Early interpretation of scalar quantifiers in context: Mousetracking evidence for the role of social reasoning

Key words: Disfluency, Scalar quantifiers, Mouse-tracking

Wei Li[1], Hannah Rohde[2], Martin Corley[1]
[1] *Psychology, PPLS, University of Edinburgh, UK*
[2] *LEL, PPLS, University of Edinburgh, UK*

The scalar quantifier *some* is ambiguous between a literal meaning ("some and possibly all") and a pragmatically strengthened meaning ("some but not all", known as scalar implicature). Listener's interpretations of *some* have been shown to be influenced by context (Breheny, Ferguson,& Katsos, 2013; Breheny, Katsos, & Williams, 2006; Panizza, Chierchia, & Clifton, 2009; Politzer-Ahles and Husband, 2018). For example, Loy et al. (2019) investigated how the interpretation of *some* depends on rapid reasoning about the speaker's manner of speech. Loy et al. used a context in which interpreting *some* literally (larger some-and-possibly-all value) is likely to be socially undesirable ("I ate some oreos") and showed that where speakers were disfluent ("I ate, uh, some oreos"), listeners were more likely to make an early commitment to a literal interpretation than when the speakers were fluent.

Here, we vary the social context, in order to test whether listeners in Loy et al.'s (2019) experiment were reasoning socially (i.e., using social information in their interpretation of *some* by taking into account the context that eating more oreos is socially undesirable), rather than simply associating disfluency with a literal interpretation of *some*. In an online mousetracking experiment, we use the context of a job interview, in which, critically, the literal meaning ("I got some and in fact all 'A's for my psychology courses") is expected to be the one that a speaker would likely prefer to convey, while the pragmatic implicature meaning ("I got some, but in fact fewer 'A's") is the one that the speaker would want to hide. Once again, we manipulate whether the speakers are disfluent ("I got (uh) some 'A's"). If listeners are reasoning socially, we expect them to interpret disfluency as indexing the less desirable (here, pragmatic) interpretation of *some*.

We recorded 150 participants' mouse movements in a web-based task in which we manipulated Disfluency (present vs. absent) within-subjects in a set of 12 target trials. In each target trial, participants saw four images with different numbers of qualifications displayed on the screen, each representing one of four potential interpretations of the meaning of *some* (Fig. 1), and heard an interviewer ask an interviewee about their qualifications (Example 1; other examples asked about, e.g., numbers of languages spoken, with ticks against 1, 2, 4 or 5 out of five national flags). Each session additionally included 24 filler trials, which did not contain *some* or the disfluency 'uh', to reduce the chance that participants noticed the experimental manipulation.

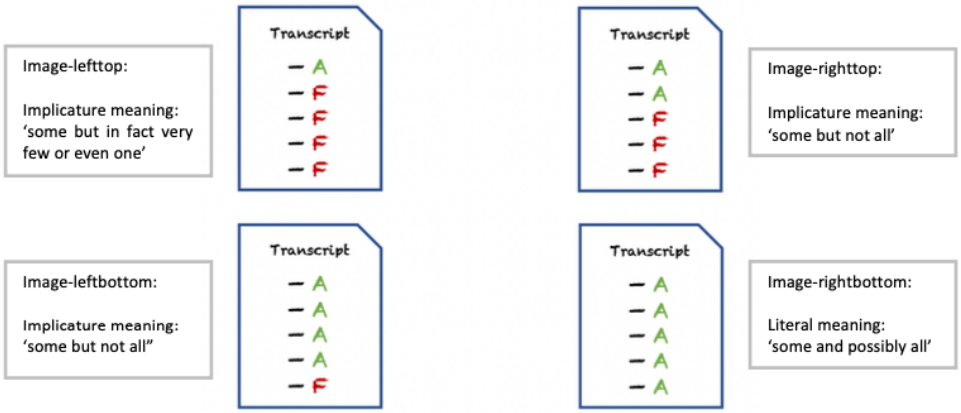

Fig. 1 Specific meanings of *some* each image is expected to represent

Example 1 How many 'A's have you got for your psychology-related courses?
(a) I've got *some* 'A's.
(b) I've got, uh, *some* 'A's.

We measured both the final click results (i.e., which image each participant clicked at the end) as well as the trajectories of participants' mouse movement during each trial.

The total numbers of clicks on each image by condition are shown in Table 1. As predicted under an account in which disfluency can serve as a cue to enable social reasoning rather than simply a cue for a literal interpretation of *some*, participants' responses confirm that the presence of disfluency does indeed bias interpretation in favour of the socially undesirable meaning, but here the meaning is no longer the literal interpretation of *some*: For the disfluent compared to the fluent condition, there were fewer clicks on the two- and four-A images, but more clicks on the one-A image. Clicks on the one-A image were modelled using a mixed-effects logistic regression with the within-participant predictor of manner of delivery (fluent and disfluent), including random intercepts and slopes by participant and trial. Participants were more likely to click on the one-A image following a disfluent utterance compared to a fluent utterance ($\beta = 8.074$, SE = 0.591, $p = <0.001$).

Table 1:
Total number of mouse clicks recorded on each image (one-tick/A, two-tick/A, four-tick/A, or all-tick/A) by manner of delivery (disfluent/fluent)

Condition	One tick/A	Two ticks/As	Four ticks/As	All ticks/As
Disfluent	148	688	45	0
Fluent	67	724	78	1

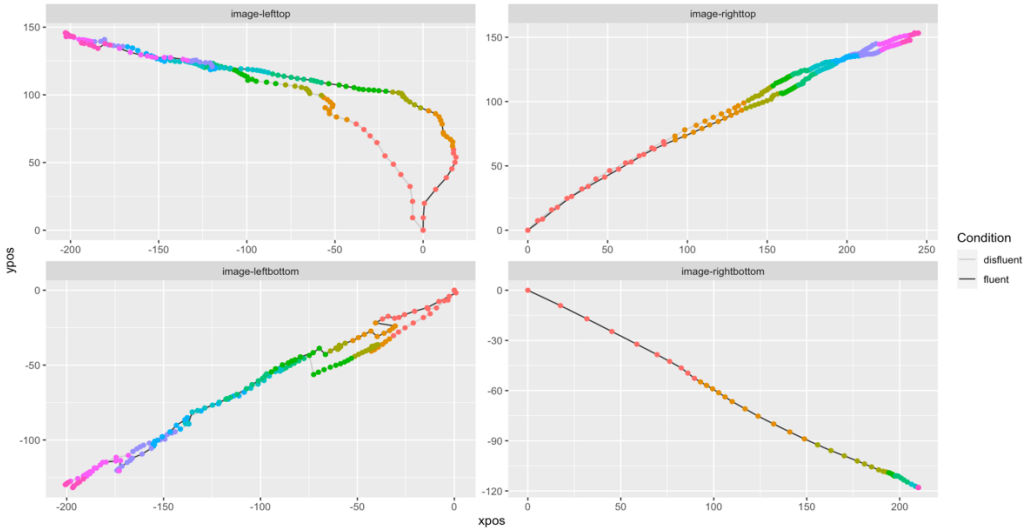

Fig.2 Aggregated mouse trajectories towards four images by condition (disfluent/fluent), and the colours of points (from red points at the centre of the screen to violet in each corner) indicate 10%, 20%, 30%...100% of trial time

Figure 2 shows participants' aggregated mouse trajectories towards each image in each condition (disfluent/fluent). The colours of points (from red points at the centre of the screen to violet in each corner) indicate each 10% of trial time. Only the patterns for mouse movements in which participants eventually click on the one-A image show obvious differences. Participants appear to move faster, and more directly, towards the one-A image in the disfluent condition. In the fluent condition, they show hesitant movements towards other images, taking more of the time before they click to decide to move towards and click the one-A target.

This preliminary exploration of the mouse-tracking leads to two important conclusions. First, in this context (in which it is desirable to have more qualifications), disfluency does bias towards interpretations of *some* which imply smaller numbers (the pragmatic interpretation). In fact, it would appear that the literal meaning of *some* is quite often ignored (in 17% of disfluent trials and 8% of fluent trials), leading instead to an interpretation where *some* implies one. Taken together with the results from Loy et al. (2019), this suggests that listeners take the social context into account when reasoning about scalar quantifiers such as *some*. Second, this reasoning happens very quickly: Where utterances are disfluent, listeners make the decision to select the one-A target (if they are going to) very quickly, and initiate mouse movements appropriately. Where the utterances are fluent, however, they are more hesitant, showing early movements which suggest that the two-A (literal-compatible) interpretation of *some* is initially in contention.

Reference

Breheny, R., Ferguson, H. J., & Katsos, N. (2013). Taking the epistemic step: Toward a model of on-line access to conversational implicatures. *Cognition*, *126*(3), 423-440.

Breheny, R., Katsos, N., & Williams, J. (2006). Are generalised scalar implicatures generated by default? An on-line investigation into the role of context in generating pragmatic inferences. *Cognition*, *100*(3), 434-463.

Loy, J. E., Rohde, H., & Corley, M. (2019). Real-time social reasoning: The effect of disfluency on the meaning of some. *Journal of Cultural Cognitive Science*, *3*(2), 159-173.

Panizza, D., Chierchia, G., & Clifton Jr, C. (2009). On the role of entailment patterns and scalar implicatures in the processing of numerals. *Journal of memory and language*, *61*(4), 503-518.

Politzer-Ahles, S., Husband, E. M., Zwaan, R., & Willems, R. (2018). Eye movement evidence for context-sensitive derivation of scalar inferences. *Collabra: Psychology*, *4*(1).