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Event-method directed forgetting: Forgetting a video segment is more effortful than remembering it

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ABSTRACT

Videos were presented depicting events such as baking cookies or cleaning a fish tank. Periodically, the video paused and an instruction to Remember (R) or Forget (F) the preceding video segment was presented; the video then resumed. Participants later responded more accurately to cued-recall questions (E1) and to true/false statements (E2–5) regarding R segments than F segments. This difference was larger for specific information (*the woman added 3 cups of flour*) than for general information (*the woman added flour*). Participants were also slower to detect visual probes presented following F instructions compared to those presented following R instructions. These findings suggest that intentional forgetting is an effortful process that can be performed even on segments of otherwise continuous events and that the result is a relatively impoverished representation of the unwanted information in memory.

1. Introduction

In a typical directed-forgetting paradigm, participants are presented with a series of study items (words, pictures, sentences, etc.) each of which they are instructed to either remember (R) or forget (F). When memory is subsequently tested for both the R and F items, participants perform better for R items compared to F items. This difference is referred to as a directed forgetting effect. There have been many variants of the directed forgetting paradigm that differ primarily in terms of how and when the R and F instructions are presented (for a review see Basden & Basden, 1998 or Bjork, 1972). Most of these variants have been categorized as belonging to either the item method or the list method (see Basden, Basden, & Gargano, 1993; for a review, see MacLeod, 1998).

The item-method paradigm, first developed by Bjork and Woodward (1973), is generally employed to study intentional forgetting at encoding. In this paradigm, study items are presented one at a time, each followed by an R or F instruction (e.g., Hourihan, Ozubko, & MacLeod, 2009; MacLeod, 1989; Quinlan, Taylor, & Fawcett, 2010); memory is subsequently tested for all items. A directed forgetting effect obtained using the item method is attributed to selective rehearsal of the R over the F items (Basden et al., 1993), accomplished in part by the engagement of cognitive mechanisms that actively withdraw processing resources from the representation of the unwanted F item in working memory (Fawcett & Taylor, 2010; Taylor, 2005; Taylor & Fawcett, 2011) and any other items that enter working memory shortly thereafter (Fawcett & Taylor, 2012). In contrast, the list-method paradigm is generally employed to study intentional forgetting at retrieval. In this paradigm, a single R or F instruction is presented following study of a complete list of items, after which participants are asked to remember a second list (e.g., Geiselman, Bjork, & Fishman, 1983; McNally, Clancy, Barrett, & Parker, 2004); a directed forgetting effect is measured as better subsequent memory for List 1 items for participants receiving an R instruction rather than an F instruction (referred to as the *costs* of directed forgetting) as well as superior performance for List 2 items for participants receiving an F instruction rather than an R instruction (referred to as the *benefits* of directed forgetting). Although the directed forgetting effect obtained using the list method has historically been attributed to inhibition of the F list at retrieval (e.g., Basden et al., 1993; Geiselman et al., 1983), more recent data suggests that a change in mental context between the R and F list presentation may play at least some role (Sahakyan & Kelley, 2002). Importantly, inhibitory and context-driven accounts of list-method directed forgetting need not be mutually exclusive and many modern theorists still believe inhibition to play a crucial role in this paradigm (e.g., Pastotter, Kliegl, & Bauml, 2012; Racsmány & Conway, 2006).

Recognizing the limitations of these traditional paradigms, Golding and Keenan (1985) and later Gottlob, Golding, and Hauselt (2006)

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explored whether participants could forget part of a continuous narrative. Golding and Keenan (1985) found that participants remembered erroneous spatial directions to ensure that these errors were not incorporated into future navigational decisions. In other words, marking the directions as irrelevant did not lead to intentional forgetting, as happens when an F instruction is applied to discrete words or lists of words, purportedly because whereas that information became nominally irrelevant to the navigational task, being erroneous did not render the directions functionally irrelevant as they could still prevent a wrong turn. In contrast, Gottlob et al. (2006) found that participants were capable of intentionally forgetting phone numbers that had been labeled as erroneous and replaced by the "correct" number. In this case, there was no inherent value to remembering the irrelevant phone number so it was successfully forgotten.

Joslyn and Oakes (2005) conducted the first diary study of directed forgetting in which participants kept a written record of the events they experienced across a two-week period. After the first week, half of the participants were instructed to forget the entries they had recorded whereas the remaining participants were given no such instruction. The participants who received an F instruction recalled the descriptive titles of fewer Week 1 events compared to the participants who did not receive this instruction. No difference was observed for the details of the events for which participants successfully retrieved the title, although it is possible that retrieval of the title may have resulted in a release of inhibition (e.g., Bjork & Bjork, 1996) and/or reinstatement of context (e.g., Sahakyan & Kelley, 2002) masking any differences for this measure. While innovative, it is possible that participants recorded central details pertaining to the reported events making them more readily retrieved so long as the titles of the events were available. This issue is not easily resolved using self-generated information but rather requires the presentation of events under controlled conditions.

Fawcett, Taylor, and Nadel (in press) addressed this concern using a novel *event-method* directed forgetting paradigm in which they embedded R and F instructions into videotaped vignettes that depicted a continuous sequence of events aimed at accomplishing a single goal (e.g., baking cookies).[1] In their study participants watched four videos depicting common events (e.g., such as baking cookies) during which they were instructed to remember certain segments of the otherwise continuous event and forget others. Each video consisted of eight segments lasting 35 s that were presented sequentially without interruption so that, from the participants' perspective, the video was a continuous sequence of events. Memory instructions were represented by changing the color of the border that surrounded the viewing port containing the video: Participants were required to remember everything that was presented in the video while the border was green and to forget everything that was presented in the video while the border was purple. The assignment of the R and F instructions was randomized across segment, with the restriction that each video contained four R segments and four F segments.

Across five experiments, Fawcett et al. (in press) observed better subsequent memory performance for R segments compared to F segments using test questions or true/false statements. This difference remained even when an event segmentation task (see Zacks, Tversky, & Iyer, 2001) was employed to encourage conceptual encoding of the *entire* video (i.e., all R and F segments). In their final experiment, Fawcett et al. (in press) demonstrated that the effect of intentional forgetting in this paradigm was smaller (or even non-existent) for relatively general test statements (e.g., *the woman added flour*) compared to the robust effect observed for relatively specific test statements (e.g., *the woman added 3 cups of flour*). This finding suggests that intentional forgetting has a graded effect on the to-be-forgotten information, with a greater loss of details relative to gist (although see Joslyn & Oakes, 2005).

Fawcett et al. (in press) provided a strong test of the hypothesis that participants could selectively forget the details of unwanted events when the memory instructions were presented concurrent to the studied material. Concurrent memory instructions unobtrusively indicated the R and F information without interrupting the events to which they referred and therefore emulated a natural viewing experience. However, this finding would be ever more compelling if demonstrated in a paradigm wherein the memory instruction was presented after the to-be-remembered or to-be-forgotten segment had already been encoded. Whereas a concurrent memory instruction requires the participant to control the manner in which the R or F information is encoded, a delayed memory instruction requires the participant to control the representation of the R or F information within memory. Accordingly, Fawcett et al. (in press) demonstrated that participants could preferentially ignore F segments and process R segments as they were encoded, impacting the specificity of the resulting memory trace. It is our current goal to determine whether participants are capable of preferentially suppressing F segments and processing R segments immediately after they have been encoded — and whether this effect will also be limited to relatively specific information. To address this question the current experiment adapted Fawcett et al.'s (in press) paradigm to use a delayed as opposed to a concurrent memory instruction: Following each segment, the video paused, the screen cleared and participants received a green- or purple-filled circle instructing them to remember or forget the *preceding* segment. Further, to explore the mechanisms via which the R and F instructions are instantiated in our task we presented a visual probe ('*') requiring a speeded detection response following most of the R and F memory instructions (see Fawcett & Taylor, 2008; see also, Fawcett & Taylor, 2010, 2012; Taylor, 2005; Taylor & Fawcett, 2011).

2. Experiment 1

In Experiment 1, participants viewed videos of common events such as baking cookies or cleaning a fish tank. The videos were each separated into eight discrete segments lasting 35 s: Participants were instructed to remember a random half of the segments contained within each video and to forget the remainder. Participants were also required to make a speeded response to report the detection of a probe sometimes presented following the memory instruction. Longer reaction times (RTs) were taken as an index of increasing cognitive demands (see Kahneman, 1973). Following the study phase trials, participants responded to questions testing their knowledge for *all* video segments regardless of the associated memory instruction. Recent evidence within the item-method has revealed that enacting an F instruction is an effortful process capable of slowing subsequent responses (e.g., Fawcett & Taylor, 2008), interacting with visual attention through the magnification of inhibition of return (Taylor, 2005; Taylor & Fawcett, 2011), and interfering with the formation of incidental memories (Fawcett & Taylor, 2012). These behavioral findings, along with recent neuroimaging work (e.g., Wylie, Foxe, & Taylor, 2008) suggest that intentional forgetting may under certain circumstances involve the engagement of active control processes aimed at suppressing further processing of the unwanted information. In light of these findings, in addition to predicting that participants would respond more accurately when tested for R compared to F segments, to the extent that instantiating an F instruction is more effortful than instantiating an R instruction (Fawcett & Taylor, 2008) we also

[1] We have adopted the term *event-method directed forgetting* to describe Fawcett et al. (in press) as well as the current paradigm because it emphasizes the target of the R and F memory instructions. Whereas item-method directed forgetting pairs each memory instruction with a specific item and list-method directed forgetting pairs each memory instruction with a specific list, the memory instructions in the current study cannot be ascribed to either. Each segment is no more an item than a list. The segments instead represent the dynamic combination of visual features into a cohesive vignette with numerous sub-elements that are broadly conceptualized as "events". In adopting this terminology we recognize that certain past experiments also fall within this definition (e.g., Joslyn & Oakes, 2005) — we do not claim to be the first to study the intentional forgetting of events or actions, we only intend to encourage others to recognize that the item/list-method nomenclature is perhaps unbefitting to such instances.