An investigation of scalars in the antecedents of conditionals
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1. Introduction. We present an experiment investigating the interpretation of conditionals whose antecedents contain a scalar item.[1] At issue was whether these antecedent clauses received a strengthened interpretation consistent with the generation of an embedded scalar implicature. It is accepted that the occurrence of scalar implicatures in this environment is variable (Levinson 2000, Fox, Chierchia and Spector 2011); but to date there has been no systematic investigation of the factors governing this variability, although various suggestions have been made (see Geurts 2009 and Fox et al. 2011). This experiment explores the proposal in Simons 2010 that the choice of strengthened vs. unstrengthened readings depends on the relative plausibility of each reading. Geurts 2009 further suggests that scalar strengthenings of antecedents involve a process distinct from that responsible for scalar implicatures in unembedded cases. Through the use of a think-aloud protocol, we provide some evidence that this is the case.

2. Methodology. The experiment consisted of a questionnaire presented in an online format but completed in the presence of the experimenter. Each questionnaire item presented an utterance, with the utterance content briefly described (e.g. "The operating manual for a piece of machinery says: *If the Z-plate is warm, turn the S-dial counterclockwise*."). The 15 target items were conditionals whose antecedent contained the scalars *some*, *sometimes* or *warm*. Of these, 2 were examples which, by virtue of their content and context, the experimenters judged to be most plausible under a strengthened reading of the antecedent (S-prompts); 4 were examples which we judged most plausible under an unstrengthened reading (U-prompts); 6 were "neutral" examples for which context and content provided no deciding information (N-prompts, see example above); 3 were coherent only given a strengthened reading of the antecedent, e.g.: *If we give an extension to some of the students, the others will be upset* (TF-prompts). In addition to the target stimuli, participants were presented with 12 control items in which a scalar item occurred in a simple clause with no operators. 12 distractor items were also included. For each utterance presented, participants were asked to respond with *yes*, *no* or *I don't know* to a question of the form "Did the speaker mean S?", where S was an explicit paraphrase of the strengthened reading of the target sentence.

Participants (*n*=26) were also asked to "think aloud" as they decided how to answer the question. Audio recordings were made of the entire session, and the responses were subsequently coded for the following features:

- **H:** Participant references a higher item on the scale (e.g. *all* or *most* rather than *some*, *hot* rather than *warm*, or *always* rather than *sometimes*).
- **L:** Participant references an item lower on the same scale (e.g. *lukewarm* as an alternative to *warm*; *a few* as an alternative to *some*) or an item on the

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[1] This experiment was conducted as part of the primary author's master's thesis, under the supervision of the secondary author and David Danks at Carnegie Mellon University. A link to the full thesis is provided in the references.

corresponding inverse scale (e.g. *cool/cold* as an alternative to *warm*; *never* as an alternative to *sometimes*).

- **A:** Participant references alternate utterance the speaker might have made instead of the utterance given in the prompt.
- **P:** Participant considers possible alternate states of the world (alternate scenarios to that given in the prompt)
- **CS:** Participant explicitly exhibits sensitivity to context, either by making reference to his/her own general world knowledge, embellishing the context beyond what is given in the prompt, and/or saying that he/she lacks necessary contextual information.

3. Primary Results. Participants' judgments on the target items largely accorded with those of the experimenters, supporting the hypothesis that strengthening in antecedents is governed by general considerations of plausibility. TF-prompts and S-prompts were assigned a strengthened reading in the majority of instances (TF = 93.6%, S = 73.1%), far more than U-prompts (33.7%) or N-prompts (37.8%). Embedding had a clear effect on strengthening; e.g. for *some*, in the unembedded (control) prompts 96.2% were strengthened, while in the embedded (target) prompts only 50.8% were strengthened. Table 1 below presents the full distribution of responses.

Table 1		Yes	No	I don't know
Target	*Some*	**50.8%**	**45.4%**	**3.8%**
	Sometimes	**64.6%**	**33.1%**	**2.3%**
	Warm	**42.3%**	**48.5%**	**9.2%**
Control	*Some*	**96.2%**	**1.9%**	**1.9%**
	Sometimes	**91.3%**	**6.7%**	**1.9%**
	Warm	**35.6%**	**58.7%**	**5.8%**

The think-alouds revealed a difference in reasoning about scalars in antecedents vs. simple sentences. In reasoning about simple sentences, participants showed a reasonably strong tendency (41.7% of responses) to make reference to an alternate utterance containing a higher item in the scale (coded as **H&A**), in line with Gricean reasoning. An example of this reasoning is shown below:

Example 1: H&A responses

35. Jane has a small flock of chickens on her farm. One morning she said to her husband:

"Some of the chickens laid eggs this morning."

Does Jane mean:

Some but not all of chickens laid eggs this morning.

- I'm going to say yes, because if all of them had she would have said that. (subject 101)
- Yes. She would say all the chickens laid the eggs if that's what she wanted to say. (subject 109)

In contrast, when interpreting scalars in antecedents, only 10.8% of responses made reference to an alternative utterance. Instead, participants tended to consider an alternate

situation (coded as **H&P**). **H&P** reasoning was identified in 36.9% of responses to conditional items, but in only 4.2% of responses to control items. As an example of **H&P** reasoning, consider:

Example 2: H&P response

> 39. Bobby wants his mother to read him a story. His mother says:
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> "If you pick up some of your toys, then I will read you a story."
>
> Does his mother mean:
>
> If you pick up some but not all of your toys, then I will read you a story.

- I will say "no," because his mother would probably be ecstatic and read him several stories if he picked up all of his toys, and what she's really saying is *if you pick up at least some of them [the toys]*. (subject 101)

The distribution of **H&A** vs. **H&P** reasoning is shown in Table 2 below:

Table 2	H&A	H&P
Target	10.8%	36.9%
Control	41.7%	4.2%

As shown by the example above, H&P reasoning took the form of evaluating whether the situation described by the consequent of the conditional would plausibly continue to hold in an alternate situation; specifically, the situation corresponding to the one *excluded* on the strengthened interpretation of the antecedent. If this was the case, then the strengthened reading of the conditional was typically rejected. While **H&A** reasoning in control items reliably led to a strengthened interpretation (100% of the responses that exhibited this reasoning in the control prompts were given a strengthened reading), this was not the case for the H&P reasoning in the target items: amongst the responses that exhibited this reasoning in the target prompts, 39.1% received a strengthened reading and 56.4% received an unstrengthened reading. An example of this variation is given below:

Example 3: Variation in Responses to Target Prompts

> 18. A professor and his TA are having a meeting. The professor says:
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> "If some of the students fail the exam, then I will give an extra credit assignment."
>
> Does the professor mean:
>
> If some but not all of his students fail the exam, then I will give an extra credit assignment.

- Yes, 'cause … maybe not. Okay, so, if some of them [fail the exam], you'll give extra credit, but if <u>all</u> of them … he might do something else. Okay, so yeah, it is saying the same thing. (subject 102)
- I think that if all of the students failed then he would also give an extra credit assignment, so I'll disagree. If *some*, or *all* – it's the same idea here. (subject 105)

4. Additional Results. Participants' responses to the control prompts revealed an unexpected variation in the behavior of the various scalars under investigation. We discovered that *warm* is significantly less robust than *some* or *sometimes*. Control prompts with *some* or *sometimes* were strengthened over 90% of the time, whereas only

35.6% of the control prompts with *warm* received a strengthened interpretation. *Warm* turned out to be susceptible to a number of different contextual factors, the most striking feature of which was the salience of *cold* or *cool*. Subjects frequently referred to *cold* or *cool* in response to items containing the scalar *warm* (**L** responses occurred in 43.8% of the control prompts containing *warm* and in 33.3% of the target prompts containing *warm*), whereas they rarely referred to *none* or *never* in reference to *some* or *sometimes* (range: 8.3-0%, depending on the type of prompt). *Warm* was also seen to be sensitive to a variety of other unexpected contextual factors. One of the unexpected factors was the speaker's inability to guarantee that *warm* will not become *hot*. The idea seemed to be that because the speaker cannot guarantee that the temperature will not go from warm to hot, the speaker cannot <u>mean</u> *warm but not hot*. Subjects were also influenced in one prompt by the mention of the fact that a sweater was someone's favorite ("Cindy is putting on her favorite blue sweater. She says to her mother: *This sweater keeps me warm on winter days*."). The idea seemed to be that the sweater wouldn't be Cindy's favorite if it made her hot, so Cindy must mean that the sweater keeps her *warm but not hot* on winter days.

5. Conclusions. While the experiment described here is rather unsophisticated, it produces results which indicate that further work in the directions suggested here are worthwhile. For the study of embedded vs. unembedded scalar inferences, the experiment suggests that the type of pragmatic reasoning involved in the two cases may indeed be different. Further work to investigate this question, not only with conditionals but with other embedding constructions, is motivated. For the study of scalar inferences in general, the experiment suggests that the narrow focus on the behavior of scalar quantifiers and of *or* (vs. *and*) may be skewing theoretical discussion: our view of the robustness of scalar inferences may change when we take into account a broader range of scalar items. Finally, we hope that this experiment will encourage others in the use of "think-aloud" protocols in pragmatic experimentation. As shown here, this protocol can provide new insights into processes of pragmatic reasoning.

References

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