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The role of forget-cue salience in list-method directed forgetting

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Research suggests that manipulating the wording of the forget cue in list-method directed forgetting affects the magnitude of directed forgetting both in younger children (Aslan, Staudigl, Samenieh, & Bauml, in press) and in older adults (Sahakyan, Delaney, & Goodmon, 2008). This occurs when the forget cue overemphasises the importance of forgetting in the current context. The present experiment investigated whether de-emphasising forgetting affected the magnitude of list-method directed forgetting in college adults. Some participants received overt forget cues that explicitly instructed them to forget earlier studied items, whereas others received covert forget cues that implied forgetting by emphasising selective remembering (e.g., ''you will only need to remember some of the items''). Results indicated equivalent directed forgetting for both types of cues. However, regardless of the type of cue received, participants who reported using specific forgetting strategies in response to the forget cue showed directed forgetting, whereas those that reported doing nothing did not show any effects. The results underscore that successful directed forgetting requires engagement of controlled processes.

Keywords: Directed forgetting; Controlled processes; Metacognition.

Forgetting is often viewed as a memory flaw. Many times this is the case—important information often escapes us right when we need it most. However, forgetting can also be functionally adaptive. Using memory efficiently requires the ability to forget irrelevant information and remember relevant information. Such a need usually arises from implicit cues in the situation or environment. For example, when new versions of software applications become available, people must reduce access to the out-of-date software functions and commands in order to adapt to the new work environment. Sometimes, however, the need to forget is stated explicitly. An instructor might ask new students to forget bad techniques or habits that were learned earlier and to instead learn new techniques and ways of performing.

Bjork (1989) described intentional forgetting as a functional process that allows the memory system to update itself. Intentional forgetting is often studied using the directed forgetting procedure, invented by Bjork, LaBerge, and Legrand (1968). Directed forgetting studies involve presenting participants with some information and instructing them to either remember or forget portions of that information. The forget or remember cues are delivered either on an item-by-item basis (i.e., item method), or after a block of items have been presented (i.e., list method). The current study used the list method, and therefore we limit further discussion to list-method studies.

In the list method participants study a list of words, then receive a cue instructing them to either remember or forget that list, and then study

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a second list. Free recall tests show impaired memory for List 1 and enhanced memory for List 2 for the forget group relative to the remember group (e.g., Bjork, 1970; Geiselman, Bjork, & Fishman, 1983; Reitman, Malin, Bjork, & Higman, 1973; Sahakyan & Kelley, 2002). These effects are known as the costs and benefits of directed forgetting, respectively (for reviews, see Bauml, 2008; Bjork, Bjork, & Anderson, 1998; MacLeod, 1998).

Although directed forgetting effects have been demonstrated consistently across different procedures and laboratories, the manner in which the forget cue is delivered differs from study to study. Researchers have employed one of two broad categories of forget cues: cues that explicitly instruct the forgetting of List 1, and cues that highlight the selective remembering of List 2. Explicit forget cues typically tell participants that List 1 was ''just for practice'' and that there will be no test on items from this list (e.g., Basden, Basden, & Gargano, 1993; Sahakyan & Kelley, 2002). In contrast, selective remembering cues imply List 1 forgetting by telling participants that they will only be tested on List 2 (Epstein, 1969a, 1969b; Lehman & Malmberg, 2009; Shebilske & Epstein, 1973). For example, Lehman and Malmberg (2009) told participants that they were going to study three lists but would only have to remember one of the lists, the identity of which would be revealed later in the experiment. The remember group proceeded to study all three lists with no mention of which list would be later tested, whereas the forget group studied the first two lists and were then told that the next list would be the tested list and that they ''[did] not need to worry about the first two lists''. Although there is no explicit mention of forgetting, the selective remembering cue used here implies that the first two lists can be forgotten. Lehman and Malmberg (2009) obtained both costs and benefits using this procedure.

Do selective remembering cues produce effects of similar magnitude as the explicit forget cues? This is the focus of the current investigation. Although both types of cues imply List 1 forgetting, framing a forget instruction in terms of remembering may affect the magnitude of directed forgetting. People become more aware of their memory's limitations when predictions of future memory performance are framed in terms of how much will be forgotten rather than how much will be remembered (Finn, 2008; Koriat, Bjork, Sheffer, & Bar, 2004). Explicitly instructing someone to forget recently learned information may prompt people to think about their own memory and forgetting abilities to a greater extent than simply giving them a selective remembering instruction. Furthermore, if directed forgetting requires the activation of ideas of forgetting, then framing a forget cue explicitly could produce effects of greater magnitude than framing the cue in terms of remembering

Research has shown that the wording of the forget cue can produce significant costs in populations that do not typically show directed forgetting. For example, Sahakyan et al. (2008) observed directed forgetting in older adults only when they used a ''modified'' forget cue, which encouraged participants to engage in forgetting despite thinking that they had already forgotten—a common sentiment among older adults. Likewise, Aslan et al. (in press) obtained directed forgetting in first graders only when they emphasised the need to forget (i.e., the experimenter pretends that the wrong list was presented, acts flustered, and encourages the participants to forget the ''incorrect'' list), but not with the standard forget cue (i.e., participants are told to forget the list because they would not be tested on it). Both of these studies over-emphasised the forget cue in order to obtain directed forgetting in populations that do not typically respond to directed forgetting. However, the modifications of the forget cue had no effect on young adults in those studies, presumably because they engaged in directed forgetting even with the regular instruction. We investigated whether young adults may show diminished directed forgetting if the forget cue de-emphasised the idea of forgetting by leaving out any mention of the word ''forget'' altogether. We hypothesised that variations in the forget cues may activate different ideas about memory and forgetting, and alter the magnitude of directed forgetting even in younger adults. If a forget cue explicitly mentions the need to forget a list of words, people may be more inclined to engage in effortful forgetting strategies compared to selective remembering cues which may be less likely to activate the idea that forgetting requires effort. In Sahakyan et al. (2008) older adults reported engaging in specific strategies when the forget cue placed a high emphasis on the need to forget, whereas with the standard forget cue older adults did not deploy any strategies to forget, in part because they believed they had already forgotten the target list. Whether older adults showed directed forgetting or not depended on whether

they engaged in forgetting strategies in response to the forget cue.

In this study we evaluated the magnitude of the directed forgetting across overt and covert forget cues. Overt forget cues are the same as the standard forget instruction employed in the majority of directed forgetting research, whereas covert forget cues are the same as a selective remembering instruction, which emphasises remembering only one of the lists without instructing participants to forget anything. We also collected retrospective verbal reports of the different forgetting strategies that participants used in response to the forget cue, as well as the reports regarding the study strategies used to encode the items.

METHOD

Participants

Participants were 160 UNCG undergraduates who participated for course credit.

Design

The study employed a Cue (forget vs remember) by Salience (overt vs covert) by List (list 1 vs list 2) mixed factorial design, with List as the only within-participants variable.

Materials

A total of 32 unrelated medium frequency nouns were split into two lists of 16 items each. The order of the two lists was counterbalanced during encoding. Within each list, the presentation order of the items was randomised for each participant.

Procedure

Participants were presented two lists of words to study for a later memory test. Words were presented on the computer screen for 4 seconds per item. Participants in the overt-forget group first studied List 1 but were then told that this list was a ''practice list'' designed to help them get used to the task. They were told that their memory for that list would not be tested and that they should try to forget those words. The overt-remember group was told to remember List 1 because the list would be tested later. Thus overt forget and remember cues explicitly specified that participants should either forget or remember the first list.

The forget and remember cues were also delivered covertly. Participants in these conditions were told at the beginning of the experiment that they would study two lists but only one of the lists would be tested later on. They were told to study the lists until receiving further instructions about which list would be tested. After List 1, the covert-forget group was told that only List 2 would be tested later on, whereas the covert-remember group was not told anything about which list would be tested; it was simply told to prepare to study a second list of words. Thus the covert cues did not explicitly instruct participants to either forget or remember List 1.

After List 2 participants received a free recall test. They were given a blank sheet of paper for 90 seconds and instructed to write down as many List 1 items they could remember. The forget group participants were told to write down these words even though they were told they would not be tested on them. Participants were then given another blank sheet for 90 seconds to recall List 2.

Finally, participants completed a brief questionnaire. In the forget groups we asked, ''Did you believe me when I told you that you would not be tested on List 1? Please write down yes or no.'' In addition, we inquired about what participants did in response to the forget cue. In the overt group we asked, ''What did you do to forget list 1? If you clearly remember what you did, please write that down. If you do not remember clearly, please do not make up anything at this point. If you did not do anything to forget the words, or if you specifically tried to remember them, please indicate this.'' In the covert group we asked, ''When you finished studying the first list and I told you that you would only have to remember the second list, what did you do? If you clearly remember what you did, please write that down. If you do not remember clearly, please do not make up anything at this point. If you did not do anything, or if you specifically tried to remember List 1, please indicate this.''

We also inquired about the study strategies from all participants by asking them, ''What did you do to learn the words from List 1 and List 2?'' The data from this aspect of the questionnaire will be discussed briefly in the General Discussion. More central to the current investigation were the

reports of the forgetting strategies, which we coded and analysed.

RESULTS

An item was scored as correct regardless of whether it was recalled on the corresponding recall sheet, as is typical in directed forgetting studies. Recall was analysed with Cue (forget vs remember) × Salience (overt vs covert) × List (list 1 vs list 2) mixed analysis of variance (ANOVA), where List was the only within-participants factor. The results are summarised in Table 1. There was a significant directed forgetting effect as implied by the List × Cue interaction, $F(1, 156) = 29.75$, $p < .001$, $\eta^2 = .16$. There was also a significant recency effect, favouring List 2 recall ($M = .39$, $SD = .19$) over List 1 recall ($M = .34$, $SD = .19$), as confirmed by the main effect of List, $F(1, 156) = 11.42$, $MSE = .021$, $p < .01$, $\eta^2 = .07$. (None of the remaining main effects or interactions was significant: all Fs < 1, except for the List × Salience interaction, $F(1, 156) = 1.67$, $p = .19$.) To evaluate the costs and the benefits of directed forgetting we examined the recall of each list separately as a function of Cue and Salience. Although salience did not interact with cue in the higher-order analysis, we nevertheless included it in the analyses because it is central to the paper.

The analysis of List 1 recall revealed a main effect of Cue, $F(1, 159) = 10.56$, $MSE = .033$, $p < .01$, $\eta^2 = .07$, with impaired recall in the forget group ($M = .29$, $SD = .18$) compared to the remember group ($M = .38$, $SD = .18$). Neither the main effect of Salience nor the interaction was significant, Fs < 1. The same factors were used to analyse List 2 recall. There was a significant main effect of Cue, $F(1, 159) = 8.31$, $MSE = .034$, $p < .01$, $\eta^2 = .05$, with enhanced recall in the forget group ($M = .43$, $SD = .17$) compared to the remember group ($M = .35$, $SD = .19$). Neither the main effect of Salience nor the interaction was significant, Fs < 1. To summarise, we obtained the costs and the benefits of directed forgetting regardless of whether the forget cue was delivered in an overt or covert manner. Cue salience did not differentially affect the magnitude of directed forgetting.

TABLE 1
Proportion recalled as a function of Salience, Cue, and Study List

	List 1 (costs)		*List 2 (benefits)*	
Cue	*Covert*	*Overt*	*Covert*	*Overt*
Forget	.30 (.17)	.28 (.19)	.43 (.17)	.44 (.18)
Remember	.40 (.17)	.37 (.19)	.34 (.18)	.36 (.21)

Values in parentheses represent *SD* of the mean.

Next we analysed retrospective reports to see how the salience manipulation affected the use of forgetting strategies. Prior research suggests that, in older adults, directed forgetting depends on the use of forgetting strategies (Sahakyan et al., 2008). If participants in the overt and covert forget conditions utilised forgetting strategies equally often, this may explain why the salience manipulation might not have been significant.

The effect of forgetting strategies on directed forgetting

Responses on the brief questionnaire contained information about the strategies people engaged in in response to the forget cue. The most frequent responses included (1) stopping rehearsal of List 1 words, (2) engaging in thoughts unrelated to List 1 words (termed *diversionary thought*), (3) pushing List 1 words out of mind, (4) not thinking of List 1 or letting List 1 words come to mind (termed *do not think*), (5) clearing head and setting List 1 words aside, and (6) doing nothing. The classification of the reported strategies into the six categories was rather unambiguous; the experimenters independently coded the responses and had 100% agreement. Table 2 shows the percentage of overt and covert forget-group participants who reported these strategies.

Evaluating the relative effectiveness of different strategies in directed forgetting requires substantial sample sizes and should become an important goal for future research.[1] In the current experiment we opted to combine the first five categories in Table 2 into a single condition denoting participants who engaged a forgetting strategy (termed the *doing-something* group), and compared that condition against the participants who reported doing nothing (termed the *doing-nothing* group).

[1]Numerically, out of the first five forgetting strategies listed in Table 2, most were associated with directed forgetting except for the "pushed words out of mind" strategy and the "clear head /set words aside" strategy, which were associated with the absence of directed forgetting.

TABLE 2
Percentages of forget-group participants who used different forgetting strategies as a function of Salience

Forgetting strategy:	*"stopped rehearsal"*	*"diversionary thought"*	*"pushed words out of mind"*	*"did not thinkof words"*	*"clear head/ set words aside"*	*"did nothing to forget"*
Covert	20%	17.5%	5%	15%	15%	27.5%
Overt	7.5%	27.5%	2.5%	37.5%	2.5%	22.5%

Out of all forget participants, 25% reported doing nothing in response to the forget cue. Interestingly, the probability of doing something versus nothing did not vary between the overt and the covert forget cue conditions, $\chi^2 < 1$ (see Table 2). In other words, cue salience did not differentially impact the probability of engaging a forgetting strategy. Next we analysed List 1 and List 2 recall as function of Salience (overt vs covert) and Group (doing-something vs doing-nothing vs remember). Based on prior research from our lab with older adults, we expected to obtain directed forgetting only for those participants who reported engaging in a forgetting strategy.

A Salience by Group ANOVA on List 1 recall revealed a main effect of Group, $F(2, 154) = 7.03$, $MSE = .032$, $p < .01$ (see Figure 1, top panel). The doing-something group recalled significantly fewer items than the remember group, implying directed forgetting costs, $t(138) = 3.74$, $p < .001$. However, there was no significant difference between the doing-nothing group and the remember group, $t < 1$. The difference between the doing-something and doing-nothing forget groups approached significance, $t(78) = 1.90$, $p = .06$. Neither the main effect of Salience, nor the interaction were significant, both Fs < 1.

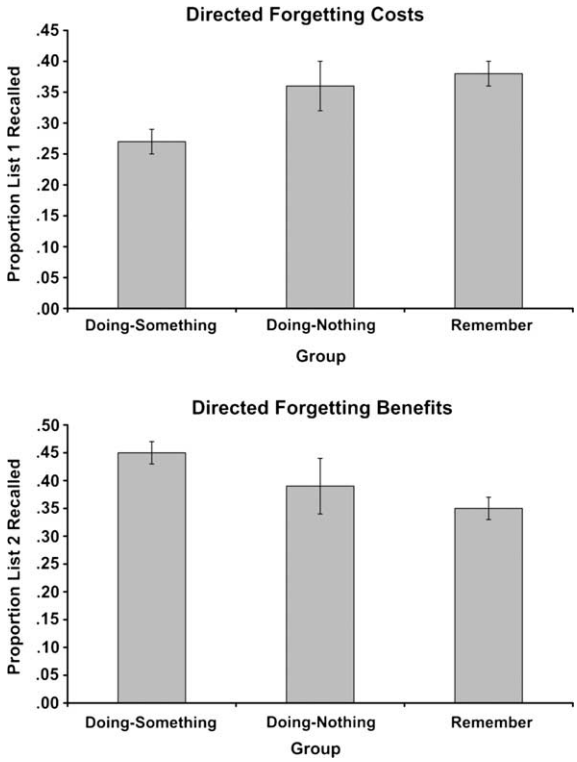

Figure 1. Mean proportion List 1 recall (top portion) and List 2 recall (bottom portion) by group. The error bars represent $\pm SE$ of the mean.

The same analysis was performed on List 2 recall and revealed a main effect of Group, $F(2, 154) = 4.93$, $MSE = .033$, $p < .01$ (see Figure 1, bottom panel). Recall was significantly higher in the doing-something than in the remember group, implying directed forgetting benefits, $t(138) = 3.27$, $p < .001$. In contrast, the doing-nothing group did not differ from the remember group ($t < 1$), suggesting that there were no benefits in the doing-nothing group. The difference between the doing-something group and the doing-nothing group was not significant, $t(78) = 1.31$, $p = .20$. There was neither a main effect of Salience nor interaction, both Fs < 1.

The results suggest that engaging in forgetting strategy is crucial if the costs and benefits are to be obtained. Participants who reported using a specific strategy in response to the forget cue showed both the costs and the benefits, whereas participants who did nothing showed no directed forgetting. This pattern was found regardless of whether the forget cue was overt or covert as indicated by the absence of any main effects or interactions with salience.

DISCUSSION

We had hypothesised that the overt forget cues might lead to greater directed forgetting effects than the covert cues, because the overt cues are more likely to prompt participants to engage in specific strategies in order to forget. Covert cues, on the other hand, may not activate the notion that forgetting requires effort, and therefore participants may be less likely to engage in forgetting strategies, which would lead to smaller

directed forgetting effects. Although we obtained directed forgetting with both types of cues, the magnitude of the effect was unaffected by whether the cues explicitly mentioned forgetting or emphasised selective remembering instead. Equivalent directed forgetting for the two salience groups were obtained despite utilising larger samples than are employed in directed forgetting studies.

Although the framing of the cue in terms of explicit forgetting or selective remembering did not matter for the magnitude of directed forgetting, the use of a specific forgetting strategy produced greater costs and benefits compared to when no forgetting strategy was used. This finding was obtained irrespective of the overt or covert cue type. Understanding why some participants chose to engage forgetting strategies whereas others did not requires additional research. One possibility is that doing-nothing participants did not trust the forget cue and instead believed they would be tested on List 1. In the post-experimental questionnaire, 34% of the forget group participants reported "not believing" the forget cue. However, there was no correlation between the belief in the forget cue and whether or not participants used a forgetting strategy (phi coefficient was $\varphi = .08$, $p = .50$). In fact some participants engaged forgetting strategies despite not trusting the cue (32%), whereas others trusted the cue but did not necessarily do anything in response to it (60%). This suggests that deciding to use forgetting strategies was not simply motivated by whether or not participants trusted the forget cue. Given that we found significant directed forgetting only among those that reported engaging in forgetting strategies, we further subdivided the doing-something group into those who believed the forget cue ($N = 41$) and those who did not believe the forget cue ($N = 19$). Separately comparing these conditions to the remember group revealed significant directed forgetting in both groups ($ps < .01$). This result further emphasises that what matters in directed forgetting is whether or not participants engaged in specific strategies rather than whether they trusted the forget cue.

Another possibility is that the reason that the presence of a forgetting strategy matters in directed forgetting is that it is simply correlated with a strategy switch. Prior research suggests that the forget group is more likely than the remember group to switch from shallow encoding on List 1 to better encoding strategies on List 2 (Sahakyan & Delaney, 2003). It could be that, in the current study, the doing-something participants were overall more strategic than the doing-nothing participants, in that they were more likely to switch to better encoding strategies (in addition to using a forgetting strategy). The strategy shift was shown to contribute to directed forgetting benefits (Sahakyan & Delaney, 2003), but it may also contribute to the costs because it could enhance the context shift (Sahakyan & Kelley, 2002). Therefore we examined the List 1 and List 2 encoding strategies to see if doing-something participants were more likely to switch to better encoding strategies compared to doing-nothing participants.

Following Sahakyan and Delaney (2003), we coded a study strategy on each list as shallow if the participant reported rehearsal, intermediate if the strategy involved creating inter-item associations between a few words, and deep if it involved interactive imagery, a story mnemonic, or creating sentences. Then we coded whether or not participants switched to a better strategy on List 2 (e.g., switching to intermediate or deep strategy on List 2 was coded as "switching"). The experimenters independently coded the responses and had 100% agreement.

Consistent with prior research, we found that the forget group was twice as likely to switch to a better encoding strategy on List 2 than the remember group, $\chi^2(1, N = 160) = 3.37$, $p = .06$. However, in the forget group there was no correlation between the likelihood of engaging in the forgetting strategy and the likelihood of switching to a better strategy on List 2 (phi coefficient $\varphi = -.06$, $p = .62$). Although the costs and benefits obtained in the doing-something participants were substantially larger among those who switched strategies between the lists ($ps < .005$), they were nevertheless also significant among those who did not switch strategies ($ps < .05$). Thus engaging forgetting strategies helped reduce access to List 1 words, which in turn reduced proactive interference on List 2 words even among those participants who did not switch study strategies.[2]

[2]Although Sahakyan and Delaney (2003) argued that the strategy switch effect was much larger than the escape from proactive interference in obtaining List 2 benefits, they nevertheless found escape from proactive interference in their study, although it did not reach significance. The current results are not inconsistent with their claims although the relative sizes of these effects were different across these two studies.

Overall, the decision to use a forgetting strategy may hinge on people's beliefs about the efficacy of their own memory as well as ideas about what it means to forget something intentionally. Research suggests that theory-based inferences are implicated in metacognitive processes of monitoring and control (Koriat, 1997; Koriat & Bjork, 2006). In the context of directed forgetting, participants who perceive their memory to be poor may not even try to forget (e.g., Sahakyan et al., 2008). In contrast, participants who perceive their memory to be good may be more likely to consider ideas about forgetting, which could dictate their decision to employ a forgetting strategy. For example, believing that intentional forgetting is an effortful process may increase the use of forgetting strategies. However, participants who believe that intentional forgetting is not an effortful process may react passively to the forget cue and show less forgetting as a result. Understanding how metacognitive processes contribute to directed forgetting should become a priority for future research.

Research showed that the intent to learn per se is not an important variable in remembering; what matters more is what people do to learn the information (Hyde & Jenkins, 1973; Mandler, 1967; Postman, 1964). One may be tempted to conclude from our salience manipulation that the intention to forget does not matter because even with implied exclusion we obtained directed forgetting. However, the strategy analysis reveals that the results were mainly driven by participants who developed strategies. Whether the covert-group engaged strategies with an intention to forget List 1, or whether forgetting happened as a consequence of engaging controlled processes is less clear. The current results unambiguously suggest that what matters in directed forgetting is how people respond to the forget instruction, regardless of whether that cue explicitly instructs them to forget, or merely implies forgetting. Anderson (2005) has suggested that just because the intention to forget is not made explicit in a task does not mean that controlled forgetting processes will not be recruited. Studies using the retrieval-practice paradigm have shown that instructions to retrieve recently learned information can cause forgetting for other information (Anderson, Bjork, & Bjork, 1994; Anderson & Spellman, 1995). Never during the retrieval-practice paradigm are participants instructed to forget. Anderson (2005) argues that active control processes can be recruited either by an individual's intention to forget or when a task requires a demand for control. In our experiment the demand for control is made explicit in the overt-forget group: participants are told to forget List 1. In the covert-forget group the demand for control may come from emphasising the importance of remembering only List 2, which may activate the notion that interference from List 1 would be harmful. In order to overcome this interference, controlled processes are recruited and targeted towards List 1, the consequence of which is reduced List 1 recall.

Overall, the current results are consistent with findings with older adults, and underscore the importance of engaging forgetting strategies for the emergence of directed forgetting even among younger adults.

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