Emotional constraints on intentional forgetting

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Abstract

One way people control the contents of their minds is intentional forgetting—voluntarily forgetting events after they have happened. The events people would most like to forget are unpleasant and emotional. This study used a directed forgetting procedure with emotional and neutral pictures to examine whether people can intentionally forget emotional events as easily as mundane ones. When the to-be-forgotten list was neutral, participants showed successful intentional forgetting. But when the to-be-forgotten list was emotional, directed forgetting failed. Results contribute to understanding the ways that emotion constrains mental control by capturing mental processes including memory retrieval. Emotion may short-circuit attempts to forget those parts of the past people would most like to forget.
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Introduction

In the film *Eternal Sunshine of the Spotless Mind* (Gondry, 2004), a corporation named Lacuna, Inc. has developed technology for the focused erasure of unwanted memories. Customers choosing this procedure all want to erase painful memories—ex-lovers, departed spouses, long-time pets. What happens when a person tries to forget an emotional past? Research suggests that the mind treats emotional events differently from mundane ones, often resulting in better recall when people try to remember. But emotional memories are also unique in another way. Sometimes, people do not want to remember. This article asks whether emotional memories linger when people would rather forget.

Emotion and memory

Emotions are functional because they signal important events and prepare a body and mind to react (Dolan, 2002; Frijda, 1986; Tooby & Cosmedes, 1990). For example, emotions draw attention to the most relevant aspects of the

environment (Ohman, Flykt, & Esteves, 2001), color the interpretation of new information (Murphy & Zajonc, 1993), and guide decision-making (Bechara, Damasio, & Damasio, 2000). These cognitive adjustments make a person more sensitive to cues that may pose a threat or require action. In short, emotions are signals that an event is important and requires a response. Along with these other cognitive adjustments, emotion may enhance memory. A strong memory for a painful event will help avoid it in the future, while a strong memory for a pleasant event will help seek it out again. From an adaptationist perspective, a well-designed cognitive system is likely to build in a preference for emotional memory.

In a well-known study based on this rationale, Brown and Kulik (1977) predicted that dramatic events such as the assassination of John F. Kennedy should produce strong and detailed photograph-like memories. Although such "flashbulb" memories do appear to be accompanied by subjective qualities such as vividness and confidence, later research showed that they are not necessarily accurate (Neisser & Harsch, 1992; Talarico & Rubin, 2003). In some cases, autobiographical memory for emotional events is more distorted than memory for neutral events (Marsh, Tversky, & Hutson, 2006). The fact that even highly

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emotional memories can be prone to errors led some theorists to doubt whether emotion plays the strong role in memory that was posited (Brewer, 1992; McCloskey, 1992).

The perspective emerging from recent research puts these two views in a larger context. Even though emotional memories are not photograph-like copies of experience, well-controlled studies have shown that emotion can enhance memory accuracy (e.g., Bradley, Greenwald, Petry, & Lang, 1992; Ochsner, 2000). Memory is strengthened most for the central, emotionally meaningful aspects of events, often at the expense of peripheral details (Easterbrook, 1959). Neuropsychological evidence suggests that interactions between the amygdala and hippocampus are critical (e.g., Cahill & McGaugh, 1998; Hamann, 2001; McGaugh, 2003; Labar & Phelps, 1998; Ochsner & Schacter, 2000; Phelps, 2004). These studies show that emotionally arousing events spark intense amygdala activity. The amygdala is believed to alter how the hippocampus consolidates memories, resulting in preferential memory for emotional events. These findings suggest that, all else equal, emotional events are more likely to be remembered than unemotional events. We know almost nothing, however, about how emotional memories respond when people deliberately endeavor to erase them.

Intentional forgetting

People spend a lot of time trying to regulate the contents of their own minds. One way they do so is "up-front," by selectively attending to certain aspects of their world (Jacoby, Kelley, & McElree, 1999). This may be one of the most successful ways to control the contents of memory because how people direct their attention strongly affects what they later recall (Broadbent, 1957). Another way people regulate their thoughts is "on-line," by intentionally suppressing particular thoughts. On-line regulation can be successful or unsuccessful depending on certain factors, including whether attention and a good distracter are available (Wegner, 1994). Both methods of mental control can be fragile. Attention can be captured, and suppressed thoughts can rebound. But once a person has attended to an event, thought about it, and consigned it to memory, there is still one option. He or she may choose to forget.

Research on intentional forgetting shows that people can forget certain information when they wish to (Bjork, 1970; Bjork & Woodward, 1973). In a typical directed forgetting experiment, participants study a list of words with instructions to remember them for a later test. In one condition (the Forget condition) the experimenter tells participants to forget the first list, which they have already studied, and concentrate on learning a second list. In the other condition (the Remember condition) participants are told to remember both lists of words. On a later test, both groups are asked to recall all the words on both lists, ignoring any previous instructions to forget.

There are two consistent effects in this kind of study. First, participants in the Forget condition recall fewer words from the to-be-forgotten list than participants in the Remember

condition, which is *prima-facie* evidence for intentional forgetting. However, demand effects could also cause some subjects in the Forget condition to withhold words from the first list that they actually remember. The second result is more difficult to explain away with demand effects; participants in the Forget condition show better memory for the second list than participants in the Remember condition. This finding provides evidence that participants in the Forget condition do not have the first list as a source of interference. Participants in the Remember condition have two sets of items competing for retrieval, but those in the Forget condition have only one. These two results—lower recall of the to-be-forgotten words and higher recall of the to-be-remembered words—make up the intentional forgetting effect.

The key to intentional forgetting is what happens when memories are retrieved. The importance of retrieval has been demonstrated in studies that compare recall and recognition memory tasks. Success on either kind of task requires that items be encoded and stored. Whereas recall tasks require active search and retrieval of a memory, recognition tests present the studied item as a direct cue to memory. That item needs only to be checked against whatever representation is stored. Because the directed forgetting effect is strong on recall tasks but weak or absent on recognition tasks, theorists have concluded that retrieval inhibition, rather than unlearning, is key to intentional forgetting (Bjork, 1989; Geiselman, Bjork, & Fishman, 1983; but see Sheard & MacLeod, 2005). Because participants in the Forget condition perform well on a recognition test of the to-be-forgotten words, the items must be stored in memory. But retrieval is blocked in the Forget condition.

Bjork (1989) provides an example of how this trick of memory benefits drivers when parking in a new spot every day. For today, it is useful to remember where the car is parked. But it is also useful to forget where the car was parked yesterday, as it prevents confusion about where the car is now. Intentional forgetting can help update memory for any changing information, like wrong directions, a switched meeting time, or a friend's new phone number. But is it equally effective for forgetting an ex-lover's phone number after a painful breakup? We have only the slimmest evidence about how intentional forgetting fairs against an emotional memory.

Intentional forgetting and emotion

A few studies have examined intentional forgetting in the context of emotion. These studies have mainly concerned clinical disorders and coping styles. For example, Power and colleagues (2000) reported that clinically depressed participants showed no directed forgetting for unpleasant words (see also Hertel & Girstle, 2003). Depressed participants showed improved recall for to-be-forgotten words without a corresponding change in recall of the to-be-remembered second list.

Myers, Brewin, and Power (1998) tested whether individuals with a repressive coping style—a tendency to avoid and deny negative emotions—were especially adept at

forgetting unpleasant information. The study used a traditional intentional forgetting paradigm with emotionally pleasant and unpleasant words as items. Independent of coping styles, the results replicated the basic directed forgetting effect for both pleasant and unpleasant words. Taking individual differences into account, repressors showed lower recall of unpleasant words when they were instructed to forget them compared to non-repressors. They did not, however, show any enhanced recall of to-be-remembered items (see also Myers & Derakshan, 2004).

Further examining the idea of memory repression as a coping strategy, McNally and colleagues (2004) tested for intentional forgetting of trauma-related versus pleasant words among persons who had reported experiencing abuse as children. Results showed two basic findings. First was a standard directed forgetting effect, in which to-be-remembered words were better recalled than to-be-forgotten words. Second, trauma-related words were better remembered than pleasant words for all subjects. The directed forgetting effect was no different for trauma-related versus pleasant words, and those subjects reporting childhood abuse did not differ from control subjects who had not reported abuse.

These studies have focused on *who* is likely to show enhanced or disrupted intentional forgetting of specific kinds of emotion-related memories. However, previous research has not addressed the fundamental relationship between emotion and intentional forgetting. The studies just described did show significant directed forgetting effects for pleasant, unpleasant, and trauma-related words, suggesting that intentional forgetting for emotional words is greater than zero. But the studies do not answer the question of whether emotional events resist intentional forgetting, for two reasons. The first reason is that none of the studies included a control condition in which emotionally neutral items were compared to emotionally significant items. We cannot, therefore, draw any conclusions about whether intentional forgetting is different for emotional as compared to mundane items. If, for example, a significant directed forgetting effect were found for emotional words, but the effect for non-emotional words were twice as large, then this pattern would be informative about the role of emotion in limiting intentional forgetting.

The second reason that the relationship between emotional events and intentional forgetting remains unanswered may be even more important. Previous studies used emotion-laden words as stimuli, such as "sex" and "death." Though words like these certainly convey emotional information, by themselves they produce very little emotion. The question we are really interested in is about events that change the way a person feels. It is not clear that emotional words can answer that question, because a significant directed forgetting effect for those items might simply mean that participants respond to them as fairly mundane events. To better address events that evoke emotions we used photographs. The power of pictures to elicit emotions is clear to anyone who has been repulsed by violent movies or charmed by baby photos. Consider the difference between

reading the word "murder" and seeing a bloody crime scene photograph. To test the effect of emotion on intentional forgetting we decided to use photos powerful enough to change participants' emotional states.

We first briefly summarize a pilot study confirming that the picture items affected participants' emotions. Following the pilot study we report the main experiment, which tested whether participants could selectively forget emotional material. Based on findings that emotion tends to capture and monopolize mental resources, we expected that participants would show the typical directed forgetting effect for neutral items, but little or no directed forgetting for emotional items.

Pilot study

Thirty-seven undergraduate volunteers (23 women, 14 men) participated. We selected 16 pleasant and 16 unpleasant photos from a set of images used to elicit emotional reactions (Lang, Bradley, & Cuthbert, 1995). One group was randomly assigned to study pleasant items and the other to study unpleasant items. During the study phase, each item was presented for 2.5 s in the center of a computer monitor, with a 2 s interval between each item.

Following the picture viewing, participants completed a mood questionnaire. Mood items were selected from commonly used mood adjective checklists, but were tailored to the kinds of mood we expected to be most relevant for the items studied. Participants were asked to rate the extent they were feeling each of the following at the present moment, on a scale from 1 (not at all) to 7 (extremely): *elated, interested, happy, entertained, calm, amused, depressed, angry, nervous, disgusted, annoyed, sad, hostile, afraid, uncomfortable.*

The mood items were averaged into a single index of mood, with negative mood items reverse coded (Cronbach's alpha = .85). Higher values reflect more positive mood. As predicted, participants in the pleasant condition reported significantly better mood ($M = 4.89$, $SD = .71$) than participants in the unpleasant condition ($M = 3.97$, $SD = .80$), $t(35) = 3.72$, $p < .001$. These results confirm that the images were sufficient to affect participants' emotional experiences.

Main experiment

This experiment manipulated the emotional relevance of items in the context of a directed forgetting paradigm. Participants studied two lists of picture items. After studying the first list, half of participants were instructed to forget that list because it was only practice for the critical memory list. The other half was instructed to remember both the first and second lists. Crossed with this Remember–Forget manipulation was a manipulation of Emotional versus Neutral pictures. Because we were interested in the effects of emotional significance, rather than pleasant or unpleasant emotions, we included both pleasant and unpleasant images in the emotional condition.

Method

Participants

Two hundred-eighteen undergraduates (120 women, 96 men, and two who failed to report gender) participated.

Materials

Images were selected from a standardized set of stimuli published by Lang et al. (1995). Sixteen pleasant and 16 unpleasant items were selected such that they were matched on arousal ($M = 5.20$ and 5.29, respectively) and differed only in pleasantness ratings (Pleasant: $M = 7.54$, Unpleasant: $M = 2.69$). Thirty-two neutral items were selected. These were intermediate in valence ($M = 4.99$) and lower in arousal than the emotionally significant items ($M = 3.76$). The lower arousal ratings for neutral items are of necessity because arousal is strongly correlated with emotion, both pleasant and unpleasant in valence.

So that items could be recalled verbally, each item was assigned a simple descriptive name consisting of one or a few words. For example, a picture of a dead dog was named "dead dog," and a picture of a playful father and children was named "father and two girls." When the items were presented for study, one photo at a time was presented on a computer monitor, with its name directly below it. We took care that the names referred unambiguously to only one item. We selected names so that if a participant remembered an image but could not remember the verbal name, simply describing the photo would provide the approximate name. Items were selected to be unrelated to each other conceptually.

Design and procedure

The design of the study was a 2 (List 1 Emotionality: Emotional vs. Neutral) × 2 (List 2 Emotionality: Emotional vs. Neutral) × 2 (Instruction: Forget vs. Remember) between groups design. Because we were interested in the effect of emotional relevance, rather than pleasantness or unpleasantness, both pleasant and unpleasant items were included in the emotional group (for a total of 32 items per list). Within each group, items were randomly intermixed. Emotionality was manipulated on both List 1 and List 2 so that the effect of trying to forget emotional items could be separated from the simple presence of emotional items on the to-be-remembered list. The emotional and neutral items were divided into two sets, which were counterbalanced through the first and second lists. Each set of items was thus equally likely to appear on the first or second list, across participants.

Following the same procedure as the preliminary study, participants were introduced to a study on memory for images. Before beginning the study phase they were told to study the images and names because they would be asked to remember them later. Each item was presented for 2.5 sec, with a 2 sec interval between items. After the first list had been presented, participants in the Forget condition were told that the first list had actually been a practice trial, and that they should forget that list and instead remember the critical list, which would be presented next. Participants in the Remember condition were told that they had completed one list, and that a second list would also presented. They were instructed to remember both lists.

Following the study phase, a filler task asked participants to spend one minute typing as many US states as they could. Next the memory test was administered. Participants were asked to type the names of as many items as they could remember from both lists. Participants in the Forget condition were told to disregard the earlier instruction, and that we were interested in their memory for both lists, including the "practice" list. Following the recall test, participants completed some demographic questions, and were debriefed.

Results

Scoring recall protocols

Recall performance was scored by coders blind to the Forget/Remember condition. Items were scored according to "gist" so that if a participant listed a name that clearly described one of the images it was counted as correct, even if the proper name was not produced. For example, the item named "father and two girls" could be called "dad and kids." Intrusions and unclear references were rare. If the coder could not clearly discern the intended image from the name reported, the item was not scored as correct.

Memory performance

The proportion of items recalled from each list was analyzed using a 2 (List: 1 vs. 2) × 2 (List 1 Emotionality) × 2 (List 2 Emotionality) × 2 (Instruction) mixed model Analysis of Variance (ANOVA). The List 1 vs. List 2 variable refers to whether memory for items from List1 or List 2 is being examined. Preliminary analyses showed no main effects or interactions involving participant gender, so this variable was not included in the reported analyses.

First, replicating much prior research on emotion and memory, there was a main effect of Emotionality, such that more items were recalled from emotional lists than from neutral lists. This effect obtained for both List 1 Emotionality, $F (1, 210) = 7.48$, $p < .01$, and List 2 Emotionality, $F (1, 210) = 10.98$, $p < .01$. There was a main effect of List, such that overall more items from List 2 were recalled than from List 1, $F (1, 210) = 22.29$, $p < .001$. Also there were two theoretically trivial two-way interactions: List X List 1 Emotionality, $F (1, 210) = 14.46$, $p < .01$, and List X List 2 Emotionality, $F (1, 210) = 40.90$, $p < .01$. These interactions simply indicate that when List 1 was emotional, List 1 was better remembered, and when List 2 was emotional, List 2 was better remembered. That is, whatever list contained

emotional items showed better recall. These simple interactions were qualified by more theoretically relevant predicted interactions, as described next.

Our main hypothesis was that participants would show a typical directed forgetting effect for neutral items, but not when they were trying to forget emotional items. The typical directed forgetting effect would be demonstrated by a two-way List X Instruction interaction, indicating that a Forget instruction caused participants to recall less from the first list, but more from the second list, compared to a Remember instruction. In fact, this List X Instruction interaction was significant overall, $F (1, 210) = 6.98$, $p < .01$. However, it was qualified by the predicted three-way List X Instruction X List 1 Emotionality interaction, $F (1, 210) = 5.71$, $p < .05$. Fig. 1 displays the means in the critical comparisons. Because List 2 Emotionality was not involved in any of the effects, the data are collapsed across this variable.

As the figure shows, when List 1 was neutral, a directed forgetting effect was observed. The simple List X Instruction interaction was strong in this condition, $F (104) = 12.63$, $p < .001$. Focused comparisons showed that fewer items were recalled from List 1 in the Forget condition than the Remember condition, $F (1, 104) = 4.30, p < .05$. At the same time, more items from List 2 were recalled in the Forget condition than the Remember condition, $F (104) = 7.18$, $p < .01$. This pattern fits the typical directed forgetting effect; participants who intentionally forgot the first list showed reduced recall for the first list, but boosted recall for the second list.

The pattern was very different when List 1 was emotional. In this condition, no main effects or interactions were evident (all F's < 1), indicating the absence of a directed forgetting effect. No higher order interactions were significant, beyond the critical three-way interaction reported above.

The absence of effects involving List 2 Emotionality suggests that the critical factor was whether the to-be-for-gotten items were emotional, rather than simply the presence of emotional items in the memory set. Regardless of whether the second list was emotional or neutral, people were successful at intentionally forgetting the first list when it was neutral, but unsuccessful when it was emotional. The selective impact of List 1 emotionality is important because only List 1 items were the focus of forgetting attempts. When the first list could not be put out of mind because of its emotional significance, two results followed. First, the items from List 1 were remembered better at the final recall test. Second, these lingering items interfered with memory for new items from the second list.

The absence of directed forgetting for emotional items is unlikely to be an artifact of low statistical power, as the sample size was relatively large. And whereas the effect size of the directed forgetting interaction for neutral items was "medium" by conventional standards ($\eta^2 = .11/r = .33$), it was very small for emotional items ($\eta^2 = .0003/r = .02$). These findings support the claim that intentional forgetting is more difficult for emotional events than for emotionally neutral ones.

A final set of analyses was conducted to test whether the Forget instruction differentially affected pleasant or unpleasant memories. For the first analysis, recall of pleasant and unpleasant items from List 1 were examined as a function of the memory Instruction (for those participants who received emotional items on List 1). There was a significant main effect of Pleasantness, such that participants recalled more unpleasant items ($M = .48, SD = .21$) than pleasant items ($M = .34, SD = .20$), $F (1, 103) = 28.56$, $p < .001$. However, the forgetting instruction did not interact with pleasantness, $F (1, 103) = .04, ns$. A parallel analysis was run for those participants who received emotional items on List 2. Again, unpleasant items ($M = .59, SD = .19$) had an advantage over pleasant ones ($M = .43, SD = .19$), $F (1, 103) = 41.25, p < .001$. However, there was neither a main effect nor interaction for the Forget instruction (F's < .03, ns.). This pattern of results shows that both pleasant and unpleasant emotional memories resisted intentional forgetting.

Discussion

This study showed that when participants tried to forget emotional or neutral memories, they were able to forget only the neutral ones. Emotional memories were persistent, loitering even when asked to leave. The painful or unhappy memories people would most like to leave behind may be the ones that are most difficult to dislodge.

These results contrast with some previous studies, which found directed forgetting effects for emotional items. Previous studies, however, used word lists which may have elicited thoughts about emotional concepts rather than eliciting emotional states from participants. Emotional states, rather than simply the activation of emotional knowledge, may be critical for the difference to emerge.
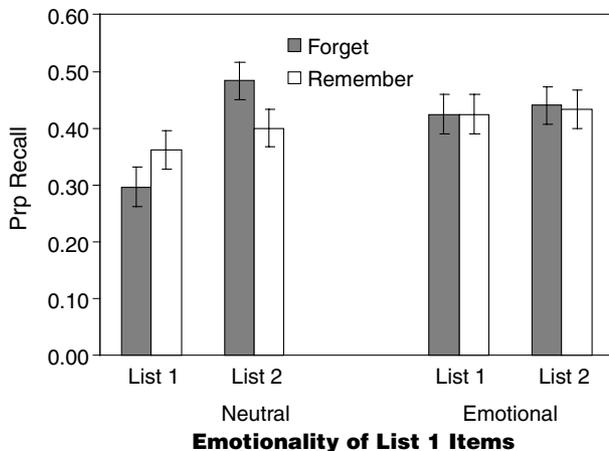
Fig. 1. Proportion of items recalled from List 1 and List 2 as a function of List 1 Emotionality and Forget versus Remember instructions. Error bars represent one standard error.

Possible mechanisms

The present results suggest that affective experience undermines forgetting but they do not identify mechanisms for the effect. By a retrieval-inhibition theory of intentional forgetting, two processes seem critical (Bjork, 1989). The first is mental segregation of to-be-forgotten items from to-be-remembered items. The second process is retrieval inhibition, intentionally reducing activation for memory items (Anderson & Bjork, 1994). Events that are intentionally forgotten are not erased from memory, but access to them is blocked. This is why people can recognize "forgotten" items that they do not produce on recall tests. According to this theory, people attempt to isolate the events they want to forget from other memories, and block access to the sequestered events.

Emotion might intervene at either step. Because emotional items are processed more elaborately than unemotional items, participants might form more links between emotional events and other memories, reducing segregation. Emotion may also interfere with retrieval inhibition because emotion renders events salient, and therefore highly accessible (Ohman et al., 2001). Emotion may therefore subvert intentional forgetting by undermining both of its building blocks.

The fact that emotional events are normally remembered better than neutral ones leads us to consider an alternative explanation for our results. Namely, the failure to intentionally forget might be attributed simply to high memorability rather than emotion per se. By this account, whenever memory performance is relatively high, intentional forgetting should fail. This explanation cannot easily account for our results because many studies have found directed forgetting at both high and low levels of memory accuracy. Some of the classic demonstrations of the directed forgetting effect were made in the context of performance that was as high or higher than in the current study (e.g., Bjork, 1970). For a more direct comparison, Sheard and MacLeod (2005) compared subjects who were high versus low in memory performance. They found that the high-memory group showed directed forgetting effects that were at least as strong as the low-memory group. In another comparison, they examined serial position curves in a directed forgetting study. A typical serial position curve shows that memory is best for items presented at the beginning and at the end of a list, and much poorer for items in the middle. Directed forgetting effects were largest for the beginning and ending items, where memory was greatest. Our findings are not well-explained by a general difficulty explanation, because intentional forgetting is commonly found even when memory performance is high.

Even though a simple memorability account does not easily explain our findings, it suggests an important related question. Are the effects we observed unique to emotion, or could other variables produce similar effects? In our view, emotion must have its effects through the same basic mechanisms as other variables. For example, all of the findings that emotion enhances memory can be explained in terms of basic mental operations, such as encoding, storage, and retrieval. When we suggest that the mind treats emotional events differently from mundane ones, we do not mean that it uses a unique set of tools. Emotion signals that an event matters, and mobilizes the tools needed to deal with it. Emotion focuses attention and increases elaboration (aspects of encoding), facilitates consolidation (storage), and increases accessibility (retrieval). Acknowledging that emotion has its mnemonic effects through basic mental processes does not diminish the importance of emotion. Instead, it makes the interactions between emotion and cognition a more tractable problem to study.

Implications for interactions between emotion and cognition

Our findings add to accumulating evidence that emotion places limits on the ability to control the contents of the mind. Previous research on selective attention shows that emotional stimuli capture attention quickly and involuntarily (e.g. Ohman et al., 2001), and research on thought suppression shows that trying to suppress emotional thoughts can be particularly difficult (Wegner & Gold, 1995). These lines of research converge to show that emotion can co-opt a person's thoughts from the very beginning. The present research adds the conclusion that once an emotional event has seized attention and secured a place in memory, it can continue to usurp thought.

Our results suggest that even a relatively mild emotional reaction can undermine intentional forgetting. Of course, this study does not permit the conclusion that emotional memories can never be forgotten. If the motivation to forget were powerful enough, individuals might be able to overcome the effects of emotion by enlisting additional strategies. These results do, however, provide evidence that at a given level of effort at intentional forgetting, emotional memories are less cooperative than unemotional ones.

Clinical implications

Research on emotion-memory interactions has been guided in part by clinical interest in the ways that individuals cope with traumatic experiences. Given its potential clinical relevance, intentional forgetting has been suggested as one way that people may replace troubling memories with happier ones (Bjork, Bjork, & Anderson, 1998). Our findings contribute to the question of whether forgetting can be helpful in coping with traumatic experiences, though caution is needed in generalizing from the mild emotions of the laboratory to the intense emotions that characterize trauma. The findings suggest that, all else being equal, emotional memories are more difficult to forget than unemotional memories. Theories that include intentional forgetting of emotional memories may need to specify how this forgetting is accomplished and how a coping strategy manages to overcome the basic advantage that emotional events have in memory.

Intentional forgetting is one way that people struggle to regulate the contents of their minds. At every turn in that struggle, emotion may have its own plans. Perhaps this should not be surprising, as one of the functions of emotion is to interrupt and re-prioritize a person's thoughts and actions. Although it may be adaptive in an evolutionary sense (Tooby & Cosmedes, 1990), the tendency for emotions to seize control is all too often unwanted. How many people would rather forget embarrassing blunders or painful losses? Contemplating the advantages of forgetfulness, Nietzsche (1886/1989) wrote, "blessed are the forgetful, for they get the better even of their blunders." But when it comes to voluntary forgetfulness, our blunders may be better yet.

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