Cumulative semantic interference persists over a one-hour delay

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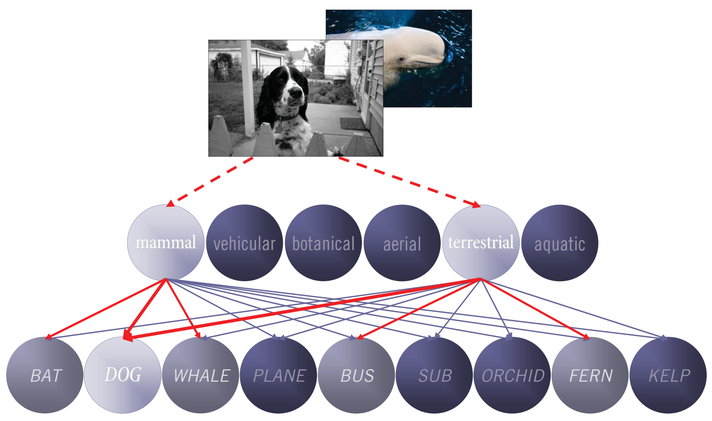
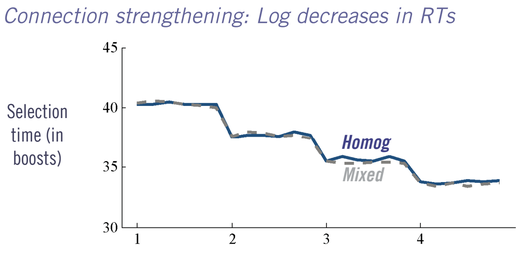
Cumulative semantic interference refers to the fact that retrieving a certain word (*e.g.* DOG) becomes more difficult after retrieving other semantically related words (*e.g.* CAT).

It may result from incremental learning during lexical access
(*e.g.* Howard, Nickels, Coltheart, & Cole-Virtue, 2006; Oppenheim, Dell, & Schwartz, 2010)



In this model, incremental learning during blocked-cyclic picture naming produces persistent repetition priming and semantic interference

Connection strengthening: Log decreases in RTs



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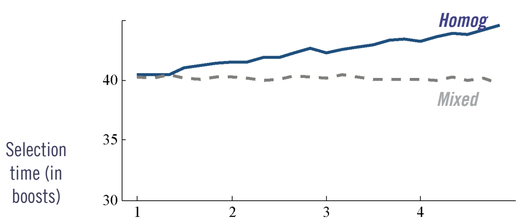
Connection weakening: Log increases in RTs



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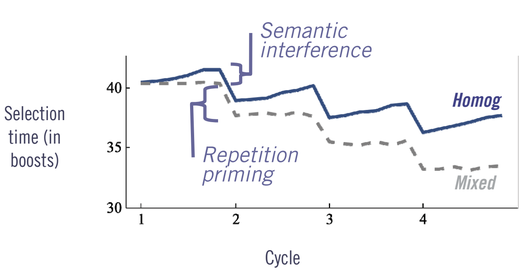
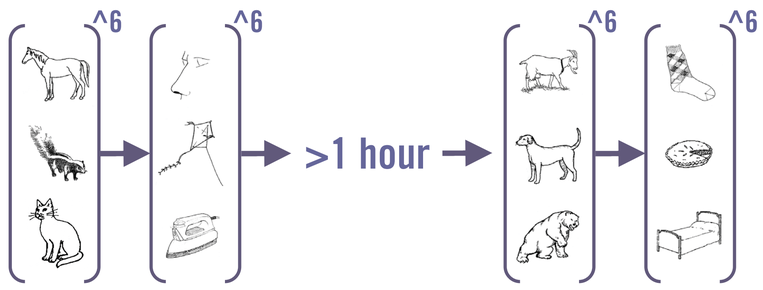


And interference that arises from learning should have some lasting effect, even after a long delay

But how long does cumulative semantic interference actually last in humans?

While implemented models (*e.g.* Howard *et al.*, 2006; Oppenheim *et al.*, 2010) assume that these changes persist indefinitely, cumulative semantic interference has only been demonstrated to persist on the order of seconds (Damian & Als, 2005; Hsiao *et al.*, 2010; Schnur *et al.*, 2006) or minutes (Nickels *et al.*, 2008), and is commonly thought to completely dissipate after only 3-4 minutes (Damian & Als, 2005; Wheeldon & Monsell, 1994). So it is theoretically important to ask, how long does cumulative semantic interference last?

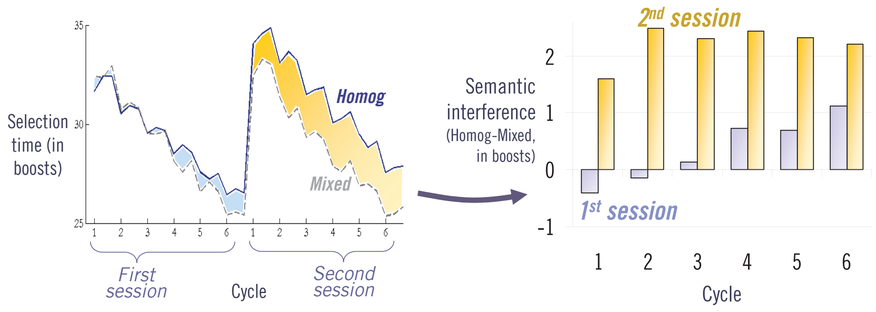
Experiment 1
Blocked cyclic picture naming



72 black-and-white line drawings
(48 pictures per participant)

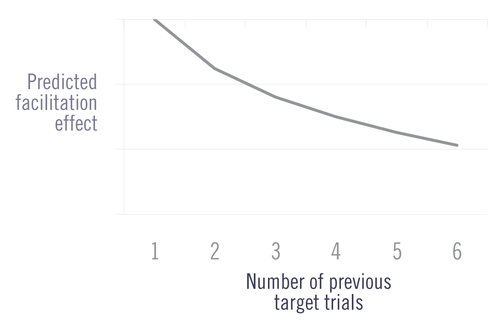
6912 trials
(24 participants * 2 conditions * 2 sessions * 4 blocks * 6 cycles * 3 pictures)

Model prediction for a persistent interference effect[1]

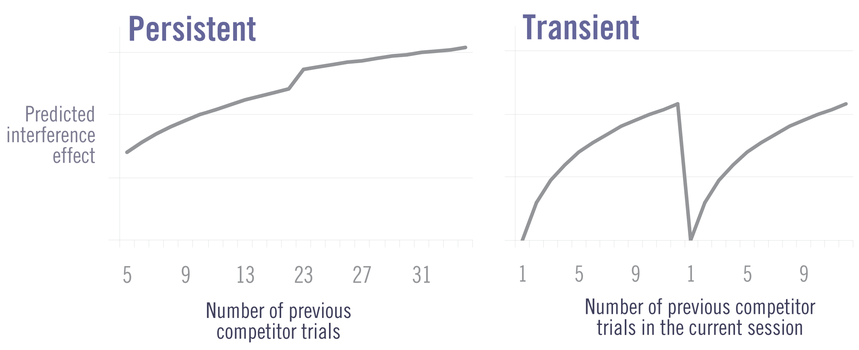


A statistical approximation of the network model[2]

- A logarithmic function for repetition priming

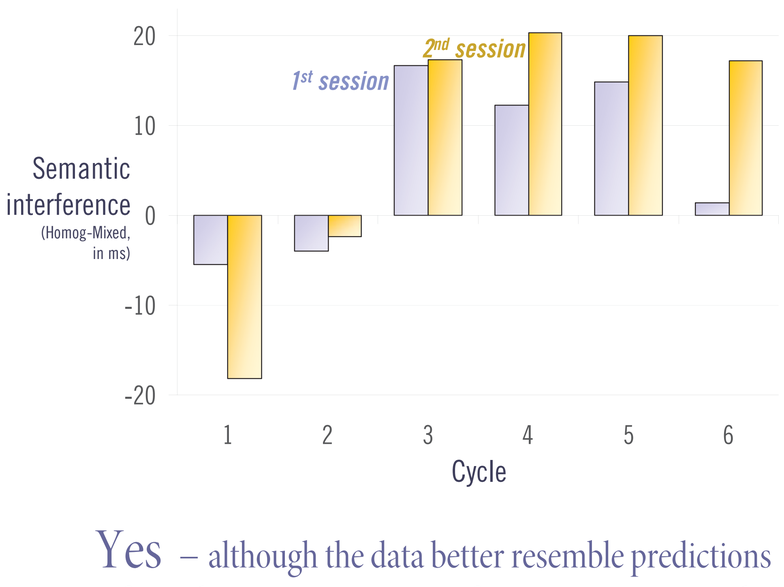


- Two possible functions for cumulative semantic interference:



Do human naming latencies reflect any persistent effect of semantic interference ?

Results

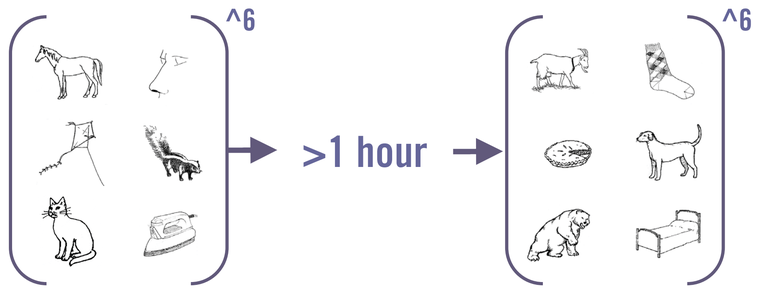


Yes – although the data better resemble predictions for the transient interference account, the interference effect is somewhat stronger in the second session, such that including the persistent interference function significantly improves the transient interference model ($p<0.001$). This suggests that at least some portion of the accumulated semantic interference persists over a one hour delay

1. Model training and parameters in this simulation were identical to those in Simulation 3 of Oppenheim et al. (2010). The main differences here were a.) implementing a 72-item vocabulary, and b.) simulating the course of an entire experiment rather than isolated blocks.

2. The full LME model additionally includes random intercepts for each subject and item, as well as random slopes, by subject, for session and ordinal position within a cycle.

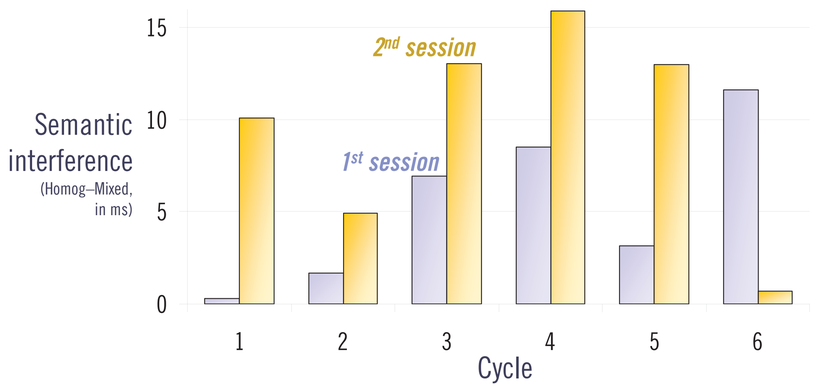
Experiment 2
Interleaved cyclic picture naming



(Otherwise identical to Experiment 1)

Will the contribution of the persistent interference effect replicate?

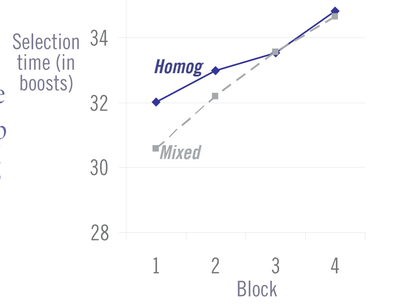
Results

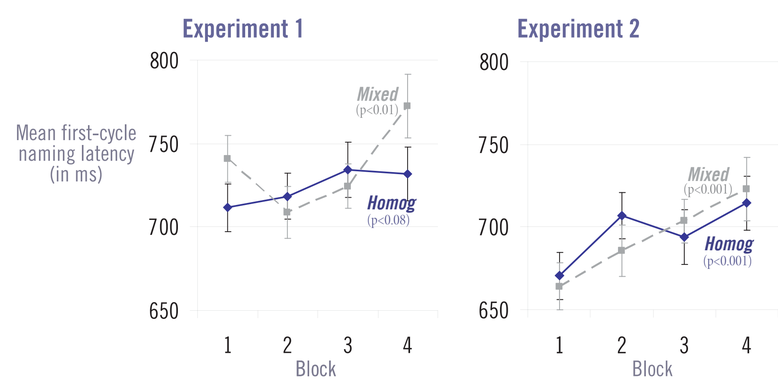


Yes – the case is clearer here: including the persistent interference function again significantly improves a model that already includes transient interference function ($p<0.001$), but the reverse does not hold true ($p>0.5$). The persistent interference function also significantly improves a model that includes a more traditional semantic context-by-cycle interaction ($p<0.001$).

Another consequence of persistent semantic interference

Semantic interference extends across blocks:
When categories in the mixed condition are accessed in multiple blocks, or when categories overlap (*e.g.* Vigliocco *et al.* 2002, Alario & Martin, 2010), naming latencies should increase across blocks. And they do, in both experiments.





Discussion

- Cumulative semantic interference may be better understood – and analyzed – as an incremental effect than as a binomial context manipulation
- Interference can persist across lags at least 20 times longer than previously demonstrated, supporting incremental learning accounts
  - Connects word learning to persistent effects in the human memory literature
- Interference also accumulates across blocks, affecting semantic and homogeneous conditions alike
  - Thus the mixed condition may not provide the baseline previously expected

Conclusion

Semantic interference accumulates incrementally and persists indefinitely, demonstrating learning mechanisms by which speakers heuristically optimize lexical access to meet expected future challenges

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