The cost of attention in semantic processing

Veena Dwivedi, Hope Magnue, Leslie Rowland & Kaitlin Curtiss

In a recent paper (Dwivedi, 2013), 3 self-paced reading experiments examined the processing of quantifier scope ambiguous (QSA) sentences such as *Every kid climbed a tree*. A new model of language comprehension was proposed, where it was argued that the parser operates in a serial manner but grammatical algorithms are not primary (in contrast to claims by Frazier & Clifton, 1996). Instead, the parser operates in a heuristic first, algorithmic second manner. It is assumed that heuristic processing is a shallow form of perception, whereas algorithmic processing requires higher levels of attention. As such, it is hypothesized that factors contributing to allocation of attention would affect heuristic vs. algorithmic processes. The present experiment used the paradigm as developed in Kurtzman & MacDonald (1993), with a slight change modification to Control unambiguous contexts in order to ensure their referential nature (Kaplan,1978)

	AMBIGUOUS CONTEXT	UNAMBIGUOUS CONTROL
PLURAL CONTINUATION	*Every kid climbed a tree.* ✓ *The trees were in the playground.* (surface scope)	*Every kid climbed those trees* ✓ *The trees were in the playground.*
SINGULAR CONTINUATION	*Every kid climbed a tree.* **??** *The tree was in the playground.* (inverse scope condition)	*Every kid climbed that tree.* ✓ *The tree was in the playground.*

The table above summarizes which condition should be dispreferred on algorithmic grounds: the inverse scope interpretation of QSA sentences. This pattern of results was found (Exp2 in Dwivedi, 2013)) in the question response accuracy of participants who had just read QSA context sentences followed by singular vs. plural continuation sentences. That is, even after having just read the singular continuation sentence *The tree was in the playground, w*hen asked *How many trees were climbed?* ONE SEVERAL, participants performed at chance levels. However, RTs for continuation sentences did not pattern as expected on algorithmic grounds, instead, these showed patterns consistent with lexical-pragmatic biases. This is consistent with Ferreira et al.'s claim that the parser operates using 'good enough' processing strategies. Deep processing of stimuli is not predicted in real-time language comprehension.

The present work seeks to test this claim by investigating whether the addition of an appropriate linguistic 'pre- context' could modulate attention. Perhaps participants do not process QSA sentences deeply because the strong quantifier *every* does not have a context set over which it can be interpreted. At least 30 participants will be run by April; 10 have been run so far. Results reveal a 10% drop in accuracy rates, surprisingly, for the Control conditions, whereas accuracy rates did not change for the Ambiguous conditions. This could be due to the fact that whereas the Ambiguous pre-context sentence merely sets the scene for the upcoming QSA context, *The kids spotted the park on the long walk. Every kid climbed a tree. The tree(s) was/were…* for Control conditions, the pre-contexts had a synonym for the referential direct object NP, such as *The kids spotted the oak(s) on the long walk. Every kid climbed that/those tree(s). The tree(s) was/were…* Thus, when participants had to answer *How many trees were climbed?* they would have undergone what Garrod & Sanford (1994) call the 'resolution' phase of co-reference, which is integration of the NP *trees* in the question. In the Ambiguous condition, no extra integration for the meaning of *trees* is required at the question. Thus, at this early phase of data collection, it

seems that there is a cost in terms of accurately responding to the question *How many trees were climbed?*; where the cost does not have to do with scope computation but instead has to do with the attentional resources required to interpret *trees* in the question itself.

References

Dwivedi, V.D. (2013). Interpreting quantifier scope ambiguity: Evidence of heuristic first, algorithmic second processing. PLoS ONE 8(11): e81461. doi:10.1371/journal.pone.0081461

Ferreira, F. (2003). The misinterpretation of non-canonical sentences. *Cognitive Psychology, 47*, 164-203.

Ferreira, F., & Patson, N. D. (2007). The "good enough" approach to language comprehension. *Language and Linguistics Compass, 1,* 71–83.

Frazier, L, & Clifton, C., Jr. (1996). *Construal*. Cambridge, MA: MIT Press.

Garrod, S., Sanford, A., (1994). Resolving sentences in a discourse context: how discourse representation affects language understanding. In: Gernsbacher, M. (Ed.), *Handbook of Psycholinguistics*. Academic Press, pp. 675–698.

Kaplan, D. (1978). Dthat. In P. Cole (Ed.), *Pragmatics: Syntax and semantics* (pp. 221-243). New York: Academic Press.

Kurtzman H. S., & MacDonald, M. C. (1993). Resolution of quantifier scope ambiguities. *Cognition, 48,* 243-279.

MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. *Psychological Review, 101*, 676-703.