatoes.
c. I doubt that every housemate of Sue has potatoes.
d. ??I doubt that every housemate of Sue has any potatoes.

In (109a), we have a plain indefinite. In (109b), we have the same sentence with an NPI replacing the plain indefinite (which, in the hypothesis we are entertaining, induces domain widening). In (109c), a universal quantifier intervenes between negation and the (plain) indefinite, and the result is perfectly grammatical. In (109d) we do the same with the NPI, and the sentence becomes noticeably degraded. *Every*, in that position, seems to interfere in the relationtionship between the NPI and the licensing context. This is surprising. Effects of this sort are quite familiar from syntax. Often enough we see syntactic relations that are affected by interveners. Often enough a relation between X and Y is disturbed by an intervening Z, which might in its own right establish the relevant relation with Y, as schematically illustrated in (110a) (taken from Rizzi 2001):

(110) a. . . . X . . . Z . . . Y . . .
b. I wonder who could solve the problem in this way.
c. *How do you wonder who could solve the problem t ?

For example, wh-island effects [such as the contrast between (110b) and (110c)] can be explained in this way. The relation between *how* and its trace in (110c) is disturbed by the intervention of another wh-element. The effect in (109d) appears to be of a similar nature. But if the relation in question is semantic in nature (i.e., check whether domain widening induced by A leads to strengthening under C), there is no obvious reason why we should expect effects of this sort. This is particularly so in view of the fact that though *every* is a potential NPI licensor, *any* in (109c) occurs on its wrong side, so to speak, that is, on the side in which *every* is upward entailing and could not license an NPI anyhow.

A point worth underscoring in this connection is that SIs aren't subject to anything like intervention, as seen in the following example:

(111) a. Every girl invited every boy three times. (exactly)
b. Every boy whom **every** girl has invited three times please stand up. (at least)

Sentence (111a) clearly has a highly prominent "exactly" reading. Sentence (111b) does not. The upper *every* removes the embedded implicature, and in doing so it is not disturbed by the intervention of the embedded *every*. Example (111) forms a minimal pair with (109c and d). So there are no intervention effects between scalar terms and what determines the presence or absence of the scalar implicature. Nor would we expect it in the theory I have outlined. Implicature calculation is a purely semantic process that involves the comparison of two potential values. For example, the upper *every* in (111b) compares the two available values of its argument and chooses the strongest, period.

Summing up, NPIs, unlike SIs, display both roofing and minimality effects (terms that I am using here and throughout in a purely descriptive manner). Now, it is conceivable, even a priori desirable, that phenomena of this sort, so similar to others that arise elsewhere in grammar, are to be accounted for in terms of a uniform theory of locality (but cf. section 4.3). Be that as it may, we see that the optimistic picture we had at the beginning of this section must be substantially qualified. We hoped we had a unified way to understand NPIs and SIs in terms of relative informational strength. An NPI broadens the quantificational domain of a plain indefinite; but this is informative (and hence felicitous) only in negative contexts. A SIs strengthens an assertion (taking into account the relevant scale); but this is informative (and hence felicitous) only in positive contexts. This makes us see why NPIs and SIs are sensitive to the same contexts. But we also see that the locality conditions in the phenomena at hand are very different from each other, and it is hard to understand why. In particular, if the key to NPIs is a pragmatic condition and if such conditions kick in the conceptual/intentional system *after* the computational system of grammar has done its job, locality effects are unexpected to begin with. If, instead, pragmatics work as in our proposal, the locality effects would be different from what they in fact are. This is the dilemma.

4.2. Theory outline

The main insight of recent semantic proposals on NPIs is that they make explicit the intuition that such items involve a comparison of some sort. In K&L, NPIs involve a comparison of two domains; in Krifka's (1995) proposal, a comparison among a whole scale of domains; in Lahiri's (1998) approach, a comparison of likelihood (analogous to that involved in the analysis of focal particles like *even*). I will stick to this general view and propose a variant of K&L's approach, which blends with aspects of the other two. The result, coupled with my approach to SIs, should lead to a better understanding of the relevant phenomena.

Here is the basic idea. NPIs are parasitic upon indefinites. They differ from the meaning of basic indefinites (say, the meaning of *some*) in that they invite us to consider possible domain expansions—not necessarily a specific one: any reasonable domain expansion will do. Let me elaborate on this idea to make it clearer. The meaning of NPIs comes, as it were, in two parts. First, as in the version of K&L's idea discussed in the previous section, they introduce into the domain variable associated with indefinites a variable ranging over increasing functions:

(112) $\text{any}' = \lambda P \lambda Q\ \text{some}_{g(D)}'(P)(Q)$ (where, for any D, $g(D) \supseteq (D)$)

Second, this domain-extending function must be *universally* closed at some point in the derivation. Crucially, such an operation of quantificational closure is subject to a condition (or, if you wish, carries a presupposition). Its result must lead to something stronger than the corresponding meaning with a plain indefinite. I will make this idea more precise shortly. Meanwhile, let me enunciate the principle:

(113) Strengthening/blocking
Domain expansions must be universally closed. Such closure must lead to strengthening with respect to the meaning of the plain indefinite.

What quantificational closure over domain-expanding functions achieves is twofold. First, we are freed from having to assume that NPIs require a *specific* way of extending the domain. Second, we can compositionally implement pragmatic strengthening as a condition on quantificational closure. Let me illustrate. Suppose we have an NPI in a positive sentence such as *any man walked in*. Its base meaning, according to our hypothesis, would be as in (114a). If we apply closure to it, we get (114b):

(114) a. $\text{some}_{g(D)}$'(man')(walked in')
b. $\forall g \in \Delta[\text{some}_{g(D)}$'(man')(walked in')]
c. some_{D}'(man')(walked in')

I am assuming that no form of quantification is ever possible without a domain restriction, and universal closure is no exception. So Δ in (114b) ranges over the domain expansions the speaker may be willing to entertain. Formula (115c) represents, instead, the sentence meaning corresponding to *any man walked in*, with the plain indefinite replacing the NPI (i.e., the competitor). Now, (114c) asymmetrically entails (114b).[23] Hence, the condition on strengthening, which closure must satisfy, is not met. Consequently, the sentence is ungrammatical.

Suppose now we embed our example sentence under some DE operator as in *it is false that any man walked in*. The base meaning is (115a). The presence of negation gives us another possible site for quantificational closure, that is, above negation. The result is given in (115b).

(115) a. $\neg\, \text{some}_{g(D)}$'(man')(walked in')
b. $\forall g \in \Delta\, [\neg\, \text{some}_{g(D)}$'(man')(walked in')]
c. $\neg\, \text{some}_{D}$'(man')(walked in')

Formula (115b) says, "For any (reasonable) way of expanding the domain of quantification it is not the case that some man in the extended domain walked in." Clearly, (115b) asymmetrically entails (115c). Hence, the competitor of the NPI-sentence is weaker and the condition on closure is met. Moreover, the sentence is grammatical. Obviously the basic insight is just K&L's. However, I borrow from Lahiri (1998) the idea that NPIs must be assigned scope (in our version, the site of quantificational closure). And, like him, I make this operation contingent upon strengthening. There are two differences with respect to Lahiri's proposal, one of form, the other of substance. First, Lahiri requires that the sentence with the NPI be "less likely" than its alternatives (as he is analyzing the Hindi "even one" construction). My condition is just equivalent to his since being stronger entails being less likely. Second, Lahiri identifies NPI scope assignment with association with focus. This, for Hindi, is plausible since NPIs in Hindi are literally formed with the use of the focus particle *even*. But if we wanted to generalize Lahiri's proposal to other languages (which Lahiri is careful not to do), we face a problem. For although NPIs are compatible with focusing, they do not *require* any special focus assignment (in the form of, say, a special stress contour). The relevant alternatives are not evocated via focus. It's just a lexical property of *any* that it contrasts with ordinary indefinites.[24]

I mentioned also that with my proposed modification, domain expansion is no longer an absolute requirement. More specifically, it may just happen that the base domain (i.e., what I have been indicating as D) is already, so to speak, the largest reasonable domain. In this case the only "extension" of D to be considered will be D itself (which is allowed since g is not required to be properly increasing). This, as we saw, is in keeping with our intuitions. To put it differently, an NPI, in the present modified view, does not necessarily signal an actual, specific domain expansion; it signals, rather, willingness to expand the domain (an effective way of couching its role, which I owe to A. von Stechow). Notice that even in the limiting case in which there is no suitable expansion around, the proposed semantics still serves a useful purpose, namely, that of signaling that the indefinite must wind up within the scope of a DE operator (and hence it reduces potential ambiguities). But such an effect is not stipulated as the primary role of NPIs. It is rather a byproduct of how their semantics works out (and, more specifically, of the requirement that the use of NPIs leads to formal strengthening).

One further remark: I think that the proper way of thinking of (113) is in terms of something like "blocking", as is familiar from much work in morphology. The presupposition to which NPIs are subject puts them in an "elsewhere" relation with indefinites, on the assumption that the former are parasitic upon the latter. Intuitively, NPIs are a more marked version of indefinites (not dissimilar from, say, the relation between pronouns and their clitic counterparts). This brings about a sort of blocking effect, whereby the use of NPIs is blocked by the indefinites whenever the former don't give rise to a communicational advantage over the latter. Distributed morphology may provide a good framework for fleshing this out. For the time being, I am not in condition of being less vague.

Let me now try to be more explicit on how strengthening is formally implemented. I will first describe its semantics and then its syntax. (Readers not interested in formal details may safely skip this paragraph). Imagine introducing in our logical form a variable binding operator $\mathbf{O}_\Delta$ with the following semantics:

(116) Strengthening (/blocking)
$\|\mathbf{O}_\Delta, g\phi\| = \forall g \in \Delta\|\phi\|$, if $\forall g \in \Delta\|\phi\|$ entails $\|\phi'\|$; otherwise $\|\mathbf{O}_\Delta, g\phi\|$ is undefined,
where ϕ' is identical to ϕ, with all occurrences of g removed.

Such an operator is what we would use to close off a domain-expanding function. The semantics given in (116) is still a first approximation, which might be improved on in many ways,[25] but it is sufficiently precise to give the reader something to work with. Let me use a simple example. Consider a sentence such as *I din't eat any potato*. Before closure, its logical form will be (117a); after closure, it will be (117b):

(117) a. $\text{not}\ (\text{any}_{g(D)}\ \text{potato}_i\ [\text{I ate}\ t_i]] \Rightarrow \neg\ \text{some}_{g(D)}'(\text{potato}')(\lambda x\ \text{I ate}\ x))$
b. $\mathbf{O}_{\Delta,g}\ \text{not}\ (\text{any}_{g(D)}\ \text{potato}_i\ [\text{I ate}\ t_i]] \Rightarrow \forall g \in \Delta\ \neg\ \text{some}_{g(D)}'(\text{potato}')(\lambda x\ \text{I ate}\ x))$

According to (116), the closure of a sentence ϕ [i.e., in this case, (117a)] must be stronger than ϕ', which is identical to ϕ with all occurrences of g removed. That is, (117b) must be stronger than

(118) $\neg\ \text{some}_D'(\text{potato}')(\lambda x\ \text{I ate}\ x))$

Since (117b) is in fact stronger than (118), the result of closing (117a) is well defined. Essentially, **O** is a presuppositional universal quantifier restricted to domain-extending functions. The presupposition is that the result must entail the meaning of the corresponding sentence with *some*.

Usually quantificational closure is taken to be subject to mapping conditions (Diesing 1992). We may exploit this general line of approach to closure to enforce the requirement that domain-extending functions (present in the lexical entry of NPIs) must be eventually closed. Here is one way of executing it. First, observe that in the case of scalar terms, the individuation of the relevant alternatives is done through lexically specified scales (a list of words in paradigmatic opposition with each other). Because of this, scalar terms need no special morphology to flag that their use may lead to strengthening. Quantificational domains, on the other hand, are not coded in lexicalized scales but in covert domain variables. So if one wants to signal domain expansion, one *must* resort to some morphological device specialized to this task. And morphological features enter into agreement relations. It is thus to be expected that the morphology of NPIs must agree with the morphology of some suitable head, just as, say, wh-words must enter into such a relation with, for example, interrogative complementizers. The second issue is what counts as a suitabile head. Given the semantics of NPIs, it must be a DE-head (any other choice would lead the interpretive component to crash). So we may assume that DE-heads carry a feature that, when active, must be checked by an NPI. This feature marks in syntax possible scope sites for closure, the relevant mapping hypothesis being now obvious:

(119) The domain of a +DE-head maps onto the scope of **O**.

To recapitulate, suppose an NPI is selected in an enumeration. There will have to be a head with the appropriate semantic quality and an active feature that will constitute the domain of quantificational closure. Any other option will lead the derivation to crash either in the syntax or in the semantics.[26]

As an immediate consequence of this way of implementing quantificational closure (through a feature that may be associated with negative heads), we get an account of why NPI licensing is subject to a roofing constraint. If you have an NPI and

a string of DE-heads C-commanding it, clearly only the closest relevant head may agree with the NPI (however, you will want to cash this in formally):

(120) [. . . NEG. . . . [. . . NEG. . . . [. . . NPI . . .] . . .] . . .]
|__________|
|_____X_____________|

This, given my mapping hypothesis, forces the closest DE-head to act as the scope site for universal closure (and hence as the level at which the condition on strengthening must be checked). What happens above that level (i.e., how many negative operators there may be) remains without consequence.[27]

To sum up, my hypothesis is that NPIs are parasitic on weak quantifiers and close off quantificationally the domain (or situation) variable implicit in the former. In positive contexts, this constitutes a loss of information with respect to plain existentials; in negative contexts, it leads, instead, to strengthening. Hence, pragmatic and/or morphological considerations prevent NPIs from occurring in positive contexts (not embedded under a DE-head). The NPIs involve a comparison of domains (as proposed by K&L) but not a lexicalized scale (like scalar terms).

4.3. Intervention

The approach to NPIs outlined above captures their sensitivity to DE-contexts, a property NPIs share with SIs. However, the two phenomena also differ in some important respects. One difference between the two phenomena is the flip-flop versus roofing effects. This difference, too, now makes sense. The SIs are in turn inserted and removed across DE-operators, in a pistonlike fashion because the scalar requirements are checked at every step of the derivation (as is necessary to keep the strengthened meaning stronger)—whence the flip-flop effect. The NPIs, per contra, are not part of scales. They involve a generalization over quantificational domains that must lead to a stronger statement than plain indefinites. In virtue of their parasitic nature, they are subject to a constraint that relates their contribution to that of their host. Roofing follows from this. In particular, I suggest (in the spirit of much previous work) that this constraint takes the form of a morphological requirement. If their special morphology (necessary to signal potential domain widening) enters into an agreement relation with a negative head (the only kind of heads they could agree with, in virtue of their semantics), then roofing follows from the properties of agreement (e.g., the probe must seek out the closest goal). But even if such a morphological requirement were not there, if strengthening or blocking is just freely checked, the empirical effects of roofing would also be expected: in the presence of c-commanding negative heads, we would always have a site at which strengthening can be satisfied (namely, the closest one), and nothing that happens thereafter would affect that.

So we have a proposal that does arguably improve some on the previous semantic ones that directly inspired it, namely K&L's, Krifka's, and Lahiri's. With respect to K&L, besides the general issues just mentioned, we no longer have to posit a specific domain extension (which, in fact, does not seem to always take place). Krifka (1995) tries to directly reduce NPIs to scalar implicatures (albeit of an abstract kind, involving a hierarchy of domains), which makes it difficult to account for the differences between the two phenomena. Lahiri (1998) links NPI licensing closely to focus, which may be fine for Hindi, but it's problematic for NPIs in general. Be that as it may, there is an outstanding problem for all the theories we have considered (including my own), and that is the intervention effect.

Let us briefly review the facts. Here is a representative sample:

(121) a. I doubt that Theo drank the leftover wine or any coffee.
a'. *I doubt that Theo drank the leftover wine and any coffee.
b. Mary doesn't wear any hearing at every party (Linebarger 1981).
O.K.: not [any hearing$_y$ [every party$_x$ [Mary wears t_y at t_x]]]
*not [every party$_x$ [any hearing$_y$ [Mary wears t_y at t_x]]]
c. I didn't meet a person who read any of my poetry.
c'. *I din't meet ten/the people that read any of my poetry.
d. I won't marry a woman who has little money because I get any advantage out of it.
d'. *I won't marry a woman who has any money because I get any advantage out of it.

The general puzzle at hand is that in all of the ungrammatical cases, the semantic condition required for NPI licensing is met. Consider, for example, the following pair of sentences:

(122) a. It is not the case that everyone has some potatoes.
a'. $\neg \forall x\ \text{some}_D'(\text{potatoes})(\lambda y\ \text{has}(x,y))$
b. *It is not the case that everyone has any potatoes.
b'. $\forall g \in \Delta \neg \forall x\ \text{some}_{g(D)}'(\text{potatoes})(\lambda y\ \text{has}(x,y))$

The semantic value of the (agrammatical) *any* sentence (122b) is indeed stronger than the one of the corresponding *some* sentence (122a), as is shown by their respective meanings. Hence, we would expect no blocking effect (i.e., insofar as semantics goes, the sentence should be grammatical). It seems reasonable to conclude that semantics cannot be the cause of intervention. Of course, one can always tack an extralocality condition on any theory.[28] But this does not make us understand why effects of this sort arise in this way and with these specific items.

We seem to have an argument to go with a syntactic account. Intervention effects are known from much work on locality in syntax, where they are extensively discussed. We have hypothesized that NPIs enter into an agreement relation with negative heads. It is then to be expected that such a relation will be disturbed by the intervention of a class of operators. I have argued that this is what in fact happens for roofing. I also noted that the roofing effects might in fact be derived in some other fashion. So, although roofing lends some plausibility to the overall idea of a syntactic relationship between the licensor and the NPI, it does not constitute an exceedingly strong argument in favor of it. Now, however, we have arguably more of the

same. In (121), we see that a relationship between a potential licensor and an NPI is quite clearly disturbed by a class of operators, and this time no other account is readily forthcoming. On the syntactic tack we have taken all we need to do is assume that the relevant operators carry some feature that disturbs the agreement relation between the NPI and its licensor. Roofing, viewed as a syntactic phenomenon, sets the stage. Intervention phenomena provide us with seemingly independent evidence that syntax (e.g., agreement) is indeed the right way to look at NPI licensing. And we can live happily ever after.

But some outstanding puzzles do remain. I'll mention three. The first concerns the class of interveners. They are strong determiners (*every*, *most*, and the definite article); also numerals seem to intervene (cf. 121c), even if with them our intuitions are a bit shakier. Nonnumeral indefinites (the indefinite article, *some*, and bare plurals) do not intervene. In the realm of sentential operators, *and* intervenes but *or* does not. (cf. 121a vs. 121a'). So, strong quantifiers, numerals, and *and* must carry the disturbing feature. The problem here is that it is not clear in what sense the interveners form a natural class that would justify them in carrying the same feature. One might try saying that the culprit is universal quantification (as, e.g., Lahiri 1998 suggests). A reason for thinking that this is the right idea is that conjunction is a meet operator, just like universals, whereas disjunction corresponds to existential quantification. The numerals, however, do not fit smoothly with this idea. One would have to claim that, at least in one reading, they, too, involve universal quantification. But this is not so plausible (especially if the "exactly" reading of numerals is an implicature and hence not part of their core meaning). At any rate, even if this hypothesis was right, why exactly would universals intervene?

Be that as it may, we seem to face a problem here. In accounting for roofing in syntactic terms, we didn't face any such problem. In that case, we simply have to say that the NPI agrees with the closest DE head. But in extending this idea to intervention, we are forced to say that a number of other operators that are clearly not DE (like the numerals or *and*) carry a feature that disturbs licensing of NPIs. Because it is not clear that such a feature has any independent status, we run the risk of making up a diacritic that simply means +intervener.

There is also a second reason to doubt that universal quantification is the culprit. Consider the case of *if* clauses. They do not intervene (cf. 123a), yet their (default) interpretation is generally taken to involve a universal operator (over worlds or situations), as illustrated in (123b):

(123) a. I doubt that if John gets drunk, anyone will be surprised.
b. $\neg \forall w$ [if John gets drunk in w][anyone will notice in w]

Formula (123b) is a rough representation of the meaning of (123a), in reflection of the idea that in general *if* clauses are restrictors of an operator, whose default interpretation is that of a universal quantifier. So the semantics of (123a) is isomorphic to that of, say, (121b) or (122b), with the same (or the same type of) operator involved. Yet in (123) we see no sign of intervention. This constitutes a second puzzle: if universals intervene, why don't *if* clauses, which involve a universal operator, intervene?

Finally, consider the case of *because* clauses, which are closely related to *if* clauses. According to some—see, for example, Dowty (1979)—*because* clauses are defined in terms of *if* clauses. Yet the former behave very differently from the latter with respect to the problem at hand. Whereas *if* clauses do not intervene, *because* clauses do. Consider the contrast in (121d and d'). In both sentences, negation has scope over the *because* clause. This is necessary in order to get the NPI contained in the *because* clause properly licensed. The relevant logical forms are roughly the following:

(124) a. ¬ BECAUSE (I get any advantage out of it, I will marry a woman that has any money).

b. ¬ BECAUSE (I get any advantage out of it, I will marry a woman that has little money).

Notice that (124a) parallels (123b). Yet whereas (123a) is grammatical, (124a) is not. Why? Moreover, as (124b) shows, licensing across the *because* operator per se is permissible. So it is not the *because* operator as such that intervenes but the *because clause* as a whole. Or, in different terms, if we regard *because* as a two-place operator, the intervention effect takes place only with respect to its second argument, not with respect to the first. Why would this be so?

What these considerations jointly show is that the paradigm in (121) cannot be so readily understood by hypothesizing that certain heads carry a feature that disturbs a syntactic relationship between the NPI and its licensor. With enough assumptions, we can surely get a feature base approach to work. But quite a few quirks remain, and I don't see a profound explanation coming out of it as readily as one might have hoped. Maybe intervention is doomed to remain a mystery.

Wait. We forgot about implicatures. What could implicatures possibly have to say about intervention? Against any prima facie plausibility, I would like to suggest that they are actually the real culprits. Let me try to make my case by first looking back at examples like (122). In trying to decide whether the semantic condition that licenses *any* was met, we considered and compared just *plain* meanings of (122a) and (122b) (and concluded on this basis that the semantic condition on strengthening was duly met). But sentences have implicatures; that is, they have strong meanings that, in our approach, are assigned by the computational system (or by a computational system parallel to and accessible from that of core grammar). In particular, a sentence like (122a) is expected to have an implicature of the following sort:

(125) a. Strong meaning of *it is not the case that everyone has some potatoes*:
$\neg \forall x\ some_D'(potatoes)(\lambda y\ has(x,y)) \wedge \exists x\ some_D'(potatoes)(\lambda y\ has(x,y))$

b. It is not the case the case that everyone has some potatoes, but someone does.

The strong meaning of the relevant sentence in plain English is given in (125b). Compare with this the meaning of the ungrammatical sentence with *any*, repeated here:

(126) Meaning of of *it is not the case that everyone has any potatoes*:
$\forall g \in \Delta \neg \forall x\ some_{g(D)}'(potatoes)(\lambda y\ has(x,y))$

Clearly, (126) does not entail (125a), even though it entails its first conjunct. So if we assume that strengthening must be met with respect to strong meanings, we see that in the case at hand it cannot be. *Any* here is not properly licensed after all.

The idea is that NPIs compete not with the plain meanings of the corresponding sentences with indefinites but with their strengthened meanings. This is not implausible. If their role is to lead to a stronger statement than that which one otherwise would get, they should, in fact, compete with the strongest possible assertion that could be made with the relevant alternative. Accordingly, strengthening and blocking should be reformulated as follows:

(127) a. Universal closure of a sentence with *any* is defined only if the result is stronger than the *strong* meaning of the corresponding sentence with some.

b. $\|\mathbf{O}_\Delta,g\phi\| = \forall g \in \Delta \|\phi\|$, if $\forall g \in \Delta \|\phi\|$ entails $\|\phi'\|^s$; otherwise $\|\mathbf{O}_\Delta,g\phi\|$ is undefined, where ϕ' is identical to ϕ, with all occurrences of g removed.

Here (127b) is the formal counterpart of (127a). This constitutes a trivial modification of our original proposal. But as a consequence of it, strong meanings become the blockers of *any*. This simple move has the effect of ruling out all the bad cases in (121). To illustrate it further, consider the case of *and*:

(128) a. *I doubt that John ate the cake and drank any coffee.

b. $\forall g \in \Delta \neg$ (ate (j, the cake) $\wedge$ $some_{g(D)}'$(coffe)(drank(j, y))

The competitor and its strong meaning (in plain English) are given in what follows:

(129) a. I doubt that John ate the cake and drank some coffee.

b. I doubt that John ate the cake and drank some coffee, but I believe that he did one of the two.

Again, whereas (128) would entail the first conjunct of (129b), which corresponds to its plain meaning, it fails to entail the conjunct as a whole. Hence *any* is blocked.

Don't we run the risk of ruling out too much by switching to (127)? Not really. There will be plenty of cases in which strong meanings and plain ones are predicted to coincide. In such cases, our present formulation of blocking will make the same predictions as our previous one. This is trivial and will occur whenever no scalar term is involved. Thus, for example, in *I doubt that John has any money*, beating the strengthened meaning tantamounts to beating the plain one (and this will indeed happen, thanks to the presence of negation). It is more interesting, that this is expected to happen also in the presence of scalar terms, under certain circumstances. Consider, for example, the counterpart of (129a), with *or* replacing *and*.

(130) a. I doubt that John ate the cake or drank any coffee.

b. I doubt that John ate any cake or drank some coffee.

Here *or* is the weakest member of its scale. This means that in positive contexts it will trigger an implicature (the familiar exclusive construal). But in a negative context, last becomes first: *or* becomes the *strongest* member of the scale, and the strongest members of a scale can trigger no implicature. In fact, (130a) has none. So the strong meaning of (130a) is just its plain meaning, and potential domain widening follows its due course. That is, when we apply universal closure to (130a) we obtain something that is stronger (and more informative) than its competitor (viz. 130b). And so *any* in (130a) is properly licensed. The same goes, mutatis mutandis, for simple existentials like *some* or *a*; just like *or*, they are the weakest members of their respective scales; under negation they become the strongest, and no implicature gets in the way of NPI licensing.

Putting *because* clauses aside for the moment and looking at quantifiers and operators, we now see why interveners and noninterveners divide up the way they do. Interveners are strong members of a scale; noninterveners are the weakest ones. Whether my proposal is right or wrong, this generalization seems to be on the right track—presumably, not by accident. The intervention effect must be related to the scalar nature of the elements involved. Our conjecture is that under negation strong members of a scale give rise to an implicature that blocks NPIs. This in a sense is turning Linebarger's (1981) theory on its head. Linebarger used implicatures to license certain occurrences of *any* that her immediate scope constraint was not able to accommodate. I am proposing that the so-called intervention effect is a byproduct of a positive scalar implicature that (some) negative sentences carry along. Such an implicature prevents NPIs from satisfying the strengthening condition to which they are subject. They fail, in the relevant contexts, to yield something stronger than the alternative with the plain indefinite.

The behavior of numerals now also falls into place. Under negation, they, too, have (a possibly rather weak but nonetheless present) positive scalar implicature. In section 4, I discussed the case of (131a), which implicates (131b):

(131) a. John isn't twenty.
b. John is close to twenty.

Also something like (132a) normally implicates something like (132b):

(132) a. I doubt I met eleven people that read some of my poetry.
b. I believe I met at least someone who read some of my poetry.

Now take the sentence parallel to (132a), in which *any* replaces *some*, namely, the deviant (121c') discussed above and repeated here:

(121) c'. *I din't meet eleven people that read any of my poetry.

This sentence fails to entail the conjunction of (132a) and (132b), which corresponds to the strong meaning of the relevant competitor, and *any* is blocked.

As we saw, sometimes intermediate values of a scale in a negative context lose their implicature. The reason is due to the fact that the scale gets "truncated." That is, the mentioned amount is selected as the smallest relevant value of the scale. In this case, under negation, such an element will become the strongest and no implicature

will come about. Hence, the intervention effect should disappear. Contrast, for example, (121c') with

(133) I never had eleven kids who won any championship. (said by a soccer coach)

As eleven is the minimal number of players on a soccer team, this number can naturally be selected as the smallest element of the contextually relevant scale. Under negation, it becomes the strongest and no implicature comes about. As soon as this happens, intervention indeed gets weaker. In other words, the scales that are naturally associated with (132a) and (133), respectively, are

(134) a. < x, 11, 12>, where x is some nonnull number minor that 11
b. <11, 22, 33 . . . >, where we group numerals by multiples of 11 (i.e., by teams)

So, under negation, (132a) has a positive implicature, whereas (133) does not. With numerals, this kind of "now you see it, now you don't" effect, though clearly present, is not so easy to construct because in the typical contexts in which mentioning a specific numeral is appropriate, a relatively fine-grained scale with several intermediate ladders will typically be salient. This explains why, in general, numerals will tend to display intervention [i.e., cases like (133) are harder to come across than cases like (121c')]. But with the quantifiers, especially with vague ones like *many*, where no specific amount is mentioned, the suspension of negative implicature under negation is much easier to come across, as we saw. This explains why often enough intermediate quantifiers like *many* don't show intervention:

(135) I typically don't have many students with any background in linguistics.

The reason, I think, is because in this case we are leaving open the possibility that in fact we may well have no student with any background. That is, the positive implicature is absent. The mechanism that allows this to happen is always the same, as in the case of numerals. We can select a truncated scale <many, every> in which, under negation, *many* becomes the strongest member. With such a scale, the positive implicature that *many* under negation would otherwise trigger, disappears. If we choose a context in which the implicature is present, we also get intervention back with *many*. This can be accomplished by focusing *many* or by making the relevant background assumptions sufficiently explicit:

(136) Typically in that course you do get some students that are interested. ?? But don't expect that many students will show any interest.

Sentence (136) clearly has a positive implicature parallel to (132b). Because of such an implicature, *any* winds up being positively embedded. Thus the *any* sentence fails to lead to strengthening, as it should in order to be properly licensed; and sentence (136) is degraded. This kind of behavior of numerals and intermediate quantifiers with respect to intervention seems to be very hard to explain in a feature-based approach.

This raises, however, a general issue for our proposal. Let me try to lay it out as clearly as I can. Implicatures are, in general, cancellable. Shouldn't we expect, therefore, that when they are removed, intervention effects should disappear or be weakened with *any* kind of intervener? Shouldn't we, in other words, expect that if we remove the relevant implicature, *every* should behave like *many*? For that matter, how can we possibly rely on implicatures, generally held to be an extragrammatical phenomenon, to account for the degraded grammatical status of certain sentences?

The point is that, for independent reasons, the claim that implicatures are extragrammatical is probably wrong. Or rather, whether we like to think of them as extragrammatical or not, scalar implicatures are computed in parallel to the syntactic computation, and (at appropriate stages) the results of the two computational processes are accessible to each other. Look in particular at the present setup. For any expression α, we have a well-defined characterization of its plain meaning $\|\alpha\|$ and of its strong one $\|\alpha\|^{s}$. This enables us to directly state a condition in NPI-licensing in terms of strong meanings. Strengthening must be checked with respect to *strong* meanings. The fact that implicatures can be cancelled (i.e., that in certain contexts we want to use plain meanings) does not and cannot affect this fact. If sentences with *any* fail to be stronger than the strong version of the corresponding sentences with *some*, the condition on *any* licensing cannot be met. And that's the end of it.

To clarify further, suppose, for example, I try to say, "I doubt that every student has any background." Grammar gives me two meanings, the plain one $\|$ I doubt that every student has any background$\|$ and the strong one $\|$I doubt that every student has any background$\|^{s}$. It does not matter which one I choose. Whichever one I choose, I am required to check whether it entails the relevant competitor, which is $\|$I doubt that every student has some background$\|^{s}$. Since that fails, the sentence in question is ruled out. The disappearance of intervention with numerals or a quantifier like *many* is an all together different matter. In that case, by simply choosing a suitable scale (which we independently know that we must be able to do), we can get a strong meaning $\|$I doubt that many students have any background$\|^{s}$, which is equivalent to its plain meaning; with respect to such an interpretation, strengthening is met and *any* is grammatical. Independently motivated axioms on scales prevent me from doing the same with *every* (and other operators).

Let us now turn to other types of sentential operators—*if* and *because* clauses. A puzzling aspect of intervention noted above was the fact that *if* clauses, although involving a universal quantifier over worlds, show no intervention effect. The answer to that, from the present point of view, is straightforward. It is not the inherent feature of an operator that causes intervention. It is, rather, its position on a scale (if any). *If* clauses are not part of a lexicalized scale. Hence, under negation they don't have a positive implicature of the sort that could get in the way of NPI-licensing. This leads us to the issue of *because* clauses. They do show intervention effects. However, just like *if* clauses, *because* clauses do not seem to belong to a scale. Hence, it is not obvious what my approach might have to say about them. Although this might well turn out to be a problem, there are a few preliminary considerations that are worth pointing out. The obvious observation is that *because* clauses are strongly factive. This, per se, is not enough to conclude much. We know that NPIs may be licensed by certain factives, like *be surprised*,[29] and thus factivity by itself can hardly be the

cause of ungrammaticality in intervention cases. However, I think that the specific form in which factivity gets realized in *because* clauses is indeed responsible for their peculiar behavior vis-à-vis intervention. Let me try to illustrate this idea. Consider a sentence like (137a) on the LF schematically indicated in (137b):

(137) a. John didn't complain because Mary was in a bad mood.
b. not [John complained BECAUSE Mary was in a bad mood]

The problem is the following. If, assuming an LF-isomorphic to (137b), we embed an NPI in the main clause, we get intervention (whereas if we embed it in the subordinate clause, we do not). Now suppose that the factive nature of *because* clauses is due to the circumstance that they actually involve a double assertion. Suppose, in other terms, that a sentence such as "John complained because Mary was in a bad mood" is literally interpreted as "John complained and that was caused by Mary's being in a bad mood." Accordingly, the logical form of a plain (nonnegated) *because* clause like (138a) is as shown in (138b):

(138) a. John complained because Mary was in a bad mood
b. [John complained]$_i$ and CAUSE (Mary was in a bad mood, x_i)

So, *because* clauses are covert conjunctive statements where the first conjunct is the main clause (which is actually asserted) and the second conjunct is formed by the CAUSE operator; the second argument of the latter [x_i in (138b)] is a covert pronominal element bound by the main clause. This reflects the intuition that "p because q" does two things: asserts p and adds to it a specification of what causes it. Now consider what would happen if we embed a structure like (138b) under negation, as in (139):

(139) not [[John complained]$_i$ and CAUSE (Mary was in a bad mood, x_i)]

Formula (139) is of the form $\neg (p \wedge q)$; such formulas, as we saw above, generally implicate $(p \vee q)$. That is, the strong meaning of (139) would be

(140) $\neg$ [[John complained]$_i$ $\wedge$ CAUSE (Mary was in a bad mood, x_i)]
$\wedge$ [[John complained]$_i$ $\vee$ CAUSE (Mary was in a bad mood, x_i)]

Given the factivity of CAUSE (i.e., the fact that *CAUSE (p, q)* entails $p \wedge q$), formula (140) is provably equivalent to

(141) [John complained]$_i$ $\wedge \neg$ CAUSE (Mary was in a bad mood, x_i)

In other words, the strong meaning of (139) would be (141). This would explain why wide scope negation of a *because* clause is generally construed as negating just the cause, not what gets caused. A further consequence of this approach is that whenever negation is construed as having wide scope, an NPI in the main clause can never be licensed. Consider, for example, (121d'), whose logical form (under the current hypothesis) is given in what follows:

(142) [I will marry any woman]$_i$ $\wedge \neg$ CAUSE (I get any advantage out of it, x_i)

I leave it to the reader to verify that this sentence so construed fails to be stronger than its competitor (in which a plain existential replaces *any*). On the other hand, if *any* is embedded just in the subordinate clause [i.e., as in (143)] strengthening will be met and *any* is, therefore, properly licensed:

(143) a. I won't marry a woman because I get any advantage out of it.
b. [I will marry a woman]$_i$ $\wedge \neg$ CAUSE (I get any advantage out of it, x_i) competitor:
c. I won't marry a woman because I get some advantage our of it.

Again, I must leave it to the reader to verify that this is indeed so.

The key to this proposal is that *because* clauses are hidden conjunctive statements, which, like overt conjunctions, carry a positive implicature under negation. In other words, they are sort of covertly scalar terms (in the sense that they involve conjunction). If this proves tenable, we would have a general explanation of the behavior of *because* clauses under negation, including the failure of NPIs to be licensed whenever negation is assigned wide scope over *because*. The viability of such a hypothesis needs, of course, a much closer scrutiny than that which we are able to do here. The purpose of the present exercise is to give some preliminary plausibility to the idea that positive implicatures are also likely to play a role in this case, once the factivity of *because* clauses is better understood.[30]

A further interesting problem needs some attention.[31] It has to do with negative scalar quantifiers like *few*. As is well known, such quantifiers license NPIs:

(144) Typically, few students know any linguistics.

However, sentences of this form also have a robust positive scalar implicature, so the strong meaning of (144) can be paraphrased as in (145a):

(145) a. Few students know any linguistics but some do.
b. Few students know some linguistics but some do.

The problem is that if (145a) is the strong meaning of (144), *any* is not expected to be licensed under the present view. If we compute the meaning of (144), we see that it fails to entail its competitor, (145b). Taking (145a) as an informal representative of the (strong) meaning of (144), we see that the first conjunct of (145a) entails the first conjunct of (145b), as *any* there is negatively embedded. But the second conjunct of (145a) would fail to entail the second conjunct of (145b) (as *any* there is positively embedded); as a consequence, (145a) as a whole fails to be stronger than (145b) as a whole. Hence, *any* should be blocked, contrary to fact.

I think that in spite of what prima facie appears, this behavior of *few* does actually make sense from the perspective we are adopting. I will first give what I think is the empirical generalization behind the fact under discussion. Then I will illustrate how it follows. Take another look at the basic intervention cases, for example, at the pattern in (121). Our claim is that there are certain positive implicatures that get in the way and provoke intervention. Notice that in all the cases of intervention documented in the literature, we are invariably dealing with what we have called *indirect* scalar implicatures. The schema is always the same, namely,

(146)
implicature
. . . NEG . . . SCALAR TERM . . . NPI . . .
licensing

The generalization, therefore, is that licensing is degraded whenever, through the interaction of the upper negation and an intervening scalar term, an implicature comes about. It is in exactly this configuration that scalar terms that are not the weakest in their scales become interveners. In contrast, the implicature with *few* is a direct one. It arises from *few* by itself, not from its interaction with a higher polarity-reversing function. I believe that direct implicatures can never cause intervention. If we were to give a schematic representation to the case of *few*, we might go for the following:

(147) . . . FEW . . . NPI
⇑
implicature licensing

Perhaps, the most appropriate way to think of this is in terms of processing. Direct implicatures can arise only after a scalar term has been introduced. For direct implicatures to be added, we first have to compute the regular meaning and then the implicature. In my system, this is done via Krifka's (1995) rule. But independently of implementation, the crucial thing here is that we must compute the plain meaning *before* computing the strong one. This, in turn, gives us a chance to check *any* licensing *before* the scalar implicature has been factored in. That is, we can check the condition on *any* licensing before Krifka's rule applies; and at that stage, strengthening will be satisfied and *any* licensed. Moreover, nothing that happens thereafter (namely, the introduction of the implicature) will affect this fact. In contrast, the way in which indirect implicatures are computed is very different. In computing strong meanings, we must use a special form of functional application, one that is sensitive to the character of functions. If a function is not DE, we use the regular function application. If the function is DE, we have to recalibrate. Indirect implicatures arise through this process of recalibration, which is part and parcel of functional application. So there is no way around indirect implicatures; they are not added after the plain meaning (of the whole expression) has been computed. Consider (126) again and imagine having to check the condition on *any*. If we check it right after the scalar term, we are still in a positive context (and the semantic computation will crash). If we check it after negation, we are in a negative context all right, but the implicature will be there (as it arises when we apply negation to the rest) and strengthening will fail. So the fact that not all positive implicatures get in the way of NPI licensing is, in fact, predicted. Only indirect implicatures can play such a role.[32]

The difference between direct and indirect implicatures, on which I am relying to account for the behavior of quantifiers like *few*, does not seem to be an artifact of the present way of looking at things. Some preliminary evidence suggests that direct and indirect implicatures are in fact processed differently. It has been observed in the psychological literature that unjustified violation of implicatures encounters strong resistance in adults. For instance, Gualmini et al. (2001) show that in a truth-value judgment task, a sentence like (148) is rejected by adults in a situation in which the relevant implicature is violated.

(148) Every pirate stole a jewel or a necklace.

In a situation in which in fact every pirate steals a jewel and a necklace, we have, in our current terms, a direct implicature violation, which adults reject. In contrast with this, Gualmini et al. run the same type of task with the following sentence:

(149) No pirate stole a jewel and a necklace.

Such a sentence has an *indirect* scalar implicature, namely, that some pirate stole a jewel or a necklace. If adults are asked to evaluate the sentence in a situation in which such an implicature is violated (i.e., in a situation in which pirates stole various things, but no pirate stole a necklace and no pirate stole a jewel), the acceptance rate is significantly higher than with (148). This happens in spite of the fact that adults do get the implicature associated with (149).[33] Thus, whereas direct and indirect implicatures are both computed online, adults seem to be more ready to tolerate violations of indirect implicatures, which means that these two types of implicatures must be distinguished by our processing system. This, in turn, may lend some independent plausibility to my idea that direct and indirect implicatures also play a different role vis-à-vis the intervention effect.

Taking stock, we see that specific aspects of my implementation are clearly amenable to further developments and improvements. But the basic idea should be clear: NPIs compete with strong meanings of indefinites. The presence of certain positive implicatures in negative sentences sometimes prevents NPIs from fulfilling their raison d'être in contexts in which we would otherwise expect them to do so. The main advantage I see to this idea is that we no longer have to hypothesize that, say, conjunction has a feature that interferes with NPI licensing, but disjunction does not; that *every* does, but *some* does not; and so on. We now see why certain elements (the interverners) form a natural class. And this leads to a rather principled (if surprising) account of the facts. If the present approach is on the right track, intervention in NPI-licensing is epiphenomenon. It has no formal status. It arises from the interplay of the general licensing condition on *any* (it must lead to strengthening with respect to *some*) and the way strong meanings (i.e., implicatures) are computed.[34]

5. Concluding remarks

I started with an observation that had been made several times in the literature: scalar implicatures and items like *any* are sensitive to the polarity of the context in which

occur. We have first explored to what extent and in what form this observation holds. The main outcome (that surely needs further refinements) is that the contexts in which *any* is licensed (in both its NPI and free-choice variant) appear to be to a remarkable degree the same as those in which scalar implicatures are recalibrated (i.e., direct implicatures are removed and indirect ones come about). This fact, by itself, raises many interesting issues. The mechanisms at the basis of both phenomena must be somehow sensitive to similar factors. To find out whether this is indeed so, one has to go through a careful examination of how SIs are computed and NPIs licensed. Let us review the main (provisional) conclusions we've reached on these matters.

The dominant view on SIs is that they are computed at the level of root sentences, after grammar stricto sensu has finished its job. We have seen, however, that this position leads to difficulties. The interaction of SI-computation with several connectives and quantifiers (like disjunction, existentials, and nonmonotone quantifiers) turns out to be problematic. We have therefore explored a different view, according to which SIs are introduced locally and projected upward. The basic idea is that SIs are factored in by a recursive computation parallel to the standard one that builds up and interprets Logical Forms. Just as we have a well-defined notion of "standard" or "plain" meaning for any expression α, we also have a notion of "strengthened" or "scalar" meanings for any α. The latter is, in fact, a simple variant of the former, computed in a similar way. Essentially, whenever we hit a scalar term (computing bottom up) we introduce the corresponding implicature. This is then maintained until we find a monotonicity-reversing function. Upon encountering such a function, we remove the implicatures introduced thus far and perform a local recalibration (introducing the indirect implicatures). It is as if phrases (rather than root sentences) are passed through a pragmatic component, that is, a component sensitive to the quantity of information of relevant alternatives and other such factors. As a consequence of this shift, the problems with the recalcitrant connectives and quantifiers fall into place, some fairly complex cases of implicature come out right, and the resulting system remains computationally tractable. The next question (for further research) is whether other phenomena generally held to fall within pragmatics may be treated in a similar way or whether this is a characteristic of scalar implicatures and scalar reasoning.

On the NPI front, what seems to be going on is somewhat different. Essentially, NPIs are a marked form of indefinites. Their specificity is perhaps the presence of some kind of domain expansion (or willingness to consider alternative domains), which gives them a modal flavor. Being marked alter ego's of more basic forms, NPIs cannot be freely used. We need some justification to use them in place of their less marked alternatives. The idea here is that the use of NPIs (and, thus, modification of quantificational domains) must turn out to be more informative than the use of basic forms. This looks like a reasonable condition or presupposition of NPI use: generalizing over domain expansions is admissible only when it yields something stronger than that which one gets without such a generalization. And, given that NPIs are potential domain wideners of indefinites, strengthening can happen only in negative (DE) contexts—whence their peculiar distribution.

This leads immediately to the question, How exactly does the generalization over domain expansions (i.e., the universal closure) come about? How is it enforced? Several plausible answers can be explored. We have considered two. Such a closure may be viewed as an inherent semantic requirement to which NPIs are subject, a sort of "somewhere" condition of semantic well-formedness. Or perhaps closure is associated with a feature of elements that agrees with NPIs (where such elements, or rather their projection, map onto the scope of the relevant closure operation). In either case, we get the beginning of an interesting account of similarities and differences between NPIs and SIs. What they have in common is (local) comparison of degree of informativeness with a set of competitors: for SIs, their comparison among items on a scale, for NPIs, comparison with indefinites. Such comparison in informativeness is responsible for the sensitivity to polarity reversals. Where SIs and NPIs differ is in the dimensions of the respective comparisons. For SIs, such comparison is built into a recursive bottom-up interpretive process, where the relevant condition is checked at each step all the way up (whence the flip-flop of implicatures). For SIs, it is morphologically (i.e., lexically) driven. Hence, once the relevant condition is checked, that's it (no flip-flop). And if such a condition is part of a form of agreement (at a distance), some kind of locality effect is to be expected. We get, thus, a seemingly well-balanced overall picture of the two phenomena under discussion. Moreover, as we saw, this approach to NPIs might also solve some more specific problems of the immediate predecessors that inspire it.

The final main point of this investigation concerns a further difference between NPIs and SIs, namely, the fact that whereas the former display intervention effects, the latter do not. It is conceivable that intervention is just a facet of locality; this is particularly plausible since, as we saw, locality considerations play a very different role in SI-computation than in NPI licensing. However, a direct syntactic approach to intervention does not readily account for why interveners and noninterveners divide up the way they do. An interesting empirical generalization, in this connection, is that if we look at quantifiers and sentential operators, the interveners are all strong scalar terms; the noninterveners are, instead, weak ones. This suggests that intervention, in the case at hand, may have to do with the way in which implicatures come about. Our conjecture is that NPIs compete with the scalar meaning of indefinites. That is, NPIs are licensed only if they turn out to be stronger than the scalar value of the corresponding sentences with plain indefinites. What happens in intervention contexts is that an indirect implicature comes about (in presence of strong scalar terms), and this prevents NPIs from meeting the strengthening condition. On the other hand, if the interveners are weak scalar elements, no indirect implicature comes about and the NPI turns out to be stronger than its competitor.

In the standard view of the syntax/pragmatics interface, this kind of phenomena is just the type of things that shouldn't exist. And the explanation I have provided should in principle be impossible. If the computational system of grammar sets up interpreted logical forms for root sentences and then passes them onto the conceptual/intentional system for pragmatic processing, it clearly can have no access during its computation to the results of the latter. It is one of the tenets (or, as the case may be, dogmas) of such a view that syntactic (and semantic) computations cannot have direct access to pragmatics. In my proposed modification, this is, instead, quite conceivable. The condition in NPI-licensing is a clear illustration. A grammatical (morphosemantic) well-formedness condition in NPIs has to check on something that is usually held to belong to pragmatics. The resulting system is still, I would say, modular. The syntactic and semantic computation and the pragmatic one are autonomous. But now we don't wait until the end to do our pragmatics; we compute recursively. Consequently, at any stage or phase of the recursion, each one of the two systems can in principle have access to the results of the immediately previous phases of the other (nota bene: the results, not the inner workings).

My proposal on the intervention effect may well turn out to be wrong. Insofar as I can see, this would not, by itself, immediately undermine the proposals on SI-computation and NPI-licensing. They have been motivated on independent grounds (internal to the respective phenomena). It is true, however, that if my proposal on intervention is not wholly off the mark, it would constitute a particularly robust confirmation of the basic idea we have explored here: namely, that some aspects of pragmatic processing fall under the purview of grammar or, equivalently, that some aspects of the pragmatic system are more grammar-like than we thought so far.

Besides these general questions that concern central aspects of how grammar is organized, there are a host of side issues that call for further research. In investigating SIs, I've often appealed to intuitions about "default" values or about accommodation. Isn't this pushing the current linguistic methodology (of relying on intuitions) a bit far? Aren't some of the key judgments a bit too subtle? Well, perhaps this is an area (or another area) in which psycholinguistic experimentation and linguistic theorizing may fruitfully interact. Experiments may be designed to actually test the presence or absence of the relevant SIs in the target contexts. I've already mentioned Gualmini's et al. (2001) work in this connection. Noveck et al. (2001) try to explore the consequences on reasoning of the generalization on the distribution of SIs explored here. In particular, they set up a reasoning task in which pairs of premises, such as those in (150) and (151) are given out and subjects are asked whether a certain conclusion is warranted:

(150) a. If P or Q, then R; P and Q — Does R follow?
b. If P then P or Q; P — Does P and Q follow?

The inference in (150a) is overwhelmingly accepted [in contrast with what happens with (150b)], in spite of the fact that the second premise is given in conjunctive form. This confirms that the default interpretation of disjunction in the antecedent of a conditional is inclusive. What is interesting here is that we are dealing with abstract syllogistic frames with letter variables, where the only "real" words are *or* and *if . . . then*. Hence the relevant effect cannot be imputed to anything like scripts and lexical or world knowledge of any kind. It must be due to the meaning of the only "real" items that occur in the experimental material.

There are also interesting issues having to do with acquisition. Consider the pair in (151) and contrast it with the pair in (152):

(151) a. *Every student read anything.
b. Every student who read anything on language will know these facts.

(152) a. Every student wrote a paper or made a classroom presentation.
b. Every student who wrote a paper or read a classroom presentation will get an A.

It is not easy to figure out how a child can learn the contrast in (151). But it is even harder to imagine how she could learn the difference in meaning between (152a) and (152b). After all, in (151) we are dealing with the distribution of an overt morpheme. And it is conceivable (though not very plausible) that a sophisticated detector of statistical correlations might eventually zero in onto such a distributional quirk. But in cases like (152), all the action concerns meaning. Morphology or distributional patterns play no role. What goes on in (152) is simply that we interpret *or* in one way in (152a) and in another way in (152b). How is the child going to figure that out? It seems to me that the generalization under discussion yields a particularly strong version of the poverty of stimulus argument. It is thus interesting to find out when exactly the child starts acting in an adultlike manner with respect to implicature. Noveck (2001) finds out that children learn certain SIs relatively late because, for a fairly long time, they accept SI violations much more readily than the adult controls. He attributes this to a lack of (or slower maturation of) pragmatic knowledge. Reinhart (1999) has made some interesting suggestions relevant to Noveck's findings, inspired by the well-known difficulties children encounter with nonreflexive pronouns (i.e., principle B of the binding theory). Couching Reinhart's suggestions in the terminology adopted here, I can say that the non-adultlike behavior of children vis-à-vis implicatures may be due to the fact that implicature computation involves a comparison with a set of competitors. This task presumably requires more working memory than the plain meaning, and the relevant resources are not available to children. Thus, according to Reinhart, the problem is not so much in the lack of knowledge of pragmatic principles (say, quantity) or in the capacity of using them in reasoning. It is a task-specific limitation of working memory. Perhaps the present approach may help bring this issue into sharper focus. I have distinguished between the definition of "strong" meaning—namely, α^{s}, which involves taking into account relevant alternatives—and the final choice on how to increment the context, given a choice between two options. These two processes are clearly distinguished, and to the extent that they use similar principles (like quantity), they use them in very different ways. Perhaps the reasons for children's behavior is to be sought in these differences. Noveck's results are partly confirmed by the work of Gualmini et al. (2001), who, however, also find groups of children that perform in an adultlike manner quite early on. It is interesting that through a pragmatic felicity task (which involves inviting children to judge which of two target sentences better describes a given scene), Gualmini et al. also find out that the children who do not perform in an adultlike manner appear to be attuned to the fact that certain sentences are pragmatically more appropriate than others. Although they accept sentences with implicature violation, they also show a preference for the competitors. This seems consistent with Reinhart's hypothesis, interpreted in the light of the present approach. Children have pragmatic principles and apply them competently; but the working-memory resources necessary to compute α^{s} may take time to mature. Obviously, more work needs to be done in this area.

Besides these interface questions, there are many open problems internal to the phenomena we have investigated that I simply have to leave open at this point. In particular, there are several cases of intervention I either discussed in a very preliminary fashion (like *because* clauses) or could not discuss at all (e.g., the contrast of bridge and nonbridge verbs). I also said nothing on different types of NPIs (like minimizers, so called N-words in Romance, or Zwart's 1996 typology). Nor did I address the issue of the relation between Free-Choice items and NPIs. The viability of the present approach and of the overall perspective on which it is based ultimately rests also on how these matters will eventually be addressed.

Appendix: Formal definitions and examples

(1) For any expression α, $\|\alpha\|^{ALT}$, the set of potentially relevant alternatives to α, is defined as follows:

a. For α lexical,

$$\|\alpha\|^{ALT} = \begin{cases} \{\alpha_1, \ldots, \alpha_n, \ldots\}, \text{ if } \alpha \text{ is part of a scale } < \alpha_1, \ldots, \alpha_n, \ldots >, \\ \{\alpha\} \text{ otherwise} \end{cases}$$

To go on with the definition, it is useful to define a generalized operation of application that allows us to apply a set of functions to a set of arguments of the appropriate type. Let us call such an operation Ap. Here is its definition:

b. If B is a set of functions and A a set of arguments of a type appropriate to the functions in B, then

$$Ap(B,A) = \{\beta(\alpha); \beta \in B\ \alpha \in A\}$$

Whenever no confusion arises, I will simply write B(A) for Ap(B,A).

I now complete the definition of the set of relevant alternatives of an expression. I only consider the case corresponding to functional application (generalization to rules of binding is straightforward).

c. For $\alpha = [\beta\ \gamma]$, where β is of a functional type and γ of a suitable argumental type,

$$\|\alpha\|^{ALT} = \begin{cases} Ap(\{\|\beta\|\}, \|\gamma\|^{ALT}), & \text{if } \|\beta\|^{ALT} \text{ is a singleton} \\ Ap(\|\beta\|^{ALT}, \{\|\gamma\|\}), & \text{otherwise} \end{cases}$$

d. Examples:

$\|$John smokes $\|^{ALT} = \{$smoke' (j)$\}$

$\|$John smokes or Mary smokes $\|^{ALT} = \|$John smokes and Mary smokes $\|^{ALT} =$

$= \{$ smoke(j) $\vee$ smoke'(m), smoke'(j) $\wedge$ smoke'(m)$\}$

$\|$it is not the case that John smokes or Mary smokes $\|^{ALT} =$

$= \|$it is not the case that John smokes and Mary smokes $\|^{ALT} =$

$= \{ \neg$ (smoke(j) $\vee$ smoke'(m)), $\neg$ (smoke'(j) $\wedge$ smoke'(m))$\}$

From now on, we write α^{ALT} for $\|\alpha\|^{ALT}$.

The next step is defining a function that selects the member from an alternative set that is immediately stronger than our designated target. If β is the target [i.e., what gets uttered) and α^{ALT} the relevant alternative set, the member of α^{ALT} immediately stronger than β [in symbols $S_\beta(\alpha^{ALT})$] is defined as follows:

(2)
$$S_\beta(\alpha^{ALT}) = \begin{cases} \alpha', \text{ where } \alpha' \text{ is the weakest member of } \alpha^{ALT} \text{ such that } \alpha' \text{ entails } \beta \text{ and not vice versa, if there is such an } \alpha'. \\ \bot \text{ (the contradiction), otherwise} \end{cases}$$

When β is understood (e.g., as being identical to α), I'll omit marking it explicitly and simply write $S(\alpha^{ALT})$.

We now define for any α, the set $\|\alpha\|^{s}$ of its admissible strong meanings. It will be the *smallest* set of semantic values of the appropriate type that satisfies the following conditions:

(3) a. For α lexical, $\|\alpha\|^{s} = \{ \|\alpha\| \}$ (B: base of the recursion)

b. Suppose $\|\alpha\|$ is of type t. Then $\|\alpha\|^{s} \supseteq \{\xi \wedge \neg S(\alpha^{ALT}) : \xi \in \|\alpha\|^{s} \}$ (KR: Krifka's rule)

c. Suppose $\alpha = [\beta\ \gamma]$, where $\|\beta\|^{s}$ is of type <a,b> and $\|\gamma\|^{s}$ of type a. Then (SA: Strong apply)

$$\|[\beta\ \gamma]\|^{s} \supseteq \begin{cases} Ap(\|\beta\|^{s}, \|\gamma\|^{s}), \text{ if } \|\beta\| \text{ is not DE} \\ \{ \|\beta\|^{s}(\|\gamma\|) \wedge \neg S_{\|\beta\|(\|\gamma\|)}(\|\beta\|(\gamma^{ALT})) \}, \text{ otherwise} \end{cases}$$

I assume that Boolean operators $\subset, \wedge, \neg$ are generalized to all types that "end in t" in the usual manner. Strictly speaking, $\|\alpha\|^{s}$ is a relation, not a function (see examples):

(4) John smokes or Mary smokes.

a. $\|$John smokes$\|^{s} \supseteq (\|$smoke$\|^{s}(\|$John$\|^{s})$ [by SA]= {smoke'(j)} [by B]

b. $\|$Mary smokes$\|^{s} \supseteq \|$smoke$\|^{s}(\|$Mary$\|^{s})$ = {smoke'(m)}

c. $\|$John smokes or Mary smokes$\|^{s} \supseteq$ {smoke'(j) $\vee$ (smoke'(m)} [by SA]

d. $\|$John smokes or Mary smokes$\|^{s} \supseteq \|$Mary smokes or John smokes$\|^{s} \supseteq \{ \xi \wedge \neg S_{[smoke'(m) \vee smoke'(j)}([smoke'(m) \vee smoke'(j)]^{(AL^{\cdot})}) : \xi \in \|$John smokes or Mary smokes$\|^{s} \}$ [by KR]

e. $\|$John smokes or Mary smokes$\|^{s} \supseteq \|$Mary smokes or John smokes$\|^{s} \supseteq \{ ([smoke'(m) \vee smoke'(j)] \wedge \neg S_{[smoke'(m) \vee smoke'(j)}([smoke'(m) \vee smoke'(j)]^{ALT} \}$ [from (c) and d) and tautologous transformations]

f. $\|$Mary smokes or John smokes$\|^{s} \supseteq \{ [smoke'(m) \vee smoke'(j)] \wedge \neg S_{[smoke'(m) \vee smoke'(j)}(\{ [smoke'(m) \vee smoke'(j)], [smoke'(m) \wedge smoke'(j)] \}) \}$ [def. of ALT]

g. $\|$Mary smokes or John smokes$\|^{s} \supseteq \{ [smoke'(m) \vee smoke'(j)] \wedge \neg [smoke'(m) \wedge smoke'(j)] \}$, [def. of S]

We abbreviate (g) as follows:

h. $\|$Mary smokes or John smokes$\|^{s} \supseteq \{ [smoke'(m) \vee^{s} smoke'(j)] \}$

i. $\|$Mary smokes or John smokes$\|^{s} = \{ [smoke'(m) \vee smoke'(j)], [smoke'(m) \vee^{s} smoke'(j)] \}$ [from (c) and (g), by the smallest set condition].

(5) The following derivation contains a slight abuse in the use of lambas. It could be easily avoided at the cost of being more precise or pedantic on the semantics of abstraction.

Someone$_i$ [e$_i$ smokes or e$_i$ drinks].

a. $\|$ e$_i$ smokes or e$_i$ smokes$\|^{s}$ = $\{[smoke'(e_i) \vee smoke'(e_i)], [smoke'(e_i) \vee^{s} smoke'(e_i)]\}$

b. $\|$ someone$_i$ [e$_i$ smokes or e$_i$ smokes]$\|^{s} \supseteq (\|$ someone$_i$ $\|^{s}(\lambda e_i \|$[e$_i$ smokes or e$_i$ smokes]$\|^{s})$ [SA + slight abuse of notation] $\supseteq \{(someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)], (someone_i\ \lambda e_i\ [smoke'(e_i) \vee^{s} smoke'(e_i)]\}$

c. $\|$ someone$_i$ [e$_i$ smokes or e$_i$ smokes]$\|^{s} \supseteq \{(someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)] \wedge\neg S\ (someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)]]^{ALT}), (someone_i\ \lambda e_i\ [smoke'(e_i) \vee^{s} smoke'(e_i)] \wedge\neg S\ (someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)]]^{ALT})\}$ [KR]

d. $\|$ someone$_i$ [e$_i$ smokes or e$_i$ smokes]$\|^{s} \supseteq \{(someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)] \wedge\neg\ everyone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)], someone_i\ \lambda e_i\ [smoke'(e_i) \vee^{s} smoke'(e_i)] \wedge\neg\ everyone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)]\}$ [def. of ALT]

e. $\|$ someone$_i$ [e$_i$ smokes or e$_i$ smokes]$\|^{s} = \{ someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)], someone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)] \wedge\neg\ everyone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)], someone_i\ \lambda e_i [smoke'(e_i) \vee^{s} smoke'(e_i)] \wedge\neg\ everyone_i\ \lambda e_i\ [smoke'(e_i) \vee smoke'(e_i)]\}$ [from (d) and (b) by the smallest set condition]

(6) It is not the case that John smokes or Mary smokes.

a. $\|$it is not the case that John smokes or Mary smokes$\|^{s} \supseteq$ $\{ \|not\|^{s}(\|$ John smokes or Mary smokes$\|) \wedge \neg S(\|not\|(\|$ John smokes or Mary smokes$\|^{ALT})) \}$ [by SA]

b. $\|$it is not the case that John smokes or Mary smokes$\|^{s} \supseteq$ $\{ \neg \|$ John smokes or Mary smokes$\| \wedge \neg S(\|not\|(\|$ John smokes or Mary smokes$\|^{ALT})) \}$ [B]

c. $\neg$ [smoke'(j) smoke'(m)] $\wedge \neg S(\|not\|(\|$ John smokes or Mary smokes$\|^{ALT}))\}$

d. $\{\neg [smoke'(j) \vee smoke'(m)] \wedge \neg S(\|not\|(\{ smoke'(j) \vee smoke'(m), smoke'(j) \wedge smoke'(m)\}))\}$ [def. of $\| \|^{ALT}$]

d. $\|not\|(\{ smoke'(j) \vee smoke'(m), smoke'(j) \wedge smoke'(m)\}) = \{ \neg [smoke'(j) \vee smoke'(m)], \neg [smoke'(j) \wedge smoke'(m)]\}$ [def. of Ap]

e. Since no member of the set in (e) is stronger than $\neg$[smoke'(j) $\vee$ smoke'(m)], it follows that

$$S(\|not\|(\{ smoke'(j) \vee smoke'(m), smoke'(j) \wedge smoke'(m)\})) = \bot$$

Hence,

f. $\{\neg [smoke'(j) \vee smoke'(m)] \wedge \neg \bot\}$ [from (c) by substitution of identicals]

g. $\{\neg [smoke'(j) \vee smoke'(m)]\}$ [from (f) by tautologous transformations]

(7) a. I doubt that it is not the case that John or Mary smokes.

To simplify things a bit, let us represent (a) as not [not [John smokes or Mary smokes]].

b. $\|$ not [not [John smokes or Mary smokes]$(\|^{s} \supseteq \{ \neg (\|$ (not (John smokes or Mary smokes]] $\|) \wedge\neg S\ (\neg\neg[smoke'(j) \vee smoke'(m)^{(ALT)})\}$ [by SA]

c. $\{\neg\neg[smoke'(j) \vee smoke'(m)] \wedge \neg S\ (\{\neg\neg[smoke'(j) \vee smoke'(m)], \neg\neg[smoke'(j) \wedge smoke'(m)]\})\}$ [by def. of $\| \|^{ALT}$]

d. $\{[smoke'(j) \vee smoke'(m)] \wedge \neg S(\{[smoke'(j) \vee smoke'(m)], [smoke'(j) \wedge smoke'(m)]\})\}$ [tautologous transformations]

e. $\{[smoke'(j) \vee smoke'(m)] \wedge \neg [smoke'(j) \wedge smoke'(m)]\}$ [by def. of S]

(8) Nobody that smokes and drinks gets to be 60.

LF: [[No [body that t smokes and drinks]] [t gets to be sixty]]

a. Let us write 60(x) for "x gets to be (at least) sixty."

b. $\|[t \text{ gets to be sixty}]\|^s \supseteq \{60(x) \wedge \neg 61(x)\}$ [by KR]

c. $\|\text{No body that smokes and drinks}\| = NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])$

d. $\|\text{No body that smokes and drinks}\|^s \supseteq \{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]]) \wedge \neg S(NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]^{ALT}))\}$ [by SA]

e. $\|\text{No body that smokes and drinks}\|^s \supseteq \{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]]) \wedge \neg S(\{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]), NO(\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)]])\})\}$ [by def. of ALT and Ap]

f. $\|\text{Nobody that smokes and drinks}\|^s \supseteq \{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]]) \wedge \neg NO(\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)]])\})\}$ [by def. S]

g. $\|\text{Nobody that smokes and drinks}\|^s \supseteq \{\lambda P[NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])(P) \wedge SOME((\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)])(P)]\}$ [tautologous transformations]

h. $\|$ [[No [body that t smokes and drinks]([t gets to be sixty]] $\|^s \supseteq \{\lambda P[NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])(P) \wedge SOME((\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)])(P)]\ (\lambda x[60(x)]) \wedge \neg S(NO(\lambda x[person(x) \wedge [smoke(x) \wedge drink(x)])\ ((\lambda x[60(x)]^{ALT}))\}$ [by SA]

i. $\|$ ([No [body that t smokes and drinks]] [t gets to be sixty]] $\|^s \supseteq \{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])(\lambda x[60(x)]) \wedge SOME((\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)]])(\lambda lx[60(x)]) \wedge \neg S(\{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)])\ ((\lambda x[59\ (x)\ ]), NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)])\ ((\lambda x[60(x)\ ]), (NO(\lambda x[person(x) \wedge [smoke'(x) \wedge drink'(x)])\ ((\lambda x[61(x)\ ])\}\ )\}$ [def. of ALT and GenAp

j. $\|$ [[No [body that t smokes and drinks]] [t gets to be sixty]] $\|^s \supseteq \{NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])(\lambda x[60(x)]) \wedge SOME((\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)])(\lambda x[60(x)]) \wedge \neg NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)])\ ((\lambda x[59\ (x)\ ])\}$ [def. of S]

k. $\|$ [[No [body that t smokes and drinks]] [t gets to be sixty]] $\|^s = NO(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)]])(\lambda x[60(x)]) \wedge SOME((\lambda x[person'(x) \wedge [smoke'(x) \vee drink'(x)])(\lambda x[60(x)])] \wedge SOME(\lambda x[person'(x) \wedge [smoke'(x) \wedge drink'(x)])\ ((\lambda x[59\ (x)\ ])$ [tautologous transformations; smallest set condition]

Notes

The first version of this work was presented in the fall of 1999 at the Center for Cognitive Science in Lyon and at the Pontignano workshop (which concluded Chomsky's visit to Italy). Subsequent versions were presented at NELS, University of California at Irvine, UCLA, University of Tuebingen (Fall 2000); at the DGfS meeting in Leipzig and at Massachusetts Institute of Technology (Spring 2001). All those audiences contributed significantly to give shape to the original ideas. I also would like to thank I. Caponigro, C. Cecchetto, S. Crain, J. Gajewski, A. Gualmini, T. Guasti, E. Guerzoni, L. Meroni, F. Panzeri, O. Percus, and U. Sauerland.

1. See, for example, Fauconnier (1975), Horn (1989: 230ff.), Krifka (1995), Landman (1998), Israel (1998), among many others.

2. The relevant entailment holds whenever the set of men is nonempty. Or, equivalently, we will be assuming a presuppositional view of determiners like *every*, according to which *every N* is taken to be uninterpretable as there are no Ns in the domain of quantification. See, for example, de Jong and Verkuyl (1985).

3. On scales, besides the works cited in the text, see, for example, Gazdar (1979) and Hirschberg (1985). Heim (class lectures, Fall 1999) individuates in monotonicity a necessary condition for being part of a scale. For arguments that monotonicity is not also a sufficient condition, see Landman (1998).

4. Two caveats are in order. First, the notion of entailment is to be understood as generalized in the usual way to all types (that "end in t"—see Partee and Rooth 1983). Second, entailment must be understood as being relativized to contextually shared knowledge in the sense of Stalnaker (1978). See Heim (1984) and von Fintel (1999) for relevant elaborations of Stalnaker's view.

5. U. Sauerland (personal communication) suggests that one way around this problem might be analyzing disjunction $p \vee q$ by using such epistemic possibility operators as $[\Diamond p \wedge \Diamond q]$. The consequences of this move need careful consideration. For example, it is not clear that a scalar treatment of the exclusiveness implicature associated with disjunction can be maintained under such a view (without ad hoc assumptions).

6. The localist may be accused of predicting too strong truth implicatures with universal quantifiers. (a) is predicted to implicate (b):

(a) Everyone wrote a paper or made a presentation.
(b) Everyone either wrote a paper or made a classroom presentation and not both.

The localist would predict the implicature to be

(c) It is not the case that everyone did both.

I think that the (possible) presence of the strong implicature (b) is plausible. Suppose we make a bet on (the truth of) (a). I bet that everyone wrote a paper or made a classroom presentation. Then we find out that half of the people did both (while the other half, one of the two). What would happen? I think there would be discussion on who won the bet. If the embedded strong implicature was simply not there, there should be no ground whatsoever for arguing in such a case.

7. I am assuming that (i) subjects originate within the VP, (ii) *or* can coordinate VPs, and (iii) QR can apply at the VP level. Accordingly, the subject *Mary* in (27b) is extracted across the board out of the coordinated VP. These assumptions are made just for explicitness sake. None is crucial to the conceptual point at hand.

8. One of the few authors who takes an explicit position in favor of such a view is Landman (1998). His arguments are developed in the context of a treatment of numerals within an event-based semantics. The present chapter is an attempt at pursuing his proposal for all implicatures (while remaining neutral with respect to event semantics).

9. An alternative methodology would involve considering the implicature separately from the meaning. Thus, for example (28a), repeated here, would implicate (b):

(a) It's false that Sue harassed some students.
(b) It's false that Sue harassed some though not all the students.

But the results would not change. If (a) implicates (b), then (28c) ought to be a possible continuation.

10. For some speakers (more tolerant in the use of the indicative future for optatives)

the contrast is not as sharp; however, in most dialects the subjuntive contrasts with the indicative future in forcing the optative interpretation.

11. Something similar also happens with the quantifiers. Even in positive contexts, we do not often consider all of the possible values of a given scale. For example, a sentence like (a) below clearly has (c) as an implicature; whether it also implicates (b) is much less clear. It will depend on what is specifically at issue in the context:

a. Some students will do well.
b. Not many students will do well.
c. Not every student will do well.

This means that out of a certain scale (say <some, many, most, every>) we select the contextually most relevant segment. In the case of quantifiers, in the absence of information to the contrary, the safest bet is often <some, every>.

12. I owe this way of putting it to a suggestion of H. Truckenbrodt.

13. The system I have in mind is the version of Dynamic Intensional Logic developed in Chierchia (1995). The dynamic aspect has its importance because implicatures interact with presuppositions. The basic idea of dynamic semantics is that sentences are interpreted as functions from contexts into new contexts. Such functions are undefined for contexts that do not satisfy the presuppositions of the sentence. Thus (modulo accommodation) it is impossible to update a context c through a sentence S if c does not satisfy S's presuppositions. The reader not familiar with dynamic semantics won't need anything beyond this general idea to follow the proposal.

14. The formal definition employs a generalized notion of functional application Ap(A,B), which lets us apply sets of functions to sets of arguments.

15. Thanks to Jon Gajewski and Irene Heim for pointing out a bug in a previous formulation of this rule.

16. An assumption I will be making is that every Boolean operator is generalized to functional types (that "end in t"—cf. Partee and Rooth 1983 for discussion) through a "pointwise" definition. For example, if P and Q are predicates (in Montague's notation, of type <e,t>), then

(b) $P \wedge Q = \lambda x\, [P(x) \wedge Q(x)]$

and so on.

17. My interpretive procedure has a seemingly odd consequence. Consider the following sentences:

(a) John smokes or drinks.
(b) It is not true that John doesn't smoke or drink.

Sentence (b) involves a double negation and it is truth conditionally equivalent to sentence (a). Furthermore, they have the same implicature (that John doesn't do both). However, the set of strong meaning of sentence (a) technically includes also its plain one, whereas this is not so for sentence (b):

(c) Strong meanings of sentence (a): $\{\text{smoke(j)} \vee \text{drink(j)}, \text{smoke(j)} \vee \text{drink(j)} \wedge \neg \text{smoke(j)} \wedge \text{drink(j)}\}$.
(d) Strong meanings of sentence (b): $\{\text{smoke(j)} \vee \text{drink(j)} \wedge \neg \text{smoke(j)} \wedge \text{drink(j)}\}$.

The strong meanings of sentence (a) are built up directly via Krifka's rule, whereas the strong meanings of sentence (b) come in indirectly via functional application. This looks like a quirk, without any empirical effect. But it turns out to have interesting (if controversial) consequences in connection with the intervention effect of NPIs. We will come back to this point in section 4.3.

18. This can be seen as part of the general conditions for felicitous use of a sentence S in a context c, in the spirit of Stalnaker (1978). Schematically,

Felicity conditions on context updates.
A sentence S is felicitous in a context c relative to its value V(S) iff:
i. S's presuppositions relative to V(S) are met in c

$$(c + V(S) \text{ is defined})$$

ii. V(S) is the most informative interpretation that doesn't lead to contradiction

$$(c + V(S) \neq \emptyset$$
$$c + V(S) \subset c$$
$$c + V(S) \subseteq c + V'(S), \text{ for all } V' \neq V)$$

19. In slightly different terms, we may view the proposal as follows. The plain semantic value of a sentence ϕ tells us how a context c may be modified by it (i.e., it yields a recursive characterization of a context incrementation function $c + \phi$). The strengthened semantic value yields a notion of strengthened context incrementation ($c +^{s} \phi$) by taking into account the role of relevant alternatives. Speakers will tend to use cooperatively these two manners of adding information to the context that grammar makes available.

20. Much of the same effect can be obtained by indexing formulas to situation variables (see Percus 2000 for a recent discussion). All that I say about quantificational domains can be recouched in terms of situations.

21. Lahiri (1998) doesn't explicitly discuss the issue of locality. But Sauerland (1999) has presented a minimality-based account of intervention that builds on Lahiri's proposal.

22. See, for example, the discussion in Haspelmath (1997: 106ff. and references quoted there); cf. also Israel (1998).

23. This holds, of course, if Δ is nonempty (i.e., nontrivial).

24. I believe that the approach just sketched in terms of universal closure of the domain (or situation) variable might also be extended in an interesting way to Free-Choice *any*, in the spirit of Dayal's (1998) proposal. But exploration of this must be left to some other occasion.

25. The operator O can be given a generalized quantifier version. And the *some* alternatives can be specified in model theoretic terms through a recursive definition (akin, once again, the how Rooth (1985) defines focal alternatives or to how I define scalar alternatives).

26. Some kind of feature checking also seems to be necessary to mark the varying strength of NPIs. As Zwarts (1996) shows, NPIs may require negative heads of varying strength (DE, antiadditive, or antimorphic). My semantics of NPIs has the potential to explain why NPIs requires DE-ness. But any more stringent requirement must come from something else. Also relevant is the question of how local the relation between the NPI and the trigger is allowed to be. Here, too, there is some cross-linguistic variation that may be related to different properties of the relevant morphological features.

27. Roofing might also be derived from the semantics alone. Suppose, for example, you have two negative heads stacked up.

(a) . . . NEG1 . . . NEG2 . . . NPI . . .

If we close at the level of NEG1, the derivation crashes, for strengthening cannot be met because the two negations cancel each other out. Closing at the level of NEG2 is permissible. This predicts that if we have a sequence of negative heads, we could have closure (i.e., check that strengthening is met) at any odd-numbered negative site insofar as semantics goes:

(b) . . . NEG 1 . . . NEG2 . . . NEG3 . . . NPI . . .

So, for the moment, I don't have a strong argument against a purely semantic account of roofing. But it strikes me as implausible that things work this way.

28. For example, Krifka (1995) builds into his theory conditions on where the "assertion" operators that check the semantic condition on NPI licensing may be inserted.

29. For a discussion of how this may occur consistent with the general line we are exploring here, see von Fintel (1999).

30. Space prevents me from getting into intervention effects with the definite article and with nonbridge verbs. I think, however, that that also comes for free, roughly along the lines suggested in Krifka (1995).

31. I owe this point to Dominique Sportiche.

32. Recall that in my approach, a sentence such as *Few students know any linguistics* has two strong values, one with the implicature, the other without it (whereas sentences with indirect implicatures have only one strong value). This is where treating $\| \|^{s}$ as a relation, rather than as a function, comes in handy since it provides a straightforward mechanics to capture the idea discussed in the text.

33. In Gualmini et al. (2001), adults where asked which sentence, between (136) and "no pirate stole a jewel or a necklace," would better describe the situation at hand. The reply was overwhelmingly in favor of the latter, thus showing that adults were attuned to the pragmatic infelicity of (149) in this situation.

34. It seems to me that the spirit of the present proposal on intervention is close to that of Szabolcsi and Zwarts's (1992) on weak islands. But obviously we cannot jump to conclusions concerning all sorts of intervention-type effects.

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Structures and Beyond

The Cartography of Syntactic Structures, Volume 3

EDITED BY
ADRIANA BELLETTI

OXFORD
UNIVERSITY PRESS
2004