

Does Implicature Processing Rely on Negation Processing? Examining the Source of the Cost of Scalar Inferences

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Introduction Previous research has demonstrated that Scalar Implicatures (SIs) incur extra cognitive costs [1]: interpreting (1) with an SI, as in (1a), requires more time than interpreting it logically, as in (1b).

(1) *Some cherry trees are blooming.*

1a. SI-based interpretation: *Not all cherry trees are blooming.*

1b. Logical interpretation: *At least some cherry trees are blooming.*

As shown in (1a), utterances with an SI imply negative information. Accordingly, it has been proposed that the delay associated with SIs can be attributed to the difficulty of processing negation, rather than to the inferential process per se [2]. Here, we hypothesize that the processing of utterances with SIs may be equivalent, in terms of cognitive costs and reliance on Executive Functions (EFs), to the processing of explicitly negated utterances.

Method Participants (N = 220; mean age = 33 years) completed an EF task [3] and a sentence-picture verification task (Table 1). Conditions *some*-Implicature and *not-all*-False require participants to reject the same sentence-picture configuration (see Figure 1; 5/5 cards have ants). Similarly, *some*-True and *not-all*-True require participants to accept the same sentence-picture configuration (3/5 cards have turtles). Unlike the other conditions, *some*-True does not require verifying (implied or explicit) negative information.

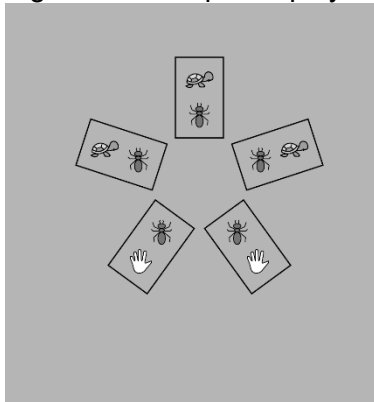
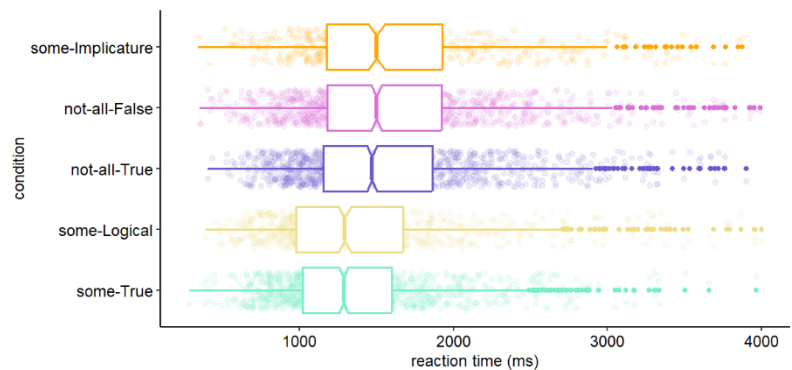
Results Reaction Times (RTs) were significantly shorter in *some*-True compared to all other conditions (Figure 2). No difference emerged between *some*-Implicature (i.e., sentences with *some* implying “not all” via SI generation) and the conditions in which *not all* is explicitly asserted (*not-all*-False and *not-all*-True). Across all conditions, higher inhibition predicted shorter RTs. Lower processing speed was associated with a significant increase in RTs, specifically in the *some*-Implicature condition compared to the *some*-True condition, but neither *not-all* condition differed from *some*-True.

Discussion and Conclusion We found no RT differences between the verification of *some*-sentences with SIs and their explicitly negated counterpart (= *not-all*-False), whereas *some*-sentences without SIs were processed faster than all other conditions. Inhibition did not selectively modulate the speed of SI processing, but processing speed did. Thus, our results suggest that negative information, which is implicit in SIs, is likely to affect the verification of SIs; the delay associated with SIs could therefore largely stem from difficulties with negation. At the same time, the selective effect of processing speed on SIs suggests that SI generation relies on additional mechanisms beyond negation processing.

Table 1

Condition	DP	Implicature	Negation	Example sentence (paired with Fig. 1)
<i>Some</i> -underinformative: = Some-Implicature (if the sentence is rejected) = <i>Some-Logical</i> (if the sentence is accepted) ¹	<i>Some</i>	Yes (when the sentence is rejected)	Implied (when the sentence is rejected)	<i>Some cards have ants</i>
Not-all-False	<i>Not all</i>	No	Explicit	<i>Not all cards have ants</i>
Some-True	<i>Some</i>	No	No	<i>Some cards have turtles</i>
Not-all-True	<i>Not all</i>	No	Explicit	<i>Not all cards have turtles</i>

Figure 1: Example display.

Figure 2: Reaction times by condition (including *some-Logical*, not included in the final analysis).

References

- [1] Bott, Lewis, and Ira A. Noveck. "Some Utterances Are Underinformative: The Onset and Time Course of Scalar Inferences." *Journal of Memory and Language* 51, no. 3 (2004): 437–57. <https://doi.org/10.1016/j.jml.2004.05.006>.
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- [3] Wessel, Jan R. "Prepotent Motor Activity and Inhibitory Control Demands in Different Variants of the Go/No-Go Paradigm." *Psychophysiology* 55, no. 3 (2018): e12871. <https://doi.org/10.1111/psyp.12871>.

¹ Since only the rejection but not the acceptance of *some*-underinformative sentences is predicted to require inferring negated information, trials in which participants accepted *some*-underinformative sentences are included in Figure 2, but were not considered in the final analysis.