Interference or Decay in Working Memory? A Reply to Barrouillet & Camos

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Barrouillet and Camos (B&C) raise three objections to our conclusion that short-term forgetting is caused by interference rather than decay [1]. They suggest that (a) interference models are "vague"; (b) considering forgetting as a function of delay is questionable; and (c) the Time-Based Resource-Sharing (TBRS) model is not challenged by the data we cited. We believe that these objections do not withstand scrutiny.

First, at least one interference model (Serial Order in a Box—SOB [2, 3]) is precisely specified and quantitatively predicts *accuracy and latency of responses*, including in B&C's complex-span task. The TBRS, by contrast, does not seem able to predict data such as serial position curves, grouping effects, or effects of phonological similarity.

We agree that interference models should predict the effects of distractor type—as indeed they do; the extent of forgetting differs considerably between different distractors [4], exactly as predicted by SOB and contrary to a simple decay view. B&C furthermore ask whether stimuli could be sufficiently dissimilar *not* to cause interference; evidence for non-specific retroactive interference [5] suggests that the answer is "no." Simulations with SOB show that interference does not require similarity; dissimilar distractors disrupt the memory representation at least as much as similar ones. Another interference model [6] predicts that feature overlap (not similarity) causes interference, and the data also confirm this prediction [7].

Our case against decay does not rest on a null effect but on (a) massive forgetting created by a single interfering event, with (b) almost no further forgetting caused by several additional identical events [8]; decay models cannot handle both results simultaneously because they must assume strong decay combined with weak rehearsal to explain (a), and weak decay combined with strong rehearsal to explain (b).

Second, B&C object to our examination of forgetting as a function of time, arguing that we must consider the opportunity for memory restoration (via rehearsal) in between distractors. Our article reveals our agreement ([1]; Figure 2). We agree in particular that additional time for restoration translates into better memory. This is why we examined time-based forgetting while preventing rehearsal by continuous distraction [8].

B&C's third objection concerns our "self-paced" methodology [8] which ostensibly permitted rehearsal. But by B&C's own way of computing cognitive load (CL) as the ratio of measured reaction times (RTs) to available time (their Box), our method is appropriate to maximize CL: we likewise measure RTs and immediately present the next stimulus, hence CL is approximately equal to 1. Moreover, B&C's observed CL approximately equal to .5 reveals their procedure to be as self-paced as ours because their participants' RTs were not capped by a deadline; hence the only difference between procedures is the post-response delay.

It follows that the TBRS is challenged by data in which CL is approximately equal to 1 and distractor time has no effect on forgetting [8]. Dismissing these results by appealing to rehearsal risks an escape into circularity that is common with verbal theorizing and that reinforces the principal point of our article [1]: Progress is possible only by modeling the processes involved in memory and forgetting. The onus is on decay theorists to implement a *process* model that can quantitatively account for all the available data.

References

[1] Lewandowsky, S., Oberauer, K., & Brown, G. D. A. (in press). No temporal decay in verbal short-term memory. *Trends in Cognitive Sciences*.

[2] Farrell, S., & Lewandowsky, S. (2002). An endogenous distributed model of ordering in serial recall. *Psychonomic Bulletin & Review, 9*, 59-79.

[3] Lewandowsky, S., & Farrell, S. (2008). Short-term memory: New data and a model. *The psychology of Learning and Motivation, 49*, 1-48.

[4] Lewandowsky, S., Geiger, S. M., & Oberauer, K. (2008). Interference-based forgetting in verbal short-term memory. *Journal of Memory and Language, 59*, 200-222.

[5] Wixted, J. T. (2004). The psychology and neuroscience of forgetting. *Annual Review of Psychology, 55*, 235-269.

[6] Oberauer, K., & Kliegl, R. (2006). A formal model of capacity limits in working memory. *Journal of Memory and Language, 55*, 601-626.

[7] Oberauer, K., & Lange, E. B. (2008). Interference in verbal working memory: Distinguishing similarity-based confusion, feature overwriting, and feature migration. *Journal of Memory and Language*, *58*, 730-745.

[8] Oberauer, K., & Lewandowsky, S. (2008). Forgetting in immediate serial recall: Decay, temporal distinctiveness, or interference? *Psychological Review, 115*, 544-576.