Scalar Items in Embedded Position: Another Experimental Approach

Fabian Schlotterbeck, Michael Franke and Petra Augurzky

Abstract

. . . make concrete . . .

1 Introduction

This paper deals with the interpretation of two types of sentences, namely:

(1) All of the students read some of the papers. (AS)

(2) Exactly one of the students read some of the papers. (ES)

In AS-sentences the scalar item *some* like takes scope under universal quantifier *all*. In ES-sentences *some* takes scope under non-monotonic quantifier *exactly one*. These sentences are interesting, because, according to current pragmatic theorizing, they may have at least three conceivable readings. The main question we are interested in here is which of these three conceivable readings is available to subjects naïve to all pragmatic theory. We are moreover interested in the more refined question which of the available readings naïve subjects prefer.

What are the possible readings of AS- and ES-sentences? Scalar *some* is usually assumed to receive a semantic interpretation similar to logical $\exists$, so that the sentence *Some boys cried* is literally true in a situation where all boys cried. But it is also known to invite upper-bounding inferences in plain utterances:

(3) a. Hans solved some of the problems.

b. $\rightsquigarrow$ Hans solved some but not all of the problems.

The classical explanation of this inference, following the pioneering work of Grice (1975), has it that (3b) is a pragmatic inference, a so-called *quantity implicature*, derived by an abductive inference as the best explanation of why am informed, knowledgable and cooperative speaker has uttered (3a) when she could also have uttered the semantically stronger and relevant:[a]

a. redo labels of examples

(3) c. Hans solved all of the problems.

If this upper-bounding inference would occur often and systematically enough, then it may well be that also embedded occurrences of *some* get enriched, in some fashion or

other, to contribute the enriched meaning *some but not all* also under the scope of other logical operators. Indeed, even Grice envisaged this possibility when he wrote: "It may not be impossible for what starts life, so to speak, as a conversational implicature to become conventionalized" (Grice, 1975, p.58). But then there are at least three relevant candidate readings for AS- and ES-sentences: (i) a *literal reading* like in (1a) and (2a) where *some* has only its literal meaning; (ii) a *global reading* like in (1b) and (2b) where, according to the Gricean intuition, we enrich utterances of (1) and (2) with the negation of alternativ utterances of the corresponding sentences (4) and (5) where *some* is replaced by *all*; and also (iii) a *local reading* like in (1c) and (2c) where *some* is read to mean *some but not all* in the scope of the embedding quantifier. 

(1) All of the students read some of the papers.

   a. All of the students read some and maybe all of the papers. (AS-LIT)

   b. All of the students read some and maybe all and it's not the case that all of the students read all of the papers. (AS-GLB)

   c. All of the students read some but not all of the papers. (AS-LOC)

(2) Exactly one of the students read some of the papers.

   a. Exactly one of the students read some and maybe all of the papers. (ES-LIT)

   b. Exactly one of the students read some and maybe all and it's not the case that exactly one of the students read all of the papers. (ES-GLB)

   c. Exactly one of the students read some but not all of the papers. (ES-LOC)

(4) All of the students read all of the papers.

(5) Exactly one of the students read all of the papers.

Section 2 will discuss these reading in more detail and, by giving some helpful illustrations, make clear that these readings are all distinct but logically dependent on each other in interesting ways.

The empirical questions we would like to ask, namely (i) which of these readings are available, and (ii) which of the available ones are the preferred interpretations, are highly relevant because they lie at the heart of the current debate about the exact location and nature of the interface between semantics and pragmatics. There are three major camps which are —more or less fiercely— involved in this border war, all of which make different predictions about availability and preferences of readings. We will give a more detailed description of the various theoretical positions below in Section 3, but on a first rough approximation the situation is the following.

Firstly, there are pragmatic traditionalists who seek to conserve the spirit of Grice's (1975) original ideas as much as possible (e.g. Spector, 2006; Sauerland, 2004; Russell, 2006; Schulz and van Rooij, 2006; Geurts, 2010; Franke, 2011). Traditionalists happily acknowledge the existence of global readings, but might consider local readings either unavailable or a beast distinct from scalar implicatures. An often phrased intuition of the traditionalists is that local readings, since they are special kinds of inferences, require special intonation, in particular emphatic stress on the scalar item.[b]

b. give references

Opposed to that is the camp of lexical conventionalists (e.g. Levinson, 2000; Chierchia, 2004) who maintain that scalar *some* is lexically ambiguous between the standard logical meaning *some and maybe all* and the upper-bounded meaning *some but not all*. As the latter is considered a default, lexical conventionalism has no problem accounting for local readings, and in fact would consider these the preferred readings.

Thirdly and finally, there is the camp of grammaticalists who defend that the distribution of upper-bounded readings of *some* is best explained by postulating a silent operator, akin to the meaning of the particle *only* (Chierchia, 2006; Fox, 2007; Magri, 2011; Sauerland, 2012; Chierchia et al., forthcoming; Chierchia, forthcoming). According to the grammatical view, this silent operator may be applied in compositional semantics also in the scope of other logical operators, but, so as not to overgenerate readings, the availability of readings is constraint by the *strongest meaning hypothesis* (Dalrymple et al., 1998). Grammaticalist theories predict that all three types of readings are available. Moreover, according to the grammatical view, the local reading is preferred for AS-sentences, while the global one is preferred for ES-sentences. (More precisely, as we will see Section 3, depending on the variant of the strongest meaning hypothesis employed, either the global reading is predicted to be preferred for ES-sentences, or the global and the local reading are predicted to be equally preferred.)

Due to its theoretical significance, a number of previous studies have already probed into the availability of readings for AS- and ES-sentences (e.g. Geurts and Pouscoulous, 2009; Clifton and Dube, 2010; Chemla and Spector, 2011). However, as we will argue in Section 4, results have not been as clear-cut as one might have hoped for. Even worse so, taken in conjunction, the empirical evidence is inconclusive as to whether local readings exist. We hypothesized that previous studies might be insufficiently informative because of the focus on (variants of) a picture-verification paradigm.[c] The problem is that in order to test the availability of different candidate meanings different pictures have to be presented, so that effects of pictorial complexity or stereotypicality could never be ruled out entirely. Moreover, previous studies have only accumulated limited evidence pertaining to the second question that may help decide between theoretical positions, namely which of the attested readings subjects prefer.

In reaction to this situation, we therefore studied a different mode of visual presentation: subjects were presented with pictures that were partly covered and could incrementally be uncovered at the subjects' request; for each ((partially) covered) picture, subjects had to decide whether they could already give a truth-value judgement or needed more information.[d] This way we obtained behavioral data that is both indicative of the reading subjects assumed and independent of the complexity of the visual stimulus. At the same time, we hypothesized that the incremental nature of this task would shed light on the preferences over readings, because the temporal distribution of truth-value judgments would give away which reading subjects were waiting to evaluate, so to speak. To test whether our method is indeed suitable to detect interpretation preferences, we included ambiguous test items like (6) which are known to preferentially receive the late-closure reading in (6a) and not the dispreferred, but attested early-closure reading (6b).[e]

c. relate to Bob van Tiel's work

d. mention who else does this

e. insert references to literature on EC-LC processing

(6) The letter is connected with circles and squares with suns.

a. The letter is connected with squares with suns and circles. (LC)

b. The letter is connected with circles with suns and squares with suns. (EC)

Finally, since it is often argued (see Section 3) that intonational stress on an embedded scalar item can favor a local reading we presented sentence auditorily and manipulated stress accordingly. The design of our studies is detailed in Section XYZ.

· summarize results

The paper is structured as follows. Section 2 elaborates on the three kinds of relevant readings for our target sentences. Section 3 works out the different theoretical positions and their predictions about availability and preference. Section 4 recaps the results of previous studies on this subject, arguing for the need of a more refined methodology. Section 5 describes our experimental design. Section 6 states our results, which we discuss in Section 7.[f]

[f] rephrase eventually

2 Get to know your readings

Three readings are *prima facie* conceivable for the AS- and ES-sentences in (1) and (2). These are logically distinct, but also logically dependent in intricate ways. To see this, let us look at each kind of sentence in turn.

2.1 AS-sentences

An AS-sentence like (1) has a literal reading as in (1a), a global reading as in (1b) and a local reading as in (1c).

(1) All of the students read some of the papers.

a. All of the students read some and maybe all of the papers. (AS-LIT)

b. All of the students read some and maybe all and it's not the case that all of the students read all of the papers. (AS-GLB)

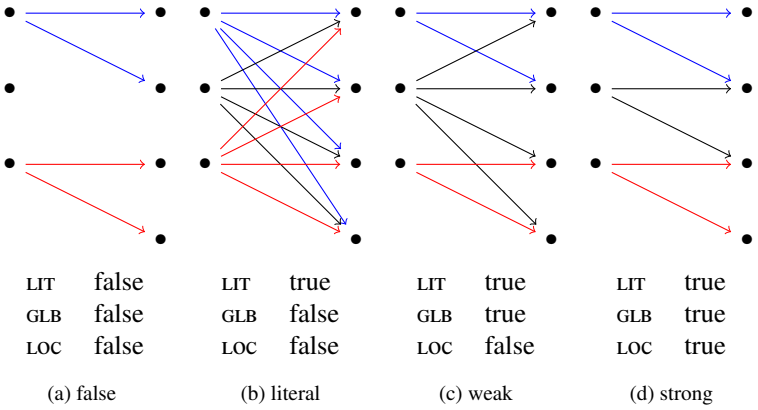
c. All of the students read some but not all of the papers. (AS-LOC)

These readings stand in a strict entailment relation, namely the local reading asymmetrically entails the global reading, which asymmetrically entails the literal reading:

(7) LOC $\subset$ GLB $\subset$ LIT

That GLB $\subseteq$ LIT is obvious, given that GLB is defined as the conjunction of LIT and the negated (relevant/feasible) alternative(s) of the to-be-interpreted utterance. The entailment is asymmetric, because the information that not all of the students read all of the papers is not entailed by the literal reading. To see that LOC $\subset$ GLB, notice that the case where all of the students read some but not all of the papers is a special case of the case where all of the students read some (and maybe all), while not all of the students read all of the papers.

Given these entailment relations, there are four kinds of situations, the names for which we borrow from Chemla and Spector (2011), that we can distinguish based on different truth values for our candidate readings:



(a) false (b) literal (c) weak (d) strong

Figure 1: Distinguishing scenarious for AS-sentences

situation	truth value		
	LIT	GLB	LOC
false	0	0	0
literal	1	0	0
weak	1	1	0
strong	1	1	1

Examples of these kinds of situations are given in Figure 1, where the dots on the right of each diagram are students, the dots on the left problems and an arrow from a student to a problem indicates that that student sovled that problem.[g] Notice that, except for the literal situation in Figure 1b, other arrangements of arrows might equally well serve as examples.

g. improve graphics

2.2 ES-sentences

The situation for ES-sentences like (2) is similar, but a little more complicated because the embedding quantifier is non-monotonic. Again, we consider a literal reading as in (2a), a global reading as in (2b) and a local reading as in (2c).

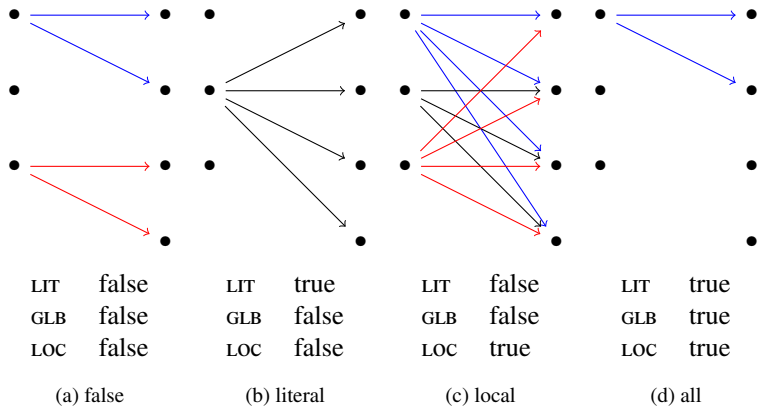
(2) Exactly one of the students read some of the papers.

a. Exactly one of the students read some and maybe all of the papers. (ES-LIT)

b. Exactly one of the students read some and maybe all and it's not the case that exactly one of the students read all of the papers. (ES-GLB)

c. Exactly one of the students read some but not all of the papers. (ES-LOC)

Entailment relations in this case are non-linear:



(a) false (b) literal (c) local (d) all

Figure 2: Distinguishing scenarious for ES-sentences

(8) LIT ⊃ GLB ⊂ LOC

Of course, GLB ⊆ LIT by definition of global readings. But the entailment is asymmetric, because the extra information that it is not the case that exactly one student read all of the papers is not entailed by the literal reading (2a). However, unlike for AS-sentences, LOC is not stronger than GLB, but asymmetrically entailed by the latter. To see this, notice that the global reading is equivalent to:

(2b′) Exactly one of the students read some but not all and everybody else read none of the papers.

This reformulation also makes clear that LOC and LIT are logically independent.

Given these entailment relations, there are again four different situations, named following Chemla and Spector (2011), corresponding to the four possible distributions of truth values:

situation	truth value		
	LIT	GLB	LOC
false	0	0	0
literal	1	0	0
local	0	0	1
all	1	1	1

Examples for each situation are given in Figure 2. Again there several possible scenarios within each truth-value distribution, except for the literal situation in 2b.

3 Theories and predictions

With some mild simplification, we can distinguish three main theoretical positions that make different predictions about the available and preferred readings of AS- and ES-sentences (c.f. Horn, 2006; Geurts, 2010; Sauerland, 2012, for overview). We will refer to these here as traditionalism, conventionalism and grammaticalism and treat each one in turn. Since there is some leeway in assessing the predictions for some of these positions (depending on which of several reasonable additional assumptions we should adopt), we will distinguish different varieties of each position. For convenience, the predictions of each (variety of each) position are also summarized in Table 1 at the end of this section.

3.1 Traditionalism

We refer to traditionalism as traditionalism because of its conservative stance towards Grice's original theory of conversational implicatures (Grice, 1975). Many author's have defended traditionalist positions in this sense. Of the more recent literature, we would consider as traditionalist, among others, contributions such as by Spector (2006); Sauerland (2004); Russell (2006); Schulz and van Rooij (2006); Geurts (2010); Franke (2011).

According to Grice, conversational implicatures, of which quantity/scalar implicatures are a special case, are to be thought of as rationalizations of speaker behavior. Central in this reasoning is the assumption that the speaker's behavior is efficient (if not optimal) and goal-oriented. Usually, the assumed goal of conversation is cooperative exchange of helpful information from the speaker to the hearer.

Consequently, the Gricean recipe (c.f. Geurts, 2010) for deriving a simple scalar inference like that in (3b) from an utterance of (3a) is as follows: if the issue whether Hans solved only some or all of the problem is relevant, then a cooperative and knowledgable speaker would utter (3c) if in a position to do so; hence, one of the most natural explanations of why such a speaker has not uttered (3c), but only (3a) is that she is uncertain of whether (3c) is true; but on the assumption that she is knowledgeable (competent, opinionated, informed . . .) it follows that (3b) should in fact be true.[1],**h**

h. do we need to enlarge on epistemic implicatures?

(3) a. Hans solved some of the problems.

b. $\rightsquigarrow$ Hans solved some but not all of the problems.

c. Hans solved all of the problems.

A similar line of reasoning applies immediately also to AS- and ES-sentences and derives the global reading in a straightforward way. Consequently, traditionalism predicts that both literal and global readings are available: literal readings, because these form the starting point of pragmatic reasoning; global readings because these may be arrived at by the Gricean recipe.

[1] We are glossing here somewhat swiftly over the more nuanced details of the derivation of implicatures targeting the speaker's epistemic state (e.g. Gazdar, 1979; Soames, 1982), as this is not crucially relevant for the issues we are interested in here.

Whether traditionalism predicts a preference for global or literal readings depends on whether the auxiliary assumptions necessary to derive global readings by the Gricean recipe are plausibly met in the particular case of utterance of AS- and ES-sentences. These auxiliary assumptions include relevance of the extra information provided in the global reading, mutual awareness that the stronger alternative has been a speaker option, the speaker's competence about the issue, etc. Normally, traditionalist accounts would assume that these extra assumptions are met. In that case, traditionalism would predict that the global readings should be preferred over the literal readings. On the other hand, it might also be hypothesized that, for example, a competence assumption is harder to justify for AS- and ES-sentences in general than for simpler sentences such as (3), because of the additional quantificational element: it might be less clear that the speaker knows exactly how many students solved how many problems, than that the speaker knows exactly how many problems, e.g., Hans solved. In that case, or if any other assumption of the Gricean recipe cannot be maintained, traditionalism would predict that the literal reading would be preferred over the global one. But that means that there are at least two varieties of traditionalism that, depending on which additional assumptions we would make, yield slightly different predictions: the strong variety of traditionalism maintains that the auxiliary assumptions of the Gricean recipe hold usually/strongly/unless-completely-intenable and therefore predicts that global readings are preferred over the literal ones; the weak variety of traditionalism holds that the auxiliary assumptions are more fragile and predicts that literal readings are preferred over the global ones.[2] **i**

i. acknowledge comment by Philippe Schlenker here

What about the local reading then? Here, the situation is slightly different for AS- and the ES-sentences. Look at ES-sentences first. Traditionalism does not predict that a local reading is available for ES-sentences, at least not as a quantity implicature (c.f. Geurts and Pouscoulous, 2009; Chemla and Spector, 2011). This is because traditionalism assumes that quantity implicatures are pragmatic enrichments of the literal meaning of an utterance, obtained by conjoining the literal meaning with a suitable set of negated alternatives. But since the literal and the local reading of ES-sentences are logically independent, there is no way that local readings can be derived in a traditionalist manner as a quantity implicature. Traditionalism often does concede that (something like) local readings can occur if scalar items are marked with *special intonation*, albeit then as a signal of a different pragmatic process (e.g. Horn, 2006; Geurts, 2009, 2010). We will come back to this issue in Section 4.5.

On the other hand, as for AS-sentences, there is a traditionalist way of deriving the local implicature, namely by assuming that not only (4) is an alternative to (1), but also the sentence in (9).

(1) All of the students solved some of the problems.

(4) All of the students solved all of the problems.

(9) Some of the students solved all of the problems.

[2] For clarity: although weak traditionalism does not predict the global reading to be preferred, it would might or might no still predict an epistemically weak implicature, similar to the global reading, that the speaker is uncertain whether the stronger alternative is true. Whether it does predict that depends on which auxiliary assumption are assumed to be met and which are not.

Clearly, if we conjoin a literal reading of (1) with the negation of (9) we obtain exactly the local reading. (Notice that the negation of (9) entails the negation of (4), so it makes no difference (not) to add it in this case.) Consequently, traditionalism does predict that the local reading of AS-sentences is available if (9) is an available alternative. We should therefore introduce another distinction: restricted traditionalism assumes that (9) is not available and therefore predicts that the local reading for AS-sentences is not available; in contrast, unrestricted traditionalism assumes that (9) is available and so is the local reading.

Still, even unrestricted traditionalism would not predict that the local reading is preferred over the global reading. This is because the derivation of the local implicature via (9) hinges on yet another auxiliary assumption, namely the availability of the alternative in (9), which seems much less obvious and therefore presumably is less readily available than the alternative in (4). Consequently, we derive the following predictions about preferences for unrestricted traditionalism: weak unrestricted traditionalism prefers the literal over the global over the local reading, while strong unrestricted traditionalism prefers the global over the local over the literal reading. The predictions for all of the relevant theoretical positions are also summarized in Table 1.

3.2 Conventionalism

Lexical conventionalism is a position that has been defended only by a minority (Levinson, 2000; Chierchia, 2004). This notwithstanding, the position is *prima facie* highly plausible as well.[3] The general idea is that the upper-bounding inference from *some* to *some but not all* occurs so frequently that it would be inefficient to go over and over again through the kind of Gricean reasoning that traditionalists propose. Conventionalism therefore assumes that the scalar inferences has become routinized, hard-wired, so much so that there are two lexical entries for a scalar item like *some*, one with meaning *some and maybe all* and one with the meaning *some but not all*.

Levinson (2000) proposed that the latter is the preferred default meaning. Call this position defaultism. Levinson's defaultism has strong empirical evidence against it, because several processing studies show that the computation of scalar inferences appears to be time- and effort-consuming, when they *do* arise, not when they *don't*, as defaultism would have it (c.f. Breheny et al., 2006; Breheny and Katsos, 2008; De Neys and Schaeken, 2007).[4] **j** For completeness sake, let's call literalism **k** the opposite view that the literal meanings are *ceteris paribus* preferred. We are not aware that anyone has defended this option, but we will come back to this later on.

j. more references!

k. better name?

Both varieties of conventionalism make interesting predictions about available readings for AS- and ES-sentences. Unaided, conventionalism does not predict that global readings are available. The lexically stored upper-bound for scalar *some* only allows to derive literal and local readings. Moreover, defaultism predicts that local readings are preferred over literal ones. Contrary to that, our dummy position of literalism predicts that literal readings are preferred over local ones.

[3] Compare also Sauerland (2012) who argues quite favorably for a pragmatically informed conventionalism, although eventually dismissing it in favor of grammaticalism.

[4] But there is also competing evidence that scalar inferences are immediate, low-level processes (Grodner et al., 2010).

3.3 Grammaticalism

The third and final kind of theoretical position we should consider here is grammaticalism. It is safe to say that grammaticalism is currently *en vogue* with ever more very sophisticated theoretical evidence (i.e., evidence based on intuitive judgements and more theoretical considerations) being excavated in its favor (c.f. Chierchia, 2006; Fox, 2007; Magri, 2011; Sauerland, 2012; Chierchia et al., forthcoming; Chierchia, forthcoming). When it comes to the predictions of available readings of AS- and ES-sentences, grammaticalism looks a bit like the conjunction of traditionalism and conventionalism. But conceptually speaking, grammaticalism goes down a road of its own.

Grammaticalism approaches quantity implicatures by postulating a silent operator that can be variably applied during compositional computation of a sentence's truth-value (Chierchia, 2006), if necessary multiple times (Fox, 2007). This silent operator is variably referred to as O(·) or Exh(·), because it is assumed to be similar in effect to the meaning of particle *only* or of the mechanism of *exhaustive interpretation* (Groenendijk and Stokhof, 1984; von Stechow and Zimmermann, 1984; van Rooij and Schulz, 2004; Schulz and van Rooij, 2006; Fox, 2007). For our purposes here, it is enough to note that Exh(·) is a poly-typed function that enriches an expression X, which crucially need not be a full proposition, based on a set of (suitable, relevant) alternatives to X, Alt(X), that yields an enriched meaning of the form:[5]

(10) $\text{Exh}(X, \text{Alt}(X)) = X \bigwedge_{A \in \text{Alt}(X)} \neg A.$

As this operator can apply at various scope sites, the grammatical approach predicts that all three readings of AS- and ES-sentences are available: literal readings arise if no exhaustification operator is applied; global readings arise if the exhaustification operator takes sentence-wide scope as in (11); and local readings arise if the exhaustification operator takes scope under the respective quantifiers as in (12).

(11) a. Exh(All of the students solved some of the problems)

b. Exh(Exactly one of the students solved some of the problems)

(12) a. All of the students Exh(solved some of the problems)

b. Exactly one of the students Exh(solved some of the problems)

It is obvious that the grammatical approach, as described so far, is rather flexible in that it makes many readings available. It is so flexible, in fact, that it must be constrained in some way or other to shield the approach against overgeneration. The easiest examples where this is crucial are occurrences of scalar items in downward-entailing environments, such as in:

(13) It's not the case that Hans solve some of the problems.

[5] More sophisticated formulations of exhaustive interpretation have been proposed (e.g. Schulz, 2005; Schulz and van Rooij, 2006; Spector, 2006; Fox, 2007) but this simple formulation is sufficient for the purposes of this paper. Also, we gloss here over non-trivial details in the way this operation is to be specified exactly within a compositional semantics, so as to also apply to sub-propositional expressions (Chierchia, 2006).

But an assertion of normally would be taken to convey (14a), not he disjunctive meaning in (14b).

(14) a. Hans solves none of the problems.
b. Hans solved none or all of the problems

The latter, however, is a reading that grammaticalism predicts to be available, if the Exh(·)-operator takes scope under the negation, as in:

(15) It's not the case that Hans solved Exh(some of the problems)

Indeed, this reading is not unattested, for witness a continuation of (13) as in:

(16) It's not the case that Hans solve *some* of the problems. He solved *all* of them.

But this reading does seem to be marked, in that it requires exceptional contextual circumstances and a non-standard intonational stress.

To account for the markedness of certain examples, grammaticalism is therefore aided by a principle that specifies which readings are to be preferred if several readings are generated by optional applications of Exh(·) in the compositional computation of semantic values. The principle that grammaticalists adhere to (c.f. Fox and Spector, 2009; Chierchia et al., forthcoming; Chierchia, forthcoming) is the strongest meaning hypothesis of Dalrymple et al. (1998). If a given sentence has several conceivable readings, the strongest meaning hypothesis selects for the strongest of these. But this is only a rough formulation. Details might matter. Chierchia et al. (forthcoming) discuss two variants of the strongest meaning hypothesis. Towards a formal definition, fix a sentence with propositional content S with candidate readings $C(S)$, where $C(S)$ contains S and all readings derivable from inserting Exh(·) at suitable scope sites. Then define *ceteris paribus* preferences among members of $X, Y \in C(S)$ as a stronger partial relation:

(17) $X > Y$ iff $X \subset Y$ (Chierchia et al., forthcoming, (104))

or a weaker partial relation:[1]

(18) $X > Y$ if $X \subset Y$ and X and Y are readings obtained from applications of Exh(·) at exactly the same scope sites, except for one
(Chierchia et al., forthcoming, (105))

1. mention that ill-defined

In the following we will speak of strong grammaticalism or weak grammaticalism, depending on whether (17) or (18) is used.

These two varieties of grammaticalism give rise to different predictions about preferred readings. It is easy to see that the preference on readings that strong grammaticalism predicts is just a mirror of the entailment relations in (7) and (8): for AS-sentences strong grammaticalism predicts that local readings are preferred over global readings which in turn are preferred over literal readings; for ES-sentences strong grammaticalism predicts that global readings are most preferred, while literal and local readings are not ranked with respect to preference. Weak grammaticalism, on the other hand, predicts that both AS- and ES-sentences preferably get either a local or a global reading rather than a literal reading. But weak grammaticalism does not rank these former two with respect to each other because they differ in more than one application of the Exh(·) operator. These predictions are all summarized also in Table 1.

	availability				preference	
theory	AS-GLB	AS-LOC	ES-GLB	ES-LOC	AS	ES
traditionalism						
weak restricted	✓	–	✓	–	LIT > GLB	LIT > GLB
weak unrestricted	✓	✓	✓	–	LIT > GLB > LOC	LIT > GLB
strong restricted	✓	–	✓	–	GLB > LIT	GLB > LIT
strong unrestricted	✓	✓	✓	–	GLB > LOC > LIT	GLB > LIT
conventionalism						
defaultism	–	✓	–	✓	LOC > LIT	LOC > LIT
literalism	–	✓	–	✓	LIT > LOC	LIT > LOC
grammaticalism						
total	✓	✓	✓	✓	LOC > GLB > LIT	GLB > LIT, LOC
partial	✓	✓	✓	✓	GLB, LOC > LIT	GLB, LOC > LIT

Table 1: Predictions of the relevant theoretical positions

4 Previous studies

The rather divergent predictions made by rivaling theoretical positions call for empirical testing. Indeed, a small number of studies have gathered useful evidence. The following briefly reviews the studies of Geurts and Pouscoulous (2009), Clifton and Dube (2010) and Chemla and Spector (2011). Unfortunately, the conjoined evidence from all of these studies is inconclusive as to the availability of local readings. Moreover, we argue that the question of which reading is preferred for AS- and ES-sentences is only insufficiently addressed by previous studies.

4.1 Geurts and Pouscoulous (2009)

Geurts and Pouscoulous (2009) conducted a picture-verification task to find out whether local readings of AS- and ES-sentences are available.[6] The critical conditions of their study presented subjects with pictures like those in Figure 1c and 2c where the local reading gets a different truth-value from the literal and the global reading. In particular, for AS-sentences the local reading is false for the critical picture in Figure 1c whereas the literal and global readings are true; for ES-sentences the local reading is true for the critical picture in Figure 2c, whereas the literal and global readings are false.

The results of Geurts and Pouscoulous were strikingly unambiguous: there were *no* responses indicative of a local read *at all*! In other words, all of the subjects judged AS-sentences true in a situation like in Figure 1c and all of the subjects judged ES-sentences false in situations like 2c.

[6] Actually, Geurts and Pouscoulous (2009) did not use ES-sentences, but sentences where scalar *some* was embedded under non-monotonic quantifier *exactly two* (with appropriate pictures, of course). This case is a little more complex, but we will gloss over this here, treating their data, as it if was obtain for ES-sentences.

4.2 Clifton and Dube (2010)

Geurts and Pouscoulous's paper was quickly succeeded by three commentaries: Ippolito (2010) supported Geurts and Pouscoulous's finding, Sauerland (2010) criticized, both based on theoretical considerations; Clifton and Dube (2010) replied with a small experimental study of their own. Clifton and Dube really only paid attention to AS-sentences, which is quite unfortunate. They were worried that Geurts and Pouscoulous's picture-verification paradigm might unjustly de-emphasize local readings for AS-sentences, because asking whether a sentence fits a picture, as Geurts and Pouscoulous did, might create a bias for accepting sentences also on a weaker, dispreferred reading. Unfortunately, this criticism does not apply to the non-monotonic ES-condition, where subjects unanimously *rejected* the ES-sentences, despite the fact that they could have accepted it based on the local reading.

Nonetheless, Clifton and Dube's experimental data is worthwhile considering because their study was aimed at finding out about a potential preference relation between local and literal readings. Clifton and Dube conducted a picture-choice task where, in the critical conditions, subjects were presented with an AS-sentence and a pair of pictures. Subjects were asked to "indicate which shape is best described by the sentence" and could choose either picture, or options 'both' and 'neither.' There were two versions of this experiment, differing in which kind of picture pairs were presented on critical trials.

In version 1, the picture pair consisted of the weak and strong situations in Figures 1c and 1d. The response percentages observed by Clifton and Dube were:

weak	strong	both	neither
3	39	57	1

That the majority answer is "both" could be taken as evidence that the literal reading is the preferred one. But the almost 40% of choices for the strong situation, so Clifton and Dube argue, might be indicative of the availability of the local reading.

In version 2 of Clifton and Dube's experiment, the picture pair consisted of the literal and weak situations in Figures 1b and 1c. In this case, response percentages were:

weak	literal	both	neither
28	6	50	17

Again the majority response "both" might speak for a preference for the literal reading, but, as Clifton and Dube argue the 17% of "neither" answers in this case again suggest that the local reading is available.

Taken together, Clifton and Dube take these results to contradict Geurts and Pouscoulous's findings. Local readings are, after all, attested if subjects are given a choice as to which situation they consider most fitting for an AS-sentence.

- possible shortcomings/problems to be mentioned later:
    - no ES-sentences tested

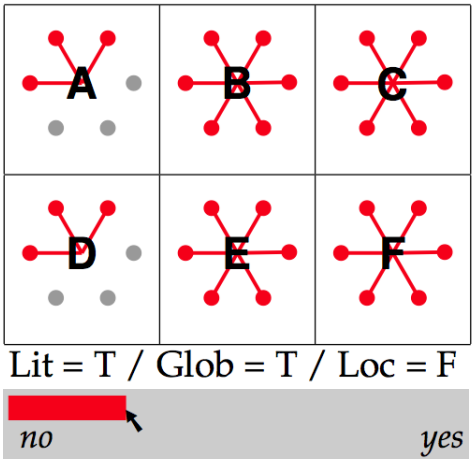


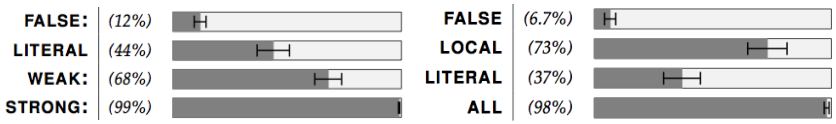
Figure 3: Example of critical trial for AS-condition by Chemla and Spector's (2011)

- not explicitly probed for (relative preference of) global readings
- unclear whether design assesses preferences of readings or targets pictorial complexity / typicality (van Tiel)

4.3 Chemla and Spector (2011)

Chemla and Spector (2011) also took issue with Geurts and Pouscoulous's design, arguing that, firstly, the pictorial material used in Geurts and Pouscoulous's study was unduly difficult; that, secondly, these pictures also may have failed to make the local reading sufficiently relevant; and that, thirdly, the restriction to a categorial choice (whether the sentence fits or does not fit the picture) may induce a bias against non-preferred readings in cases where candidate readings stand in entailment relations (c.f. Sauerland, 2010, for this latter criticism). To meet these potential problems, Chemla and Spector (2011) presented subjects with pictorial material like that in Figure 3, which was assumed to be easier to assess and better at highlighting the relevance of the local readings. Additionally, subjects were asked, not for categorial judgements, but for graded judgements: subjects could freely click on a scale, as shown in Figure 3, to indicate how much they considered a picture fitting for a given sentence (c.f. Chemla, 2009, for more on this method).

Albeit in a different format, the pictures used by Chemla and Spector were all different instantiation of the situation types in Figures 1 and 2. The results reported from this study are averaged clicking positions, as shown in Figure 4. According to Chemla and Spector, the crucial piece of evidence for the availability of local readings for AS-sentences was that these sentences yielded higher graded acceptability scores for the strong situation than for the weak situation (although these differ only with respect to the truth value of the local reading). In a similar way, evidence for the availability of the local reading for ES-sentences would come from the difference between the local



(a) AS-condition (b) ES-condition

Figure 4: Results from Chemla and Spector's (2011) study

and the literal situation. Strikingly, in the latter case, the ES-sentences received an average of 73% acceptability in a the local situation although the literal and global readings are false in this case.

- possible shortcomings/problems to be mentioned later:
  - not desirable to raise the level of relevance of local readings, because we want to test the base-line / default (cite Geurts / van Tiel)
  - cannot separate judgements about sentences from judgements about pictures (van Tiel)
  - unclear what graded truth-value judgements measure exactly (re-read Chemla (2009) if needed)

4.4 What's missing

- independence of pictorial complexity and preference of reading
- provide a benchmark from which to deduce preference relations
- control for intonational pattern (present auditorily)

4.5 The role of intonation

WHERE TO PUT THIS: PREVIOUS SUBSECTION, HERE OR LATER?

- intonational effects discussed by Horn (2006); Geurts (2009, 2010), (c.f. Chemla and Spector, 2011)
- mention Schwarz et al. (2008) (re-read, check for newer version)

5 Design

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

6 Results

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

7 Discussion

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

References

Breheny, Richard and Napoleon Katsos (2008). *Experimental Investigations of the Semantics/Pragmatics Interface*. Course Material for ESSLLI.

Breheny, Richard et al. (2006). "Are Generalised Scalar Implicatures Generated by Default? An On-Line Investigation into the Role of Context in Generating Pragmatic Inferences". In: *Cognition* 100.3, pp. 434–463.

Chemla, Emmanuel (2009). "Presuppositions of Quantified Sentences: Experimental Data". In: *Natural Language Semantics* 17.4, pp. 299–340.

Chemla, Emmanuel and Benjamin Spector (2011). "Experimental Evidence for Embedded Scalar Implicatures". In: *Journal of Semantics* 28, pp. 359–400.

Chierchia, Gennaro (2004). "Scalar Implicatures, Polarity Phenomena and the Syntax/Pragmatics Interface". In: *Structures and Beyond*. Ed. by Adriana Belletti. Oxford University Press, pp. 39–103.

— (2006). "Broaden Your Views: Implicatures of Domain Widening and the Syntax/Pragmatics Interface". In: *Linguistic Inquiry* 37.4, pp. 535–590.

— (forthcoming). *FC Nominals and FC Disjunction: The Identity Thesis*. Ed. by Anamaria Fălăuş. Palgrave Macmillan.

Chierchia, Gennaro et al. (forthcoming). "The Grammatical View of Scalar Implicatures and the Relationship between Semantics and Pragmatics". In: *Semantics. An International Handbook of Natural Language Meaning*. Ed. by Claudia Maienborn et al. de Gruyter.

Clifton, Charles and Chad Dube (2010). "Embedded Implicatures Observed: A Comment on Geurts and Pouscoulous (2009)". In: *Semantics & Pragmatics* 3.7, pp. 1–13.

Dalrymple, Mary et al. (1998). "Reciprocal Expressions and the Concept of Reciprocity". In: *Linguistics and Philosophy* 21.2, pp. 159–210.

Fox, Danny (2007). "Free Choice and the Theory of Scalar Implicatures". In: *Presupposition and Implicature in Compositional Semantics*. Ed. by Uli Sauerland and Penka Stateva. Hampshire: Palgrave MacMillan, pp. 71–120.

Fox, Danny and Benjamin Spector (2009). "Economy and Embedded Exhaustification". Handout for a talk given at Cornell University.

Franke, Michael (2011). "Quantity Implicatures, Exhaustive Interpretation, and Rational Conversation". In: *Semantics & Pragmatics* 4.1, pp. 1–82.

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

Geurts, Bart (2009). "Scalar Implicature and Local Pragmatics". In: *Mind and Language* 24.1, pp. 51–79.

— (2010). *Quantity Implicatures*. Cambridge University Press.

Geurts, Bart and Nausicaa Pouscoulous (2009). "Embedded Implicatures?!?" In: *Semantics & Pragmatics* 2.4, pp. 1–34.

Grice, Paul Herbert (1975). "Logic and Conversation". In: *Syntax and Semantics, Vol. 3, Speech Acts*. Ed. by Peter Cole and Jerry L. Morgan. Academic Press, pp. 41–58.

Grodner, Daniel J. et al. (2010). ""Some," and Possibly All, Scalar Inferences are not Delayed: Evidence for Immediate Pragmatic Enrichment". In: *Cognition* 166, pp. 42–55.

Groenendijk, Jeroen and Martin Stokhof (1984). "Studies in the Semantics of Questions and the Pragmatics of Answers". PhD thesis. Universiteit van Amsterdam.

Horn, Laurence R. (2006). "The Border Wars: A Neo-Gricean Perspective". In: *Where Semantics Meets Pragmatics*. Ed. by Klaus von Heusinger. Vol. 16. Current Research in the Semantics/Pragmatics Interface, pp. 21–48.

Ippolito, Michela (2010). "Embedded Implicatures? Remarks on the debate between globalist and localist theories". In: *Semantics & Pragmatics* 3.5, pp. 1–15.

Levinson, Stephen C. (2000). *Presumptive Meanings. The Theory of Generalized Conversational Implicature*. Cambridge, Massachusetts: MIT Press.

Magri, Giorgio (2011). "Another Argument for Embedded Scalar Implicatures based on Oddness in Downward Entailing Environments". In: *Semantics & Pragmatics* 4.6, pp. 1–31.

De Neys, Wim and Walter Schaeken (2007). "When People Are More Logical Under Cognitive Load: Dual Task Impact on Scalar Implicature". In: *Experimental Psychology* 54.2, pp. 128–133.

van Rooij, Robert and Katrin Schulz (2004). "Exhaustive Interpretation of Complex Sentences". In: *Journal of Logic, Language and Information* 13, pp. 491–519.

Russell, Benjamin (2006). "Against Grammatical Computation of Scalar Implicatures". In: *Journal of Semantics* 23.361–382.

Sauerland, Uli (2004). "Scalar Implicatures in Complex Sentences". In: *Linguistics and Philosophy* 27, pp. 367–391.

— (2010). "Embedded Implicatures and Experimental Constraints: A Reply to Geurts & Pouscoulous and Chemla". In: *Semantics & Pragmatics* 3.2, pp. 1–13.

— (2012). "The Computation of Scalar Implicatures: Pragmatic, Lexical or Grammatical". In: *Language and Linguistics Compass* 6.1, pp. 36–49.

Schulz, Katrin (2005). "A Pragmatic Solution for the Paradox of Free Choice Permission". In: *Synthese* 147, pp. 343–377.

Schulz, Katrin and Robert van Rooij (2006). "Pragmatic Meaning and Non-monotonic Reasoning: The Case of Exhaustive Interpretation". In: *Linguistics and Philosophy* 29, pp. 205–250.

Schwarz, Florian et al. (2008). "Strengthening 'or': Effects of Focus and Downward Entailing Contexts on Scalar Implicatures". Unpublished manuscript; retrived from semanticsarchive March 11 2011.

Soames, Scott (1982). "How Presuppositions are Inherited: A Solution to the Projection Problem". In: *Linguistic Inquiry* 13.3, pp. 483–545.

Spector, Benjamin (2006). "Scalar Implicatures: Exhaustivity and Gricean Reasoning". In: *Questions in Dynamic Semantics*. Ed. by Maria Aloni et al. Amsterdam, Singapore: Elsevier, pp. 229–254.

von Stechow, Arnim and Thomas Ede Zimmermann (1984). "Term Answers and Contextual Change". In: *Linguistics* 22.1, pp. 3–40.