The interaction of semantic information and parsing biases: An A-maze investigation

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This study uses the A-maze task (Boyce et al., 2020) to examine the influence of semantic information on online parsing biases. In the A-maze task, as in all maze task variants (see e.g., Forster et al., 2009), each word in the sentence is presented along with a distractor, and the participant selects the member of the pair that best continues the sentence as quickly and accurately as possible. Boyce et al. (2020) have demonstrated that like other versions of this task, the A-maze produces robust and highly localized indications of incremental processing difficulty. However, the A-maze improves on other versions of this task in that it involves distractors that are automatically generated for each word, which simplifies and systematizes item creation. Crucially, these distractors are generated by a program that selects words that are unlikely (or high in "surprisal") at each point in the sentence. This means that distractor words are sometimes ungrammatical, sometimes semantically unexpected, and sometimes both. In this way, the A-maze essentially forces incremental syntactic ***and*** semantic integration of each word into the developing sentence structure. The present study takes advantage of this task feature to examine the influence of semantic constraints on syntactic parsing biases in sentence types that have yielded somewhat conflicting findings under other online reading paradigms.

The sentence types of interest involved reduced and unreduced relative clauses (RCs) with sentential subjects that were either animate (and good agents for the RC verb) or inanimate (and poor agents/good themes for the RC verb), as in the following examples:

reduced/animate
The defendant examined by the lawyer turned out to be unreliable.
unreduced/animate
The defendant who was examined by the lawyer turned out to be unreliable.
reduced/inanimate
The evidence examined by the lawyer turned out to be unreliable.
unreduced/inanimate
The evidence that was examined by the lawyer turned out to be unreliable.

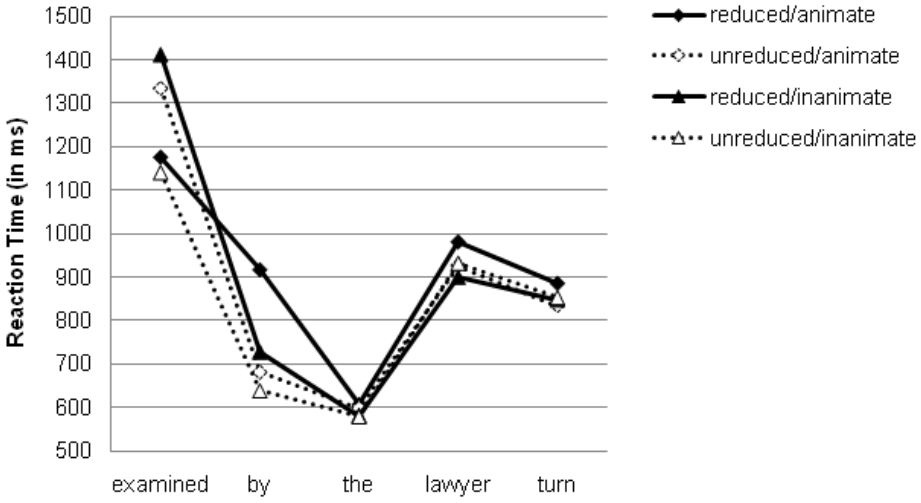
Many studies have indicated a clear preference for a main-clause interpretation of the RC verb (*examined*) in reduced RC sentences. This is evidenced by processing difficulty (compared to unreduced RC controls) at words that disambiguate the structure of the sentence -- i.e., at and after the RC *by*-phrase. In a now-classic eye-tracking study, however, Trueswell et al. (1994) found that these "garden-path effects" were effectively eliminated under first-pass time in sentences with inanimate subjects. This was taken to indicate that semantic information -- in this case, animacy and semantic fit with the verb -- can override structure-based parsing biases. In a set of follow-up experiments, however, Clifton et al. (2003) found comparable garden-path effects in these sentences, regardless of the animacy of the subject. This was particularly the case under regression path duration, a first-pass reading measure that includes regressive fixations.

The present study (*N*=32) attempted to adjudicate between these somewhat conflicting findings using the A-maze task. The results revealed processing difficulty at the RC verb in reduced/inanimate sentences (see the results table and figure below), indicating that readers detected the semantic mismatch between the inanimate NP and the verb at this point in the sentence (!*The evidence examined...*). Despite this clear indexation of semantic information, however, there were robust garden-path effects for both reduced/inanimate and reduced/animate sentences. These effects were found exclusively at the first word of the disambiguating *by*-phrase (*by*) and were particularly large for reduced/animate sentences. Taken together, these results indicate that in an online reading task that appears to force incremental syntactic ***and*** semantic processing, semantic constraints cannot override syntactic parsing biases. Rather, semantic information appears only to facilitate reanalysis when the input is inconsistent with these biases. This study also indicates that the maze task -- and the A-maze task in particular -- provides a useful method for investigating core theoretical questions in sentence processing.

Mean response times (in milliseconds) by condition and region, with standard errors of the mean for repeated measures in parentheses.

	examined	*by*	*the*	*lawyer*	*turned*
The defendant					
reduced/animate	1175 (19)	917 (30)	608 (9)	981 (16)	886 (21)
unreduced/animate	1334 (27)	680 (13)	598 (6)	926 (17)	834 (19)
The evidence					
reduced/inanimate	1411 (34)	727 (15)	581 (8)	899 (19)	847 (23)
unreduced/inanimate	1141 (27)	638 (18)	578 (8)	932 (14)	853 (23)
Animacy	--	***	*	--	--
RC type	--	***	--	--	--
Animacy* RC type	***	**	--	--	--
animate reduced vs. unreduced	**	***	--	--	--
inanimate reduced vs. unreduced	***	***	--	--	--

*** p<.001, ** p<.01, * p<.05, -- not significant



Mean response time (in milliseconds) by region and condition.

References

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