Title
Do Scalar Implicatures Prime? The Case of Exclusive ‘or’

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 43(43)

ISSN
1069-7977

Authors
Husband, Edward Matthew
Patson, Nikole

Publication Date
2021

Peer reviewed

Do Scalar Implicatures Prime? The Case of Exclusive 'or'

E. Matthew Husband (matthew.husband@ling-phil.ox.ac.uk)
Faculty of Linguistics, Philology and Phonetics, Clarendon Institute, Walton St.
Oxford, OX1 2HG

Nikole Patson (patson.3@osu.edu)
Department of Psychology, MR 170D Morrill Hall, 1465 Mt Vernon Ave.
Marion, OH 43302

Abstract

Understanding language requires comprehenders to understand not only what speakers say, but what speakers might imply. Scalar items (e.g. *some*, numerals) often invite comprehenders to compute scalar implicatures, pragmatically strengthening the semantic meaning of scalar items by negating their stronger alternatives. Recent priming evidence suggests that scalar implicatures may share underlying mechanisms, priming both within and between implicature types. We report two experiments designed to extend these finding to *or*, which has an inclusive meaning that can be strengthened to an exclusive meaning, potentially via scalar implicature. Experiment 1 investigated *or* alongside *some* and numerals, holding the number of visual symbols constant. Experiment 2 reduced the visual complexity of Experiment 1. Both experiments found robust within-category priming, but failed to fully replicate or extend between-category priming effects. We discuss implications of these results with respect to visual manipulations and the potential fragility of priming across different categories of scalar implicature.

Keywords: exclusive or; priming; scalar implicatures

Introduction

Understanding language requires comprehenders to not only recover the compositional meaning of an utterance but also make inferences about a speaker's intended meaning.

Consider the following conversation:

Speaker A:	Have you finished grading your exams?
Speaker B:	I've finished some of them.
Speaker A:	You have to finish them in two days or you'll be fired!
Speaker B:	Oh no! I thought I still had a whole week. I'm going to be up all night!

This (unfortunately) familiar conversation is easy to understand, but doing so relies on the speakers drawing certain inferences in addition to all of the other language processes going on. When Speaker B says "*I've finished some of them*", the only way the rest of the conversation makes sense is if Speaker A interpreted the utterance to mean that Speaker B has not 'finished grading all of the exams'. Similarly, when Speaker A says that the exams have to be finished "*in two days or you'll be fired*", Speaker B recognizes that Speaker A intends this to mean 'in exactly two days' with the consequences being 'either finish them in that time or will be fired', but not both, hence Speaker B's panic about not having seven more days for grading.

These types of inferences are known as scalar implicatures and have been extensively studied in linguistic theory (Grice, 1957; Levinson, 1983, 2000), psycholinguistics (e.g., Bott & Chemla, 2016; Bott & Noveck, 2004; Chierchia et al., 2001; De Neys and Schaeken 2007; Grodner, et al., 2010; Huang & Snedeker 2009; Noveck, 2001; Noveck & Posada 2003; Papafragou & Musolino, 2003; Politzer-Ahles & Husband, 2018), and the ERP literature (e.g., Hunt et al., 2013; Spychalska et al., 2016).

There are multiple theories as to how scalar implicatures are computed (Sauerland, 2012). Despite their differences, the majority of theories posit that the processing of scalar implicatures involves the activation of alternatives and strengthening of the basic semantic meaning by the negation of those alternatives. Consider the sentence in (1): When comprehenders compute the semantic content in the sentence (1), they also activate its truth-conditionally stronger scalar alternatives (3). Given that the speaker of (1) could have said (3) but did not, the comprehender can infer that the speaker thinks that (3) is not true. This licenses a scalar implication to negate the stronger alternatives (4) and derive the pragmatically strengthened/enriched meaning in (5).

(1)	Sentence:	Some of the apples are red.
(2)	Semantic content:	Some and possibly all of the apples are red.
(3)	Alternative:	All of the apples are red.
(4)	Scalar implicature:	Not all of the apples are red.
(5)	Strengthened meaning:	Some but not all of the apples are red.

Recently Bott and Chemla (2016) used a sentence-picture matching priming paradigm to demonstrate that some types of scalar implicatures share underlying mechanisms. On each prime trial in these experiments, participants were given a sentence containing a scalar term (e.g. "some", "four") such as, *Four of the pictures are letters*. Two pictures appeared below the sentence. Participants were instructed to select which of the two pictures best matched the sentence. On prime trials, only one of the two pictures was compatible with the sentence. For weak prime trials, the compatible picture was consistent with the weak (semantic) meaning of the sentence (e.g., five of the pictures were letters, consistent

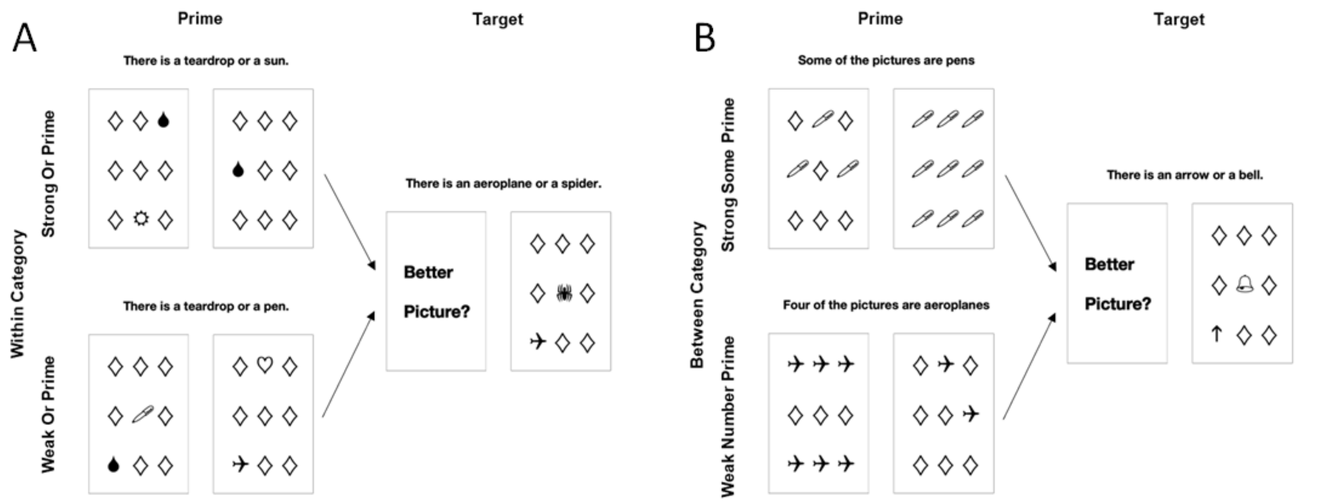

Figure 1: Example stimuli for Experiment 1. A) An example of a within category prime and target trials using the scalar item "or". The strong prime is on top and weak prime on bottom. B) An example of a between category prime and target trial. The strong prime on top illustrates a "some" item, and the weak prime on bottom illustrates a numeral item ("four").

with the "at least four" reading of the sentence). For strong prime trials, the compatible picture was consistent with the strong (pragmatic) meaning of the sentence (e.g., exactly four letters appeared on the screen). Following two prime trials, participants were given an ambiguous scenario which required participants to choose between a picture consistent with a weak interpretation or a "Better Picture". Choosing "Better Picture" on these target trials indicated that participants were entertaining a strong interpretation of the sentence. Consistent with the priming literature, participants were more likely to select a weak interpretation if they had seen two weak prime trials and a strong interpretation (via "Better Picture") if they had just seen two strong prime trials. More surprisingly, this priming occurred not only within the same type of implicature, but also between most types of implicatures. These results showed that pragmatically strengthened interpretations can be primed, similar to other lexical and structural representations. Importantly, this paradigm also offers a way to test whether different implicate types share mechanisms.

Bott and Chemla reported that three implicature types share processing mechanisms: *some*, numerals, and ad hoc implicatures. The current study was designed to extend these effects to the case of exclusive *or*. Consider the sentence in (6).

(6) John ate cake or ice cream.
(7) John did not eat cake or ice cream.

This sentence is typically understood to mean that John ate either cake or ice cream, but importantly did not eat both, a (strong) exclusive reading of *or*. However, under negation, as in (7), *or* is typically interpreted as having a weak inclusive meaning. The comprehender likely interprets the sentence to mean that John didn't eat cake *and* didn't eat ice cream. Like the pragmatically strengthened meanings of *some* and numerals, exclusive *or* shows delays in processing (Schwarz et al., 2008) and emerges later in acquisition (Chierchia et al., 2001), suggesting that it may be derived by scalar implicature (Chevallier, et al., 2008). However, alternative views argue that free choice *or* is not derived by implicature (Chemla & Bott, 2014). This leaves open the question of whether exclusive *or* shares the same processes found in *some* and numerals.

To investigate whether exclusive *or* is derived by similar processes found in *some* and numerals, we adapted Bott and Chemla's (2016) priming paradigm with *some* and numeral *four* and attempted to extend the effect to *or* in two experiments. These experiments addressed whether the exclusive interpretation of *or* 1) can prime itself, 2) can be primed by other types of implicature, and 3) can prime other types of implicature.

In addition to these research questions, we also considered the effect that visual complexity might have in the Bott and Chemla priming paradigm. The pictures used in Bott and Chemla (2016) included only symbols that were relevant to the sentence. For example, for a sentence like There are four circles, the image used in their study only contained circles, it did not contain any distractor items. Furthermore, the number of symbols on the screen varied across prime types. Pictures for "some" always included 3 (strong) or 9 (weak) symbols, and pictures for numeral "four" always included 2 (false), 4 (strong), or 6 (weak) symbols. Therefore, the picture with the larger number was always related to the weak interpretation across these two types of implicature. Therefore, participants may have been primed to select the picture with a large number of symbols. To rule out this alternative explanation for the priming effect, we held the number of symbols constant in Experiment 1. Keeping the

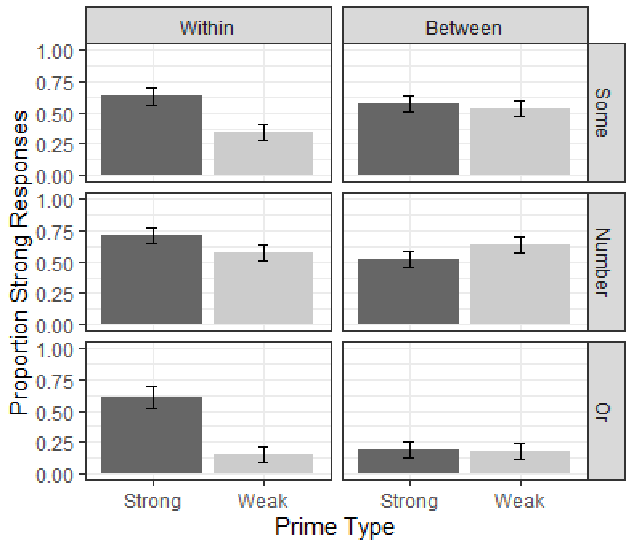

Figure 2: Results from Experiment 1. Priming is shown by the difference between the strong and weak bars. Between-category priming is pooled across primes (e.g. Between Or included both Some → Or and Number → Or primes).

number of symbols constant also increased the visual complexity as it required that we included distractor symbols.

Experiment 1

The goal of Experiment 1 was to extend the findings from Bott and Chemla to exclusive *or* while controlling visual complexity. Experiment 1 used the same design and procedure as Bott and Chemla. The stimuli used in Experiment 1 were similar to Bott and Chemla's, except that the pictures used in this study all contained nine symbols, whereas numbers of symbols in Bott and Chemla's pictures varied by condition. This change was made to keep the stimuli visually consistent and rule out a potential alternative explanation for Bott and Chemla's findings.

Methods

Participants 132 participants were drawn from Prolific (https://www.prolific.co/). Each was paid £3.75 for their participation.

Design and Materials Following Bott and Chemla (2016), 216 items (72 per category) were constructed with two within-category prime types (strong vs. weak; Figure 1A) and four between-category prime types (strong vs. weak between the other 2 categories; Figure 1B) for 6 prime-target combinations per implicature type (12 observations per condition). There were three implicature types: *some*, number, and *or*. 36 filler trials were also included (12 per category). On target trials, one of the two pictures was 'covered' by the phrase "Better Picture" while the other was only consistent with the basic weak semantic meaning. Choosing "Better Picture" on these target trials indicates that participants had a pragmatically strong interpretation in mind. Targets were preceded by either two strong primes, which paired a picture consistent with a pragmatically strengthened meaning with a picture consistent with the basic weak semantic meaning, or two weak primes, which paired a picture inconsistent with the basic semantic meaning with a picture consistent with a semantically weak meaning. Both prime trials were drawn from the same category.

Unlike Bott and Chemla, all pictures included nine total symbols. Relevant symbols were randomly assigned to 3-by-3 grid and any remaining spaces were filled with a filler symbol. This required participants to visually identify the symbols to do the task accurately on prime and target trials. See Figure 1 for examples of the stimuli.

Table 1: Results of the mixed effects ANOVA for Experiment 1.

	F	df_M	df_R	p
Prime Category	6.427	1	126	.013
Prime Strength	104.603	1	252	<.001
Target Type	328.785	2	906	<.001
Category × Strength	104.258	1	252	<.001
Category × Target Type	20.763	2	906	<.001
Strength × Target Type	21.917	2	906	<.001
Category × Strength × Target Type	5.197	2	906	.006

Table 2: Contrast between strong and weak primes by Category and Target Type for Experiment 1 (df = 255 for all comparisons).

Target Type	Prime Category	Est	SE	t	p
Number	Between	-0.113	0.030	-3.773	<.001
	Within	0.136	0.031	4.384	<.001
Some	Between	0.042	0.030	1.449	.149
	Within	0.287	0.031	9.322	<.001
Or	Between	0.018	0.030	0.603	.547
	Within	0.462	0.029	10.572	<.001

Procedure Participants were instructed to select the picture that "best matched the sentence" that they were shown. On each trial, participants were presented with two pictures and a sentence and asked to choose which picture best matched the sentence.

Participants were shown three practice examples using "There is a…" and a pair of pictures pitting single relevant symbols against one another (e.g. "There is a spider" with a picture containing a spider or a picture containing a teardrop) or a pair of pictures with a single relevant symbol against "Better Picture". Responses and response times were collected by button press indicating whether the left or right picture best matched the sentence.

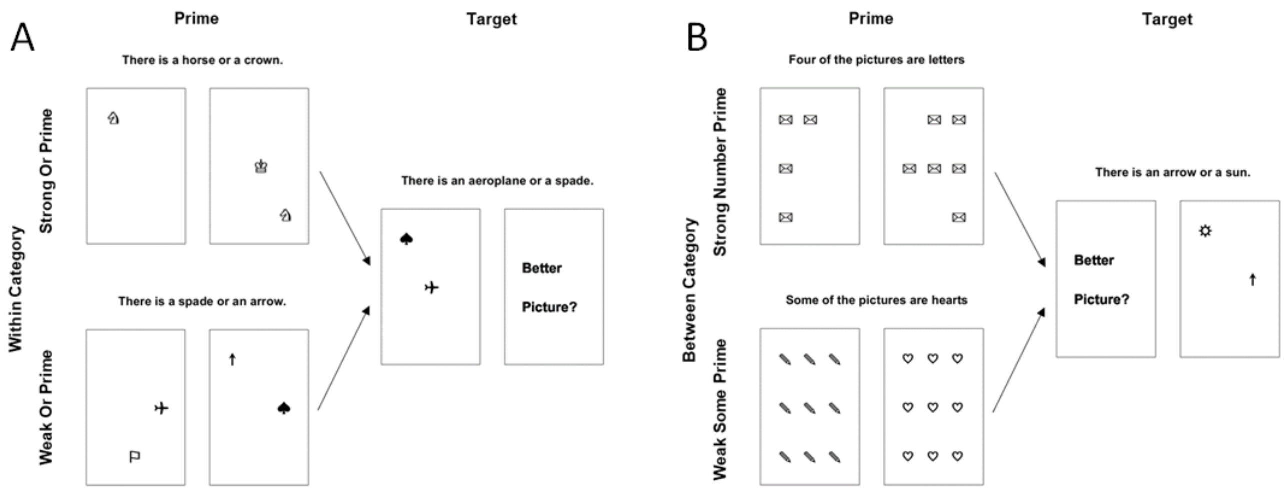

Figure 3: Example stimuli for Experiment 2. A) An example of a within category prime and target trials using the scalar item "or". The strong prime is on top and weak prime on bottom. B) An example of a between category prime and target trial. The strong prime on top illustrates a numeral ("four") item, and the weak prime on bottom illustrates a "some" item.

Predictions If pragmatic strengthening can be primed, then at least within category, strong primes are predicted to increase the rate of "Better Picture" responses compared to weak primes. More importantly, if the mechanism deriving pragmatic strengthening of *some*, *four*, and *or* is shared, then strong primes should also increase the rate of "Better Picture" responses over weak primes between category type.

Results

Only trials where participants responded correctly to the primes were included in the analysis. The results of Experiment 1 are shown in Figure 2. Following Bott and Chemla (2016), our dependent variable was the proportion of strong response on target trials ("Better Picture" responses) and between-category priming was assessed by pooling across different implicature types. For example, between-category priming for *Some* targets pooled the data for *Or* and Number prime trials. We used by-subjects mixed effect ANOVA to compensate for the quasi-complete separation (near-zero proportions) in some of the target conditions which is poorly handled by logit GLME models. A by-subjects mixed effect ANOVA revealed a 3-way interaction of Prime Category Type, Prime Strength, and Target Category Type ($F(2,906) = 5.197$, $p = .006$; see Table 1). Paired contrasts between strong and weak prime conditions across Prime Category and Target Type revealed a higher proportion of strong responses when primed with strong relative to weak primes for within-category targets (*Some*: $t = 9.374$, $p < .001$; Number: $t = 4.407$, $p < .001$; *Or*: $t = 10.277$, $p < .001$). Between-category targets, however, either failed to demonstrate priming (*Some*: $t = 1.237$, $p = .217$; *Or*: $t = 0.608$, $p = .544$) or revealed a reversal (Number: $t = -3.843$, $p < .001$), contrary to prediction.

The failure to observe priming was not the result of pooling the between-category prime types together. Disaggregating the between-category primes with follow up comparisons for each Target Category revealed a marginally significant effect *Some* target priming by Number primes ($t = 1.720$, $p = .088$) and significant priming with *Or* primes ($t = 2.841$, $p = .005$). *Or* targets showed no effect from Number primes ($t = 1.089$, $p = .278$) or *Some* primes ($t = 1.444$, $p = .151$). Number targets showed no effect from *Or* primes ($t = 0.145$, $p = .884$) and significant inhibition from *Some* primes ($t = -5.562$, $p < .001$).

Discussion

The results of Experiment 1 replicated the within-category priming effect for scalar implicatures and extended it to the *or* implicature. However, the results did not show a between-category priming effect across category types. While the numerals showed a between-category effect, it went in the opposite direction, indicating inhibition rather than facilitation of the strong reading when primed for a strong reading by *or* or *some*.

Perhaps including nine symbols on each picture, which required participants to clearly identify the symbols, blocked priming based on visual characteristics between categories, such as proportion of symbols present in one picture over the other. Experiment 2 explores this possibility by removing filler symbols from the picture stimuli.

Experiment 2

Experiment 1 did not replicate the between category effect reported by Bott and Chemla (2016). One potential explanation is that our stimuli were visually different than those in Bott and Chelma: All of our pictures had exactly nine symbols on them while Bott and Chemla's had various numbers. The addition of filler symbols forced participants to identify the relevant symbols before verifying which picture best matched the sentence. Experiment 2 was designed so that

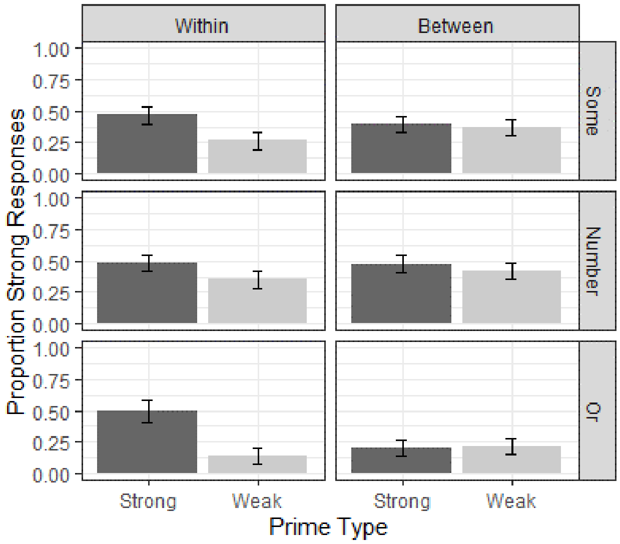

Figure 4: Results from Experiment 2. Priming is shown by the difference between the strong and weak bars. Between-category priming is pooled across primes (e.g. Between Or included both Some → Or and Number → Or primes).

our stimuli were more similar to Bott and Chemla's to test whether this would allow us to replicate the between category priming effect with reduced visual complexity.

Methods

Participants 132 participants who did not participate in Experiment 1 were recruited from Prolific. Each was paid £3.75 for their participation.

Design and Materials 216 items from Experiment 1 were adapted for Experiment 2. Filler symbols were removed, so that the pictures varied in the number of symbols, similar to Bott and Chemla (2016), though symbols were still randomly assigned to 3-by-3 grid. See Figure 3 for examples of the stimuli. All other aspects of the design remained the same as Experiment 1.

Procedure Same as Experiment 1.

Predictions If the visual complexity in Experiment 1 affected priming, then removal of filler symbols may reveal the between-category priming effect, with strong primes increasing the rate of "Better Picture" responses over weak primes between category type.

Results

The results of Experiment 2 are shown in Figure 4. A by-subjects mixed effect ANOVA revealed a 3-way interaction of Prime Category Type, Prime Strength, and Target Category Type ($F(2,914) = 11.490$, $p < .001$; see Table 1). Paired contrasts between strong and weak prime conditions across Prime Category and Target Type revealed a higher proportion of strong responses when primed with strong relative to weak primes for within-category targets (*Some*: $t = 6.723$, $p < .001$; Number: $t = 4.296$, $p < .001$; Or: $t = 9.096$, $p < .001$). Between-category targets demonstrated priming only for Number ($t = 2.013$, $p = .045$). Other between-category targets failed to demonstrate priming (*Some*: $t = 0.971$, $p = .332$; *Or*: $t = -0.541$, $p = .589$).

Table 3: Results of the mixed effects ANOVA for Experiment 2.

	F	df_M	df_R	p
Prime Category	0.702	1	127	.404
Prime Strength	84.913	1	254	<.001
Target Type	104.252	2	914	<.001
Category × Strength	51.097	1	254	<.001
Category × Target Type	5.157	2	914	.006
Strength × Target Type	1.209	2	914	.299
Category × Strength × Target Type	11.490	2	914	<.001

Table 4: Contrast between strong and weak primes by Category and Target Type for Experiment 2 ($df = 254$ for all comparisons).

Target Type	Prime Category	*Est*	*SE*	*t*	*p*
Number	Between	0.056	0.028	2.013	.045
	Within	0.128	0.030	4.296	<.001
Some	Between	0.027	0.028	0.971	.332
	Within	0.203	0.030	6.723	<.001
Or	Between	-0.016	0.029	-0.541	.589
	Within	0.362	0.040	9.096	<.001

The failure to observe priming was not the result of pooling the between-category prime types together. Disaggregating the between-category primes with follow up comparisons revealed *Some* targets showed no priming from Number primes (t = 0.232, p = .817) but was primed by *Or* primes (t = 3.372, p = .001). *Or* targets showed inhibition with Number primes (t = -2.532, p = .013) and no priming from *Some* primes (t = 1.641, p = .103). Only Number targets showed consistent priming from both *Or* primes (t = 2.382, p = .019) and *Some* primes (t = 2.402, p = .018).

Discussion

The results of Experiment 2 are comparable with those found in Experiment 1. Again, the experiment found a within-category priming effect across all implicature types. However, the data did not reveal a between-category priming effect for *some* and *or*. Unlike Experiment 1, numerals did show a between-category priming effect similar to Bott and Chemla (2016).

General Discussion

The data in our experiments partially replicate Bott and Chemla (2016). Both experiments showed within-category priming for pragmatically strengthened meanings. Importantly, these experiments extended this result to (exclusive) *or*. These data add to the existing evidence demonstrating that pragmatically enriched sentence meaning can prime across trials.

However, we did not find evidence for priming between categories. Neither *some* nor *or* showed evidence for between-category priming. Numerals, on the other hand, showed both inhibition (Experiment 1) and facilitation (Experiment 2). This suggests that between-category priming may be more fragile than initially thought.

The lack of between-category priming for the exclusive *or* conditions, may suggest there is no single formal mechanism that is involved in computing the implicature involved in exclusive *or*, *some*, and number words. In fact, recent evidence from Meyer and Feiman (2021) using a similar priming paradigm found that free choice disjunctions (e.g., John can take a red umbrella or a green umbrella, which implies John can take one or the other, not both) were not primed by *some* and number words. They interpreted this as evidence that Free choice disjunction does not share mechanisms with some and number words. An important difference between our data and the data reported by Meyer and Feiman is that their data showed between-category priming between *some* and number words. Given our lack of between-category priming for these conditions, it is impossible to make strong claims about the mechanisms involved in exclusive *or* based on our data.

One possible explanation for the lack of between-category priming may be due to visual properties of our stimuli. In Experiment 1, all of the pictures in our trials contained nine symbols, requiring participants to identify the symbols before making their judgment. This differed from Bott and Chemla (2016) whose stimuli had various numbers of symbols on them, depending on condition. This added visual complexity may have washed out any between-category priming effects, suggesting that a reduction in visual complexity may have revealed the expected between-category priming effect.

In Experiment 2, we reduced the visual complexity of our stimuli by removing the filler objects, but between-category priming was only found for numerals. It is still possible, however, that our failure to find between-category priming for *some* and *or* was driven by the visual characteristics of our stimuli. Unlike Bott and Chemla (2016), which used simple and consistent visual configurations across trials, the visual configuration of symbols in our stimuli varied across trials in both Experiment 1 and 2. This suggests that the between-category priming effect may be mediated by visual characteristics of the stimuli in this priming paradigm.

Visual differences are known to drive priming effects in visual tasks. In visual search tasks, for example, priming can be driven by the repetition of several visual features, including complex features like stimulus configurations (Chun & Jiang, 1998). In Bott and Chemla (2016), stimulus types appeared in the same simple configuration throughout the experiment. For example, a picture with four diamonds always appeared as two diamonds on top of two other diamonds forming a square shape. Both Experiment 1 and 2 varied the position of the relevant symbols (with Experiment 1 including filler symbols) which disrupted any simple visual configurations. Therefore, it is possible that the between-category priming effect reported in Bott and Chemla may have reflected a perceptual priming effect rather than factors related to scalar implicature. Future research will be required to investigate this issue systematically.

Another possible explanation is that the stimuli used in this experiment were unnatural. Recent work, attempting to replicate Bott and Chemla's (2016) priming effects found that the use of unnatural stimuli can impact priming results (Feiman, Maldonado, & Snedeker, 2020). Similar to the data reported here, Feiman et al. failed to replicate Bott and Chemla's priming effects when they manipulated the visual features of the stimuli used in the experiment. Importantly, Meyer and Feiman (2021) used more naturalistic visual stimuli and found the same between category priming effects reported by Bott and Chemla. Taken together, our data and these previous studies indicate that more work is necessary to understand the role visual features play in these kinds of priming paradigms.

In sum, we find good evidence for priming of pragmatically enriched sentence meanings can prime themselves across trials. Between-category priming, however, appears to be more fragile and may possibly rely on the visual characteristics of the paradigm. This suggests that the evidence for shared mechanisms across different implicature types requires further careful investigation.

References

Bott, L., & Chemla, E. (2016). Shared and distinct mechanisms in deriving linguistic enrichment. *Journal of Memory and Language, 91*, 117-140.

Bott, L., and Noveck, I. (2004). Some utterances are underinformative: the onset and time course of scalar inferences. *Journal of Memory and Language, 51*, 437–457.

Chemla, E. & Bott, L. (2014). Processing inferences at the semantics/pragmatics frontier: Disjunctions and free choice. *Cognition, 130*, 380-396.

Chierchia, G., Crain, S., Guasti, M. T., Gualmini, A., & Meroni, L. (2001). The acquisition of disjunction: Evidence for a grammatical view of scalar implicatures. In *Proceedings of the 25th Boston University Conference on Language Development*, (pp. 157-168).

Chevallier, C., Noveck, I. A., Nazir, T., Bott, L., Lanzetti, V., & Sperber, D. (2008). Making disjunctions exclusive. *The Quarterly Journal of Experimental Psychology, 61*, 1741-1760.

Chun, M. M., & Jiang, Y. (1998). Contextual cueing: Implicit learning and memory of visual context guides spatial attention. *Cognitive Psychology, 36*, 28-71.

Grice, H. P. (1957). Meaning. *The Philosophical Review*, *66*, 377-388.
De Neys, W., & Schaeken, W. (2007). When people are more logical under cognitive load: Dual task impact on scalar implicature. *Experimental Psychology*, *54*, 128-133.
Feiman, R., Maldonado, M., & Snedeker, J. (2020). Priming quantifier scope: Reexamining the evidence against scope inversion. *Glossa: A Journal of General Linguistics, 5(1),* 35.
Grodner, D. J., Klein, N. M., Carbary, K. M., & Tanenhaus, M. K. (2010). "Some," and possibly all, scalar inferences are not delayed: Evidence for immediate pragmatic enrichment. *Cognition*, *116*, 42-55.
Huang, Y. T., & Snedeker, J. (2009a). Online interpretation of scalar quantifiers: Insight into the semantics–pragmatics interface. *Cognitive Psychology*, *58*, 376-415.
Hunt, L., Politzer-Ahles, S., Gibson, L., Minai, U., & Fiorentino, R. (2013). Pragmatic inferences modulate N400 during sentence comprehension: Evidence from picture-sentence verification. *Neuroscience Letters*, *534*, 246-251.
Levinson, S. C. (1983). *Pragmatics*. Cambridge textbooks in linguistics. Cambridge/New York.
Levinson, S. C. (2000). *Presumptive Meanings: The Theory of Generalized Conversational Implicature*. MIT press.
Meyer, M. C., & Feiman, R. (2021). Priming reveals similarities and differences between three purported cases of implicature: Some, number and free choice disjunctions. *Journal of Memory and Language*, *120*, 104206.
Noveck, I. (2001). When children are more logical than adults: Experimental investigations of scalar implicatures. *Cognition*, *78*, 165–188.
Noveck, I., and Posada, A. (2003). Characterizing the time course of an implicature: An evoked potentials study. *Brain and Language*, *85*, 203–210.
Papafragou, A., & Musolino, J. (2003). Scalar implicatures: Experiments at the semantics pragmatics interface. *Cognition*, *86*, 253–282.
Politzer-Ahles, S., & Husband, E. M. (2018). Eye movement evidence for context-sensitive derivation of scalar inferences. *Collabra: Psychology*, *4*, 3.
Schwarz, F., Clifton Jr, C., & Frazier, L. (2007). Strengthening 'or': Effects of focus and downward entailing contexts on scalar implicatures. *University of Massachusetts Occasional Papers in Linguistics*, *33*(1), 9.
Spychalska, M., Kontinen, J., Noveck, I., Reimer, L., & Werning, M. When numbers are not exact: Ambiguity and predicting in the processing of sentences with bare numerals. *Journal of Experimental Psychology: Learning, Memory, and Cognition.* Advance online publication. http://dx.doi.org/10.1037/xlm0000644
Spychalska, M., Kontinen, J., & Werning, M. (2016). Investigating scalar implicatures in truth-value judgement task: evidence from event-related brain potentials. *Language, Cognition, and Neuroscience*, *31*, 817-840.