Running head: DIRECTED FORGETTING

Directed Forgetting of a Single Item

Lawrence R. Gottlob

Jonathan M. Golding

University of Kentucky

William J. Hauselt

Southern Connecticut State University

Published in Journal of General Psychology, 163, 67 - 80.

Address correspondence to Lawrence R. Gottlob or Jonathan M. Golding, 125 Kastle Hall, Lexington, KY 40506-0044; gottlob@uky.edu or golding@uky.edu.

Abstract

In two experiments, we investigated directed forgetting of a single item. Participants were presented with two phone numbers to remember. Half of the participants were instructed to forget the first phone number. The first number was either learned on a single trial (Experiment 1) or on three trials (Experiment 2). In Experiment 1, there was evidence of directed forgetting due to differential encoding; the forget instruction affected recall and recognition for both phone numbers. In Experiment 2, the evidence favored differential rehearsal because the forget instruction affected recall but not recognition. These results indicate that instructions to forget can affect memory of single items.

Directed Forgetting of a Single Item

In a typical conversation, speakers and listeners comply with a number of conversational maxims. One of these is that speakers should constrain their utterances to those that are relevant to their communicative goal (see Grice, 1975). However, it is sometimes the case that speakers impart information that is irrelevant to the conversation. This can occur in various ways: (a) when the speaker misjudges the listener's ability to identify the relevance of the information; (b) when the speaker utters a conversation aside; or (c) when information is incorrect. These situations can create difficulty for the listener. Because listeners are limited in the amount of information they can process, continued processing should occur for relevant information, but should stop for irrelevant information.

It is often the case that listeners must tag information as irrelevant based on cues implicit in the discourse context. For example, a lawyer may provide a client with her office phone number in a conversation in which a comment is made about the weather. In this situation, the phone number may be considered relevant to a goal (i.e., calling the lawyer to discuss the case), whereas information about the weather may be considered irrelevant to the goal (i.e., "small talk"). Although listeners are frequently able to identify irrelevant information by means of implicit cues, speakers can also use explicit cues to designate information as relevant or irrelevant. That is, sometimes a listener is told what information is irrelevant through the use of a phrase such as "forget that." Take the client mentioned above, he might be instructed to forget the phone

number because it was incorrect. In this case, the speaker has explicitly designated this phone number as irrelevant (i.e., to-be-forgotten information). Typically, an instruction to forget specific information would be followed by the correct or relevant phone number (i.e., to-be-remembered information).

Explicit cues to segregate irrelevant from relevant information have been shown to be effective in over 30 years of research using the directed forgetting paradigm (for recent reviews see Bjork, 1998; Golding & Long, 1998; MacLeod, 1998). In this paradigm, cues are used to designate information (typically unrelated words) as “to-be-forgotten” (TBF) or “to-be-remembered” (TBR). Although participants do not expect to be tested on the TBF information, memory for both types of information is usually measured. In general, the results of these studies have shown that these cues are extremely effective in various contexts. That is, there is typically a decrease in recall of TBF information combined with an increase in recall for TBR information, compared to cases in which there were no forget cues (e.g., R. A. Bjork, 1970; R. A. Bjork, LaBerge, & LeGrand, 1968; MacLeod, 1975, 1989; Woodward & R. A. Bjork, 1971). In this way, participants demonstrate the ability to decrease the potentially interfering effects of TBF information.

Bjork (1972) initially proposed two related encoding processes to account for directed forgetting: set differentiation and selective rehearsal. Set differentiation involved the functional segregation of TBF and TBR items as a result of the explicit cues. This segregation allowed, in turn, selective rehearsal of only the TBR information. Selective rehearsal led to an increase in TBR memory

performance because there were fewer items that needed to be rehearsed and fewer items that needed to be searched during retrieval. Because the TBF items were not processed to the same degree as the TBR items, they were relatively less accessible. This inaccessibility led to fewer TBF items recalled and recognized compared to TBR items. It should be noted that encoding differences between TBF and TBR items are generally used to explain directed forgetting when cues to forget or remember are presented after individual items. This type of presentation is referred to as the "item method" (see Basden, Basden, & Gargano, 1993).

In recent years, another mechanism for directed forgetting has received empirical support: retrieval inhibition (e.g., Basden et al., 1993; R. A. Bjork, 1989; Geiselman & Bagheri, 1985; Geiselman, R. A. Bjork, & Fishman, 1983; Harnishfeger & Pope, 1996; Hasher & Zacks, 1988, MacLeod, 1989, Zacks, Radvansky, & Hasher, 1995). Retrieval inhibition is most often implicated when the list method is used, which involves presenting an entire list of words followed by a single cue to forget the list. The TBF list is then followed by a list of TBR items to remember. Using the list-method, researchers have shown that TBF words are recalled less than TBR words, but this difference is not present in a recognition task. Since retrieval demands are minimized by recognition, the results for recognition are viewed as indicative of a "release" from the retrieval inhibition found in recall.

The purpose of the present study is to examine whether individuals can use the either of the above mechanisms to forget a single item. Previous directed

forgetting research involving a single item typically has shown that this item is extremely difficult to forget, especially if the to-be-forgotten information is seen as relevant to the task or context. This includes research on forgetting a verbal direction to a destination, corrective advertising, and instructions to disregard information in court (see Golding & Long, 1998). Only Golding and Keenan (1985) in a study involving directions to a destination have shown evidence of forgetting, and only when a spatial task was used to test for memory. There are also several studies that have shown that a single item, even if irrelevant to the task at hand, is still processed and thus remembered. These include Wegner's (1994) thought suppression studies, where participants continue to think about an item (e.g., white polar bear) even though they were instructed not to do so. In Wegner's studies, however, individuals are not specifically instructed to forget information, but rather to avoid thinking about it (see Golding & Long, 1998).

The single item to be forgotten in the present study is a phone number. Phone numbers have not been used in directed forgetting research (see Golding & MacLeod, 1998), although it is clear that outside of the lab we encounter situations that involve forgetting one phone number and remembering another phone number. Using phone numbers as stimuli is high in ecological validity; remembering phone numbers for short periods of time is a common practice, and most people are also well-practiced in using and then quickly forgetting them. Because the strategies for remembering and forgetting phone numbers are so familiar, we predicted that we would find directed-forgetting effects even with an extremely small set size. In the present study, for participants in the forget

condition, there is only one phone number to forget and one phone number to remember.

A factor that is especially critical in the current context is order of recall within each phone number. In almost all previous directed forgetting experiments, lists of words could be recalled in any order; Geiselman et al. (1983) found that input order was preserved at output much better for R lists than for F lists. Of course, with phone numbers the order of the digits is as important as the digits themselves. Because a partially-remembered or mis-sequenced phone number is almost useless, we may learn strategies to encode the whole number effectively. In addition, the well-known mapping between the traditional short-term memory capacity of seven (+/- two) digits and the seven digits of the telephone number permits coherent encoding of the complete number, sequence as well as digits. Accordingly, we measured performance both in terms of digits remembered and memory for the complete number.

In the present study, participants were presented with two phone numbers to remember in order to make specific phone calls as part of the study. Half of the participants, however, were told that the first phone number they received was incorrect and that they should forget it. In Experiment 1, participants were presented the two phone numbers only once. In Experiment 2, phone number 1 was presented three times and phone number 2 was presented once.

EXPERIMENT 1

The purpose of this experiment was to investigate whether a single phone number can be forgotten, and to determine the mechanism that might be

responsible for this forgetting. As stated earlier, it is unclear whether a single phone number can be forgotten in the directed forgetting paradigm. Moreover, if the phone number is forgotten, it is yet unclear whether this forgetting will be due to encoding differences or to retrieval inhibition. As Basden et al. (1993) point out, if encoding differences underlie the directed forgetting, then both recall and recognition should be affected. In contrast, if retrieval inhibition causes the directed forgetting, then effects would be found on recall, but not recognition.

Method

Participants

Forty-eight introductory psychology students at the University of Kentucky participated in this study in partial fulfillment of a course requirement.

Design

The experiment was a 2 (memory cue) x 2 (test) x 2 (phone number) mixed-factors design. Memory cue was manipulated between participants, and included a remember condition and a forget condition. Test (recall or recognition) was manipulated between participants. Phone Number was manipulated within participants, and included phone number 1 and phone number 2. The phone numbers were counterbalanced with regard to their presentation order. In addition, the order that participants had to recall/recognize the phone numbers was counterbalanced, with half of the participants recalling/recognizing phone number 1 first and phone number 2 last or vice versa. Twelve participants were assigned to each of the four between-participant conditions.

Materials

The phone numbers that were used were constructed so that they did not share digits in a particular position--phone number 1 was 459-1273, whereas the phone number 2 was 817-0649. Therefore, four of the digits in phone number 1 (1, 7, 4, and 9) were also in phone number 2. However, the shared digits were in a different position, and on the other side of the dash, and the three remaining numbers in phone number 2 (8, 0, and 6) were not in phone number 1. No subject reported knowing a phone number that was similar to phone number 1 or 2.

Procedure

Participants performed the experiment in small groups. For the forget condition, the experimenter told the participants that they would be participating in an experiment on the effects of partial assistance or hints on complex problem solving. They were told that they would be given a complex graduate-level math problem to solve. Participants were told that, because of the difficulty of the problem, they would be given a hint to help them solve the problem after they had first tried to solve the problem on their own.

The participants were told that to receive their hint they would be allowed to consult a graduate student "helper." The way they had to get in touch with the helper was to get up from their seat, and go into the lounge next door where there were telephones, and phone the helper for assistance. They were told that this procedure was being used because it saved time, they would not have to stray very far from the room, the graduate student offices were hard to find, and it did not require the graduate students to have to waste time being available for the duration of the experiment. They were informed that they had to remember the

correct phone number they were given in order to call a graduate student to receive their hint. This was because there were several experimenters providing hints to other groups hearing different types of problems at the same time. Participants were told that they were not allowed to write the phone numbers down and that upon finishing the problem they could leave.

At this point, forget condition participants were presented phone number 1 stimulus (written on 11 x 28 inches pieces of poster board) for five seconds. After the presentation of phone number 1, the experimenter stated the following:

> Oh no -- I'm sorry -- I've got posters for a couple of different phone numbers for the spelling words study that you are not in, and I accidentally gave you a spelling hint phone number. Please forget that one. For your hint, you need to call the following number:

The poster with phone number 2 was then presented for five seconds.

Participants in the remember condition heard a slightly altered set of instructions that told them that they would be presented with more than one phone number, and that all of these phone numbers would have to be called in order to receive their hint. When the phone numbers were presented, they saw phone number 1 and then, after an amount of time equivalent to the amount of time it took to state the additional text to the forget participants, they then saw phone number 2.

After the presentation of the phone numbers, the participants were immediately tested on their recall or recognition of the phone numbers. For recall, they had to remember each phone number by writing it on a blank sheet of paper.

For recognition, they circled the correct phone number on a sheet of paper that contained the presented phone numbers and 58 distracters (2 columns of 30 each) comprising variations of these phone numbers. It should be noted that for *forget* participants, phone numbers were labeled “told to forget” and “told to remember”, whereas for *remember* participants, they were labeled “phone number 1” and “phone number 2”..

Finally, all participants were asked whether any phone number that was presented in the experiment was similar to any phone number with which they were previously familiar. If it was, the participants were asked to write down the phone number(s). After the participants had completed their data sheets they were informed that they would not do a math problem, and thoroughly debriefed on the purpose of the experiment. Discussions with all participants did not result in any subject indicating their disbelief in the experimental procedure (including the forget instruction), and no subject reported knowing anything about the experiment before they participated.

Results

The results were scored and analyzed in two ways (Figure 1). First, total performance was measured. Each phone number recalled and recognized was compared with the correct phone number, and the total number of digits that were both the correct numeral and in the correct position was recorded. Therefore, a score for recall or recognition could vary from 0 (completely incorrect) to 7 (completely correct). Second, given that it is critical for memory of a phone to be perfect there was an all-or-none measure. Participants were scored for whether

each phone number was recalled and recognized in full (i.e., all 7 digits remembered in the correct order).

Total Score. A 2 (Memory Cue) x 2 (Test) x 2 (Phone Number) analysis of variance was conducted on these results. The ANOVA yielded a significant main effect of phone number, F (1, 44) = 26.04, $p < .01$, MSE = 3.47. This main effect was qualified by a significant Memory Cue x Phone Number interaction, F (1, 44) = 12.29, $p < .001$, MSE = 3.47. There were no interactions involving test, so the data was combined across recall and recognition. There was also no effect of order; performance was identical no matter which phone number was recalled or recognized first. This absence of an order effect held for all of the other analyses in the paper.

Based on the Memory Cue x Phone Number interaction, follow-up comparisons were conducted on forget group vs. remember group for List 1 and then List 2. Participants in the forget condition had marginally lower memory of phone number 1 than participants in the remember condition, $t(46) = 1.89$, $p < .07$. Conversely, for phone number 2, participants in the forget condition had higher memory than participants in the remember condition, $t(46) = 2.40$, $p < .05$[1].

All-Or-None Score. Given the results for Total Score, it was expected that the results for this measure would also show evidence of directed forgetting due to encoding differences. All-or-none performance was a binary variable, taking values of 0 or 1 for each participant. Therefore, we used a nonparametric statistic, the Mann-Whitney U test, to analyze the results; we report z- and p-values for

each U test. As we found for Total Score, there were no significant interactions involving recall and recognition[2], so the results were combined. For phone number 1, participants in the forget condition remembered the entire phone number with lower probability than participants in the remember condition, $z = 2.00$, $p < .05$. Conversely, for phone number 2, participants in the forget condition remembered it with higher probability than participants in the remember condition, $z = 3.03$, $p < .001$.

Discussion

There were two important findings from Experiment 1. First, although some studies have found that intentionally forgetting one item can be difficult, the present results indicated directed forgetting of a single phone number. Second, the directed forgetting appears to be due to encoding differences. This interpretation is based on the finding that both recall and recognition showed forgetting, which indicates that participants in the forget condition simply discontinued rehearsal or encoding of phone number 1 upon hearing the *forget* instruction. If participants had actually encoded both TBF and TBR numbers to the same degree, recognition performance would have been similar between F and R numbers (Geiselman et al., 1983). Directed forgetting effects on recognition are typically found when the item method is used; because the F and R instructions directly follow each word, encoding is terminated for F words. When the list method is used, encoding is presumably equal between F and R words; consequently recall generally reflects forgetting while recognition does not (B. H. Basden & D. R. Basden, 1998).

Thus, even though each phone number consists of seven digits, the pattern of forgetting indicated that participants were treating each digit string as a single item to be remembered or forgotten, and that the forget instruction terminated rehearsal of the first phone number. Given the present results, was it the case that encoding differences are necessary to obtain directed forgetting and a reduction in interference of a single item? This question was addressed in Experiment 2.

EXPERIMENT 2

The results of Experiment 1 indicated that participants treated each phone number as a distinct item. This distinctive processing (see Basden et al., 1993) led participants who were instructed to forget phone number 1 to rehearse it less than phone number 2, with the result that phone number 2 was learned better (see Johnson, 1994). The F group also had better memory than the R group for phone number 2, presumably because of the reduction of interference caused by forgetting phone number 1. One question that arose from the results of Experiment 1 was whether "forcing" participants in both groups to encode phone number 1 would invoke different mechanisms for directed forgetting or even abolish it altogether. If encoding of phone number 1 was at least as good as that of phone number 2, would directed forgetting still be found, and if so, would the pattern of results differ from that in Experiment 1?

Method

Participants

The participants were 48 undergraduates enrolled in introductory psychology classes at the University of Kentucky who did not participate in

Experiment 1. Each received partial course credit for participation in the experiment.

Design and Materials

The design and materials were the same as Experiment 1. Again, no participant reported knowing a phone number that was similar to the phone numbers used in the experiment.

Procedure

Participants performed the experiment in small groups. All participants were told that that they would be participating in an experiment investigating how people use the telephone, both how they remember phone numbers and how they interact with others on the telephone. The participants were also told that they would be presented with one or more phone numbers and then they would be asked to go to another room with a telephone to make actual phone calls. At this point the first phone number was presented as in Experiment 1 for five seconds. After this presentation, the participants were given a sheet of paper to write down the phone number. The first phone number was then presented in this same way two other times for a total of three presentations, each followed by writing the phone number down. Forget condition participants were then given the following instruction:

> I would like you to forget the phone number I just gave you. Try to erase it from your memory. You will not have to call that number. Let me now give you a phone number that you will have to call.

Participants in the remember condition were given the following instruction:

I would now like to present you another phone number using these cards. You will therefore be required to remember both phone numbers in order to make two different phone calls.

After the presentation of the phone numbers, the participants were given a 5-minute distracter task (drawing a map of the United States and labeling the states) in order to increase memory demands. This 5-minute delay also allowed us to eliminate any possible recency effects arising from the design of Experiment 1. The recall and recognition tasks were then presented as in Experiment 1.

After the participants had completed their data sheets they were informed that they would not be making phone calls, and thoroughly debriefed on the purpose of the experiment. Discussions with all participants did not result in any subject indicating their disbelief in the experimental procedure (including the forget instruction), and no subject reported knowing anything about the experiment before they participated.

Results

The results (Figure 2) were scored and analyzed as in Experiment 1.

Total Score. A 2 (Memory Cue) x 2 (Test) x 2 (Phone Number) ANOVA yielded a significant Memory Cue x Phone Number interaction, $F(1, 44) = 7.88$, $p < .01$, $MSE = .96$, and a significant Memory Cue x Test interaction, $F(1, 44) = 5.02$, $p < .05$, $MSE = 4.20$. These interactions were qualified by a significant Memory Cue x Test x Phone Number interaction, $F(1, 44) = 5.72$, $p < .05$, $MSE = .96$. Examining this interaction, it was seen that for recall of phone number 1, the forget group did not differ significantly from the remember group, $t(22) < 1$.

However, for recall of phone number 2, participants in the forget condition recalled significantly more digits than participants in the remember condition, $t(22) = 3.34$, $p < .01$[3]. For the recognition task, no interactions and no simple effects were significant.

All-Or-None Score. Similar to the analysis for Experiment 1, we used the Mann-Whitney U to analyze all-or-none responses, because of the binary nature of the measure. As we found for the total score in Experiment 2, there was a difference between recall and recognition performance, so these were analyzed separately. The pattern of recall results was the same as for the total score. One notable result from the recall task was that not a single participant in the R condition was able to recall phone number 2 in its entirety. For recall of phone number 1, the forget group did not differ from the remember group, $z = 1.22$, $p > .05$. However, for recall of phone number 2, participants in the forget condition recalled the entire phone number significantly more often than participants in the remember condition, $z = 3.72$, $p < .001$. For recognition, no simple effects were significant.

Discussion

Unlike the results of the first experiment, in Experiment 2 there was a difference between recall and recognition memory. Recall showed effects of forgetting, but recognition did not. The lack of a forgetting effect on recognition indicated that encoding of phone number 1 was equal across F and R groups; this finding is common to many studies using the list method (e.g., MacLeod, 1999; Geiselman et al., 1983; Basden et al., 1993). Thus, even though the F group

received the instruction to forget phone number 1 after its exposure, because of the forced rehearsal, they encoded it to the same extent as the R group.

The unique finding in Experiment 2 was that directed forgetting was confined to recall of phone number 2. Recall for phone number 1 was not affected by the forget instruction; because this number was rehearsed three times, it was likely learned to criterion (though not to a ceiling level) by both forget and remember participants. In stark contrast, recall for phone number 2 was almost at ceiling for the forget group, but in the remember group, recall was so low that no participant was able to recall the entire phone number! The current results suggest that the *forget* instruction acted to terminate maintenance rehearsal of phone number 1, which in turn allowed better memory for phone number 2.

GENERAL DISCUSSION

In the present study, we found directed forgetting of a single item (a phone number) in two different experiments. In Experiment 1, phone numbers 1 and 2 were exposed to the same degree; when phone number 1 was to be forgotten, recall and recognition of phone number 1 were lower and recall and recognition of phone number 2 were higher, than when both phone numbers were to be remembered. Both recall and recognition were affected by memory instruction, leading to the inference that the encoding of phone number 1 differed across conditions. In Experiment 2, phone number 1 was “overlearned” (i.e., exposed three times to the participant); recall of that number did not differ across forget and remember groups. However, recall for phone number 2 was lower for the remember group than the forget group. A plausible explanation is that the F group

terminated rehearsal for phone number 1, which allowed them to allocate greater attention (rehearsal) than the R group to phone number 2. R-group participants, presumably because they were trying to rehearse two phone numbers, suffered a decrement in recall for phone number 2. Because phone number 1 was learned to an asymptotic level by both groups, recall for phone number 1 did not differ across groups. We implicate rehearsal and not encoding for this pattern of differences, because only recall and not recognition was affected.

These results are important for several reasons. First, the results of Experiment 1 show clearly that directed forgetting of a single item can be achieved. In general, previous research on intentional forgetting has shown that individuals have great difficulty forgetting a single item (Golding & Keenan, 1985; but see Golding & Long, 1998). In addition, the pattern of results across recall and recognition appear to support Basden et al's (1993) claim that directed forgetting of individual items involves distinctive processing. Therefore, it seems likely that the results in this study are a function of differential encoding; the TBR phone number is rehearsed more than the TBF phone number. Second, this was the first directed forgetting study using phone numbers as stimuli. The results of this study, like the many directed forgetting studies in the past (see Golding & MacLeod, 1998), showed that directed forgetting is a phenomenon that generalizes across many different types of materials and contexts, inside and outside the laboratory.

In discussing the learning of TBF information, it should be noted that the methodology used in Experiment 2 is different from other directed forgetting

research that uses the item method (see Basden et al., 1993; MacLeod, 1998). In this experiment we were assured that participants actually learned the TBF item. They were presented it on three occasions and after each presentation the TBF phone number had to be recalled. Only after the third presentation (at which point the phone number had been recalled 3 times) were participants informed that the phone number could be forgotten. This is very different from prior directed forgetting experiments, where it is not altogether clear that the TBF information is ever learned. In fact, when using the item method it is likely the case that the TBF items are not learned (see Johnson, 1994; MacLeod, 1998) because these items are not rehearsed as often as the TBR items.

In conclusion, this study indicates that the phenomenon of directed forgetting is found in an ecologically-valid situation. Moreover, we have shown that individuals have the ability to use explicit memory cues in unique ways, as a function of the different memory demands that they encounter. It is hoped that future research will investigate the various mechanisms invoked by memory cues, especially in more naturalistic contexts (see Golding & Long, 1998). In addition, it will be important to determine whether the adaptive use of memory cues found in the present study is also present in children and older adults, who may differ from college students in their use of various cognitive skills.

REFERENCES

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, and Cognition, 19,* 603-616.

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. 139-172). Mahwah, NJ: Erlbaum.

Bjork, E. L., Bjork, R. A., & Anderson. (1998). Varieties of goal-directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 103-137). Mahwah, NJ: Erlbaum.

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

Bjork, R. A. (1972). Theoretical implications of directed forgetting. In A. W. Melton & E. Martin (Eds.), *Coding processes in human memory* (pp. 217-235). Washington DC: Winston.

Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. L. Roediger & 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. (1998). Intentional forgetting in perspective. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 453-481). Mahwah, 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.

Geiselman, R. E., & Bagheri, B. (1985). Repetition effects in directed forgetting: Evidence for retrieval inhibition. *Memory and Cognition, 13,* 57-62.

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.

Golding, J. M., & Keenan, J. M. (1985). Directed forgetting and memory for directions to a destination. *American Journal of Psychology, 98*, 579-590.

Golding, J. M., & Long, D. L. (1998). There's more to intentional forgetting than directed forgetting: An integrative review. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp.59-102). Mahwah, NJ: Erlbaum.

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

Hasher, L., & Zacks, R. T. (1988). Working memory, comprehension, and aging: A review with a new view. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 193-225). San Diego: Academic Press.

Johnson, H. M. (1994). Processes of successful intentional forgetting. *Psychological Bulletin, 116,* 274-292.

MacLeod, C. M. (1975). Long-term recognition and recall following directed forgetting. *Journal of Experimental Psychology: Human Learning and Memory, 104,* 271-279.

MacLeod, C. M. (1989). Directed forgetting affects both direct and indirect tests of memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 13-21.

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

MacLeod, C. M. (1999). The item and list methods of directed forgetting: Test differences and the role of demand characteristics. *Psychonomic Bulletin & Review, 6,* 123-129.

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review, 101,* 34-52.

Woodward, A. E., & Bjork, R. A. (1971). Forgetting and remembering in free recall: Intentional and unintentional. *Journal of Experimental Psychology, 89,* 109-116.

Zacks, R. T., Radvansky, G., & Hasher, L. (1995). Studies of directed forgetting in older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32,* 143-156.

FOOTNOTES

[1]List 1 memory was lower than List 2 memory for the participants in the forget condition, $t(23) = 5.01$, $p < .001$, but not for the participants in the remember condition, $t(23) = 0.49$, $p < .05$.

[2]Interaction based on ANOVA, but Mann-Whitney U was used for the simple-effects comparisons.

[3] For the forget group, phone numbers 1 and 2 did not differ, $t(11) = 1.34$, $p > .05$, but for the remember group, phone number 1 recall was significantly higher than phone number 2, $t(11) = 3.56$, $p < .01$.

FIGURE CAPTIONS

Figure 1. Experiment 1 means, for Total Score (top), and All-or-None (bottom). Scores for Total Score represent mean number of digits recalled, and for All-or-None, proportion of participants (out of 12 in each group) who remembered the entire phone number. Memory cue (*forget*: black bars; *remember*: white bars) and Test (*recall*; *recognition*) were between-participants variables. List (*phone number 1*; *phone number 2*) was a within-participant variable. Error bars represent 1 SE.

Figure 2. Experiment 2 means, for Total Score (top), and All-or-None (bottom). Scores for Total Score represent mean number of digits recalled, and for All-or-None, proportion of participants (out of 12 in each group) who remembered the entire phone number. Memory cue (*forget*: black bars; *remember*: white bars) and Test (*recall*; *recognition*) were between-participants variables. List (*phone number 1*; *phone number 2*) was a within-participant variable. Error bars represent 1 SE.