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1. Abstract

If a speaker chooses one scalar term (e.g., *three*, *or*) rather than a stronger one (e.g., *four*, *and*), listeners may assume that the speaker lacked evidence for the stronger claim, giving rise to strengthened meanings like *exactly three* or exclusive *or*. Three experiments investigate the circumstances under which *or* is interpreted as exclusive *or*. The first tests the hypothesis that accenting a scalar term increases the number of scalar implicatures that are computed. The second tests the hypothesis that fewer scalar implicatures are drawn in Downward Entailing (DE) contexts than in non-DE contexts, not confounded with potential focus effects as in a previous study on the issue. The third study examines the role of DE versus non-DE contexts in a self-paced reading study. The results indicate that both focus and DE vs. non-DE context affects interpretation of *or* as predicted, and that the latter appears as an on-line effect.

2. Introduction

Scalar implicatures are becoming an area of active research in adult psycholinguistics (e.g., Bezuidenhout & Cooper Cutting, 2002; Breheny, Katsos, & Williams, 2006; Huang & Snedeker, in press; Noveck & Posada, 2003; for studies of acquisition Braine & Romain, 1981, Papafragou & Musolino, 2003, Paris, 1973). One central issue is characterizing the circumstances under which adults strengthen the interpretation of words that are members of sets of alternatives that are ordered with respect to their logical strength, e.g., all > most > many > some, and > or, ...four > three > two...? For instance, the literal meaning of the

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sentence *Some students laughed* is compatible with any of the sentences *All/most/many students laughed*. However, the enriched interpretation commonly assigned to this sentence, which can be paraphrased as "Some but not all (most/many) students laughed," is not compatible with these other sentences. The "but not all" part that makes this a logically stronger, more specific, interpretation of *Some students laughed*, is traditionally assumed to be a pragmatic enrichment of the literal meaning of the sentence and is typically referred to as a conversational implicature (Grice, 1975). Under what conditions do such implicatures arise?

The present paper reports three experiments. The first is a test of the hypothesis that listeners are more likely to strengthen the interpretation of a scalar item, here from an inclusive *or* to an exclusive *or* when the word has been prosodically focused than when it has not (which we will refer to as the "focus strengthening hypothesis"). The results support the hypothesis. Another factor that has been shown to be relevant for strengthening, e.g., by Chierchia, Frazier, & Clifton (in press) is that of Downward Entailing (DE) contexts. DE-contexts, such as the scope of negation, are contexts that license inferences from sets to subsets, e.g., from *peas* to *green peas*: *Joe didn't eat peas* entails *Joe didn't eat green peas*. Chierchia et al. showed that adults are less likely to compute scalar implicatures in Downward Entailing (DE) contexts (Heim, 1987, Ladusaw, 1979) than in non-DE contexts, and interpreted their findings in terms of the reversal of the logical strength scale that occurs in a DE context (note that *Joe didn't eat peas or beans* entails *Joe didn't eat peas and beans*). However, the results might in principle be explained by the focus strengthening hypothesis, because the DE contexts that were used (conditional expressions and relative clauses) place the scalar term in a non-focused position. The second experiment, a written questionnaire study, was designed to determine whether the claim that implicatures tend not to be drawn in DE contexts is still supported in cases where it is not confounded with the predictions of the focus strengthening hypothesis. The results of the second experiment support the DE context claim. The third experiment used a self-paced reading study to investigate whether implicatures are drawn on-line in non-DE contexts.

Three major approaches have been developed to account for the circumstances in which scalar implicatures are drawn. One, based on Relevance Theory (Carston, 1990, Sperber & Wilson, 1986), claims that implicatures are drawn ONLY when they are contextually relevant. Breheny et al. (2006) present reading data supporting this idea. Another approach, dubbed "neoGricean" (Gazdar, 1979, Horn, 1972, 1989, 1992), and developed by Levinson (2000), assumes instead that implicatures are generally and automatically computed for certain implicature triggers, such as *some* (which receives the interpretation *some but not all*), *or* (which receives an exclusive interpretation), and possibly cardinals (which receive the interpretation *exactly n*). These implicatures are later cancelled if necessary, e.g., if they conflict with information in context. Bezuidenhout & Cooper Cutting (2002) present experimental evidence in line with this claim. A third approach, spearheaded by Chierchia (2004, 2006), treats scalar implicatures as a distinguished aspect of pragmatic processing that occurs hand-in-hand with the semantic

computation. The core of his proposal is that Downward Entailing (DE) contexts do not (or are less likely to) give rise to implicatures.[1]

Chierchia et al. (in press) report results that support Chierchia's view that implicatures are less likely to be computed in DE-contexts such as the antecedent clause of a conditional sentence or the first argument position of *every*. In a one-item written completion study administered at the end of a course examination, elementary psychology students were asked to complete one of the following two discourse fragments: (a*) John has two cars...*; (b) *If John has two cars, ...* Following their completion, they were to select one of the following two possible sentences as best fitting how they interpreted the sentence: (basic, non-strengthened) *John has two or more cars*; (strengthened) *John has exactly two cars*. 89% of the 109 students who were given the simple sentence (a) to complete chose the strengthened interpretation, but only 64% of the 107 students who completed the conditional sentence (b) did (chi-square = 17.99, $p < .001$). As expected, the DE conditional context displayed significantly less strengthening of the interpretation of *two* to *exactly two*.

A full scale written questionnaire study examined pragmatic strengthening of *or*. It compared non-DE structures like (1a) with two types of DE structures that were near-paraphrases of each other (1b and 1c). More strengthened (exclusive *or*) interpretations were observed in the Upward Entailing (UE) structure (1a), 53%, than in either of the DE structures (1b) and (1c), 29% and 31% respectively.

(1) a. The teacher uses handouts or power point. He will satisfy the new regulations.
b. Every teacher who uses handouts or power point will satisfy the new regulations.
c. If a teacher uses handouts or power point, he will satisfy the new regulations.

The results support Chierchia's claim that implicatures are less likely to be drawn in DE contexts than in non-DE contexts. They also present a challenge to the Relevance Theory view that implicatures only arise in the right kind of contexts. In the non-DE context implicatures were drawn roughly half the time despite having no clear contextual trigger for drawing the implicature, as would be required on the Relevance Theory approach. In other words, even though no preceding context was present to invite the implicature in (1a), half the time participants drew an implicature anyway. While Relevance Theorists could perhaps reply that subjects might accommodate plausible contexts in the artificial experimental setup, this would still leave unexplained the difference between DE and non-DE environments, which, given their otherwise identical content, presumably would give rise to similar accommodated contexts.

The results also challenge the proposal that implicatures are drawn automatically (at least in non-DE environments), which is explicitly part of the generalized implicature view. The fact that implicatures were only drawn half the time in (1a) is problematic for this view since the implicature neither conflicted with information in the sentence nor occurred in a DE-context. Thus implicatures should always or generally have been drawn for the triggers tested (a prediction that might also be taken to be implicitly suggested in Chierchia's work).

[1] In Chierchia's original proposal, generalized implicatures are cancelled when they occur in DE contexts.

On the positive side, however, the upshot of these results, if they are indeed due to the factor of DE contexts, is that they favor theories that can account for the difference between DE and non-DE contexts (as do the results of Panizza & Chierchia, in progress, who report eye movement data in an Italian study using similar types of sentences.)

A potential problem with the evidence for the role of DE-contexts in implicature computation is that the relevant effects could at least in part be due to focus. It is commonly noted, at least in passing, that focusing a scalar item increases a listener or reader's tendency to compute a scalar implicature, presumably because focus draws attention to the speaker's use of a particular term on a scale and thus activates the scale itself. By activating the scale, the contrast between the term used and its alternatives is highlighted. For example, *Josh ate TWO flans* tends to be interpreted, according to this focus hypothesis, as "Josh ate exactly two flans" because the speaker has chosen the number *two* and highlights the choice of this numeral over other numerals on the scale by means of a prosodic focus. Similarly, *Ada bought cheddar cheese OR swiss cheese* should tend to be interpreted with an exclusive *or*, because by accenting and focusing the word *or* attention is drawn to the scale that ranks *and* as being stronger (more informative) than *or*. If the speaker had evidence that Ada bought both types of cheese, then the speaker would have used *and*.

In the non-DE example (1a), the phrase containing *or* is arguably in a focused position, the predicate of a simple sentence (Carlson, Dickey, Frazier & Clifton, in press). However, *or* occurs in the antecedent of a conditional or in a relative clause modifying the first argument of *every* in subject position in the DE examples (1b) and (1c). These are not generally thought of as focused positions. It is therefore possible that *or* is strengthened less in the DE contexts than in the non-DE context simply because it does not receive focus in the former context.

3. Experiment 1

3.1 Method

Materials. Experiment 1 was designed to test the focus strengthening hypothesis by manipulating the position of an overt pitch accent, which imparts focus in spoken English. Sixteen sentences were constructed with DP (determiner phrase) disjunction in the predicate as in (2). All sentences appear in the Appendix. The sentences were each recorded twice: once with an L+H* accent on the disjunction (*or*) and once with an L+H* accent on the auxiliary, as indicated in (2a) and (2b).[2] Two alternative interpretations, to be presented visually, were prepared for each item (2c). Apart from the focused word, the intonation was not marked by particularly prominent accents or strong intonational phrase (IPh) boundaries. Each content word had an H* accent.

[2] L+H* accents have a notably high pitch peak and are perceptually prominent. They tend to occur on contrasted material in non-emphatic speech, and on either contrasted or new material in emphatic speech. An H* accent, mentioned later in the text, is generally less prominent than an L+H* accent, but still perceptually prominent compared to an unaccented word. Material that is new to the discourse requires at least an H* accent although old material can receive the H* accent under some circumstances.

(2) a. Mary will invite Fred OR Sam to the barbecue.
b. Mary WILL invite Fred or Sam to the barbecue.
c. i. She will invite Fred or Sam or possibly both.
ii. She will invite Fred or Sam but not both.

These sentences were divided into two lists, each of which had complementary halves of the sentences with each accent position. The sentences, together with 82 other sentences (fillers and sentences from unrelated studies) plus six practice sentences were digitized at 22.5 kHz, 16 bit, and a computer presented them at a comfortable listening level over speakers in a sound-deadened chamber.

Participants and procedures. Forty-eight undergraduate University of Massachusetts students listened to the sentences (24 were given each list) and selected a paraphrase corresponding to the interpretation they assigned to the sentence. A trial began when the participant pulled a response trigger, initiating the presentation of one sentence. Order of presentation was individually randomized for each participant. After the sentence ended, the participant pulled the trigger again, and the two alternative interpretations appeared on a video monitor. The participant pulled a trigger under the answer that s/he considered to be correct for the previous sentence, and the next trial began with no feedback. Response times and answers were recorded.

3.2 Results

Table 1 presents the proportion of inclusive (and exclusive) choices, together with the mean time taken to choose each answer. The data of primary interest are the proportion of choices of each answer. The frequency of inclusive (non-strengthened) interpretations was significantly reduced by the pitch accent on *or* ($F1(1,47) = 11.59$, $p < .001$; $F2(1,15) = 22.67$, $p < .001$). While the low frequency of inclusive *or* choices made it impossible to obtain "inclusive" RTs stable enough to analyze separately from "exclusive" RTs, it is possible to claim that the overall time to answer questions was significantly longer when the pitch accent was on the auxiliary than when it was on the *or* ($t(47) = 2.43$, $p < .05$).

Table 1. Proportion of inclusive (and exclusive) choices, and response time (ms)

	Prop inclusive (exclusive)	RT, inclusive	RT, exclusive
PA on *or*	16.5% (83.5%)	4048	2942
PA on auxiliary	28.6% (71.4%)	4322	3378

3.3 Discussion

The focus strengthening hypothesis predicted that more exclusive *or* interpretations should be assigned in (2a) than in (2b). The results confirmed this prediction. Given the support for the focus strengthening hypothesis, we should revisit the evidence for the claim that implicatures tend not to be drawn in DE contexts. In Chierchia et al (see also Noveck, Chevaux, Guelminger, Sylvestre, and Chierchia, 2002), the DE contexts involved the

antecedent of a conditional and the first argument of *every* in sentences where *every* occurred in subject position. These contexts were compared to the predicate position of a simple sentence. As argued above, the DE contexts are less likely to place focus on the phrase containing *or* than the non-DE contexts are. Given that Experiment 1 demonstrated that focus can affect the interpretation of *or*, Experiment 2 was designed to see if a DE context affected interpretation in the absence of any variation in focus.[3]

4. Experiment 2

One way to keep a disjunction in roughly the same syntactic position (thereby controlling the likelihood of focus on it) but still vary whether it is in a DE context is to place the disjunction in a predicate that is or is not in the scope of a negation (which creates a DE context: *I didn't eat vegetables* entails that *I didn't eat carrots*). A computer-administered questionnaire examined whether placing a disjunction in the scope of a negation affects the likelihood that its interpretation will be strengthened. The sentences that were used, an example of which appears in (3), do not appear to differ with respect to focus. Thus, finding that more exclusive or paraphrases are chosen for the affirmative sentence (3a) than for the negative sentence (3b) would support Chierchia's claim that the DE nature of a context affects whether implicatures tend to be drawn.

4.1 Method

Materials. Twenty-four pairs of sentences like those in (3) were tested. All items appear in the Appendix. The only difference between the two versions of each sentence was whether a negation was present, or not.

(3) a. Maria asked Bob to invite Fred or Sam to the barbecue.
b. Maria asked Bob not to invite Fred or Sam to the barbecue.

Each sentence was presented together with a question, requiring selection between two or three interpretations, as shown in (4a) and (4b). Both positive and negative versions had strengthened (exclusive *or*) and non-strengthened (inclusive *or*) answers as the first two options. Since the "exclusive *or*" paraphrase of a negative sentence assumes that the negation has scope over the just the verb ("not-invite A or B"), the negative versions of the sentences received a third possible paraphrase, a biconditional, which is logically correct if the negation is taken to have scope over the (exclusive) disjunction operator, but which we did not expect many participants to accept.

[3] Note that although a narrow focus on just the scalar term may not be the most common or most natural focus in general, in the context of an experiment where a participant is repeatedly faced with, say, an inclusive or exclusive paraphrase for *or*, the participant may be more likely to assign a narrow focus on the scalar term. Especially in written judgment studies, the role of an implicit prosodic or intonational structure might in principle yield something like the pattern of data observed in the Chierchia et al. study.

(4) a. (Affirmative sentence) What did Maria ask Bob to do?
i. To invite either Fred or Sam, but not both.
ii. To invite Fred or Sam, possibly both.
b. (Negative sentence) What did Maria ask Bob to do?
i. To either not invite Fred or not invite Sam.
ii. To not invite Fred and not invite Sam.
iii. To invite neither or both but not just one.

The resulting 24 sentences (with two versions each) were combined with 92 other sentences of a variety of forms, some from other experiments and some fillers. Some of these sentences required a two- or three-choice answer, while others required a 5-point acceptability rating. Two counterbalanced questionnaire forms were constructed, each with one version of each Experiment 2 sentence.

Participants and procedures. Forty-eight University of Massachusetts undergraduates were tested in individual sessions. Each saw one of two counterbalanced forms of the questionnaire. The 116 items were presented in an individually-randomized order on a computer screen. The participant responded by typing a number (1, 2, 3 for the Experiment 2 sentences) on the computer keyboard. The computer recorded the response made to each item together with the time taken to make the response.

4.2 Results

Table 2 presents the actual counts of the answers that were chosen following affirmative and following negative sentences.[4]

Table 2. Mean Frequencies of Answers to Questions, per Subject (max = 12), Experiment 2

Condition	Answer 1 Exclusive *or*	Answer 2 Inclusive *or*	Answer 3 Biconditional
Affirmative sentence	7.79 (64.7%)	3.96 (33.0%)	0.08 (0.7%)
Negative sentence	0.81 (6.8 %)	10.29 (85.8%)	0.65 (5.4%)

The difference in mean frequency of '1' responses is highly significant ($t1(47) = 12.16$; $t2(23) = 16.13$, $p < .001$) as is the difference in frequency of '2' responses ($t1(47) = 9.26$; ; $t2(23) = 15.28$, $p < .001$). Participants were very likely to choose a strengthened reading following an affirmative sentence, but not following a negative sentence (which, interestingly, resulted in nearly as many choices of the biconditional as the apparently-simple "exclusive or" answer). Response times were longer following negative than following affirmative sentences (means of 8891 and 6977 ms), but this probably reflects nothing more than the fact that participants had to read one more answer alternative in the former case.

[4] Note that the choices of answer "3" (a total of 4) made following affirmative sentences did not correspond to a presented alternative, and presumably reflect response errors.

The results of Experiment 2 show that inclusive interpretations are chosen more often in DE contexts than in non-DE contexts, even when controlling for any effects of focus. In a DE context, there were occasional choices of one or the other possible strengthened, exclusive, interpretation, but they were quite rare. While the results from this experiment and the one by Chierchia et al. (in press) illustrated in (1) above cannot be compared in any direct way, it is worth noting that the difference between DE and non-DE contexts appears to be far more pronounced in the case of negation than in that of the antecedent of a conditional in the Chierchia et al. study. This would be surprising since in the latter, presumably both the DE-factor and the focus structure of the sentences should contribute to the difference in how frequently implicatures are drawn, while only the DE-factor is at play in the present study. If there turn out to be real differences between different operators that create DE-contexts, this would suggest that there are still other factors influencing implicature computation at play. We leave this issue to future research.

5. Experiment 3

To determine whether the preferred interpretations revealed in Experiment 2 are computed online, a self-paced reading study was conducted using sentences similar to those used in Experiment 2. One continuation was made up for each of the first sentences, as illustrated in (5). The continuation was consistent only with the exclusive interpretation of *or*. If readers compute the exclusive interpretation of *or* in (5a), where this is the stronger interpretation, then the continuation in (5a) should be particularly easy to read because it confirms the chosen interpretation of the disjunction: only if the first sentence is understood to mean that what Maria did was to invite either Fred or Sam, but not both, does it make sense to continue by giving a reason for her not inviting both. By contrast, in the downward entailing context (5b), readers should not compute the exclusive interpretation of *or*, i.e. it is understood to mean that Maria invited neither Fred nor Sam, rather than that she either didn't invite Fred or didn't invite Sam. Consequently the continuation, which makes sense based on the latter interpretation, but not the former one, should not fit with the chosen analysis of the first sentence in (5b), and should be read more slowly.

(5) a. Maria invited Fred or Sam to the barbecue. She didn't have enough room to invite both.
b. Maria didn't invite Fred or Sam to the barbecue. She didn't have enough room to invite both.

5.1 Methods

The twenty-four sentences used in Experiment 2 were used, each with one continuation for both versions, as illustrated in (5). Two sentences had to be removed from analysis because of typographical errors. The continuation was intended to be consistent with the exclusive or but not the inclusive or reading of the disjunction in the first sentence (5a), presupposing that only one person was invited or not-invited. Thus, it should be consistent with the predicted interpretation of the affirmative but not the negative sentences. Half of the texts were followed by simple two-choice questions that asked about some aspect of the

sentences but not about the interpretation of *or*. All materials appear in the Appendix. These experimental items were combined with 24 filler items and 124 items from other experiments for a total of 160 sentences (plus 6 practice sentences).

Sixty University of Massachusetts undergraduate students were tested in individual half-hour sessions. Each saw one of four counterbalanced forms of the full set of sentences, so that each sentence was tested in each sentence version and with each continuation in one form of the list, and so that equal numbers of readers saw each version and continuation. The sentences were presented in an individually randomized order to participants in a frame-by-frame moving window with underscore previews of letter position, using e-Prime (Psychological Software Tools, Pittsburgh, PA). For the Experiment 3 items, the two frames consisted of sentences 1 and 2, respectively, but some of the other items were presented in frames smaller than a single sentence. Subjects advanced from one frame to the next by pulling a response trigger, and when a question appeared, it appeared after the last frame had been read. The times taken to read each sentence plus the question answers, were recorded.

5.2 Results

Mean question answering accuracy was very high (94 and 96% correct for affirmative and negative contexts, respectively). The mean sentence reading times appear in Table 3.

Table 3. Mean Reading Times, ms, Experiment 3

Sentence 1 version	Sentence 1	Sentence 2
Affirmative (non-DE)	2601	1088
Negative (DE)	2723	1252

Only sentence 2 reading times are of interest. They were significantly longer following a negative, DE, context than following an affirmative, non-DE context ($F1(1,59) = 8.23$, $p < .001$; $F2(1,22) = 12.25$, $p < .01$). They were also analyzed using a linear mixed model analysis with both subjects and items as random factors, as advocated by Baayen, Davidson, and Bates (in press). This analysis also indicated clear statistical significance ($t = 4.451$, $p < .001$ when tested using Monte Carlo Markov Chain procedures as advocated by Baayen et al.).

One concern arises because of the longer reading times for Sentence 1 when the negative term is added to the sentence. It is conceivable that the longer reading times for Sentence 2 in the negative, DE, conditions reflects spillover from Sentence 1. However, the fact that the correlation between Sentence 1 and Sentence reading times is extremely small, at $r = 0.05$, when computed on an item-by-item basis (and quite small, $r = 0.17$, when computed on a trial-by-trial basis, a procedure that permits between-subject reading time differences to inflate the correlation coefficient) argues against attributing the long Sentence 2 reading times to spillover.

6. General discussion

The experiments reported above showed that scalar implicatures are more likely to be computed when the scalar term is focused than when it is not and they are more likely to be computed in non-DE contexts than in DE contexts. Experiment 3 showed that implicatures are drawn on-line and not just in some post-sentence deliberative phase when participants must choose a preferred interpretation of a sentence. The question now is what do these generalizations imply about the nature of the language system in general and about the pragmatic processing in particular.

Turning first to the focus strengthening hypothesis, the question is why it should hold. Numerous studies have shown that listeners and readers allocate more attention to focused constituents than to unfocused constituents (Birch & Rayner, 1997, Cutler & Foss, 1977, Cutler & Fodor, 1979 among many others). If focus defines the locus of new and important information, it is expected that listeners and readers pay special attention to focused constituents. In effect, focused constituents may carry the most information concerning the speaker/author's intent.

A related question is whether speakers also attend in particular to focused constituents. If they do, then it is natural for a listener to assume that the speaker's choice of words is particularly careful in focused constituents. If so, then the choice of a particular word rather than any of its scalar alternatives will be most informative when that word is focused (also) because the speaker can be assumed to have selected the word with care. In other words, especially for focused constituents, the listener can trust that the speaker can be held to the particular way the message was cast.

Turning to the claim that implicatures are less likely to be drawn in DE contexts, the question is again why this should be so. In Chierchia's (2004) original account, the idea was that scalar implicatures are computed as the semantic computation takes place. When an operator inducing a DE context is encountered, implicatures in its scope would be cancelled. Although this mechanism per se is not endorsed in the Chierchia et al. (in press) paper, the insight that certain aspects of pragmatic processing may be automatic and tied to grammatical contexts is important and deserves to be fully explored. The results of Experiments 2 and 3 lend some encouragement to this view in that DE contexts do lead to fewer implicatures. But the process by which this occurs is not really addressed by the present experiments. One possibility is that the DE context effects are just particular instances of Gricean effects based on relations of logical strength between alternative statements (Grice, 1989). Another possibility is that certain contexts may be coded for (other) grammatical purposes, such as keeping track of polarity items (*any*, *ever*, etc.). To take a relevant example, listeners may tend not to draw implicatures in any context that licenses NPIs such as *any* regardless of which interpretation is more informative/stronger. For example, questions license NPIs but they are not DE contexts. (See Giannikidou, 1998, for one approach to them based on veridicality. See Drenhaus et al., 2005, for ERP data on the processing of NPIs in German in questions.)

In a question like (6), intuitions suggest that there is no strong temptation to strengthen *or* to an exclusive *or* interpretation (assuming a regular yes/no-question intonation, not an alternative-question intonation with a pitch accent on both disjuncts).

(6) Did you buy cheddar cheese or swiss cheese?

This suggests that a general Gricean system of computing the most informative interpretation may not suffice as an account of computing implicatures. Something more along the lines that Chierchia envisioned may be needed, though possibly without the property of first computing an implicature and then cancelling it in DE contexts. For example, grammatically encoded contexts (those licensing *any* versus those not licensing it) may serve as guideposts for whether to compute an implicature or not. When context or a strong plausibility bias is available, it might override the default supplied by the grammatically encoded contexts.

Breheny et al. (2006) presented reading time data (from their Experiment 1) suggesting that *or* is interpreted as exclusive only when information in context invites the implicature. The experimental result fits with the expectations of a Relevance Theory approach where drawing inferences is always deliberative and costly, and therefore implicatures are drawn only in contexts where there is a pay-off in terms of contextual cohesion. But in the absence of context, we repeatedly find substantial exclusive-*or* interpretations in connection with non-DE examples, including the consequent of conditionals, the second argument of every-sentences, and the affirmative forms of the experimental items in Experiments 1-3 of the present paper. These items all can in principle be interpreted in two ways, since both an inclusive and an exclusive interpretation of *or* would result in a sensible interpretation. Thus, neither a specific sentence bias nor a preceding context seems to be required to trigger or justify the cost of drawing the implicature, as would be necessary on the Relevance Theory sort of approach. Moreover, any attempt of capturing these effects in the non-DE contexts within a Relevance Theory approach would still have to account for the difference between DE and non-DE contexts. Since the sentence pairs used in the present studies only differ with respect to the presence of negation, it would appear to be rather difficult to tease them apart in terms of relevance, since, in effect, the same alternative interpretations are at issue in the affirmative and negative versions of the sentences in experiments 2 and 3. In that case, the effect of DE-contexts would have to be accounted for separately within a Relevance Theory approach. A Relevance theorist might argue, of course, that the off-line results are irrelevant since a paraphrase selection task may implicitly invite a comparison of interpretations. But the online results in Experiment 3 are not really open to this concern.

One idea receiving attention in recent linguistic discussion is the idea that scalar items optionally activate their scalar alternatives and, when activated, these alternatives are factored into the meaning by an alternative sensitive operator (with essentially the features of *only*) (Chierchia, 2006; Fox, 2003). Although we are not in a position to discuss the details of these proposals, the notion that scales are optionally activated and that they are associated with a focus-sensitive operator fits well with our own results. Focus independently activates alternatives and these alternatives allow the meaning of the scalar term to be sharpened and defined in contrast to the active alternatives.

There are many questions about the processing of scalar implicatures that remain entirely open and in need of investigation. Perhaps most crucial of these is the relation to the processing of polarity items, and differences among individual scalar terms and particular licensing contexts. But the present work offers some support to Chierchia's important conjecture that the processing mechanisms underlying the computation of some scalar implicatures is not just an unstructured reasoning task accomplished by a general

purpose system, but instead is much more connected to the grammar and to the systematic logical properties of particular contexts.

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