Journal of Experimental Psychology:
Learning, Memory, and Cognition
2014, Vol. 40, No. 2, 596–601

0278-7393/14/$12.00 DOI: 10.1037/a0034978

RESEARCH REPORT

Additional Boundary Condition for List-Method Directed Forgetting: The Effect of Presentation Format

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The attempt to forget some recently encoded information renders this information difficult to recall in a subsequent memory test. "Forget" instructions are only effective when followed by learning of new material. In the present study, we asked whether the new material needs to match the format of the to-be-forgotten information for forgetting effects to emerge. Participants studied visually presented words or line drawings (L1) and afterward were instructed to remember or forget these items. Then a 2nd conceptually unrelated list (L2) was presented that either matched or mismatched the format of L1. Forgetting effects were observed only when the lists matched in format but not when the formats mismatched. This result establishes an important boundary condition of directed forgetting and suggests that when salient retrieval cues guide retrieval, they eliminate the effect of the "forget" cue. Implications for theories of directed forgetting are discussed.

Keywords: episodic memory, directed forgetting, encoding format, context change

To some extent, people are capable of intentionally forgetting memories that they consider irrelevant or undesirable. This has been shown, for instance, in the listwise directed forgetting (DF) paradigm (for reviews, see Bäuml, 2008; MacLeod, 1998; Sahakyan, Delaney, Foster, & Abushanab, 2013). Participants study a list of items (L1) and immediately afterward are told either to forget the items, because they were supposedly just for practice, or to keep remembering the items. Then, a second list of items (L2) is presented, which all participants are instructed to remember. A recall test follows in which participants are asked to recall items from both lists, regardless of the prior forget instruction. The typical finding is that forget-instructed participants recall fewer items from L1 and more items from L2 in comparison to participants who were instructed to remember L1. These effects are referred to respectively as the *costs* and *benefits of DF*. Different theoretical explanations for these effects have been proposed, and currently, the inhibition and the context change accounts are the most widely accepted theories. Both accounts assume that L1 forgetting reflects a retrieval problem but propose a different underlying mechanism. Proponents of the retrieval inhibition account (Bjork, 1989, Geiselman, Bjork, Fishman, 1983) assume that the costs of DF are the result of active inhibitory processes invoked in response to the forget cue. While inhibition reduces access to L1 items, leading to the costs, the benefits arise because inhibited L1 items create less proactive interference on L2, leading to improved L2 recall. Alternatively, proponents of the context change account (Sahakyan & Kelley, 2002) assume that participants change their mental context upon a forget cue (e.g., they think of something else), such that encoding of L2 occurs in a new mental context. Importantly, final recall is attempted when participants are in this new context, and it is the resulting mismatch between the recall context and the L1 encoding context that is responsible for the DF costs. According to the context account, forgetting arises due to the difficulty in reinstating L1 encoding context during recall (see also Lehman & Malmberg, 2009; Spillers & Unsworth, 2011). The benefits of DF arise because studying the lists with different contextual cues differentiates them from each other, reducing proactive interference.

An important boundary condition of DF is that forget instructions per se do not suffice to induce forgetting. Intentional forgetting is observed only when the forget instruction is followed by encoding of new material, such as L2 (Gelfand & Bjork, 1985, described in Bjork, 1989; Pastötter & Bäuml, 2007). Furthermore, DF is diminished with decreasing length of L2 (Pastötter & Bäuml, 2010) or when L2 is encoded with divided attention (e.g., Conway, Harries, Noyes, Racsmány, & Frankish, 2000; Macrae, Bodenhausen, Milne, & Ford, 1997), indicating the importance of quantity and quality of new learning. Proponents of the inhibitory account explain the need for L2 encoding by assuming that inhibition is an adaptive mechanism invoked to reduce interference, and in the absence of L2 learning, there is no need to inhibit L1 items because there is no material with which L1 could interfere.

Interestingly, the need for L2 encoding appears to be a boundary condition also for the mental context-change task (Pastötter &

This article was published Online First November 18, 2013.

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We would like to thank Alex Huttle, Diana Vesselinovitch, and Jenny Weinberg for assistance with data collection.

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Bäuml, 2007): when participants were told to remember L1 after its encoding but immediately afterward were asked to engage in distracting thoughts, and some were subsequently presented with L2 but others were not, L1 forgetting emerged only for those participants who studied L2. At first glance Pastötter and Bäuml (2007) considered this finding problematic for the context change account. If a mismatch between retrieval and encoding context underlies the forgetting effect, then a mental context change should be sufficient to induce it without any new learning. However, forgetting depends on the relative ease with which a previous context can be reinstated. In line with this argument, Pastötter and Bäuml acknowledged two reasons that L2 learning might be necessary for context-dependent forgetting. First, only if a second list is learned do retrieval cues at test need to differentiate between L1 and L2 items. Without L2 learning, no such differentiation is needed and L1 is easily accessible. Second, encoding of L2 might strengthen the new context representation. If nothing happens in the new mental context (e.g., no L2 presentation), it is effortless to switch back to the old context. This could also explain why L1 forgetting increases with the number of encoded L2 items (Pastötter & Bäuml, 2010). The more items are presented after the forget cue, the more the new episodic context gets strengthened, because "one shot" of episodic context is stored with each item (cf. Malmberg & Shiffrin, 2005), and the encoding of new context makes it increasingly difficult to reinstate the old context at the time of retrieval.

While prior studies revealed L2 learning as a critical boundary condition of DF, to our knowledge no one has explored whether the type of L2 encoding material further determines the presence or absence of DF. Although prior studies have included other materials in lieu of L2 (e.g., such as math problems instead of L2), those materials did not have to be committed to memory (Gelfand & Bjork, 1985, described in Bjork, 1989; Pastötter, & Bäuml, 2007). In contrast, in the present study, we included new items that had to be remembered for a later test, and we asked whether the postcue list had to match the encoding format of the to-be-forgotten list in order to obtain DF. If the role of L2 items is simply to help set up the new context, then any type of material that needs to be encoded in memory would become associated with L2 context, thus establishing a competing context. However, we assumed that the mere storage of competing context is a necessary but not sufficient condition for DF. The availability of retrieval cues that reinstate access to L1 encoding context further determine retrieval success and whether DF is observed (e.g., Howard & Kahana, 2002; Lehman & Malmberg, 2011; Mensink & Raaijmakers, 1988; Sahakyan & Kelley, 2002; Spillers & Unsworth, 2011). Thus, we predicted that DF would emerge only when L1 and L2 formats match, but not when they mismatch. A study by Lehman and Malmberg (2011) exemplifies the significance of retrieval cues for L1 accessibility and in turn for DF. The authors presented participants with L1 items that were all derived from a single category, without informing participants about the categorical nature of the list, whereas L2 was uncategorized. During recall, some of the participants were instructed to use the category cue to recall L1, while others were simply asked to recall L1 and thus relied on temporal cues only. Directed forgetting costs were observed when retrieval was cued with temporal context, but the impairment was eliminated when category cues were provided at test.[1] These findings show that DF depends on the availability of list-specific retrieval cues; when more specific retrieval cues are being utilized, then retrieval benefits from those cues, and DF is reduced. With regard to our study, we reasoned that when L2 is presented in a different format than L1, list format can be utilized as a retrieval cue accessing L1 items and in turn reinstating L1 encoding context. In this case, DF costs should be diminished. In contrast, when L1 and L2 are presented in the same format (as in most DF studies)—and if there is no other salient cue that differentiates L1 from L2— then participants' L1 retrieval is guided by temporal context alone. Forget-cued participants either do not spontaneously reinstate L1 encoding context or find it difficult to achieve such reinstatement because the retrieval context differs from L1 encoding context (Lehman & Malmberg, 2009; Sahakyan & Kelley, 2002; Spillers & Unsworth, 2011), and therefore, L1 recall is impaired. In sum, we expected that there would be DF costs in the format-match condition but that DF costs would be eliminated or reduced in the format-mismatch condition.

Method

Design and Participants

The experiment used a 2 × 2 × 2 between-subjects design. The three manipulated variables were as follows: (a) for the L1 format: items were either presented as line drawings or as written words; (b) for the format match: L2 either matched or mismatched the format of L1; (c) for the instruction: between lists, participants were instructed either to forget or to remember L1. Ninety-six undergraduate students from Lehigh University were randomly assigned to one of the eight experimental groups ($n = 12$ in each group, 50 females). They received partial course credit for participation.

Materials

Two lists of 15 items were created (see Appendix). Each item referred to a concrete object that was presented either as a black-and-white line drawing or a written word. All items were presented visually on a computer screen. Across lists, words were matched on frequency ($M = 45$, written frequency count based on Kucera & Francis, 1967), concreteness ($M = 595$, based on Coltheart, 1981) and word length ($M = 5.5$ letters). Across participants, each list served equally often as L1 or L2 and was equally often presented as line drawings or words.

Procedure

Participants were told that they would be presented with separate lists of words or pictures and that after each list, they would be informed about whether to forget or to remember the just-presented information (e.g., Pastötter & Bäuml, 2007, 2010). Then L1 items were presented one at a time in a randomized order on a computer screen, with a presentation rate of 3 s and an interstimulus interval (ISI, fixation cross) of 500 ms. After presentation of L1 items, participants were cued either to forget or to remember the list. Then, all participants were told that they were about to learn

[1] Similar effects occur when participants are informed about the categorical list structure prior to study (Wilson, Kipp, & Chapman, 2003).

a second list and that this list was important to remember. Then L2 items were presented with a presentation rate of 3 s and an ISI of 500 ms. Upon L2 presentation, all participants were given 30 two-digit subtraction and addition problems and were asked to solve as many as possible within 1 min. Then, participants were asked to write down all the L1 items they could remember. Afterward, they were asked to recall L2 on a separate sheet of paper. Participants were given as much time as needed to recall each list. Once they started L2 recall, they were no longer allowed to edit their L1 responses. It took participants no more than 2 min to complete recall of each list.

Results

L1 Recall

Mean proportions of items recalled from L1 as a function of cue, L1 format, and L2 format are displayed in Figure 1.

To evaluate the DF costs, we performed a factorial analysis of variance (ANOVA) on the proportion of L1 items recalled, using cue (forget vs. remember), L1 format (picture vs. words), and format match (L1–L2 match vs. L1–L2 mismatch) as factors. The results revealed marginally significant effects of cue, $F(1, 88) = 2.82$, $MSE = 0.019$, $p = .097$; and format match, $F(1, 88) = 3.16$, $MSE = 0.019$, $p = .079$; and a significant interaction between cue and format match, $F(1, 88) = 5.62$, $MSE = 0.019$, $p = .020$, $\eta^2 = .064$. When L1 and L2 formats matched, the forget group remembered significantly fewer items from L1 ($M = 0.27$, $SD = 0.14$) than the remember group ($M = 0.38$, $SD = 0.13$), $F(1, 93) = 8.25$, $MSE = 0.02$, $p = .005$, $\eta^2 = .091$, confirming DF costs. In contrast, when L1 and L2 formats mismatched, the DF costs were eliminated as evidenced by no differences in recall between the forget group ($M = 0.38$, $SD = 0.12$) and the remember group ($M = 0.36$, $SD = 0.15$), $F < 1$.

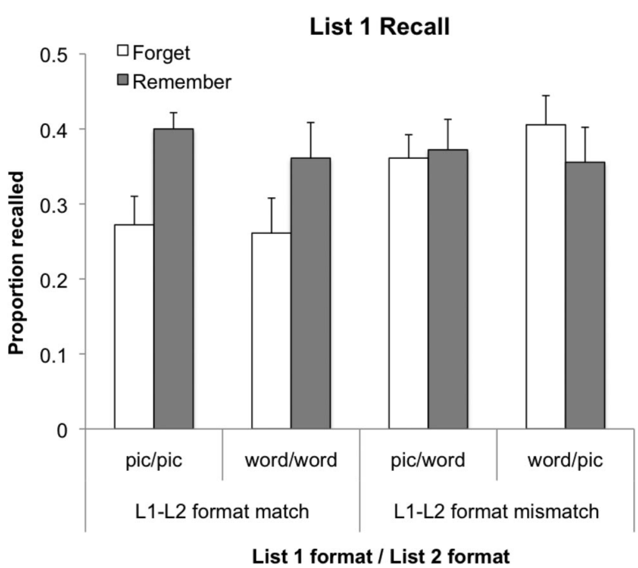

Figure 1. Mean proportions of List 1 (L1) recall as a function of instruction (forget, remember), L1 format, and List 2 (L2) format. Format match conditions were pictures/pictures and words/words. Format mismatch conditions were pictures/words and words/pictures. Error bars represent standard errors of the mean. Pic = picture; L1 = List 1; L2 = List 2.

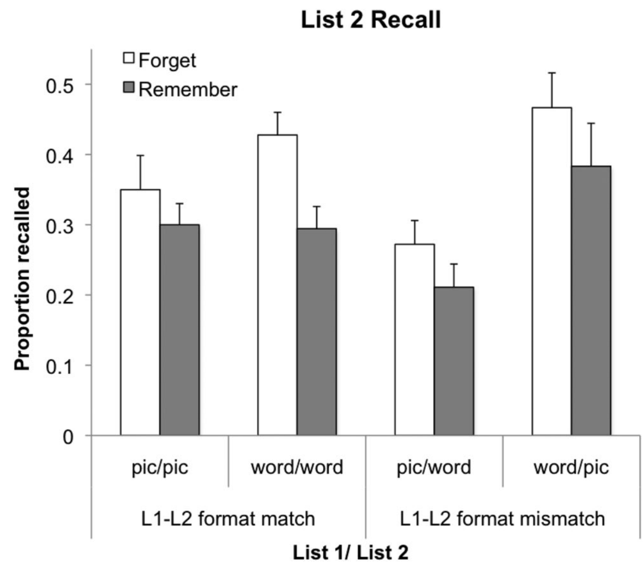

Figure 2. Mean proportions of List 2 (L2) recall as a function of instruction (forget, remember), List 1 (L1) format, and L2 format. Format match conditions were pictures/pictures and words/words. Format mismatch conditions were pictures/words and words/pictures. Error bars represent standard errors of the mean. Pic = picture; L1 = List 1; L2 = List 2.

L2 Recall

Mean proportions of items recalled from L2 as a function of cue, L1 format, and L2 format are displayed in Figure 2.

To evaluate the DF benefits, we performed a factorial ANOVA on the proportion of L2 items recalled using cue (forget vs. remember), L2 format (pictures vs. words), and format match (L1–L2 match vs. L1–-L2 mismatch) as factors. The results revealed a significant effect of cue, $F(1, 88) = 7.82$, $MSE = 0.021$, $p = .006$, $\eta^2 = .089$: participants remembered significantly more L2 items after the forget cue ($M = 0.38$, $SD = 0.16$) than after the remember cue ($M = 0.30$, $SD = 0.15$), confirming significant DF benefits overall. Additionally, a significant effect of L2 format was found, $F(1, 88) = 6.31$, $MSE = 0.021$, $p = .014$, $\eta^2 = .072$: pictures ($M = 0.38$, $SD = 0.14$) were generally better remembered than words ($M = 0.30$, $SD = 0.17$; i.e., picture superiority effect, Paivio, 1971). The interaction between L2 format and format match was also significant, $F(1, 88) = 14.03$, $MSE = 0.021$, $p < .001$, $\eta^2 = .159$. This interaction shows that picture superiority was observed only when the list formats mismatched, not when they matched. Specifically, when L1 contained pictures, L1 proactively interfered with memory for L2, eliminating L2 picture superiority. However, this interaction is not central to our hypothesis as it did not involve the cue factor (forget vs. remember), and therefore we will not discuss it further.

Discussion

The present study shows that DF depends critically on the type of material that is learned by the participants after they receive the forget instruction. We found impaired memory for L1 only when the encoding format of L2 matched the encoding format of L1, not when the formats mismatched. This was observed independently of the specific encoding format of L1, or in other words, it occurred for both L1 pictures and L1 words: memory for L1 words was reduced in the forget group when L2 was composed of words, but not when it consisted of pictures, and memory for L1 pictures was reduced in the forget group when L2 was composed of pictures, but not when it consisted of words.

The context change account (Lehman & Malmberg, 2009, 2011; Sahakyan & Kelly, 2002) can explain the reduced DF effects in the format mismatch conditions with retrieval-cue guided context reinstatement. If temporal context is the only cue that guides retrieval, as is the case when there is no additional salient list-separating cue, then DF costs occur. If, however, there are salient cues available that are specific to L1, then L1 context can be reinstated and DF costs are diminished. It appears that participants in our study spontaneously used the list format as a retrieval cue. When potential L1 retrieval cues are less salient, it might be necessary to explicitly draw participants' attention to such cues. This was the case in Lehman and Malmberg's (2011) study in which DF was abolished only when participants were informed prior to retrieval that all L1 items had belonged to the same category. Similarly, two recent articles by Bäuml and Samenieh (2012a, 2012b) showed that both guided retrieval of a subset of L1 items or re-presentation of some of L1 items as retrieval cues can eliminate DF of the remainder of L1. Thus, in situations where access to the encoding context is impaired (e.g., by the instruction to forget L1 or to change mental context between L1 and L2 encoding), re-encountering a subset of L1 items reactivates L1 context, which allows access to the remaining L1 items (Bäuml & Samenieh, 2012a, 2012b). A recent study by Hanczakowski, Pasek, and Zawadska (2012) further evidences that DF is observed only when recollection is based on temporal context, not when other associations are queried. After studying pairs of unrelated words, forget-cued participants were not impaired in an associative recognition task where they had to decide whether pairs were intact repetitions or were rearranged from study. However, the same participants had difficulties differentiating which word pairs stemmed from L1 and which from L2 (see also Gottlob & Golding, 2007).

As an alternative explanation of the lack of DF in the format mismatch conditions, one could argue that format change itself constitutes a context change, causing forgetting in the mismatch remember group also (and thereby reducing any possible differences between the forget group and remember group in the mismatch condition). However, an inspection of Figure 1 indicates that the remember groups in the format mismatch condition do not differ from the remember groups in the format match conditions, which suggests either that format mismatch itself does not produce forgetting or that such forgetting is overcome at the time of retrieval because participants rely on format-specific cues to access items on respective lists.

That format mismatch reduces forgetting is also compatible with inhibition accounts of DF (Bjork, 1989; Geiselman et al., 1983), especially those that emphasize the necessity of competition between wanted and unwanted memories. Conway et al. (2000) argued that the forget cue triggers inhibition of L1 but that such inhibition unfolds during L2 learning only if L1 has the potential to compete with L2 during later recall. If pictures do not interfere or compete with words and vice versa, then we should not see forgetting in the mismatch condition. However, it is not clear a priori why pictures on L1 and words on L2 should be less competitive with each other than two lists of words or two lists of pictures. According to the dual-code hypothesis (e.g., Paivio, 1971), line drawings are coded with both a pictorial code and a verbal code, and thus a verbal code should be present across both lists. Thus, why line drawings compete less with words is not clear unless the importance of different retrieval cues is acknowledged, which is what the context account does. The inhibition account as currently conceptualized makes it difficult to predict when a forget cue will or will not bring on inhibition because the account is missing an independent criterion that defines when the two lists of items will compete with each other and when they will not. Instead, competition between two lists is inferred from the absence or presence of DF, which leads to circularity in reasoning. How, in order to trigger inhibition, does a cognitive system determine what has the "potential to compete" with a pre-existing memory? One such signal could be the extent to which L1 items come to mind during L2 learning and hence need to be inhibited. However, for related lists, including rather weakly related lists, DF is reduced rather than increased (Barnier et al., 2007; Conway et al., 2000; Golding, Long, & MacLeod, 1994; Sahakyan & Goodmon, 2007), which is inconsistent with this view.

Both the context-change account and the inhibitory account assume that the costs and benefits reflect the operation of a single factor that not only reduces L1 accessibility but also diminishes proactive interference originating from L1, which in turn enhances L2 memory, leading to the DF benefits. Neither of these accounts can explain the dissociation observed in this study and in many other studies, where the costs and benefits are not always observed together (see, e.g., Pastötter & Bäuml, 2010; Sahakyan et al., 2013). In the current study, even though format mismatch eliminated DF costs, the benefits remained intact in all conditions. This dissociation supports two-factor theories of DF (Pastötter & Bäuml, 2010; Sahakyan & Delaney, 2003, 2005), which explain the costs and benefits with different mechanisms. According to Sahakyan and Delaney (2003), the benefits are due to participants rethinking their encoding strategies upon receiving the forget cue and choosing a more beneficial strategy to encode L2. A related, but slightly different explanation of DF benefits was proposed by Pastötter and Bäuml (2010), who argued that the benefits reflect the reset of encoding processes, which results in enhanced rehearsal of the first L2 items. The accounts are not mutually exclusive, and there is empirical evidence in support of both (cf. Sahakyan et al., 2013), such as primacy effects in L2 recall (e.g., Geiselman et al., 1983; Lehman & Malmberg, 2009; Pastötter & Bäuml, 2010) and lack of benefits when specific encoding strategies are enforced (Sahakyan & Delaney, 2003). While our finding of dissociated costs and benefits in the format change condition supports two-factor accounts of DF, it is mute to the specific mechanism underlying the benefits. If strategy change is responsible for the observed benefits, then our study suggests that upon receiving the forget cue, participants chose more elaborated L2 encoding strategies that were independent of the specific encoding format. If format had played a crucial role for the encoding strategy (such as planning to form mental images to words presented in L2), then we should have observed reduced benefits in the format change groups. That format independent strategies were chosen is plausible because participants were told prior to the experiment that they would be presented with words and/or pictures, and based on that knowledge, they might have chosen strategies that were format independent. At the same time, a simple reset of rehearsal could have caused the benefits in our study.

An alternative explanation of the benefits that were observed in our study can be delineated from Lehman and Malmberg's (2009) model of DF. In their model, the instruction to forget reduces but does not eliminate interference from L1; making postretrieval evaluation processes necessary to prevent L1 intrusions into L2 recall. This might explain why benefits were not only observed in the format match conditions (where the forget cue separated the L1 and L2 contexts) but also in the format mismatch conditions (where the forget cue *and* the list format separated contexts). In the case of different list compositions, participants can utilize the list format as an additional cue to evaluate L2 membership.[2]

Whatever the specific underlying mechanism that led to the benefits, it is evident that if DF benefits are observed, they appear to be more robust compared to the costs, which appear to be more transitory and affected by the availability of retrieval cues. Consistent with this claim, DF costs are eliminated, but benefits are preserved when category cues are introduced at test (Lehman & Malmberg, 2011) or when testing is delayed (e.g., Liu, 2001; Shapiro, Lindsey, & Krishnan, 2006). However, the question of delay seems more complex, as Abel and Bäuml (2013) observed DF costs after a delay of 12 hr but only if the participants spent the delay awake. Costs were eliminated when the delay was filled with nocturnal sleep.

Taken together, the present study reveals another boundary condition of listwise DF. Prior studies have shown that DF critically depends on the encoding of new information after the forget cue is received (Gelfand & Bjork, 1985, described in Bjork, 1989; Pastötter & Bäuml, 2007, 2010). Furthermore, DF is affected by the quantity and quality of new learning: DF decreases when new information is encoded under divided attention conditions (e.g., Conway et al., 2000; Macrae et al., 1997) and with decreasing length of L2 (Pastötter & Bäuml, 2010). Our study adds to these findings by showing that post-cue information needs to match the encoding format of the to-be-forgotten information for DF to emerge.

Retrieval success depends on the availability and utilization of retrieval cues. Absent specific cues, retrieval is attempted by reinstating the mental context that was present during acquisition. Forgetting instructions initiate a change in mental context. This new context is solidified during L2 learning. Retrieval of L1 is attempted from L2 encoding context, causing difficulties accessing L1 items and thus DF effects (cf. Spillers & Unsworth, 2011). However, if additional retrieval cues such as category membership (Lehman & Malmberg, 2011), a subset of L1 items (Bäuml & Samenieh, 2012a, 2012b), or list format (present study) are being utilized, effects of DF can be easily overcome.

[2] We would like to thank Ken Malmberg for this suggestion.

References

Abel, M., & Bäuml, K.-H. T. (2013). Sleep can eliminate list-method directed forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 39,* 946–952. doi:10.1037/a0030529

Barnier, A. J., Conway, M. A., Mayoh, L., Speyer, J., Avizmil, O., & Harris, C. B. (2007). Directed forgetting of recently recalled autobiographical memories. *Journal of Experimental Psychology: General, 136,* 301–322. doi:10.1037/0096-3445.136.2.301

Bäuml, K.-H. T. (2008). Inhibitory processes. In H. L. Roediger III (Ed.), *Cognitive psychology of memory* (pp. 195–220). Oxford, United Kingdom: Elsevier.

Bäuml, K.-H. T., & Samenieh, A. (2012a). Influences of part-list cuing on different forms of episodic forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38,* 366–375. doi:10.1037/a0025367

Bäuml, K.-H. T. & Samenieh, A., (2012b). Selective memory retrieval can impair and improve retrieval of other memories. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38,* 488–494. doi:10.1037/a0025683

Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. Roediger & F. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 309–330). Hillsdale, NJ: Erlbaum.

Coltheart, M. (1981). *MRC Psycholinguistic Database user manual (Version 1).* London, United Kingdom: Author.

Conway, M. A., Harries, K., Noyes, J., Racsmány, M., & Frankish, C. R. (2000). The disruption and dissolution of directed forgetting: Inhibitory control of memory. *Journal of Memory and Language, 43,* 409–430. doi:10.1006/jmla.2000.2706

Geiselman, R. E., Bjork, R. A., & Fishman, D. (1983). Disrupted retrieval in directed forgetting: A link with posthypnotic amnesia. *Journal of Experimental Psychology: General, 112,* 58–72. doi:10.1037/0096-3445.112.1.58

Golding, J. M., Long, D. L., & MacLeod, C. M. (1994). You can't always forget what you want: Directed forgetting of related words. *Journal of Memory and Language, 33,* 493–510. doi:10.1006/jmla.1994.1023

Gottlob, L. R., & Golding, J. M. (2007). Directed forgetting in the list method affects recognition memory for source. *Quarterly Journal of Experimental Psychology, 60,* 1524–1539. doi:10.1080/17470210601100506

Hanczakowski, M., Pasek, T., & Zawadska, K. (2012). Context-dependent impairment of recollection in list-method directed forgetting. *Memory, 20,* 758–770. doi:10.1080/09658211.2012.702774

Howard, M. W., & Kahana, M. J. (2002). A distributed representation of temporal context. *Journal of Mathematical Psychology, 46,* 269–299. doi:10.1006/jmps.2001.1388

Kucera, H., & Francis, W. N. (1967). *Computational analysis of present-day American English*. Providence, RI: Brown University Press.

Lehman, M., & Malmberg, K. J. (2009). A global theory of remembering and forgetting from multiple lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35,* 970–988. doi:10.1037/a0015728

Lehman, M., & Malmberg, K. J. (2011). Overcoming the effects of intentional forgetting. *Memory & Cognition, 39,* 335–347. doi:10.3758/s13421-010-0025-4

Liu, X. (2001). On the dynamics of directed forgetting: Facilitation and interference in the updating of human memory. *Dissertation Abstracts International, Section B: The Sciences and Engineering, 61*(11), 6159.

MacLeod, C. M. (1998). Directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 1–57). Mahwah, NJ: Erlbaum.

Macrae, C. N., Bodenhausen, G. V., Milne, A. B., & Ford, R. L. (1997). On the regulation of recollection: The intentional forgetting of stereotypical memories. *Journal of Personality and Social Psychology, 72,* 709–719. doi:10.1037/0022-3514.72.4.709

Malmberg, K. J., & Shiffrin, R. M. (2005). The "one-shot" hypothesis for context storage. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31,* 322–336. doi:10.1037/0278-7393.31.2.322

Mensink, G., & Raaijmakers, J. G. (1988). A model for interference and forgetting. *Psychological Review, 95,* 434–455. doi:10.1037/0033-295X.95.4.434

Paivio, A. (1971). *Imagery and verbal processes*. New York, NY: Holt, Rinehart & Winston.

Pastötter, B., & Bäuml, K.-H. (2007). The crucial role of post-cue encoding in directed forgetting and context-dependent forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33,* 977–982. doi:10.1037/0278-7393.33.5.977

Pastötter, B., & Bäuml, K. (2010). Amount of postcue encoding predicts amount of directed forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36,* 54–65. doi:10.1037/a0017406

Sahakyan, L. (2004). Destructive effects of "forget" instructions. *Psychonomic Bulletin & Review, 11,* 555–559.

Sahakyan, L., & Delaney, P. F. (2003). Can encoding differences explain the benefits of directed forgetting in the list method paradigm? *Journal of Memory and Language, 48,* 195–206. doi:10.1016/S0749-596X(02)00524-7

Sahakyan, L., & Delaney, P. F. (2005). Directed forgetting in incidental learning and recognition testing: Support for a two-factor account. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31,* 789–801. doi:10.1037/0278-7393.31.4.789

Sahakyan, L., Delaney, P. F., Foster, N. L., & Abushanab, B. (2013). List-method directed forgetting in cognitive and clinical research: A theoretical and methodological review. In B. H. Ross (Ed.), *The psychology of learning and motivation* (Vol. Vol. 59, pp. 131–190). Amsterdam, the Netherlands: Elsevier.

Sahakyan, L., & Goodmon, L. B. (2007). The influence of directional associations on directed forgetting and interference. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33,* 1035–1049. doi:10.1037/0278-7393.33.6.1035

Sahakyan, L., & Kelley, C. M. (2002). A contextual change account of the directed forgetting effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 28,* 1064–1072. doi:10.1037/0278-7393.28.6.1064

Shapiro, S., Lindsey, C., & Krishnan, H. (2006). Intentional forgetting as a facilitator for recalling new product attributes. *Journal of Experimental Psychology: Applied, 12,* 251–263. doi:10.1037/1076-898X.12.4.251

Spillers, G. J., & Unsworth, N. (2011). Are the costs of directed forgetting due to failures of sampling or recovery? Exploring the dynamics of recall in list-method directed forgetting. *Memory & Cognition, 39,* 403–411. doi:10.3758/s13421-010-0038-z

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review, 101,* 34–52. doi:10.1037/0033-295X.101.1.34

Wilson, S. P., Kipp, K., & Chapman, K. (2003). Limits of the retrieval-inhibition construct: List segregation in directed forgetting. *Journal of General Psychology, 130,* 359–379. doi:10.1080/00221300309601164

Appendix

Items on Lists 1 and 2

List 1: apple, boat, camel, clock, dress, drill, guitar, king, lamp, mouth, picture, snowman, spider, tree, volcano.

List 2: balloon, bird, bridge, glass, heart, ladder, newspaper, pencil, pillow, puzzle, radio, robot, swing, tent, umbrella.

Received June 19, 2013
Revision received October 1, 2013
Accepted October 4, 2013 ■