Item-Specific Encoding Produces an Additional Benefit of Directed Forgetting : Evidence From Intrusion Errors

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Abstract:

List-method directed forgetting involves encoding 2 lists, between which half of the participants are told to forget List 1. When participants are free to study however they want, directed forgetting impairs List 1 recall and enhances List 2 recall in the forget group compared with a control remember group. In a large-scale experiment, the current work demonstrated that when item-specific encoding instructions were enforced during learning, directed forgetting impaired List 1 recall, but it did not enhance List 2 recall. This pattern was found regardless of whether encoding was incidental or intentional. Whenever directed forgetting did not enhance List 2 recall, it nevertheless reduced cross-list intrusions. These results indicate that directed forgetting can help differentiate memories from one another, thereby reducing intrusions from irrelevant competing memories.

Keywords: context change | cross-list intrusions | directed forgetting | item-specific encoding | learning | forgetting | human information storage | learning | memory | psychology

Article:

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We are often bothered when memory fails us. Forgotten birthdays, missed appointments, and even the fading of our most cherished memories remind us how vulnerable we are to forgetting. However, forgetting is not always a nuisance; efficient use of memory requires the ability to forget irrelevant information and remember the relevant information (e.g., E. L. Bjork & Bjork, 1996; R. A. Bjork, 1989; MacLeod, 1988). At times, we even want to forget unpleasant events or episodes on purpose. Research in the past 30 years shows that people can intentionally forget things, a phenomenon captured in the laboratory by R. A. Bjork, LaBerge, and LeGrand's (1968) directed forgetting paradigm.

In directed forgetting experiments, people are told to forget part of the earlier encoded information. In the list method variant, participants study two lists of items. After presenting List 1, they are cued to forget it (e.g., "it was for practice" or "the wrong list"). Prototypically, the forget group produces impaired recall of List 1 (the *costs* of directed forgetting) and enhanced recall of List 2 (the *benefits* of directed forgetting) when compared with a remember control group (e.g., MacLeod, 1998). Herein we propose a third effect of directed forgetting involving enhanced differentiation of information in memory, manifesting as reduced cross-list intrusions in the forget group (cf. Lehman & Malmberg, 2009). Cross-list intrusions occur when items from another list are erroneously output during the course of testing memory for one of the lists.

To explain why forget instructions might reduce intrusions, we must describe the theories of directed forgetting. Early accounts of directed forgetting proposed that costs and benefits arise from one mechanism. For example, one account proposes that the forget cue produces the costs by inhibiting List 1 items, thereby decreasing their interference on List 2, which consequently results in the benefits (e.g., E. L. Bjork & Bjork, 1996; R. A. Bjork, 1989; Geiselman, Bjork, & Fishman, 1983). Another account suggests that the forget cue motivates participants to shift their mental context between the lists by thinking of things unrelated to the experiment (Sahakyan & Kelley, 2002). During the test, the retrieval context better matches the encoding context of List 2 than that of List 1, causing lower recall of List 1 items. The benefits occur because of contextual differentiation between the lists, which reduces interference.

More recently, two-factor accounts have emerged that attribute the costs and the benefits to different mechanisms (Pastötter & Bäuml, 2010; Sahakyan & Delaney, 2005), with different neural correlates for these effects (Bäuml, Hanslmayr, Pastötter, & Klimesch, 2008). These accounts attribute the costs to either inhibition or context change but attribute the benefits to improved List 2 encoding (Pastötter & Bäuml, 2010; Sahakyan & Delaney, 2005). For example, we proposed that the benefits emerge because the forget cue leads participants to adopt better study strategies on subsequent lists (Sahakyan & Delaney, 2003). This *strategy-change account* of directed forgetting benefits predicts no benefits in incidental learning, because (a)

there is no reason to change study strategies, and (b) study strategy is always controlled to ensure incidental learning. Indeed, two investigations involving incidental learning procedures obtained the costs without obtaining the benefits (Sahakyan & Delaney, 2005; Sahakyan, Delaney, & Waldum, 2008). Incidental learning is far from the only instance where the costs are obtained without the benefits. Our lab has contributed its share of dissociations between the costs and the benefits in the literature (Delaney & Sahakyan, 2007; Sahakyan & Foster, 2009; Sahakyan & Goodmon, 2007), but there are many reports outside of our lab with similar dissociations (Barnier et al., 2007;Conway, Harries, Noyes, Racsmány, & Frankish, 2000; Joslyn & Oakes, 2005; Macrae, Bodenhausen, Milne, & Ford, 1997; Pastötter & Bäuml, 2010; Whetstone, Cross, & Whetstone, 1996; Zellner & Bäuml, 2006).

Even if we do not observe List 2 benefits, directed forgetting may still improve memory in other ways. We suspected that materials which produce substantial cross-list intrusions might benefit from directed forgetting via reduced cross-list intrusions. If directed forgetting invokes a context change, then environmental context-change studies should prove analogous. A recent environmental context-change study had participants encode two lists of action phrases in either the same or different environments (Sahakyan, 2010). Phrases were either enacted or merely studied verbally. A memory test on both lists was later given in the same environment where List 2 was studied. Context-dependent forgetting occurred for List 1: Participants recalled fewer List 1 items when they studied the lists in different environments as opposed to the same environment. However, although there was no improvement in List 2 recall between the conditions, there were fewer cross-list intrusions when the lists were encoded in different environments as opposed to the same environment. Thus, environmental context helped list differentiation, whose benefits emerged as reduced intrusions (rather than improved recall rates). It is interesting that, when the lists were studied in the same environment, Sahakyan (2010) observed more cross-list intrusions for enacted than verbally learned actions. Enactment encourages stronger item-specific processing than does verbal encoding of actions (e.g., Engelkamp, 1998). Thus, Sahakyan's (2010) intrusion results suggest that materials invoking item-specific processing may lead to more intrusions. On the basis of this study, we suspected that we might observe reduced intrusions in directed forgetting if we implemented an item-specific orienting task.

Although no directed forgetting studies to date have observed significantly reduced intrusions in the forget group, in some studies, the forget group had numerically fewer intrusions than the remember group (Lehman & Malmberg, 2009; Sahakyan & Kelley, 2002; Sahakyan, Delaney, & Goodmon, 2008). Furthermore, a recent model of directed forgetting based on contextual differentiation predicts reduced intrusions in the forget group (Lehman & Malmberg, 2009).

One reason previous work failed to obtain significantly fewer intrusion errors in the forget group may be that people have good memory for the list from which items come. Intentional learning studies, which do not control study strategies, typically produce few intrusion errors (e.g., Zaromb et al., 2006), possibly indicating a floor effect for intrusions in earlier studies. We

suspected that incidental learning might dissociate directed forgetting benefits, as reflected in intrusion rates, from directed forgetting benefits, as reflected in the quantity of recalled items. On the basis of prior research, we expected no directed forgetting benefits in incidental learning in terms of the number of items recalled from List 2 (Sahakyan & Delaney, 2005; Sahakyan et al., 2008). However, we anticipated substantial cross-list intrusions in the remember condition, because incidental encoding in prior research led to greater difficulties with identifying items' list membership, compared with intentional learning (e.g., Geiselman et al., 1983). This could be due to either incidental encoding (e.g., participants may not encode contextual information to the same extent as when they intend to learn), or it may be driven by the item-specific processing tasks that are generally employed to implement incidental learning. Prior research documents list confusion errors when the two lists are processed with the same item-specific orienting task (Dobbins, Kroll, Yonelinas, & Liu, 1998; Gruppuso, Lindsay, & Kelley, 1997; Hunt, 2003).

Experiment

Our experiment's primary goal was to look for reduced intrusion errors following a forget instruction. To do that, we used an item-specific learning procedure that we anticipated would produce above-floor intrusion rates. Two groups learned the items using pleasantness ratings as the orienting task. One group was unaware of the upcoming memory test (the *incidental* group), and the second group was told at the outset to expect a memory test (termed the *controlled-encoding* group). These groups differed primarily in terms of the intention to learn, enabling us to discriminate whether item-specific encoding or the incidental nature of encoding was instrumental in obtaining the effect of differentiation. We also included the *traditional* directed forgetting group, which was warned to expect a test but received no special encoding instructions.

We fully controlled the recall order of the lists at the time of the test. Half of our participants were tested on List 1 first; the rest were tested on List 2 first. All reported analyses were performed only on the first-tested lists in each condition. This approach safeguards against output interference from prior recall and has been used by others in the field (Kimball & Bjork, 2002; Lehman & Malmberg, 2009).

Method

Participants and Design

Participants were 288 individually tested University of North Carolina at Greensboro undergraduates who participated for course credit. They were randomly assigned to one of the three experimental groups, with 96 participants per group. Within each group, 48 participants were in the forget condition, and 48 were in the remember condition. At the time of test, half of the participants within each cue condition were tested on their memory for List 1 first, whereas

the remaining participants were tested on their memory for List 2 first. A pure factorial Cue (forget vs. remember) × Test Order (List 1 first vs. List 2 first) × Group (incidental vs. controlled-encoding vs. traditional) design was employed.

Materials

Two lists of 15 nouns were used. For each participant, the order of the words on each list was randomized. The position of the two study lists was counterbalanced during encoding. Items are available in the Appendix.

Procedure

At the outset, the experimenter read a cover story to make the later forget instruction believable. In the *incidental* group, the cover story described comparing adults and children's perceptions of the pleasantness of different words. The cover story was identical in the *controlled-encoding* group, except that participants were warned that, in addition to the pleasantness ratings, we were also interested in their memory for words. The cover story in the *traditional* group mentioned the upcoming memory test but contained no specific instructions regarding how to study the items. The full cover stories are given in the Appendix.

In the incidental and controlled-encoding groups, participants read each word aloud and then indicated whether or not the word was pleasant by saying "yes" or "no." The experimenter monitored compliance with the instructions. Participants wore a headset that was plugged into the front of the computer, which was ostensibly recording their responses. In the traditional group, participants also read each word aloud once and spent the remaining time studying however they wished. Words appeared one-by-one for 4 s each, with a 250-ms interstimulus interval.

After List 1, in the *forget* condition, a "Sound Input Failure" error message appeared on the computer screen, accompanied by buttons labeled "Restart the Program" and "Quit and Exit." The experimenter acted as if he or she had just realized that the microphone was plugged into the wrong jack on the computer, and therefore had not been recording their responses. The experimenter apologized and asked if the participants would be willing to rate a new list, because we had lost all the data (at that point, the microphone was plugged into the "correct" jack). Once they agreed (all did), they were urged to forget the first list so that their responses would not be affected by the first list. The full forget instructions are given in the Appendix. In the *remember* condition, after List 1 participants were told that there would be another list and that they should do the same thing as before.

Participants then spent 60 s completing a worksheet containing random letters followed by a blank. They were told to fill in the next letter of the alphabet in the blank and to work as quickly and accurately as possible. Afterward, the experimenter administered a free-recall test (in the incidental group, this came as a surprise). Participants received a blank sheet of paper for 90 s,

and half were told to recall List 1 words, whereas the remaining half was told to recall List 2 words. The recall sheets were collected, and participants were given another blank sheet for 90 s and told to recall the remaining list. Finally, in the incidental group, participants were asked if they had expected a memory test and whether they had done anything to memorize the words. Seven participants were replaced because they reported rehearsing or expecting a test.

Results

To be counted toward correct recall, an item had to be recalled on the correct sheet. Items recalled on the wrong sheet were analyzed separately in the intrusion analyses. Note that this definition of "correct recall" is more conservative than is used typically in directed forgetting studies, which count any recalled item toward correct recall. We chose this definition because it produced nonoverlapping scores for proportion correct and intrusions.

Directed Forgetting Costs

A 2 Cue (forget vs. remember) × 3 Group (incidental vs. controlled-encoding vs. traditional group) factorial analysis of variance (ANOVA) was conducted on the proportion of correctly recalled List 1 words. There was a main effect of cue, $F(1, 138) = 9.72$, $p = .002$, $\eta^2 = .07$, indicating directed forgetting costs. Recall was lower in the forget condition ($M = 0.23$, $SE = .01$) than in the remember condition ($M = 0.29$, $SE = .01$). There was no interaction with group ($F < 1$). In addition to directed forgetting costs, there was also a main effect of group, $F(2, 138) = 3.73$, $p = .026$, $\eta^2 = .05$. Compared with the incidental group ($M = 0.22$, $SE = 0.01$), both the controlled-encoding group ($M = 0.29$, $SE = 0.02$) and traditional group ($M = 0.28$, $SE = 0.02$) had significantly higher recall ($p = .012$, and $p = .036$, respectively). Figure 1 summarizes the findings.
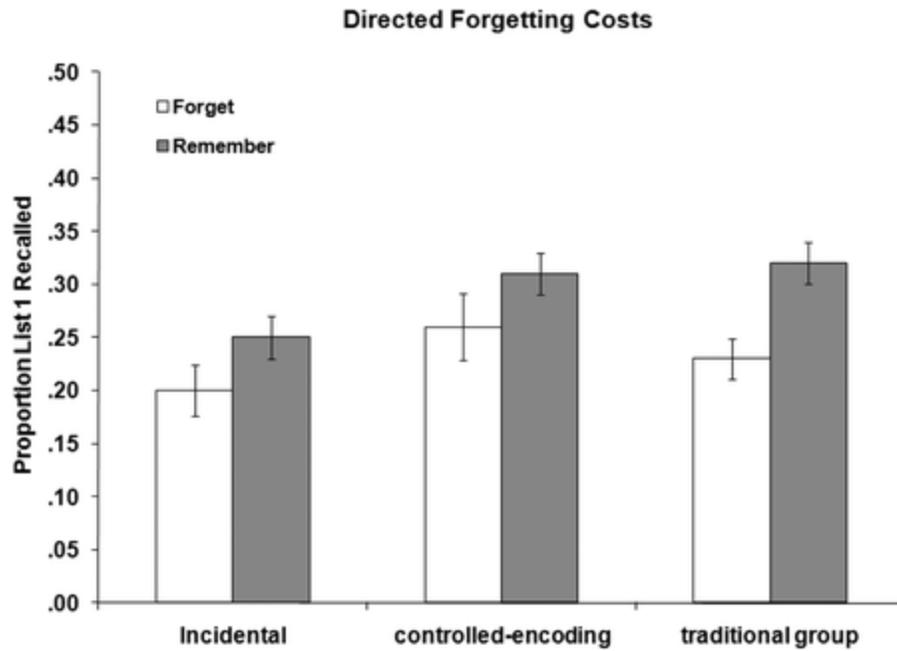
Directed Forgetting Costs

Figure 1. Mean proportion of List 1 recall (± SE) by cue and group.

Directed Forgetting Benefits

A similar analysis was conducted on the proportion of List 2 words correctly recalled. Figure 2 shows the results.
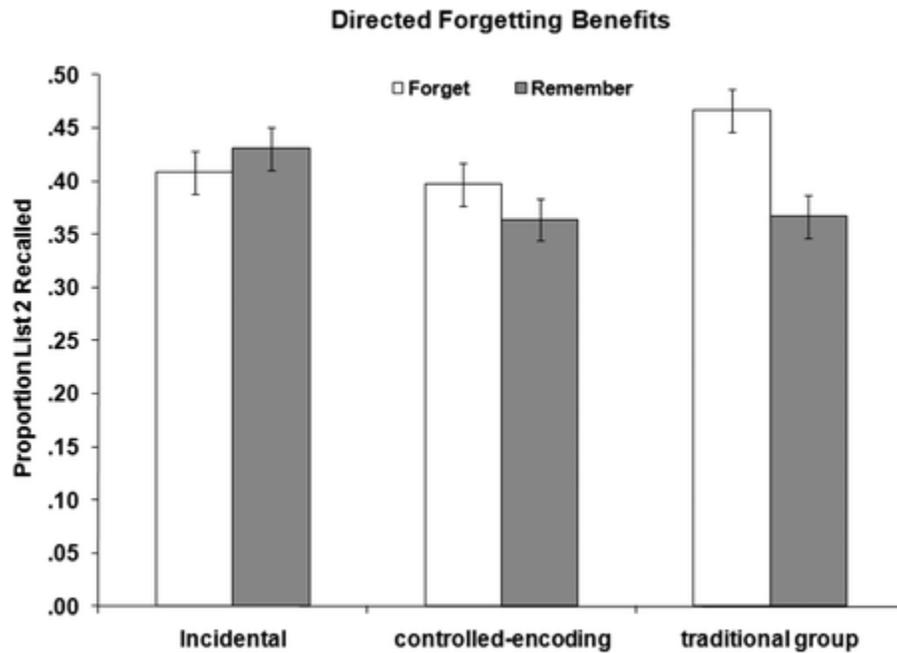

Figure 2. Mean proportion of List 2 recall (± SE) by cue and group.

Neither the main effect of group nor the main effect of cue were significant; for group, $F(2, 138)$ = 1.53, MSE = .015, p = .221; for cue, $F(1, 138)$ = 3.27, MSE = .015, p = .073. However, the Cue × Group interaction was marginally significant, $F(2, 138)$ = 2.99, p = .054, η^2 = .04. There were significant directed forgetting benefits in the traditional group as evidenced by the memory advantage of the forget condition over the remember condition, $t(46)$ = 2.28, p = .027. However, directed forgetting benefits emerged in neither the incidental group nor in the controlled-strategy group (both ts < 1). When the latter two groups were combined and compared against the traditional group, the Cue × Group interaction became significant, $F(1, 140)$ = 4.70, p = .032, η^2 = .03.

Serial Position

To validate that the traditional group employed different encoding strategies than the other groups, we examined serial position functions for the remember conditions of all three groups (see Figure 3). We focused on the remember conditions, because other studies already examined the serial position functions in directed forgetting (Geiselman et al., 1983;Lehman & Malmberg, 2009; Pastötter & Bäuml, 2010), including with materials that evoke item-specific processing (Sahakyan & Foster, 2009). A mixed factorial ANOVA with group, list, and positions (grouped into bins of three items/bin) revealed a significant Positions × Group interaction, $F(8, 276)$ = 2.76, p = .006, η^2 = .07, but no three-way interaction with list (F < 1). Figure 3 summarizes the results. In the first triplet, the traditional group had a significant primacy advantage over the incidental group (p = .013) and the controlled-encoding group (p = .013), whereas in the last triplet, the incidental and the controlled-encoding groups had a significant recency advantage over the traditional group (p = .014, and p = .039, respectively). This pattern replicated previous research demonstrating that item-specific encoding flattens primacy and reinforces recency (e.g., Seiler & Engelkamp, 2003). It therefore suggests qualitative differences in encoding strategies between the traditional group and the item-specific groups.
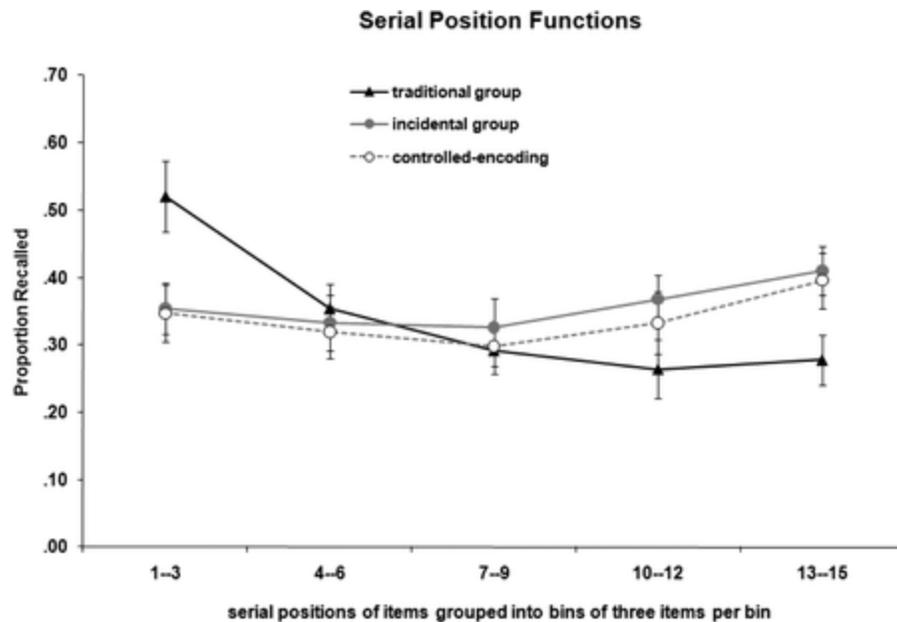
Serial Position Functions

Figure 3. Serial position functions in the remember conditions of the incidental, controlled-encoding, and traditional groups. The results are collapsed across the lists, as there was no interaction with list. The error bars represent ± SE of the mean.

Intrusion Analyses

The directed forgetting analyses discussed thus far have focused on the number of items recalled from each list. In the traditional group, the forget instruction impaired List 1 recall and enhanced List 2 recall. In contrast, in the controlled-encoding group and in the incidental group, the forget instruction impaired List 1 recall without enhancing List 2 recall. We hypothesized that even if the number of recalled List 2 items did not differ between the forget and remember groups, there might still be benefits of directed forgetting in terms of the reduced intrusion rates. If the lists become contextually differentiated, then one would expect reduced cross-list intrusions from either list in the forget group compared to the remember group (e.g., Lehman & Malmberg, 2009; Sahakyan, 2010).

In the intrusion analyses, List 1 intrusions represent the percentage of List 1 items that were erroneously recalled when List 2 was tested first in the recall sequence. Similarly, List 2 intrusions represent the percentage of List 2 items that were erroneously recalled when List 1 was tested first in the recall sequence.

The proportion of List 1 intrusions was analyzed with a 2 Cue (forget vs. remember) × 3 Group (incidental vs. controlled-encoding vs. traditional group) factorial ANOVA. Figure 4 summarizes the results. The main effect of group was not significant, $F(2, 138) = 2.08$, $MSE = .008$, $p = .129$. However, there was a main effect of cue, $F(1, 138) = 4.69$, $p = .032$, $\eta^2 = .03$, and a significant Cue × Group interaction, $F(2, 138) = 3.34$, $p = .038$, $\eta^2 = .05$. Follow-up analyses revealed no effect of group in the forget conditions ($F < 1$) but a significant group effect in the remember

conditions, $F(2, 69) = 4.42$, $p = .016$, $\eta^2 = .11$. Specifically, both the incidental group and the controlled-encoding group had more List 1 intrusions than the traditional group, as predicted ($p = .004$, and $p = .017$, respectively).
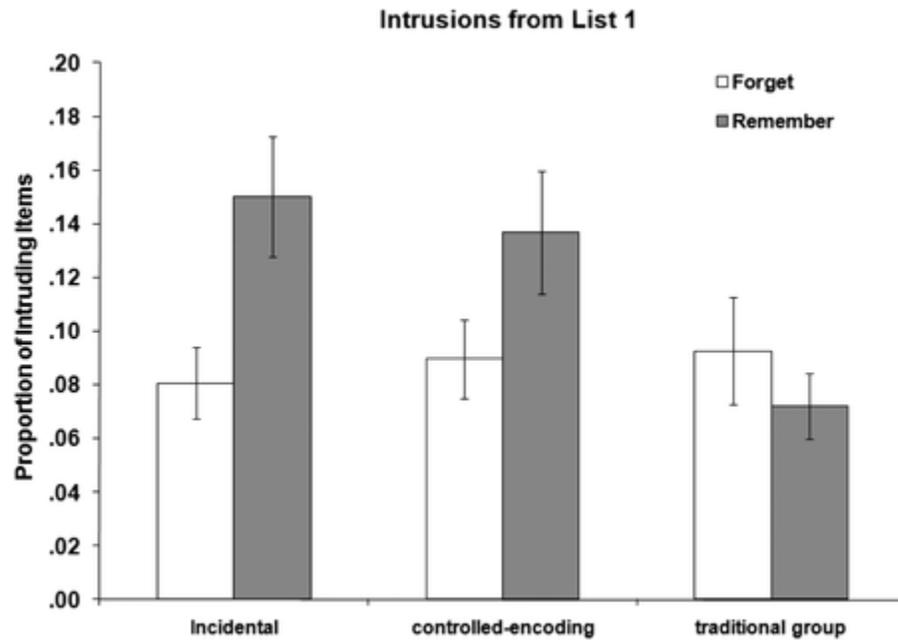

Figure 4. Mean proportion of intrusions from List 1 (± SE) by cue and group.

For List 2 intrusions, the Cue × Group ANOVA produced a main effect of cue, $F(1, 138) = 6.73$, $p = .011$, $\eta^2 = .05$, a main effect of group, $F(2, 138) = 5.78$, $p = .004$, $\eta^2 = .08$, and a Cue × Group interaction, $F(2, 138) = 3.37$, $p = .037$, $\eta^2 = .05$ (see Figure 5). Follow-up analyses revealed that the effect of group was not significant in the forget condition, $F(2, 69) = 1.74$, $MSE = .005$, $p = .184$, but was significant in the remember condition, $F(2, 69) = 5.46$, $p = .006$, $\eta^2 = .14$. Both the incidental and controlled-encoding groups had significantly more List 2 intrusions than the traditional group (both $ps = .002$).
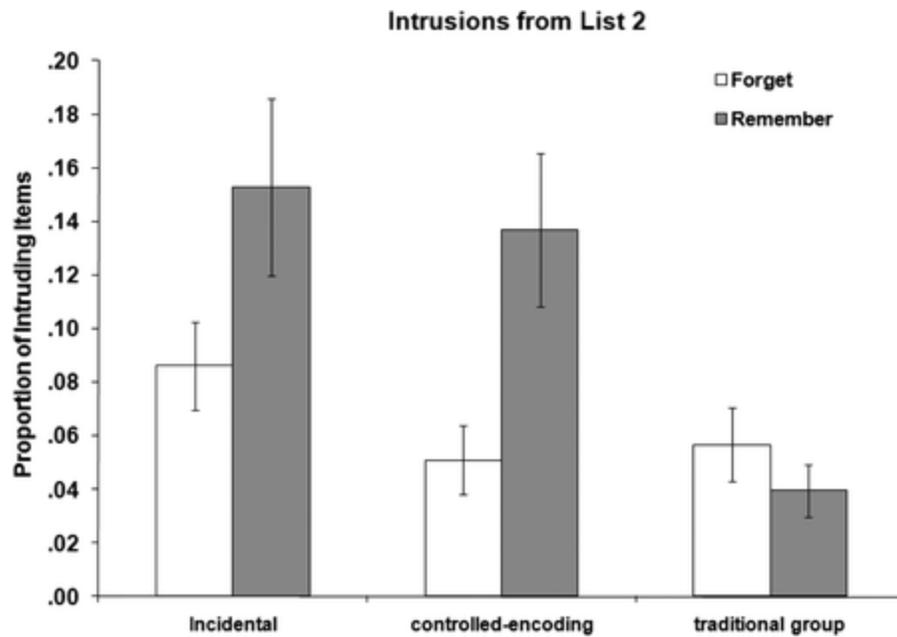
Intrusions from List 2

Figure 5. Mean proportion of intrusions from List 2 (± SE) by cue and group.

To summarize, compared with the remember cue, the forget cue had an error-reducing impact on intrusions from both lists. This was detected in the incidental group (*p* = .002) and in the controlled-encoding group (*p* = .006); however, it was not detected in the traditional group (*p* = .206). Thus, despite the absence of "traditional benefits" measured in terms of the quantity of List 2 recalled items, the forget cue reduced list confusion errors compared to the remember cue.

Discussion

Historically, directed forgetting was thought to produce two outcomes in memory: reduced memory for precue items and enhanced memory for postcue items. Our experiment demonstrated an additional benefit of intentional forgetting beyond these established effects: Directed forgetting reduced cross-list intrusion errors when item-specific encoding strategies were used. When participants rated the words—regardless of whether they encoded them intentionally or incidentally—list discrimination was better in the forget group than in the remember group.

The reduction of intrusions in the forget groups of the item-specific encoding conditions could not be attributed to lower accessibility of items in the forget group. One could have argued, for example, that if fewer List 1 items come to mind (because the forget cue reduced access to those items), there are fewer opportunities for those items to become misattributed to the wrong source. However, the forget instruction reduced intrusions from *both* lists, despite the fact that List 2 items were recalled at the same rate in the forget and remember groups. A recent model of the contextual account of directed forgetting (Lehman & Malmberg, 2009) predicts lower cross-list intrusions on both lists in the forget group, which is the pattern we observed. Contextual

differentiation should reduce intrusions from either list because the contexts of List 1 and List 2 become more distinct in the forget group and thus serve as better retrieval cues for items from their own list. In contrast, in the remember group, the List 1 and 2 contexts share more features in common, making it easy to confuse the source of items from the two lists. These findings resemble those reported in an environmental context-change study, where fewer cross-list intrusions were observed when the study contexts of the two lists were different rather than the same (Sahakyan, 2010). We predicted these outcomes on the basis of the contextual account, but other mechanisms like reduced cross-list associations might also be interpreted to produce similar effects (Bäuml et al., 2008).

Most previous studies (and our traditional group) probably did not find reduced intrusions in the forget group, because when participants are free to study any way they wish, they predominantly engage in rehearsal (e.g., Sahakyan & Delaney, 2003), which could contribute to better list discrimination compared with more item-specific encoding. Rehearsal produces chains of items during encoding that are later output together (e.g., Laming, 2009), implying that rehearsal enhances the probability of retrieving same-list items rather than other-list items during the test (i.e., it could reduce intrusions). Unlike the item-specific groups, the traditional group showed primacy (consistent with rehearsal) and fewer intrusions in the remember groups. Thus, strategic encoding differences could contribute to different intrusion rates in the remember group, making it easy or hard to detect the effect of directed forgetting on intrusions.

Other strategies besides rehearsal might also offset list confusion, making detecting reduced intrusions in the forget group difficult. For example, Golding and Gottlob (2005)reported an experiment where some participants were told to interrelate the items during encoding, whereas others were free to encode any way they wished. The authors examined categorization errors during recall, and although they did not include the strategy variable in their analyses, they reported fewer categorization errors compared with an experiment where the study strategy was completely uncontrolled. Likewise, in Geiselman et al.'s (1983) study, participants saw an alternating sequence of items and were told to judge some items for pleasantness (e.g., *judge* words) and to learn the remaining items for a later memory test without specifying the encoding strategy (e.g., *learn* words). List-classification errors were higher for the *judge* words than for the *learn* words, presumably because item-specific encoding for the *judge* words led to greater list-confusion errors. In contrast, participants may have tried to rehearse the *learn* words, which could help with list differentiation. The serial position functions plotted by Geiselman et al. (1983) support this idea, as they indicate enhanced primacy for the *learn* words and no primacy for *judge* words. Finally, in an environmental context-change study, Sahakyan (2010) found more cross-list intrusions for enacted than for verbally learned actions when the lists were studied in the same environment; however, studying the lists in the different environmental contexts reduced intrusions more for enacted than verbally learned actions.

Several prior directed forgetting papers found that the forget group was worse than the remember group at identifying items' source. Some papers tested recognition memory followed by a source identification of items (E. L. Bjork & Bjork, 2003; Gottlob & Golding, 2007; Sahakyan & Delaney, 2005), whereas others had participants recall all the items on a sheet of paper with designated columns for each of the source categories (Geiselman et al., 1983). These studies differ from the current study in many ways, but most importantly, they all involved explicit retrieval of the contextual information that accompanied each item (i.e., source). In contrast, in the current study participants did not need to explicitly retrieve the context and could rely on the cuing property of context to retrieve the items. When context is used as a retrieval cue, it selectively brings some items to mind with greater probability than others if the retrieval context matches the encoding context stored in the memory trace of those items. In contrast, source identification is a complex decision process involving attributions about memory and can be influenced by guessing biases and one's lay theories about forgetting (e.g., "This word is probably from the remember list, because I forgot the other list"). Directed forgetting may have a different effect on the use of context as a retrieval cue and the explicit retrieval of contextual information for already-retrieved items. Ideally, future research should design an experiment allowing simultaneous investigation of these two complementary problems.

Elsewhere, we have argued that the benefits emerge because some participants adopt better encoding strategies following a forget instruction and that controlling encoding strategy eliminates the benefits (Sahakyan & Delaney, 2003, 2005). Replicating earlier studies that controlled encoding strategies, we obtained no List 2 benefits. Although controlling strategy eliminates quantity-based benefits, nevertheless, we might observe contextual differentiation in the form of reduced cross-list intrusions. The results are consistent with the strategy-change account, which makes predictions about List 2 recall rates. However, the contextual account is needed to explain additional aspects of the results, specifically with respect to cross-list intrusions.

Our experiment demonstrated an additional directed forgetting benefit in reduced intrusion errors (beyond the forget instruction's established effects on precue and postcue items). This benefit is detected following item-specific encoding and may be masked when encoding is under participants' control. This study underscores the importance of controlling encoding factors in service of better understanding retrieval factors in directed forgetting.

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APPENDIX

APPENDIX A: Study Stimuli, Cover Stories, and Forget Instruction

List A: BENCH, CANDLE, CHAIR, COFFEE, DRESS, ELBOW, FLOOD, FLOWER, GAZELLE, HOTEL, MARKET, OCEAN, POTATO, SMOKE, SUGAR.

List B: APPLE, BOTTLE, CARPET, CORNER, FINGER, FISH, GRASS, GUITAR, HOUSE, JACKET, PEPPER, STREET, TICKET, TIGER, UNCLE.

In this study, we are evaluating how people's prior experiences influence which things they find pleasant and which ones they find unpleasant. Obviously, different people have different experiences, and children and adults differ in amount of their world experience and might differ in what they find pleasant or unpleasant. In this study, we are comparing the pleasantness ratings of some words between children and adults. We already obtained the ratings from the children and need your help for a comparison group. I am going to show you words one a time on the computer screen, at a rate of 4 seconds per word. Please read the word out loud and say YES if you find the word pleasant, and NO if you find it unpleasant. The microphone you are wearing on your headset will record your responses.* Do you have any questions?

*In the controlled-encoding group, a sentence was added, specifying that in addition to obtaining the pleasantness ratings, we were also interested in their memory for words.

In this study, we are interested in how well people can remember words in a list. We are going to show you words one a time on the computer screen, at a rate of 4 seconds per word. When you see the word, please read it out loud and try to remember it for a later memory test. The computer will randomly select and present some words from a large corpus of items, and we need to keep track of which words were presented to you to be able to score your responses. Therefore, you should say each word aloud so that the microphone you are wearing on your headset can record your voice. After you read the words, you should try to learn them because your memory will be tested later on. Do you have any questions?

Between the lists, the experimenter acted surprised at the "Sound Input Failure" prompt and said "I wonder what is going on… ?" After proceeding to check the microphone, (s)he said:

Oh, I know what happened. Looks like I messed up and plugged it into the headphone jack instead of the microphone jack. I am so sorry, it shouldn't have happened. We lost all the data now… Do you mind to rate another list for me? [Wait until the subject agrees.] Thank you so much. Before I restart the program, it is important that the words from the first list do not influence your ratings of the second list. Could you please try to forget those words so that they don't contaminate the data? Pretend you didn't rate anything and forget that list. Are you ready?

In the traditional group, the forget cue was identical, except with minor changes, which included the following:

Before I restart the program, it is important that the words from the first list do not influence your memory for the second list. Could you please try to forget those words so that they don't contaminate the data? Pretend you didn't study anything and forget that list. Are you ready?