If Memory Doesn't Serve: Timecourse of Syntactic Forgetting in Ellipsis and Recognition

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The past two decades have seen an increase in the prominence of memory-based theories of syntactic processing[1,2,3]. These theories use domain general memory architectures, which in turn were built on data from recognition/recall memory methods. Yet recognition/recall memory studies consistently find evidence that syntax is forgotten faster (<30s) than other information types, e.g., semantic and lexical information[4]. This is a puzzle for memory-reliant theories, because if syntax rapidly becomes unavailable in short-term memory, it should rapidly become unavailable to guide syntactic processing. Here we test whether the timecourse of forgetting for syntax in a sentence recognition task is similar to forgetting in Verb Phrase Ellipsis (VPE), a grammatical dependency that requires comprehenders to access the syntax of a prior clause.

Memory would be particularly advantageous when processing VPE, (1), because VPE can span across independent clauses but also requires strict matching of the syntactic structure of the antecedent and elided material[5]. Prior work on memory for VPE indicates that, despite the potential advantage, syntax is quickly forgotten[6], but these studies did not compare to recognition/recall to see if there was a *relative* advantage for syntax in ellipsis resolution. If there were, then recognition might not be a reliable indicator of access to syntactic memory.

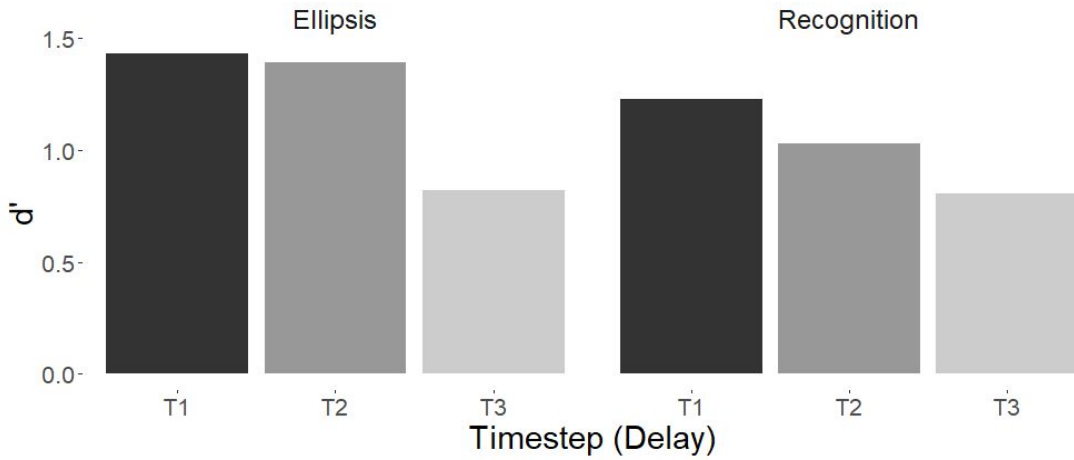
This study directly compared memory decay in ellipsis resolution and recognition over time. Either the active or passive version of (1) was presented in RSVP. On a following screen, participants (N=54) were asked to either verify whether a new sentence matched what they had seen (Recognition task) or if the active or passive version of (2) was a possible continuation (Ellipsis task)(Items=144). In both tasks, if the voice matched the correct response was '*yes*', and if voice mismatched '*no'* was correct. In between (1) and the target task, participants completed 0, 2, or 5 math problems (TIME 1,2,3 respectively) so that we could track forgetting over time. If recognition tasks underestimate available memory for syntax, performance in the ellipsis task will be less impacted by memory decay over time (forgetting) than in recognition.

Results: There was a reliable effect of TIME in Bayesian logistic models (dependent variable: accuracy), indicating that the design was able to measure forgetting as it occurred (95% Credible Interval: -0.52 – -0.32). There was also an overall *yes*-bias, indicated by MIS/MATCH and MIS/MATCHxTASK having very low probability densities around zero (95%CIs: 1.85 – 2.72 & -3.02 – -1.27 respectively). But, TASK was marginal (95%CI: -0.86 – 0.01) and the TIMExTASK posterior probability was centered near 0 (95%CI: -0.10 – 0.28). Fig.1 illustrates this with the decrease over time in *d'* (sensitivity or the ability to discriminate between the correct and incorrect items). The final sensitivity is comparable, demonstrating how quickly syntactic information is lost. However, a model of only T1 had a more reliable posterior for TASK differences (95%CI:-0.71 – -0.05), indicating that at T1 the Ellipsis task had better *initial* sensitivity to syntactic differences. This initial difference leads to a difference in the syntactic forgetting profiles of the two tasks.

The results suggest that syntax does play a privileged role in grammatical processing, but, in line with previous studies, found that the privileged role does not persist into memory. Domain general recognition memory may reasonably model rapid forgetting of syntactic information, but is not necessarily an accurate model of memory access in syntactic processing overall.

(1) a. *Active:* The politician criticized the journalist over the presentation of the new bill.
b. *Passive:* The journalist was criticized by the politician over the presentation of the new bill.

(2) *Ellipsis Task Continuations:*
a. *Active:* The T.V. pundit did too.
b. *Passive:* The T.V. pundit was too.



Bayesian Logistic Model: T1-T3

	$\hat{R}$	N_{Eff}	Mean	SD	2.5%	97.5%
Timestep	1.00	20000	-0.42	0.05	-0.52	-0.32
Match/Mismatch	1.00	15867	2.28	0.22	1.85	2.72
Task	1.00	15326	-0.42	0.22	-0.86	0.01
Timestep x Match/Mismatch	1.00	20000	-0.26	0.10	-0.45	-0.08
Timestep x Task	1.00	20000	0.09	0.10	-0.10	0.28
Match/Mismatch x Task	1.00	14970	-2.14	0.45	-3.02	-1.27
Timestep x Match/Mismatch x Task	1.00	15872	0.33	0.19	-0.05	0.71

Bayesian Logistic Model: T1 Only

	$\hat{R}$	N_{Eff}	Mean	SD	2.5%	97.5%
Match/Mismatch	1.00	15309	2.28	0.17	1.95	2.62
Task	1.00	16104	-0.37	0.17	-0.71	-0.05
Match/Mismatch x Task	1.00	15044	-1.83	0.34	-2.50	-1.18

Tables 1 & 2: Bayesian logistic analysis posterior estimates for all three timesteps (Table1) and Timestep 1 only (Table 2). Dependent measure accuracy.

[1] Lewis & Vasishth, 2005. *CogSci* [2] Van Dyke & McElree, 2006. *JML* [3] Wagers, Lau, Phillips, 2009. *JML* [4] Potter & Lombardi, 1990. *JML* [5]Johnson, 2001. *Blackwell Syntax*. [6] Garnham & Oakhill, 1987. *QJEP*.