Cloze completions reveal misinterpretation of noncanonical sentences

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Ferreira (2003) demonstrated that in non SVO sentences like passives, comprehenders occasionally assign thematic roles based on plausibility, and not syntax. For example, the question 'Who was the do-er?' after the sentence 'The dog was bitten by the man" elicits incorrect (*dog*) responses. Bader and Meng (2018) have suggested that this tendency is due to the difficulty of retrieval when a question queries a sentence held in memory, rather than to interpretive errors that arise in the course of comprehension. We report two cloze experiments investigating incorrect assignment of thematic roles in non-canonically ordered clauses. The experiments demonstrate a strong tendency in OSV clauses to produce verbs that are expected if the reader has reversed the roles of the two arguments, but are unexpected (Experiment 1) or anomalous (Experiment 2) under the correct role assignment. Thus, misinterpretation of these sentences is evident even when the sentence need not be retrieved from memory for the purpose of a secondary task.

In Experiment 1, 120 MTurk workers provided cloze completions to 66 sentences such as those in Table 1; some items were adapted from Chow et al. 2016. The sentence fragment was displayed in full, and remained on the screen as the subject typed a response. The sentences were designed so that the most frequent response in the "baseline" condition (deemed the *target verb*; e.g. *eaten* in Table 1) would not be a plausible continuation in the other conditions. Cloze probabilities for this word, by condition, are shown in Figure 1. Mixed effects logistic regression revealed that the cloze probability for this word was lower in the reversed and substitution conditions than the baseline condition. However, Figure 2 illustrates the positive relationship, across items, between the cloze probability of this word in the baseline and reversed conditions. Linear regression revealed the baseline cloze value to be a significant predictor of the reversed cloze ($\beta = .29$, $p < .001$, multiple $R^2 = .35$); it was uncorrelated with the substitution cloze ($\beta = .07$, $p = .25$, multiple $R^2 = .023$).

Production of, e.g., *eaten* in response to the reversed conditions of Table 1 does not unequivocally demonstrate mis-assignment of thematic roles; it is possible for a fish to eat a shark. To address this, in Experiment 2 80 MTurk workers provided responses to 55 sentences such as those in Table 2. In these sentences one argument was inanimate, so the target verb (*sharpened*) constituted a selectional restriction violation in the reversed sentences (i.e., a pencil can't sharpen a student). Target cloze values in each condition are shown in Figure 3. Target verb cloze in the reversed and baseline conditions were much higher than in Experiment 1, despite the target verb now being anomalous in the reversed. Figure 4 shows the relationship between cloze of the target in the reversed and baseline conditions, by item. Linear regression revealed that the baseline cloze was a highly significant predictor of the reversed cloze ($\beta = .44$, $p < .001$, multiple $R^2 = .59$).

These results reveal that participants in the cloze task frequently misinterpret the thematic roles of the arguments in these sentence fragments; the slope of the regression line in Figure 4 suggests that this may happen more than 40% of the time. Additional analyses established that this tendency is demonstrated by almost all participants. On the assumption that cloze responses implicitly measure incremental interpretation, the results confirm that non-veridical sentence representations are active during, not just after, the comprehension of non SVO sentences. These results inform our understanding of the phenomenon observed by Chow et al. (2016), where N400 amplitude did not differ for target verbs (*eaten*) in sentences such as the baseline and reversed conditions of Experiment 1. Chow et al. proposed that initial verb predictions in these structures are made without reference to the preceding arguments' specific thematic roles. Our findings suggest that insensitivity to thematic role information is sufficiently robust that even in the cloze task, the thematic roles of pre-verbal arguments in an OSV structure do not strongly constrain responding. We propose that a noisy channel model of comprehension (e.g., Ryskin et al., 2018) may be relevant to the explanation of these findings, as comprehenders may engage in Bayesian inference regarding the intended message.

Table 1: Example Item from Experiment 1

Baseline:	The surfer saw which fish the shark had … ____
Reversed:	The surfer saw which shark the fish had … ____
Substitution:	The surfer saw which fish the sailor had … ____

Table 2: Example Item from Experiment 2

Baseline:	The teacher saw which pencil the student had … ____
Reversed:	The teacher saw which student the pencil had … ____

Figure 1: Experiment 1 Mean Cloze by Condition

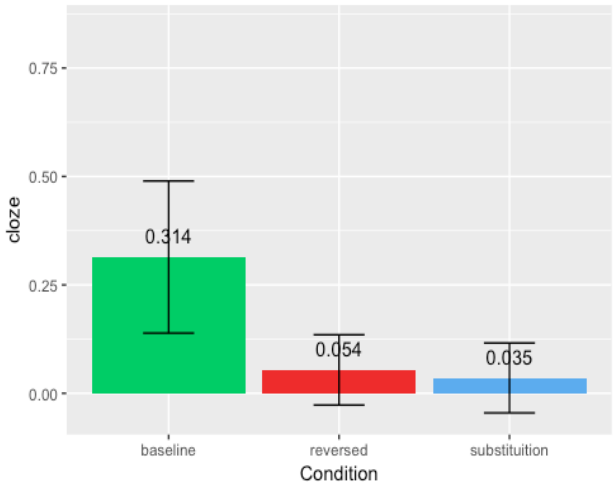


Figure 2: Exp 1 Reversal cloze ~ Baseline cloze

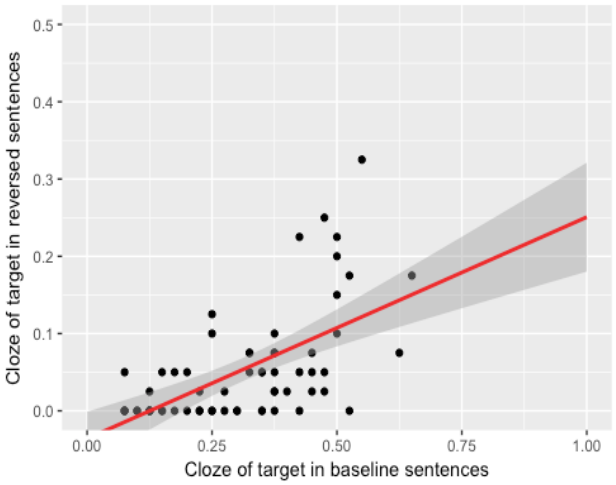


Figure 3: Experiment 2 Mean Cloze by Condition

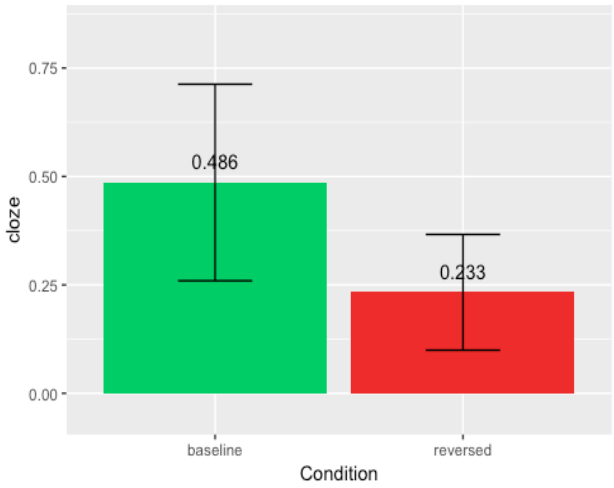
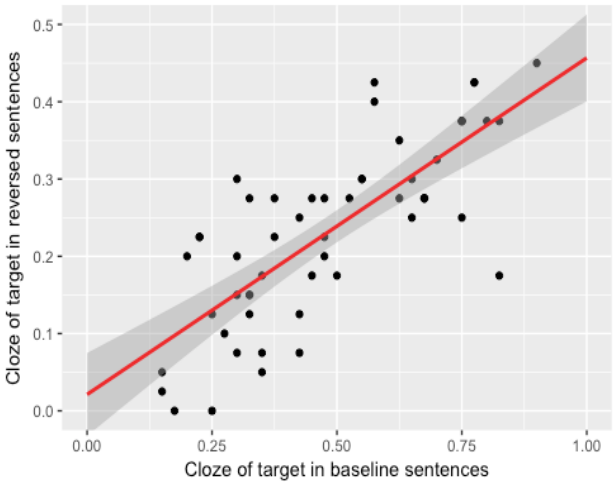


Figure 4: Exp 2 Reversal cloze ~ Baseline cloze



Bader, M., & Meng, M. (2018). The misinterpretation of noncanonical sentences revisited. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *44*, 1286.

Chow, W. Y., Smith, C., Lau, E., & Phillips, C. (2016). A "bag-of-arguments" mechanism for initial verb predictions. *Language, Cognition and Neuroscience*, *31*, 577-596.

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

Ryskin, R., Futrell, R., Kiran, S., & Gibson, E. (2018). Comprehenders model the nature of noise in the environment. *Cognition*, *181*, 141-150.