Research Article

Forgetting and Recovering the Unforgettable

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ABSTRACT—*Two experiments demonstrated striking, reversible forgetting effects that occurred even for a list of expletives. The experiments used a procedure based on the classic memory mechanisms of interference and retrieval cuing. Interference reduced recall dramatically, although appropriate cues triggered complete recovery. Distinctive, emotionally charged materials were quite susceptible to the forgetting and recovery effects. Thus, powerful forgetting effects can be obtained when participants have no intentions to forget and the materials involved are distinctive, emotional materials with sexual and violent content. This forgetting is reversible with appropriate cues. The false-memory debate can and must be informed by experimental investigations not only of false memories, but also of blocked and recovered memories.*

Some experiences, particularly those that are emotional and distinctive, may seem unforgettable. Can memories of emotional and distinctive events be blocked from consciousness, and if so, can those memories subsequently be recovered? Although there is considerable laboratory research demonstrating false memories, relatively few studies have examined blocked and recovered memories, as we did in the study reported in this article. As noted in reviews by Gleaves, Smith, Butler, and Spiegel (2004) and by Roediger and Bergman (1998), the false-memory debate must be informed by experimental laboratory research examining not only false memories, but also blocked and recovered memories.

The nature of recovered memories of traumatic abuse has been debated, and even their existence has been roundly challenged. Researchers have suggested that seemingly recovered memories might actually be false memories (e.g., Ceci & Loftus, 1994; Lindsay & Read, 1994; Loftus, 1993; McNally, 2003), have expressed doubts that highly emotional experiences are likely to be inaccessible (e.g., Jones, O'Gorman, & Byrne, 1987; McNally, 2003; McNally, Clancy, Barrett, & Parker, 2004; Reisberg & Heuer, 2004; Reisberg, Heuer, McLean, & O'Shaughnessy, 1988), and have argued that there is little experimental evidence of recovered memories (e.g., Hayne, Garry, & Loftus, 2006; Kihlstrom, 1997, 2004, 2006).

In the present study, we investigated whether interference can cause dramatic forgetting that is subsequently reversed when retrieval cues are provided. Using a combination of classic laboratory methods for manipulating interference and cuing, we repeatedly found high levels of blocked and recovered memories, even for materials that had sexually explicit and violent content.

Preventing memories of stressful and traumatic experiences from entering consciousness is important in the regulation of emotion (e.g., Philippot, Baeyens, Douilliez, & Francart, 2004). Emotional experiences are generally remembered better than unemotional events, and this frequent finding (e.g., Jones et al., 1987; McNally et al., 2004; Reisberg & Heuer, 2004; Reisberg et al., 1988) casts doubt on the notion that people are equipped with special mental mechanisms that banish unwanted memories from consciousness. Nonetheless, an increasing number of experiments have found that negatively valenced words are quite susceptible to retrieval inhibition (e.g., DePrince & Freyd, 2004; McNally et al., 2004; Myers & Derakshan, 2004; Wessel & Merckelbach, 2006), suggesting that retrieval inhibition could play an important role in the emotional regulation of memories. Some research has addressed the idea that repressors, or people who allegedly have recovered memories of childhood sexual abuse, have a special ability to forget or dissociate when tested with directed-forgetting procedures. For example, Myers and Derakshan found that the same directed-forgetting effect seen for neutral words could also be obtained with negatively valenced words, and, furthermore, that participants identified as repressors were particularly susceptible to forgetting negative words when they were tested privately. DePrince and Freyd found that individuals with histories of traumatic experiences were more susceptible than control subjects to directed forgetting of trauma words. However, McNally et al. found that forgetting of trauma words was no more prevalent in

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participants who reported repression or recovery of childhood sexual abuse than in those who claimed to have continuous memories of childhood sexual abuse.

Whether or not some individuals have a greater ability than others to forget traumatic or emotional material was not the focus of the present study. Rather, we were concerned with the cognitive basis of reversible forgetting effects, regardless of abilities or individual differences. Interference (e.g., Melton & von Lackum, 1941; Postman & Underwood, 1973) and inhibition (e.g., Anderson & Spellman, 1995; Bjork, 1989) are two cognitive mechanisms that have traditionally been invoked to explain long-term forgetting. Likewise, providing memory-retrieval cues has been a long-accepted method for evoking memories that might be otherwise inaccessible (e.g., Tulving & Pearlstone, 1966; Tulving & Thomson, 1973). Methods involving massive initial interference and experimental materials consisting of simple categorized lists of words have been reported to induce large forgetting effects that are reversible when retrieval cues are provided (Smith et al., 2003). In the present study, we investigated whether these methods could also produce large reversible forgetting effects for emotional and distinctive materials, specifically, a list of expletives.

Anderson and Green (2001) characterized the forgetting of unwanted memories as occurring in stages: The first stage involves deliberate suppression, which gives rise to inhibition of unwanted memories, and the second stage involves habitual and sustained inaccessibility of unwanted memories. Anderson and Green's data showed that repeated attempts to suppress unwanted memories cause long-term memory inhibition, supporting the first stage of their theory. Their claim that inhibitory control of memories could provide a basis for pathologically blocked memories, however, has been criticized on several counts (Kihlstrom, 2002, 2004). For example, Kihlstrom has noted that (a) recall following inhibition remains fairly high; (b) the mechanism involved in Anderson and Green's procedure is not unconscious, as might be expected; (c) there is little evidence showing that inhibited memories are recoverable; and (d) there is little evidence of high levels of inhibition with emotionally charged materials, such as those with aggressive or sexually explicit content. The present study addressed these arguments, focusing on the second stage of Anderson and Green's theory, and the results show that our approach provides a way to study these issues concerning blocked and recovered memories.

We used a retrieval-bias method, which reliably produces habitual patterns of inaccessibility (Smith et al., 2003; see Fig. 1). Drawing heavily from the classic work of Rundus (1973), Roediger (1973, 1978), and Slamecka (1968), who explored part-list cuing inhibition effects, and of Tulving and Pearlstone (1966), who showed that appropriate cues could evoke memories

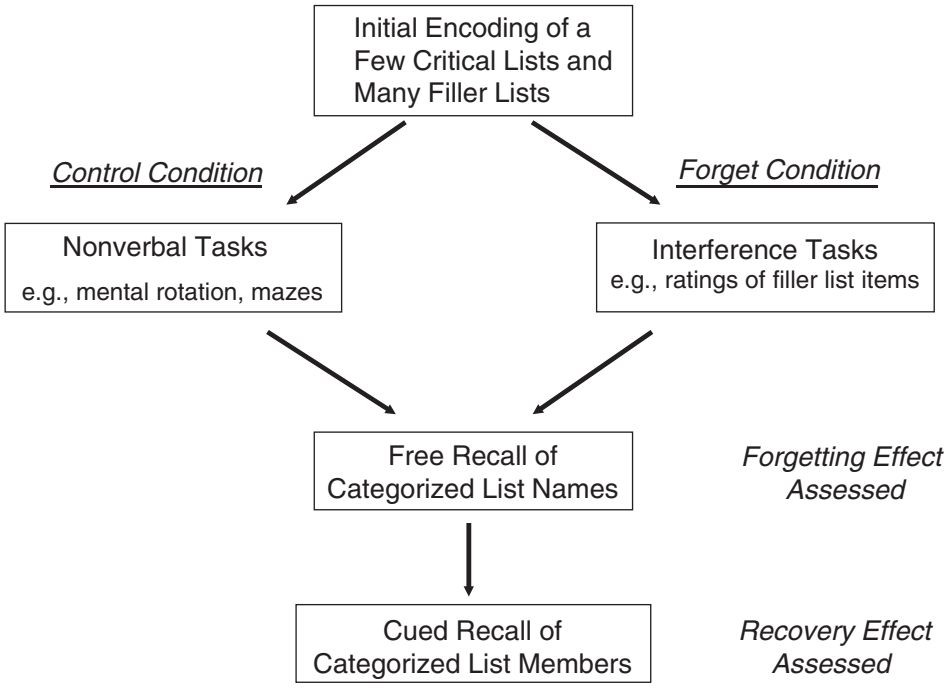

Fig. 1. The retrieval-bias paradigm used in this study. During initial encoding, participants saw members of a few critical lists and many filler lists. All participants saw the critical lists only once. Interpolated between initial encoding and a free-recall test were several tasks: nonverbal tasks for the control group and verbal tasks involving extra exposure to filler lists (but not critical lists) for the forget group. Participants were never told that a few of the lists were critical lists, or (in the case of forget participants) that those lists were not included in the interpolated tasks. Finally, a free-recall test was administered to assess the forgetting effect, and a cued-recall test was administered to assess recovery of memories.

of otherwise unrecallable material, we explored some of the limits of memory blocking and recovery. In each experiment, two groups of participants viewed many categorized word lists (three critical lists and many filler lists). Each list comprised the name of the category (e.g., *tools*) and 10 words referring to members of that category (e.g., *hammer*, *screwdriver*, *pliers*). Participants wrote each word as it was presented and rated the typicality of the category members. No mention was made of the memory tests that would be given later.

Following initial encoding, participants in the *control* group were given three nonverbal tasks (e.g., mental rotation, math problems). Participants in the *forget* group were given three semantic-processing tasks involving reexposure to the filler lists. During this phase, the critical lists were not presented again. Thus, both the control and the forget groups saw the critical lists only once (i.e., during initial encoding). The reexposures to the filler lists in the forget condition were intended to bias retrieval away from the critical lists. Retrieval bias, a bias to retrieve a subset of information in a set of memories, results in a failure to recall material outside the biased subset (Raaijmakers & Phaf, 1999; Raaijmakers & Shiffrin, 1981; Shiffrin, 1970). This laboratory method is roughly analogous to a situation in which over a period of time (e.g., third grade, summer camp) one experiences predominantly positive or neutral recurring events, such as repeating classes, television programs, or games, but also experiences an isolated event (e.g., an abusive or bizarre experience) only once. Later memories of that time period might include the repeated events, omitting the isolated experience.

For the free-recall test, participants were asked to recall the category names presented during initial encoding (e.g., *tools*). Next, participants were given the category names as cues and asked to recall the members of the lists. This cued-recall test was used to assess memory recovery for members of each critical list.

In each experiment, the critical lists were an emotional, distinctive word list (curse words); an emotional, nondistinctive word list (diseases or death); and a neutral word list (tools). In Experiment 1, all filler lists were neutral; in Experiment 2, six of these lists were replaced with emotional filler lists (e.g., sex words, gross words) to reduce the distinctiveness of the emotional critical items relative to the filler lists. The list categories were selected on the basis of emotionality, memorability, and distinctiveness. Curse words were used because they are highly emotional, highly distinctive, and highly memorable; disease- and death-related words were used because they are highly emotional, but not particularly memorable or distinctive; and tools and neutral filler categories were used because they are relatively low in emotionality, memorability, and distinctiveness.

METHOD

Participants

A total of 92 students enrolled in an introductory psychology class participated in the two experiments in partial fulfillment of an experimental-participation requirement: 45 participants (26 females, 19 males) in Experiment 1 and 47 (24 females, 23 males) in Experiment 2. All participants were age 18 years or older (mean age = 19.3 years). They were randomly assigned to the control and forget conditions. Three to 20 students participated in each experimental session. Informed consent was obtained from all participants after the nature and possible consequences of the experiment were explained to them.

Participants were screened with a brief questionnaire so that we could remove those who were sensitive to language dealing with sex or violence; screened-out participants took part in a different experiment. Approximately 8% of potential participants were screened out in this process; it cannot be known whether or not those individuals would have exhibited the forgetting and recovery effects we report here.

Design

Both experiments manipulated forgetting. Condition (forget vs. control) was a between-subjects variable.

Procedure

Initial Encoding

In the initial encoding phase, categorized lists were shown on a large television screen, 1 word at a time. Each list was presented in blocked fashion, beginning with the category name (e.g., *tools*), followed by the 10 members of that list. Each word was preceded by a 1-s "ready" slide; the word stayed on the screen for 3 s and was followed by a 3-s blank screen. Participants were told to write down each word and to indicate how typical of its category each category member was, using a scale from 1 to 10 (1 = *not typical at all*, 10 = *very typical*).

Interpolated Tasks

After initial encoding, participants performed three paper-and-pencil tasks. Participants in the control condition were given three tasks (a maze-solving task, a mirror-image task, and arithmetic problems) that were designed to require cognitive effort, but involve only nonverbal materials. Participants in the forget condition, by contrast, received three interference (retrieval-biasing) tasks involving the 21 filler lists: a word-pleasantness rating task, a size-ranking task (list members were ranked according to their estimated size or value), and a syllable-counting task. These three retrieval-biasing tasks were designed to repeatedly expose participants to the filler lists, but the critical lists were intentionally not included in these tasks. There was no mention that any lists had been removed, and the rating sheets were formatted to disguise the fact that fewer lists were present.

Thus, the critical lists were seen exactly once; they were not shown again to either control or forget participants after the initial encoding phase. For both control and forget participants,

TABLE 1
Mean Emotionality, Memorability, and Distinctiveness Ratings as a Function of List Type

	Word type					
Measure	Neutral fillers	Tools	Diseases	Death-related words	Emotional distinctive fillers	Curse words
Emotionality	14	32	88	88	74	83
Memorability	63	58	57	57	71	75
Distinctiveness	39	35	31	31	46	64

the total time needed to perform the interpolated tasks was approximately 24 min.

Memory Tests
Following either the nonverbal tasks or the retrieval-biasing tasks, all participants were given two memory tests, first a free-recall test and then a cued-recall test.

Free-Recall Test. For free recall, participants were reminded about the original task involving lists of words presented on a large television screen (all 21 lists, including the critical lists, had been seen one time on the television screen, whereas all intervening tasks were given on paper). Participants were given 3.5 min to recall as many list names (e.g., *tools*) from that task as possible. The instructions made it clear that only list names, and not list members, were to be recalled.

Cued-Recall Test. Following the free-recall test, participants were given the names of each of the three critical lists and of three filler lists, one at a time, and were asked to recall the members of those lists. They had 1 min to recall as many of the members of each list as possible.

Materials

Categorized Lists
In each of the two experiments, participants were shown 24 categorized lists, 3 critical lists and 21 filler lists. In the two experiments combined, there were 31 categorized lists. In Experiment 1, the 3 critical lists were tools, diseases, and curse words, and the 21 filler lists were neutral in terms of emotionality and distinctiveness. In Experiment 2, the 3 critical lists were tools, death-related words, and curse words, and the 21 filler lists included 15 neutral filler lists and 6 emotional and distinctive filler lists. Each list consisted of a label and 10 category members.

Critical Lists
In Experiments 1 and 2, the critical lists included emotional, distinctive words (curse words: e.g., *shit*, *fuck*, *asshole*); emotional, nondistinctive words (in Experiment 1, diseases: e.g., *polio*, *herpes*, *leukemia*; in Experiment 2, death-related words: e.g., *vulture*, *coffin*, *corpse*); and neutral words (tools: e.g., *pliers*, *screwdriver*, *hammer*).

Filler Lists
The 21 neutral filler lists were drawn from the following categories: birds, kitchen objects, clothing, countries, reading materials, living quarters, fish, vehicles, weapons, trees, fruit, insects, metals, cities, states, sports, instruments, toiletries, furniture, officials, and vegetables. In Experiment 2, 6 emotional and distinctive filler lists were substituted for 6 neutral filler lists to reduce the distinctiveness of the emotional critical items relative to the filler lists. The emotional and distinctive filler lists in Experiment 2 included three positive lists (holidays, desserts, and wines) and three negative lists (sex words, gross words, and diseases).

Norming Study
In a norming study designed to assess the qualities of the word lists, each category member of each list was rated for emotionality, memorability, and distinctiveness, on scales from 1 to 100. Thirty-two introductory psychology students ranging in age from 18 to 55 (mean age = 21.4 years) participated in the norming study for course credit. No participants in the norming study participated in the two experimental studies.

Table 1 shows the mean ratings of the words in all six types of lists.[1] Diseases, death-related words, emotional filler words, and curse words were given considerably higher emotionality ratings than were tools and neutral filler words, but only the emotional fillers and curse words were rated higher than tools and neutral filler words in memorability and distinctiveness.

RESULTS

Forgetting Effect: Free Recall of the Names of the Critical Lists

Analyses of variance (ANOVAs) were performed to assess the effect of the manipulation of forgetting on the proportion of items recalled on the free-recall test. Strong forgetting effects were found in both experiments, as in the experiments reported by Smith et al. (2003); the control groups recalled significantly

[1]The word lists are available from the first author upon request.

more critical-list names than did their respective forget groups. In Experiment 1, the overall forgetting effect was significant, $F(1, 43) = 11.74$, $MSE = 0.24$, $p = .001$, $p_{rep} = .99$. Recall of each of the three critical-list names was better in the control condition ($M = .51$) than in the forget condition ($M = .22$; see Fig. 2). The percentage of recall for *tools* was 35% higher in the control condition than in the forget condition, $t(44) = 2.49$, $p < .01$, $p_{rep} = .93$, $d = 0.74$; recall for *diseases* was 17% higher in the control condition than in the forget condition, $t(44) = 1.84$, $p < .01$, $p_{rep} = .85$, $d = 0.52$; and recall for *curse words* was 36% higher in the control condition than in the forget condition, $t(44) = 2.44$, $p < .01$, $p_{rep} = .93$, $d = 0.76$. The interaction of condition (forget vs. control) with word list (tools vs. diseases vs. curse words) was not significant, $F(2, 42) = 0.97$, $MSE = 0.16$, $p = .39$, $p_{rep} = .58$.

In Experiment 2, the overall forgetting effect was again significant, $F(1, 43) = 11.74$, $MSE = 0.24$, $p = .001$, $p_{rep} = .99$. Recall of each of the three critical-list names was substantially better in the control condition ($M = .69$) than in the forget condition ($M = .26$; see Fig. 3). The percentage of recall for *tools* was 26% higher in the control condition than in the forget condition, $t(46) = 2.10$, $p < .01$, $p_{rep} = .89$, $d = 1.64$; recall for *death words* was 63% higher in the control condition than in the forget condition, $t(46) = 5.50$, $p < .01$, $p_{rep} = .99$, $d = 1.64$; and recall for *curse words* was 41% higher in the control condition than in the forget condition, $t(46) = 3.80$, $p < .01$, $p_{rep} = .99$, $d = 1.06$. The interaction of condition (forget vs. control) with word list (tools vs. death-related words vs. curse words) was not significant, $F(2, 44) = 2.45$, $MSE = 0.15$, $p = .10$, $p_{rep} = .82$.

The forgetting effects observed in both experiments were quite large, although the effects in Experiment 2 were somewhat greater than those in Experiment 1. Whether this apparent increase was due to the fact that Experiment 2 used death-related words rather than diseases, or the fact that Experiment 2 used several emotional filler lists, is not clear.

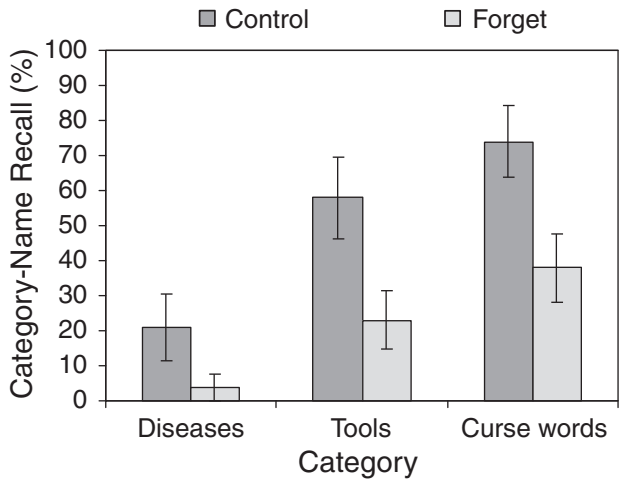

Fig. 2. Mean percentage of critical-list names recalled in Experiment 1 as a function of condition and list.

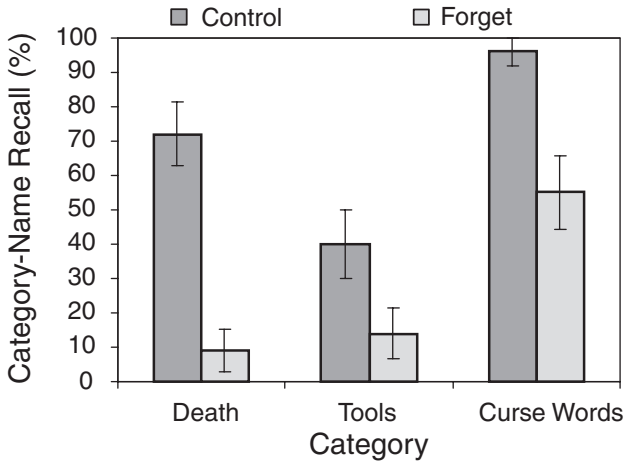

Fig. 3. Mean percentage of critical-list names recalled in Experiment 2 as a function of condition and list.

Recovery Effect: Cued Recall of Members of the Critical Lists

Although striking levels of forgetting were observed in both experiments, the forgetting effects were completely eliminated when appropriate retrieval cues were provided subsequently. Of the 45 participants in Experiment 1, all but 1 recalled three or more members for every critical list. The remaining participant was unable to recall members of one of the critical lists (tools). Thus, memories of all the critical lists were accessible (and therefore still available in memory) when participants were given appropriate retrieval cues. Likewise, in Experiment 2, cued-recall success was very high; all 47 participants recalled members of every critical list. Participants do not appear to have been guessing on the cued-recall test; they correctly recalled an average of 6.7 (out of 10) words per list, and intrusions were very rare, with a mean of only 0.08 intrusions per list.

Furthermore, although free recall of critical items showed large forgetting effects, there was no effect of the manipulation of forgetting on cued recall. Across the two experiments, there was no list for which the control group's cued recall was better than the forget group's (see Fig. 4). ANOVAs assessing the effect of condition on the proportion of list members recalled showed no significant effect for either Experiment 1, $F(1, 43) = 2.37$, $MSE = 2.85$, $p = .13$, $p_{rep} = .79$, or Experiment 2, $F(1, 45) = 0.38$, $MSE = 4.11$, $p = .54$, $p_{rep} = .47$.

Thus, critical material that had shown large forgetting effects in the previous free-recall test showed no forgetting effects when appropriate category cues were provided.

GENERAL DISCUSSION

Our findings show that our retrieval-bias methods produce a surprising level of reversible forgetting, even for emotional and distinctive materials with violent and sexual content. Other studies have demonstrated forgetting of emotional memories (Barnier, Hung, & Conway, 2004; McNally et al., 2004; Myers,

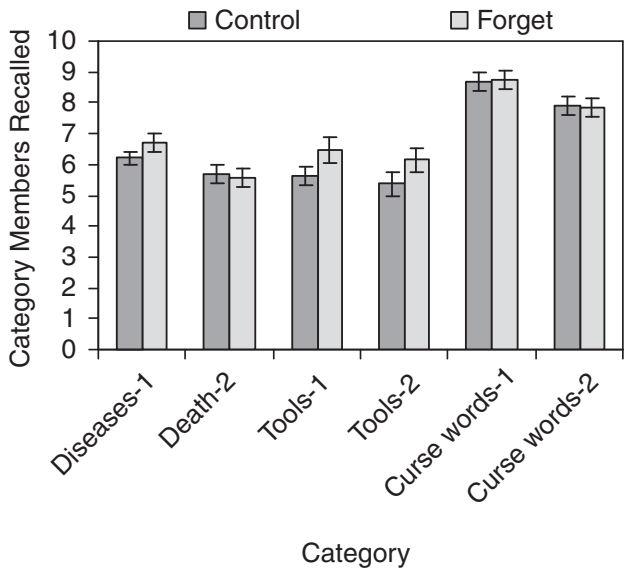

Fig. 4. Mean number of critical-list members recalled in cued recall as a function of list. The numbers in the list names indicate whether the results are from Experiment 1 or Experiment 2.

Brewin, & Power, 1998; Myers & Derakshan, 2004; Wessel & Wright, 2004), but those effects have been small relative to the effects found in the present study. Whereas the typical retrieval-inhibition effect is a difference of roughly 10% between the control and inhibition conditions, the present study found much greater differences; with curse words, for example, the percentage of recall was 40% higher in the control condition than in the forget condition in both experiments. Both of our experiments used a critical list judged by an independent group of participants to be highly emotional, memorable, and distinctive. Emotional and distinctive materials, memorable as they were in the control condition, were nonetheless susceptible to large forgetting effects following the retrieval-bias procedure. Furthermore, recoverability of forgotten emotional materials has not been demonstrated elsewhere, but in the present study, appropriate category cues reversed the forgetting effect; in both experiments, the control and forget groups performed equally well on cued recall of the critical lists' members.

The forgetting we observed was reversible with appropriate cues. Although ethical guidelines make it impossible for experimental studies to demonstrate forgetting of traumatic experiences, the present findings show that materials that are emotional, memorable, and distinctive are subject to the same forgetting effects that occur with nonemotional materials, and that such effects can be quite substantial.

Our results support one stage in Anderson and Green's (2001) theory. Anderson and Green showed that repeated suppression can cause long-term memory inhibition; these effects have been shown to have a neural basis (e.g., Anderson et al., 2004) and to occur in the case of naturally occurring negative experiences (e.g., Depue, Banich, & Curran, 2006). We have shown that repeated retrieval of diversionary thoughts, as induced by our retrieval-bias procedure, can sustain a powerful forgetting effect, a mechanism consistent with the second stage in Anderson and Green's theory. This reversible forgetting effect was caused by an experimental manipulation in which competing memories, but not targeted memories, were repeated. The question of whether other influences, such as those involved in emotion regulation, might also lead to such a repetition of diversionary memories is beyond the scope of the present study.

It should be noted that we have provided no evidence that certain individuals, such as victims of abuse, are especially susceptible to blocking and recovery effects; our research supports a cognitive basis for such effects, but does not show, for example, that individuals who have forgotten traumatic experiences have ever experienced retrieval bias, nor that such individuals may be adept at biasing retrieval away from emotional material. Indeed, our results show that no special abilities or mechanisms are necessary to produce high levels of reversible forgetting, even for emotional and distinctive materials with violent and sexual content.

Our research suggests many questions, and provides a methodology for attempting to answer them. Can the magnitude of these forgetting effects be increased, and can such effects be experimentally dissociated from memory-inhibition effects? What materials are most susceptible to forgetting and recovery, and, in particular, can memories of traumatic experiences be blocked and recovered? Are there cues that trigger recovery automatically? Are recovered memories more likely than continuous memories to include false memories? What are the affective consequences of forgetting and recovering emotional memories? Are there individual differences in susceptibility to these forgetting effects? As has been suggested by Gleaves et al. (2004) and by Roediger and Bergman (1998), the false-memory debate can and must be informed by experimental laboratory research that examines not only false memories, but blocked and recovered memories as well.

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