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Item-method directed forgetting: Effects at retrieval?☆

Tracy L. Taylor*, Laura Cutmore, Lotta Pries

Department of Psychology and Neuroscience, Dalhousie University, 1355 Oxford Street, PO 15000, Halifax, NS B3H 4R2, Canada

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A B S T R A C T

In an item-method directed forgetting paradigm, words are presented one at a time, each followed by an instruction to Remember or Forget; a directed forgetting effect is measured as better subsequent memory for Remember words than Forget words. The dominant view is that the directed forgetting effect arises during encoding due to selective rehearsal of Remember over Forget items. In three experiments we attempted to falsify a strong view that directed forgetting effects in recognition are due *only* to encoding mechanisms when an item method is used. Across 3 experiments we tested for retrieval-based processes by colour-coding the recognition test items. Black colour provided no information; green colour cued a potential Remember item; and, red colour cued a potential Forget item. Recognition cues were mixed within-blocks in Experiment 1 and between-blocks in Experiments 2 and 3; Experiment 3 added explicit feedback on the accuracy of the recognition decision. Although overall recognition improved with cuing when explicit test performance feedback was added in Experiment 3, in no case was the magnitude of the directed forgetting effect influenced by recognition cueing. Our results argue against a role for retrieval-based strategies that limit recognition of Forget items at test and posit a role for encoding intentions only.

1. Introduction

Intentional forgetting occurs when participants successfully implement top-down control to limit unwanted encoding and/or unwanted retrieval (see Anderson & Hanslmayr, 2014 for a review). In the laboratory, an item-method directed forgetting paradigm is used to elicit intentional forgetting at encoding (see MacLeod, 1998 for a review). Participants are presented with items – most often words – one at a time, each followed by an instruction to Remember or Forget. If the instruction is to Remember, participants engage in elaborative rehearsal to commit the item to long-term memory. If the instruction is to Forget, participants engage frontal control mechanisms (Bastin et al., 2012; Hauswald, Schulz, Iordanov, & Kissler, 2011; Van Hooff & Ford, 2011; Wylie, Foxe, & Taylor, 2008; Yang et al., 2013) to withdraw attentional resources from the Forget item representation (Fawcett & Taylor, 2010, 2012; Taylor, 2005; Taylor & Fawcett, 2011; Thompson, Hamm, & Taylor, 2014; see also Rizio & Dennis, 2013) and thereby limit further rehearsal (e.g., Hourihan & Taylor, 2006). Successful implementation of the memory instructions is inferred from a directed forgetting effect, which is defined as better subsequent memory for Remember items than Forget items.

Using an item-method paradigm, directed forgetting effects occur for explicit tests of memory but not for implicit tests (e.g., Basden, Basden, & Gargano, 1993; Paller, 1990) and occur for *remember* but not for *know* responses (Basden, 1996; Gardiner, Gawlik, & Richardson-Klavehn, 1994). While general information about the Forget items persists in memory, specific details are lost (Fawcett, Taylor, & Nadel, 2013a, 2013b). Indeed, Forget items that are accidentally remembered despite the intention to Forget are represented with less fidelity than items that are intentionally remembered (Fawcett, Lawrence, & Taylor, 2016), and with a seemingly weaker trace strength (Thompson, Fawcett, & Taylor, 2011). Together, these results are consistent with the dominant view that Remember and Forget items are attended and maintained in working memory until the memory instruction is presented (e.g., Gardiner et al., 1994; Hsieh, Hung, Tzeng, Lee, & Cheng, 2009; Paz-Caballero, Menor, & Jiménez, 2004) but that an instruction to Forget prevents further elaboration of the unwanted trace. As a consequence, any long-term representation of an unwanted Forget item exists in a relatively weak and/or degraded state that makes its retrieval relatively more effortful than that of an intentionally encoded

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* Corresponding author.
E-mail address: ttaylor2@dal.ca (T.L. Taylor).

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Remember item (e.g., Ullsperger, Mecklinger, Müller, 2000). Nevertheless, the fact that Forget items are represented at all argues that encoding control is not absolute (e.g., Gao et al., 2016; Lee, Lee, & Tsai, 2007).

The fact that Forget items might exist in a weak and/or degraded state raises the possibility that there may be additional contributions to item-method directed forgetting from decision-making strategies that operate at retrieval. One such strategy might be to base recognition decisions on absolute signal strength and/or quality (e.g., recollective details). Such a strategy would tend to favour successful retrieval of Remember items compared to weakly encoded and/or poorly represented Forget items. Thus, even when items defy the intention to Forget at encoding and a long-term representation is formed, there may be processes – in addition to those that take place at encoding – that operate to limit their successful recognition. Indeed, a number of imaging studies indicate that Forget items are less accessible and require more effort to retrieve than Remember items (e.g., Nowicka, Jednoróg, Wypych, & Marchewka, 2009; Paz-Caballero & Menor, 1999; Ullsperger et al., 2000; Van Hooff, Whitaker, & Ford, 2009). These results tend to be explained by inhibitory processes operating to suppress the Forget item representation at encoding and/or retrieval; however, rather than positing a role for inhibition – which should be viewed with some skepticism (MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003) – we prefer the conclusion that Forget items are less accessible and relatively more difficult to retrieve *precisely* because imperfect encoding control leads to weak and/or degraded Forget item traces. And it is this weak or degraded state that – despite increased efforts at retrieval – might make Forget items particularly vulnerable to retrieval strategies that favour recognition of more robust representations.

To be clear: We do not presume that any such effects operating at retrieval are primarily responsible for item-method directed forgetting. We merely wonder whether such processes have a role in those instances when control over encoding is incomplete. If so, it should be possible to increase retrieval of Forget items by cueing participants with respect to the expected strength and/or quality of the trace. To wit, if participants know that a test item might have been a Forget word at study, they might be inclined to base their recognition decision on a weaker and/or poorer quality representation than they might have absent such a cue.

MacLeod (1975) reported the results of a study that could potentially speak to this hypothesis. He presented study trials in an item-method paradigm and then had participants return for testing after a 1- or 2-week retention interval. Testing consisted of a 3-alternative forced-choice recognition task for which participants were required to select a studied word from amongst two simultaneously presented unstudied foil words. A key manipulation was that on some of the recognition trials, a cue informed participants whether the word they were attempting to recognise had received a Remember or a Forget instruction at study. MacLeod (1975) found no significant effect of recognition cueing on the directed forgetting effect, countering our suggestion that a cue to potential signal strength/quality should assist recognition of weakly encoded Forget items. We would argue, however, that MacLeod's (1975) study might not have provided a strong enough test of the hypothesis. Even if normal (unintentional) forgetting over MacLeod's (1975) uncharacteristically long retention intervals left the relative strength and quality of memory traces intact, a forced-choice recognition test might be a less sensitive measure than a more typical yes-no recognition test. This is because decisions in choice recognition tasks are relative (i.e., is one of the test items *more* familiar than the other(s)?) rather than absolute (i.e., is the test item presented alone sufficient to drive a recognition response?).

With this in mind, we conducted three experiments that presented cues in a yes-no recognition task that followed immediately after the study phase of an item-method directed forgetting paradigm. At study, words were presented one at a time, each followed by an instruction to Remember or Forget. At test, we colour-coded these studied words and intermixed them with an equal number of similarly coloured unstudied foil words. When test words were coloured black, they provided no information about the memory instruction that had been presented at study; these trials were akin to how yes-no recognition is usually tested. In contrast, when test words were presented in green, they cued a potential Remember item; when presented in red, they cued a potential Forget item. Our goal was to determine whether the magnitude of the directed forgetting effect would be relatively reduced when decision-making at retrieval was aided by a colour-coded cue to potential signal strength/quality (i.e., because of facilitated retrieval of weak/degraded Forget item traces). The three experiments testing this hypothesis were identical except that in Experiment 1 we intermixed the presentation of uncued and cued yes-no recognition trials; in Experiments 2 and 3 we blocked their presentation; and, to Experiment 3, we added explicit feedback on the accuracy of the recognition response.

2. Experiment 1

To determine whether retrieval-based decision processes contribute to directed forgetting effects in a yes-no recognition task, Experiment 1 incorporated recognition cues into such a task. These cues were intended to inform participants of potential item strength/quality and thereby counter a potential over-reliance on strong/high-quality indicators of absolute recognition. The goal was to determine whether recognition cues reduce the magnitude of the directed forgetting effect that is otherwise obtained in a yes-no recognition test.

2.1. Methods

2.1.1. Participants

A total of 34 Dalhousie University students participated in exchange for psychology course credit. All participants were tested individually in a single experimental session that lasted approximately 1 h.

2.1.2. Stimuli and apparatus

Psyscope X (http://psy.cns.sissa.it; cf. Cohen, MacWhinney, Flatt, & Provost, 1993) was used to present stimuli and collect responses using 24″ iMac computers equipped with extended universal serial bus keyboards and mice. All text was displayed in black font on a uniform white background, except for cued items on the recognition test, which were coloured red or green. A fixation cross ("+") and written task instructions were presented in size 24 font; all other text was presented in size 12 font. The instruction to Remember consisted of a string of 6 "R"s (i.e., "RRRRRR"); the instruction to Forget consisted of a string of 6 "F"s (i.e., "FFFFFF").

A list of 320 words was drawn from the online MRC Psycholinguistics Database (http://websites.psychology.uwa.edu.au/school/MRCDatabase/uwa_mrc.htm). These words had an average concreteness rating of 578 (R = 500–670), an average familiarity rating of 552 (R = 501–646), and an average Kuçera-Francis word frequency rating of 52 (R = 1–787), with an average length of 4.7 letters (R = 3–7) and 1.3 syllables (R = 1–3). Custom software was used to randomise and divide the 320-item word list into two lists of 160 study words and 160 foil words. The software further subdivided the study words into a list of 80 Remember words and 80 Forget words: 40 of the items on each of these lists were randomly selected to be coloured black at test; 20 were selected to be coloured green; and, 20 were selected to be coloured red. The 160 foil words were likewise randomly subdivided into a list of 80 words that were coloured black at test; 40 that were coloured green; and, 40 that were coloured red. This custom program was executed prior to collecting each data set.

2.1.3. Procedure

Participants provided written informed consent and were given a verbal overview of the experiment, which was reiterated on the computer monitor before they proceeded to the study trials. The