Psychonomic Bulletin & Review
2004, 11 (3), 555-559

Destructive effects of "forget" instructions

LILI SAHAKYAN
University of Florida, Gainesville, Florida

In two experiments, participants were given three lists of words to study and were told to (1) remember all three lists, (2) forget the first list immediately after studying it but try to remember the other two lists, or (3) forget the middle list immediately after studying it but try to remember the first and the last lists. In Experiment 1, unrelated word lists were used, whereas Experiment 2 replicated Experiment 1 with categorical lists. The results from both experiments showed that forgetting the middle list leads also to recall decrement for the first list, which was not intended for forgetting. The results are discussed in terms of the contextual change hypothesis of directed forgetting.

R. A. Bjork, LaBerge, and LeGrand's (1968) directed-forgetting paradigm has become a helpful tool for investigating memory functioning and exploring population differences. For example, R. A. Bjork (1989) saw the relevance of directed forgetting for memory updating, which entails replacing irrelevant information with more relevant information. Sahakyan and Kelley (2002) established a relationship between directed forgetting and context-dependent memory phenomena, allowing directed forgetting to be used to gain insights about the role of *mental* context in memory. Directed forgetting has also been helpful in exploring the study strategy choices that people make in response to forget instructions (Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004). Because one current account of directed forgetting proposes that the phenomenon is inhibitory in nature, the paradigm has been popular for its implications for the repression of unpleasant or traumatic memories. In addition, it is widely used in clinical and developmental psychology to investigate differences in populations with varying degrees of inhibitory control, including children (Harnishfeger & Pope, 1996), older adults (Gamboz & Russo, 2002; Zacks, Radvansky, & Hasher, 1996), depressed individuals (Power, Dalgleish, Claudio, Tata, & Kentish, 2000), and repressors (Myers, Brewin, & Power, 1998). Given the increasing interest in directed forgetting, it is important to better understand its underlying mechanisms.

This article is concerned with the list method of directed forgetting, in which people are instructed to forget a whole list of earlier-studied items (as opposed to forgetting on an item-by-item basis, which is known as the item method).

In a basic between-subjects list method directed-forgetting study, people study two lists of words. Following the first list, some participants are told to forget the previously studied list (the *forget* group), whereas others are told to remember the list (the *remember* group). Then both groups study a second list, followed by the remember instruction. Afterward, the participants are instructed to recall all the items, including those they were told to forget.

Typically, the forget group shows poorer recall of List 1 than does the remember group—a finding known as the *costs* of directed forgetting. The forget group also recalls more List 2 items than does the remember group—a finding known as the *benefits* of directed forgetting. For a more detailed review of the directed-forgetting findings, the reader is referred to E. L. Bjork, R. A. Bjork, and Anderson (1998) or Macleod (1998).

Although list method directed forgetting has been previously interpreted as purely a retrieval-based, rather than an encoding-based, phenomenon (Basden, Basden, & Gargano, 1993; R. A. Bjork, 1989; Geiselman, Bjork, & Fishman, 1983), my colleagues and I have argued that encoding processes also play an important role. Specifically, we have proposed that directed forgetting consists of two different phenomena (the costs and benefits). We view the costs as primarily retrieval based, whereas the benefits are primarily encoding based (Sahakyan et al., 2004). Evidence from recognition tests also supports the retrieval-based origins of the costs, because these tests are insensitive to the directed-forgetting instruction, suggesting that items are available in memory but are not accessible for recall (e.g., Basden et al., 1993; E. L. Bjork & R. A. Bjork, 1996; Geiselman et al., 1983). Consistent with the findings of Liu, Bjork, and Wickens (1999), which demonstrated that the benefits were more lasting than the costs, we have argued that the benefits reflect superior encoding of List 2 following the forget instruction (Sahakyan & Delaney, 2003; Sahakyan et al., 2004). The finding that particular experimental manipulations could affect the costs but not the benefits (and vice versa) motivated differentiating the directed-forgetting effect into two separate components with different underlying mechanisms (see Sahakyan & Delaney, 2003).

Because most of the implications of directed forgetting are related to impaired retrieval, in this article, we will

I am very grateful to Holly Gershow and Garin Narain for their help with the data collection. Correspondence concerning this article should be addressed to L. Sahakyan, Department of Psychology, University of Florida, Box 112250, Gainesville, FL, 32611-2250 (e-mail: sahakyan@ufl.edu).

more closely examine the theoretical mechanisms behind directed-forgetting costs. The earliest theoretical explanation of directed-forgetting costs was the selective rehearsal hypothesis (R. A. Bjork, 1970). According to this view, after the forget instruction, the participants cease rehearsing List 1 items and devote all rehearsal activity to List 2 items, whereas the remember group participants continue List 1 rehearsal during the study of List 2. Later, the retrieval inhibition explanation replaced the selective rehearsal hypothesis (R. A. Bjork, 1989). Retrieval inhibition was postulated in response to critical findings by Geiselman et al. (1983), who intermixed items that participants were told to study for a later memory test (intentional study items) with items to be judged for pleasantness (incidental study items). Their results revealed that both incidental and intentional items showed the costs and benefits of directed forgetting—findings that were difficult for the selective rehearsal hypothesis to explain. Because incidental study items were not supposed to be rehearsed in the first place, devoting all rehearsal activity to List 2 items should not have impaired List 1 recall of incidental items. Therefore, the retrieval inhibition hypothesis replaced the rehearsal view and proposed that during the time of recall, the forget instruction initiates a process that blocks or inhibits access to List 1 items, producing the costs of directed forgetting.

A variation of the retrieval inhibition account of directed forgetting proposed by Basden and Basden (1998) explains the costs as a disruption of retrieval strategy in the forget group. According to this view, the forget instruction leads participants to abandon their existing retrieval strategy and to adopt a strategy that favors the retrieval of List 2.

Recently, a context-based explanation of directed forgetting has been proposed (Sahakyan & Kelley, 2002). According to the context view, in response to the forget instruction, participants attempt to establish a new mental context, presumably by thinking of something unrelated to the experiment. The second list is then encoded with new contextual cues, which remain active during recall. The costs occur because the context during recall matches the List 2 encoding context better than it matches the context for List 1. Sahakyan and Kelley demonstrated effects similar to directed-forgetting costs in the absence of forget instructions by experimentally manipulating a mental context change in the remember group participants. In addition, when at the time of recall the participants were guided through series of steps that facilitated the reinstatement of the initial study context, the costs were significantly reduced.

EXPERIMENT 1

In this experiment, an attempt was made to further test the contextual theory of directed-forgetting costs by modifying the current two-list design of directed forgetting to include additional study lists. Participants received three lists to study, which were followed by an instruction either to remember or to forget. In one of the conditions, the participants were instructed to remember all three lists. In a second condition, the participants were told to forget List 1 immediately after studying it but to remember Lists 2 and 3. In a third condition, the participants were instructed to forget List 2 immediately after studying it but to remember Lists 1 and 3.

On the basis of its mechanism, the context change account makes a clear prediction about what should occur when participants are told to forget List 2 but not List 1. It predicts that instructing people to forget List 2 should also impair access to List 1. Accordingly, following the instructions to forget List 2, participants should be less likely to maintain the activation of contextual elements that were prevalent during List 2 encoding and, therefore, should attempt to create a new mental context, in order to comply with the forget instruction. Since the recall test is given after the encoding of List 3, the contextual cues at test will match List 3 encoding better than List 2 or List 1 encoding, producing a decrement in recall for both List 2 and List 1.

Method

Participants. The participants were 102 University of Florida undergraduates who received course credit. They were tested in groups of 3–5, with 34 participants in each of the three experimental conditions.

Materials. Three lists of 12 unrelated medium-frequency English nouns were drawn from the Kučera and Francis (1967) norms. The first two lists were counterbalanced both across the order of presentation during encoding and across the order of recall at the time of the test. The third list was always the last in the presentation and recall order. Full counterbalancing of the lists was not done, because the third list was not the focus of the predictions and served mainly to satisfy the necessary condition of directed forgetting (i.e., new learning is required after the forget instruction; R. A. Bjork, 1989).

Procedure. The participants were told that they would see three lists of words at a rate of 5 sec/word, to study for a later memory test. They were warned that each list would be followed by an instruction that would specify whether or not that list would be tested later. The participants were warned that if a forget instruction followed the list, that list would not be recalled later and should, therefore, be forgotten. They were also told that the forget instruction would appear only once or not at all. Therefore, they were encouraged to put equal effort into studying all the words, because they could not predict either the timing or the likelihood of receiving the forget instruction. The instruction to forget or remember the list was always delivered by an experimenter following the presentation of each list.

The three experimental conditions will be referred to as *FRR*, *RFR*, and *RRR*, where the position of the letter (F or R) in the sequence indicates the type of instruction that followed each of the three lists. For example, RFR refers to the group that was told to remember List 1 and List 3 but to forget List 2. After the third study list, all the groups solved arithmetic problems for 60 sec. Everyone then attempted to recall List 1, followed by List 2 and List 3, or to recall List 2, followed by List 1 and List 3. The recall was carried out on separate sheets of paper, with 1 min for recall per list.

Results and Discussion

Table 1 shows mean recall rates for all the lists. A one-way analysis of variance (ANOVA) on proportion of List 1 recall revealed a significant difference in the three experimental conditions [$F(2,99) = 5.11$, $MS_e = 0.042$, $p < .01$]. Post hoc testing using Tukey's HSD revealed that the FRR group recalled significantly fewer List 1 items than did the

Table 1
Proportion of Words Recalled From Each List in RRR, FRR, and RFR Conditions in Experiment 1

	RRR		FRR		RFR	
List	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	.47	.18	.33	.25	.34	.18
2	.38	.24	.44	.25	.20	.16
3	.37	.22	.38	.22	.31	.21

control RRR group, showing the standard costs of directed forgetting. Interestingly, the RFR group also recalled fewer List 1 items than did the RRR group, despite being told to remember the first list. Thus, the RFR group showed indirect costs of directed forgetting, although the forget instruction was directed only at List 2, and not at List 1. There were no significant differences between the FRR and the RFR groups.

A one-way ANOVA on the proportion of List 2 recall revealed significant differences in the three conditions [$F(2,99) = 11.42$, $MS_e = 0.048$, $p < .001$]. The RFR group recalled significantly fewer List 2 items than did the RRR group, confirming that the participants complied with the forget instruction. The List 2 recall difference between the FRR group and the RRR group was not significant. Thus, significant benefits of directed forgetting were not obtained (although the means were in the correct direction). No significant differences emerged in List 3 recall ($F < 1$).

EXPERIMENT 2

The findings from the previous experiment revealed that in an attempt to forget the middle list of items, the participants also forgot the first list despite being told to remember it. If the participants were unable to discriminate the two lists effectively, perhaps they could not effectively target their forgetting. Therefore, in Experiment 2, categorical lists that could easily be differentiated were used.

Method

Participants. The participants were 60 University of Florida undergraduates, tested in groups of up to 5, with 20 participants in each condition.

Materials. The three lists consisted of 12 low-frequency words from a single category (vegetables, animals, or fruits). Presentation order of the lists was fully counterbalanced.

Procedure. At the time of recall, the participants were given 3 min to recall as many words as possible from all three lists, including the ones they were told to forget. In all other respects, the procedure followed that in Experiment 1.

Results and Discussion

Table 2 shows the means for all lists. A one-way ANOVA on proportion of List 1 recall revealed differences among the three conditions [$F(2,57) = 11.87$, $MS_e = 0.027$, $p < .001$]. Post hoc testing revealed that the RRR group recalled significantly more items from List 1 than did the FRR or RFR groups, which did not differ. As in Experiment 1, both direct and indirect costs of forgetting were obtained. Even with maximum differentiation among the lists, forgetting of one category led to indirect forgetting of previous categories that were supposed to be remembered.

A one-way ANOVA on the proportion of List 2 recall also revealed significant differences [$F(2,57) = 7.75$, $MS_e = 0.029$, $p < .01$]. Consistent with Experiment 1, the RFR group recalled significantly fewer items than did the RRR or FRR groups, which did not differ. Thus, there were direct costs for the RFR group, as evidenced by poorer List 2 recall, as compared with the RRR group. As in Experiment 1, there were no benefits for List 2 in the FRR group.

A one-way ANOVA on the proportion of List 3 recall also revealed significant differences [$F(2,57) = 5.25$, $MS_e = 0.032$, $p < .01$]. Both the RFR and the FRR groups recalled significantly more items than did the RRR group, showing the benefits of forgetting. No differences emerged between the FRR and the RFR groups.

To summarize, when the lists were differentiated by separate categories, there were both direct and indirect costs of forgetting, consistent with the prior findings. Both the FRR and the RFR groups showed impaired recall of the category they were told to forget. In addition, the RFR group had an impaired memory for the category preceding the to-be-forgotten category. Both groups showed also the benefits of forgetting on List 3.

GENERAL DISCUSSION

Taken together, the results support the contextual change hypothesis of directed-forgetting costs. In the FRR group, the instructions to forget List 1 led to a significant reduction in List 1 recall, as compared with the RRR group, producing the standard costs of directed forgetting. More important were the *indirect* costs of directed forgetting in the RFR group. Instructing the participants in the RFR group to forget only List 2, but not List 1, resulted in reduced recall for both List 2 *and* List 1, as compared with the RRR condition. The findings generalize beyond unrelated word lists, since the lists in Experiment 2 consisted of separate distinctive categories. Despite list segregation, the participants forgot a category when told to forget a different category. This outcome is unexpected from the perspective of selective rehearsal theory. It is not obvious why ceasing the rehearsal of List 2 items would affect the recall of List 1 in the RFR group, unless people could not differentiate between these lists and stopped rehearsing List 1 items, thinking they were List 2 items. In Experiment 2, categorical items were used to allow list differentiation, and

Table 2
Proportion of Words Recalled From Each List in RRR, FRR, and RFR Conditions in Experiment 2

	RRR		FRR		RFR	
List	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	.53	.14	.28	.19	.36	.16
2	.48	.19	.48	.16	.30	.15
3	.39	.16	.50	.17	.56	.20

nonetheless, reduced List 1 recall was shown. One might speculate that participants could mentally rehearse List 1 items, when told to forget List 2 items, as a distractor strategy in order to forget those items. However, the present findings did not support this prediction.

The retrieval inhibition and disrupted retrieval strategy accounts of directed forgetting do not make unambiguous predictions regarding the effects of instructions to forget a middle list on an earlier list. On the one hand, these accounts can be interpreted as implying that List 1 recall in the RFR and RRR groups should not have differed, which was not the case here. On the other hand, it may be possible to assume that inhibition could spread and create higher order inhibition, thus lowering List 1 recall in the RFR group. If the forget cue blocks access to the learning episode, one could argue that it inhibits access to both lists if the lists are not sharply segregated. Similarly, the disrupted retrieval strategy could be interpreted as implying that a retrieval strategy favoring List 3 could have disrupted retrieval strategies from both List 2 and List 1 in the RFR group, especially if people did not mentally separate the first two lists. Even with sharply segregated lists, however, List 1 recall was impaired.

To summarize, although both the disrupted strategy view and the retrieval inhibition view would not *directly* predict the outcomes of these experiments, they can nevertheless be interpreted as consistent with these findings. However, additional mechanisms or assumptions may need to be incorporated to fully explain these results.

The context change account directly predicts the forgetting of List 1 items in the RFR group by assuming that participants will be more likely to establish a new context after the forget instruction. The recall context should, therefore, match the List 3 encoding context better than it matches the List 2 or List 1 context, consequently impairing List 1 recall in the RFR group.

Although this article has focused on the costs of directed forgetting, the findings provide an opportunity to discuss possible reasons for absent benefits on List 2 in both experiments. Some researchers have proposed that benefits reflect escape from proactive interference (PI) in the forget group (e.g., E. L. Bjork & R. A. Bjork, 1996). This position predicts the benefits for the forget group under circumstances permitting sufficient accumulation of PI in the remember group. However, with shorter or categorical lists, PI accumulates more slowly, which could explain why the benefits are sometimes relatively small (in comparison with the costs)—or even absent (Conway, Harries, Noyes, Racsma'ny, & Frankish, 2000). Published studies on directed forgetting employing lists of 12 items or fewer have not consistently shown benefits, whereas studies with longer lists (15 or more items) typically have reported reliable benefits. The lack of benefits for List 2 in the FRR group may have reflected insufficient accumulation of PI in the RRR group to allow the FRR group to escape from it. In Experiment 2, the benefits in the FRR group were significant by List 3, possibly because accumulated PI in the RRR group was high enough. In Experiment 1, the lack of List 3 differences could have been caused by large variability due to unrelated items and/or by unbalanced lists, since List 3 items were not counterbalanced across presentation or recall.

Another account of benefits attributes them to better encoding of items following the forget cue (Sahakyan & Delaney, 2003). Participants in the forget group often change their encoding strategy in response to the forget instruction by adopting more elaborate study strategies. Sahakyan et al. (2004) pointed out that decisions to change encoding strategy are often mediated by participants' perceived degree of success with a study strategy. The impact of more effective study strategies, as compared with less effective ones, would likely be minimized with shorter lists, since even poor strategies such as maintenance rehearsal could result in higher recall rates with short lists. Thus, one might speculate that with shorter lists, the benefits are harder to obtain because participants are not likely to recognize a poor study strategy. For example, being able to recall 7 items out of 12 on the list may be perceived as a relative success for a study strategy, whereas recall of 7 items out of 16 may be more likely to prompt a study strategy change.

The results of the present study suggest that it is hard to selectively choose what to forget. In an attempt to forget an unwanted thought or an unpleasant episode, people often try to focus on other things and engage in more pleasant thoughts. Such an activity is likely to lead to temporarily blocked access to the troubling event. However, as a consequence, information that preceded the unwanted event and was not necessarily intended for forgetting will also become less accessible. Therefore, active efforts to suppress will temporarily impair recall for everything that preceded the attempt to forget, making it impossible to achieve *selective* forgetting.

Because directed forgetting has become popular among clinical and developmental psychologists for studying individual differences, it may be worthwhile to consider the implications of the contextual theory of directed forgetting for certain populations. Interest in the paradigm is often motivated by the assumption that costs arise from an inhibitory process. Consequently, populations with impaired or underdeveloped inhibitory functions become interesting to study, because the absence or reduction of directed-forgetting costs is interpreted as diagnostic of inhibitory impairments. However, if directed-forgetting costs reflect self-induced changes in mental context, the absence of costs in certain populations may instead be diagnostic of other cognitive deficits. In particular, the contextual change theory suggests that the lack of costs likely reflects either an inability to create a new mental context or difficulty maintaining a newly created context. Difficulties in manipulating context may be more closely tied to control of attention than to impaired inhibition.

REFERENCES

Basden, B. H., & Basden, D. R. (1998). Directed forgetting: A contrast of methods and interpretations. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 157-172). Mahwah, NJ: Erlbaum.

Basden, B. H., Basden, D. R., & Gargano, G. J. (1993). Directed forgetting in implicit and explicit memory tests: A comparison of methods. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **19**, 603-616.

Bjork, E. L., & Bjork, R. A. (1996). Continuing influences of to-be-forgotten information. *Consciousness & Cognition: An International Journal*, **5**, 176-196.

Bjork, E. L., Bjork, R. A., & Anderson, M. C. (1998). Varieties of goal-directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 103-135). Mahwah, NJ: Erlbaum.

Bjork, R. A. (1970). Positive forgetting: The noninterference of items intentionally forgotten. *Journal of Verbal Learning & Verbal Behavior*, **9**, 255-268.

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

Bjork, R. A., LaBerge, D., & LeGrand, R. (1968). The modification of short-term memory through instructions to forget. *Psychonomic Science*, **10**, 55-56.

Conway, M. A., Harries, K., Noyes, J., Racsma'ny, M., & Frankish, C. R. (2000). The disruption and dissolution of directed forgetting: Inhibitory control of memory. *Journal of Memory & Language*, **43**, 409-430.

Gamboz, N., & Russo, R. (2002). Evidence for age-related equivalence in the directed forgetting paradigm. *Brain & Cognition*, **48**, 366-371.

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

Harnishfeger, K. K., & Pope, R. S. (1996). Intending to forget: The development of cognitive inhibition in directed forgetting. *Journal of Experimental Child Psychology*, **62**, 292-315.

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

Liu, X., Bjork, R. A., & Wickens, T. D. (1999, November). *List method directed forgetting: Costs and benefits analyses*. Poster session presented at the 40th Annual Meeting of the Psychonomic Society, Los Angeles.

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

Myers, L. B., Brewin, C. R., & Power, M. J. (1998). Repressive coping and the directed forgetting of emotional material. *Journal of Abnormal Psychology*, **107**, 141-148.

Power, M. J., Dalgleish, T., Claudio, V., Tata, P., & Kentish, J. (2000). The directed forgetting task: Application to emotionally valent material. *Journal of Affective Disorders*, **57**, 147-157.

Sahakyan, L., & Delaney, P. F. (2003). Can encoding differences explain the benefits of directed forgetting in the list-method paradigm? *Journal of Memory & Language*, **48**, 195-201.

Sahakyan, L., Delaney, P. F., & Kelley, C. M. (2004). Self-evaluation as a moderating factor of strategy change in directed forgetting benefits. *Psychonomic Bulletin & Review*, **11**, 131-136.

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

Zacks, R. T., Radvansky, G., & Hasher, L. (1996). Studies of directed forgetting in older adults. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **22**, 143-156.

(Manuscript received April 2, 2003;
revision accepted for publication July 21, 2003.)