

Retrieval-Induced Forgetting Predicts Failure to Recall Negative Autobiographical Memories

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Abstract

There is a positivity bias in autobiographical memory such that people are more likely to remember positive events from their past than they are to remember negative ones. Inhibition may promote this positivity bias by deterring negative memories from being retrieved. In our first experiment, we measured individual differences in retrieval-induced forgetting, a phenomenon believed to be the consequence of retrieval inhibition, and correlated that measure with individual differences in the recall of positive and negative autobiographical memories. Participants who exhibited lower levels of retrieval-induced forgetting recalled significantly more negative memories despite recalling fewer positive memories. In our second experiment, participants attempted to recall negative memories from childhood and from the previous month. Participants who exhibited lower levels of retrieval-induced forgetting recalled significantly more negative memories in both conditions. These results suggest that inhibition plays a key role in preventing the retrieval of negative autobiographical memories.

Keywords

memory, autobiographical memory, forgetting, emotions

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Despite what most people believe, forgetting does not always reflect a failure of memory (R. A. Bjork & Bjork, 1992; Schacter, 2001). In fact, some theorists have argued that the ability to retrieve a target item is determined, at least in part, by the ability to inhibit—and thus forget—nontarget items (Anderson, 2003; R. A. Bjork, 1989; Storm, 2011). Evidence for this hypothesis has come from recent work on retrieval-induced forgetting, which has shown that attempting to retrieve one item in memory can cause the forgetting of other items in memory (Anderson, Bjork, & Bjork, 1994).

In a paradigm commonly used (for a review, see Storm & Levy, 2012) to study retrieval-induced forgetting, participants are exposed to a list of category-exemplar pairs (e.g., “fruit-banana,” “metal-silver,” “fruit-lemon,” “metal-aluminum”) and then given retrieval practice for a subset of exemplars from a subset of categories (e.g., by the cue “fruit-le_____”). Retrieval-induced forgetting is observed on a final memory test when unpracticed exemplars from practiced categories (e.g., “fruit-banana”) are recalled less well than unpracticed exemplars from unpracticed categories (e.g., “metal-silver”). According to the inhibitory account of retrieval-induced forgetting, the cues presented during retrieval practice activate both target and nontarget items, and inhibition facilitates the retrieval of target items by suppressing the accessibility of nontarget items, thus making them less recallable. In this

example, during retrieval practice, “banana” is inhibited because it interferes with the retrieval of “lemon”; because of this inhibition, “banana” becomes less recallable than baseline items (i.e., “silver,” “aluminum”) on the final test.

The inhibitory account of retrieval-induced forgetting has received substantial empirical support from research employing a variety of behavioral and neurobiological methodologies (for reviews, see Anderson, 2003; Bäuml, Pastötter, & Hanslmayr, 2010; Storm, 2011; but also see C. M. MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003). One line of support has come from work showing that impaired levels of retrieval-induced forgetting are associated with certain populations and cognitive disadvantages (e.g., Aslan & Bäuml, 2010, 2011; Groome & Grant, 2005; Groome & Sterkaj, 2010; Soriano, Jiménez, Román, & Bajo, 2009; Storm & Angello, 2010; Storm & White, 2010). Individuals exhibiting lower levels of retrieval-induced forgetting, for example, tend to have lower working memory capacity (Aslan & Bäuml, 2011) and to be less able to overcome interference during creative problem solving (Storm & Angello, 2010). Furthermore, individuals

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diagnosed with attention-deficit/hyperactivity disorder (Storm & White, 2010) and schizophrenia (Soriano et al., 2009), who are believed to suffer from an inhibitory deficit, show reduced levels of retrieval-induced forgetting. These and other findings suggest that the mechanism underlying retrieval-induced forgetting plays a key role in the functioning of memory.

In the current study, we examined whether individual differences in retrieval-induced forgetting can predict the recall of positive and negative autobiographical memories. Retrieval cues are associated with an array of memories—some of which are sad, embarrassing, depressing, or hurtful—and inhibition may help keep negative memories from coming to mind and interfering with the retrieval of more positive and useful memories. Conway (2005) argued that autobiographical memory is influenced by the working self and that priority is given to information that is consistent with one's self-image and beliefs. Given that individuals' self-image and beliefs are often biased in a positive direction (Taylor & Brown, 1988), it may not be surprising that autobiographical memory is also biased in a positive direction. Whether cued voluntarily or involuntarily, positive autobiographical events are generally easier to recall and more likely to be recalled than negative autobiographical events (e.g., Berntsen, 1996; Waldfogel, 1948; Walker, Skowronski, & Thompson, 2003). Inhibition may help promote and maintain this positivity bias by preventing negative memories from being consciously retrieved when activated by a relevant retrieval cue.

If autobiographical memory is structured in a way that keeps negative or otherwise threatening information from being retrieved, then the inhibition underlying retrieval-induced forgetting may provide the perfect mechanism for accomplishing this prevention of recall. In retrieval-induced forgetting, nontarget items are inhibited because they are inappropriately activated by a given retrieval cue. In autobiographical memory, negative memories may be inhibited because they are inconsistent with an inherent bias toward remembering positive events and maintaining positive affect. It is important to note, however, that in both situations, the inhibition is presumably performed without the individual's awareness. In the retrieval-practice paradigm, participants do not know they are inhibiting nontarget exemplars, and likewise, if the current hypothesis is correct, people are unlikely to know they are inhibiting negative autobiographical memories. The distinction between inhibition without conscious awareness and conscious attempts to control one's thought is an important one. It may explain why the inhibition underlying retrieval-induced forgetting might succeed in preventing negative memories from being retrieved, although conscious attempts to do so sometimes fail (Wegner, 1994; but see Anderson & Green, 2001).

If the inhibition underlying retrieval-induced forgetting does help prevent negative autobiographical memories from being retrieved, then individual differences in retrieval-induced forgetting should predict the extent to which people are able to recall such memories. Specifically, individuals who

exhibit more retrieval-induced forgetting should show a selective impairment in the recall of negative autobiographical events. We tested this hypothesis by measuring retrieval-induced forgetting and then correlating that measure with performance on an autobiographical-memory test. In the first experiment, participants were provided neutral keywords and asked to recall either positive or negative autobiographical memories associated with those keywords. We predicted that retrieval-induced forgetting would correlate negatively with the recall of negative memories, but not with the recall of positive memories.

Experiment I

Method

Participants and design. Ninety-two undergraduates from the University of Illinois at Chicago (mean age = 19.5 years; 62 females, 30 males) participated in the experiment for credit in an introductory psychology course. Retrieval-induced forgetting was always measured before autobiographical recall.

Measuring retrieval-induced forgetting. Retrieval-induced forgetting was measured using a common version of the retrieval-practice paradigm (Storm & Angello, 2010). The paradigm began with participants studying a list of category-exemplar pairs (e.g., "fruit-banana," "metal-silver," "fruit-mango," "metal-aluminum"). The pairs included six exemplars from each of eight categories, and the order of the list was determined by blocked randomization. Specifically, participants studied six blocks of pairs, with each block including one exemplar from each of the eight categories. After studying all 48 category-exemplar pairs, participants were asked to retrieve new exemplars from four of the studied categories (e.g., "lemon"). They were shown a series of retrieval cues, each consisting of a category name plus a two-letter-stem for an exemplar of that category (e.g., "fruit-le ____"). Six cues for each of four categories (i.e., practiced categories) were shown three times each, resulting in a total of 72 retrieval-practice trials. This semantic-generation form of retrieval practice, which is often referred to as *extralist retrieval practice* (e.g., Bäuml, 2002; Storm & Angello, 2010; Storm, Bjork, & Bjork, 2008), creates two types of studied items: studied exemplars of practiced categories (e.g., "banana," "mango"), and studied exemplars of unpracticed categories (e.g., "silver," "aluminum").

After a 5-min delay, participants were given a final test in which they were shown retrieval cues consisting of a category name plus a one-letter-stem for an exemplar of that category (e.g., "fruit-b ____") and asked to recall studied exemplars associated with those cues (e.g., "banana"). Only the 48 studied but nonpracticed exemplars were tested, to eliminate the possibility of output interference. Retrieval-induced forgetting was measured by subtracting final recall performance for exemplars from practiced categories (often referred to as

Rp- items) from that for exemplars from unpracticed categories (often referred to as *Nrp* items).

Measuring autobiographical recall. Twenty neutral keywords served as retrieval cues to prompt the recall of autobiographical memories (e.g., “pool,” “medicine”). Participants in the positive condition attempted to recall memories that made them “happy, proud, pleased, or gratified” ($n = 46$). Participants in the negative condition attempted to recall memories that made them “sad, embarrassed, depressed, or hurt” ($n = 46$). Each keyword appeared on the screen for 25 s, and participants were instructed to write down memories from events that they were certain had occurred, and not to write anything if no such memory came to mind. Participants also rated each memory for clarity, detail, and emotionality using 5-point scales ranging from 1 (*vague, general, or detached*) to 5 (*clear, detailed, or emotional*, respectively). To ensure privacy, we had participants complete the autobiographical phase alone and, when finished, place their responses in a sealed envelope. A different experimenter read the responses later. Autobiographical recall was scored for each participant as the proportion of keywords that elicited an episodic memory of the appropriate valence.

Results

A significant effect of retrieval-induced forgetting was observed; exemplars from practiced categories ($M = .400$, $SE = .015$) were recalled less well than exemplars from unpracticed categories ($M = .433$, $SE = .015$), $t(91) = 2.60$, $p = .01$, $d = 0.28$. Also, a significant positivity bias was observed; participants recalled more positive memories ($M = .428$, $SE = .018$) than negative memories ($M = .353$, $SE = .022$), $t(90) = 2.60$, $p = .01$, $d = 0.55$. Prior to subsequent analysis, z scores were calculated to normalize retrieval-induced forgetting scores within the positive- and negative-valence conditions.

A regression analysis examined the proportion of variance in autobiographical recall explained by valence, retrieval-induced forgetting, and the Valence \times Retrieval-Induced Forgetting interaction. Valence consisted of a dummy variable indicating condition (positive vs. negative). The complete model was significant, $F(3, 88) = 4.45$, $p < .01$, $R^2 = .13$, and, more important, so was the Valence \times Retrieval-Induced Forgetting interaction when entered separately to assess whether it accounted for additional variance, $F(1, 88) = 5.49$, $p = .02$, $\Delta R^2 = .05$. As shown in Figure 1, retrieval-induced forgetting was positively correlated (though not significantly) with the recall of positive autobiographical memories ($r = .17$, $p = .27$), but it was significantly negatively correlated with the recall of negative autobiographical memories ($r = -.31$, $p = .04$). In other words, participants who exhibited more retrieval-induced forgetting recalled significantly fewer negative memories despite recalling numerically more positive memories.

To analyze these data further, we divided participants into three groups based on their retrieval-induced forgetting scores

(RIF groups): high-RIF participants (mean RIF effect = .16), medium-RIF participants (mean RIF effect = .04), and low-RIF participants (mean RIF effect = $-.10$). There was an interaction between RIF group and memory valence, $F(2, 86) = 4.37$, $MSE = 0.02$, $p = .02$, $\eta_p^2 = .09$ (see Table 1). Specifically, high-RIF participants, $t(29) = 3.13$, $p < .01$, and medium-RIF participants, $t(29) = 2.35$, $p = .03$, exhibited significant positivity biases, but low-RIF participants did not. In fact, low-RIF participants exhibited a nonsignificant negativity bias, $t(28) = 0.92$, $p = .36$. This pattern in positivity bias illustrates the interaction of RIF group and memory valence in autobiographical recall.

Positive and negative memories were not rated differently in terms of clarity (positive: $M = 3.9$, $SE = 0.1$; negative: $M = 3.8$, $SE = 0.1$), detail (positive: $M = 3.7$, $SE = 0.1$; negative: $M = 3.5$, $SE = 0.1$), or emotionality (positive: $M = 3.5$, $SE = 0.1$; negative: $M = 3.3$, $SE = 0.1$). More important, none of the ratings correlated with retrieval-induced forgetting. In fact, ratings of positive memories were identical for high-RIF participants (clarity: $M = 3.9$; detail: $M = 3.7$; emotionality: $M = 3.5$) and low-RIF participants (clarity: $M = 3.9$; detail: $M = 3.7$; emotionality: $M = 3.5$), and ratings of negative memories were not significantly different for high-RIF participants (clarity: $M = 3.8$; detail: $M = 3.5$; emotionality: $M = 3.2$) and low-RIF participants (clarity: $M = 3.6$; detail: $M = 3.4$; emotionality: $M = 3.1$). The fact that the ratings were so consistent suggests that despite differences in rates of recall, the autobiographical memories that low-RIF and high-RIF participants did recall had comparable qualities.

Experiment 2

The results of Experiment 1 suggest that there is an important relationship between retrieval-induced forgetting and autobiographical memory. We attempted to replicate the demonstration of this relationship in Experiment 2 using an autobiographical-memory test that required participants to retrieve negative events from specific time periods. For half of the keywords, participants attempted to recall negative events that took place during the previous month. For the other half of the keywords, participants attempted to recall negative events that took place during childhood. If the inhibition underlying retrieval-induced forgetting plays a general role in keeping negative autobiographical memories from being retrieved, then individuals exhibiting greater levels of retrieval-induced forgetting would be expected to recall fewer negative events in both conditions.

A second goal of Experiment 2 was to limit our sample to nondepressed individuals. Recent work has shown that individuals who are depressed or in a negative mood exhibit less retrieval-induced forgetting than individuals who are not depressed or are not in a negative mood (Bäuml & Kuhbandner, 2007; Groome & Sterkaj, 2010). Also, because depressed individuals, compared with nondepressed individuals, have greater recall of negative memories relative to positive memories (Blaney, 1986; Eich, Macaulay, & Ryan, 1994), it may be

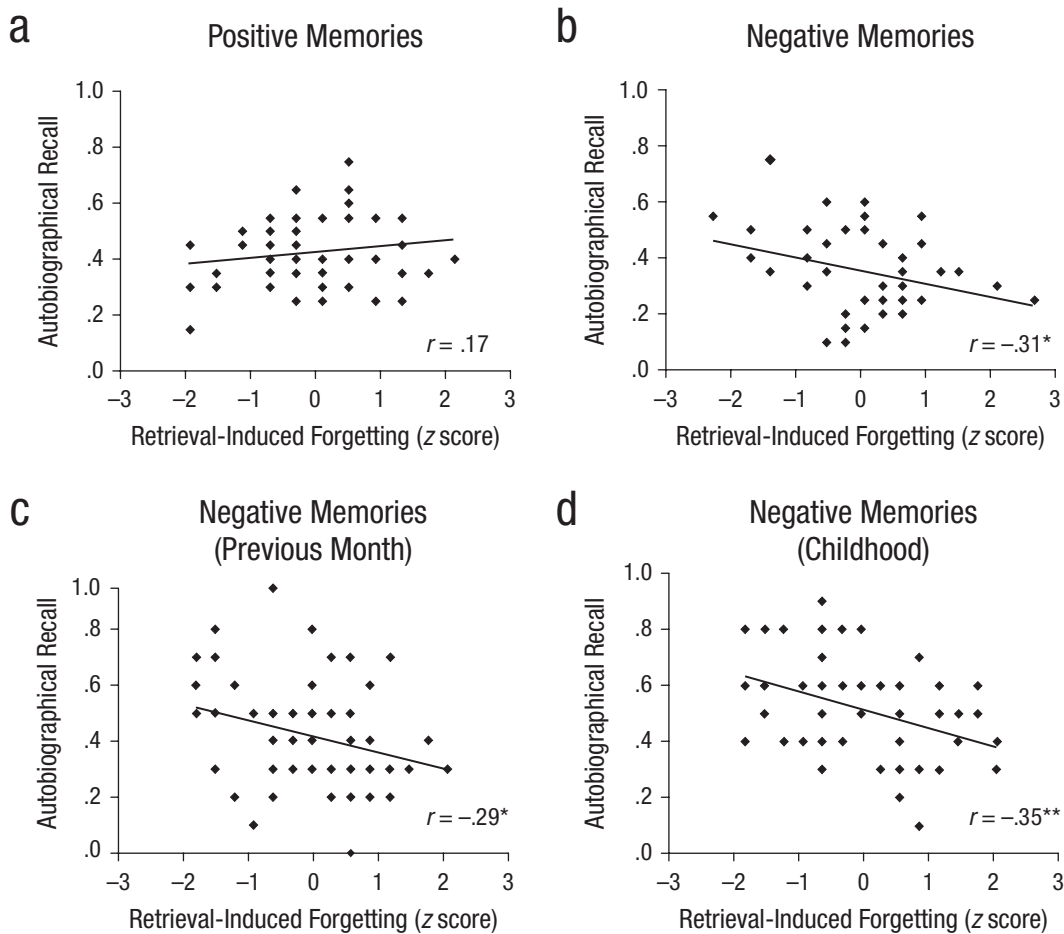


Fig. 1. Scatter plots (with best-fitting regression lines) showing autobiographical recall as a function of retrieval-induced forgetting. Autobiographical recall for each valence was operationally defined as the proportion of keywords that elicited an episodic memory of that valence; values shown are z scores. The graphs in (a) and (b) show the results for positive and negative memories, respectively, in Experiment 1. The graphs in (c) and (d) show the results for negative memories from the previous month and from childhood, respectively, in Experiment 2. Asterisks indicate significant correlations (* $p < .05$, ** $p < .01$).

that the correlation between retrieval-induced forgetting and negative autobiographical recall observed in Experiment 1 was actually driven by individual differences in depression.

Specifically, participants who were depressed may have exhibited lower levels of retrieval-induced forgetting and recalled more negative autobiographical memories than participants

Table 1. Results of Experiment 1: Autobiographical Recall and Positivity Bias in the Three Retrieval-Induced Forgetting Groups

| Group | Autobiographical recall | | | | | |
|-------------------------------------|-------------------------|-----------|-------------------|-----------|-----------------|----------|
| | Positive memories | | Negative memories | | Positivity bias | |
| | <i>M</i> | <i>SE</i> | <i>M</i> | <i>SE</i> | <i>M</i> | <i>d</i> |
| Low retrieval-induced forgetting | .39 | .03 | .44 | .04 | -.04 | -0.34 |
| Medium retrieval-induced forgetting | .42 | .03 | .30 | .04 | .12 | 0.86* |
| High retrieval-induced forgetting | .47 | .04 | .33 | .03 | .14 | 1.15** |

Note: Positivity bias was calculated by subtracting the score for negative memories from the score for positive memories.

* $p < .05$. ** $p < .01$.

who were not depressed. If so, then the correlation between retrieval-induced forgetting and negative autobiographical recall could be reduced in a sample consisting of only nondepressed individuals.

Method

Participants. A total of 89 undergraduates from the University of Illinois at Chicago (mean age = 19.8 years; 60 females, 29 males) participated in this experiment for partial credit in an introductory psychology course. The Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) was administered to measure reported levels of depression. The standard cutoff on the BDI-II at or above which a person is said to be suffering from at least a mild level of depression is 14. Sixty of the 89 participants provided BDI-II scores below this cutoff and were thus included in the analyses.

Procedure. First, retrieval-induced forgetting was measured using the same paradigm as in Experiment 1. Next, to measure autobiographical recall, we showed participants 20 neutral keywords for 25 s each and asked them to recall negative memories associated with each keyword from one of two time frames: childhood or the previous month. Once again, participants rated each memory for clarity, detail, and emotionality. The order was blocked such that participants attempted to recall 10 memories from childhood and then 10 memories from the previous month, or vice versa. To ensure that participants were recalling events from the proper time frame, we provided an explicit definition of episodic memory, and participants were told that they should feel like they were traveling back in time to reexperience the events.

Results

Significant retrieval-induced forgetting was observed; exemplars from practiced categories ($M = .353$, $SE = .016$) were recalled less often than exemplars from unpracticed categories ($M = .442$, $SE = .016$), $t(59) = 4.93$, $p < .001$, $d = 0.64$. Also, participants recalled significantly more negative autobiographical memories from childhood ($M = .510$, $SE = .023$) than from the previous month ($M = .410$, $SE = .025$), $t(59) = 4.65$, $p < .001$, $d = 0.60$.

Replicating the pattern observed in Experiment 1, the results showed that retrieval-induced forgetting correlated negatively with the recall of negative autobiographical memories ($r = -.36$, $p < .01$). In fact, as shown in Figure 1, this correlation was significant for both memories from the previous month ($r = -.29$, $p = .02$) and memories from childhood ($r = -.35$, $p < .01$). There was no detectable difference in the size of the correlation between the two conditions.

The data were also analyzed by dividing participants into three groups: high RIF (mean RIF effect = .24), medium RIF (mean RIF effect = .09), and low RIF (mean RIF effect = -.06). A significant main effect of RIF group was observed, $F(2, 57) = 4.39$, $MSE = .03$, $p = .02$, $\eta_p^2 = .13$, with high-RIF participants recalling fewer negative memories than did medium-RIF participants, and medium-RIF participants recalling fewer negative memories than did low-RIF participants (Table 2). An independent-samples t test confirmed that high-RIF participants recalled significantly fewer negative memories than did low-RIF participants, $t(38) = 2.81$, $p < .01$, $d = 0.91$.¹

Within the nondepressed sample, BDI-II scores did not correlate with retrieval-induced forgetting ($r = -.06$). High-RIF, medium-RIF, and low-RIF participants had average BDI-II scores of 7.2 ($SD = 3.7$), 7.7 ($SD = 3.7$), and 7.8 ($SD = 3.7$), respectively, $F(2, 57) = 0.14$, n.s. Also, as in Experiment 1, we failed to observe any significant relationships between any of the ratings of autobiographical-memory quality (clarity, detail, and emotionality) and retrieval-induced forgetting. For example, average ratings were not significantly different between high-RIF participants (clarity: $M = 3.8$; detail: $M = 3.5$; emotionality: $M = 3.2$) and low-RIF participants (clarity: $M = 3.6$; detail: $M = 3.4$; emotionality: $M = 3.1$). Memories from the previous month were rated to be significantly clearer (4.0 vs. 3.4), $t(54) = 5.10$, $p < .001$, $d = 0.70$, and more detailed (3.7 vs. 3.2), $t(54) = 4.07$, $p < .001$, $d = 0.55$, than were memories from childhood.

General Discussion

Autobiographical memory is biased in a way that makes people more likely to recall positive than negative events from their past (e.g., Berntsen, 1996; Waldfoegel, 1948; Walker et al., 2003). The current results suggest that the inhibition underlying retrieval-induced forgetting may play an important

Table 2. Results of Experiment 2: Autobiographical Recall in the Three Retrieval-Induced Forgetting Groups

| Group | Negative memories from previous month | | Negative memories from childhood | |
|-------------------------------------|---------------------------------------|-----------|----------------------------------|-----------|
| | <i>M</i> | <i>SE</i> | <i>M</i> | <i>SE</i> |
| Low retrieval-induced forgetting | .47 | .05 | .59 | .04 |
| Medium retrieval-induced forgetting | .42 | .04 | .53 | .03 |
| High retrieval-induced forgetting | .35 | .03 | .41 | .04 |

role in promoting and maintaining this bias. In Experiment 1, participants were given neutral keywords and asked to recall either positive or negative autobiographical events associated with those keywords. Individuals who exhibited the most retrieval-induced forgetting demonstrated a large positivity bias, whereas individuals who exhibited the least retrieval-induced forgetting demonstrated a nonsignificant negativity bias. Retrieval-induced forgetting was a particularly strong predictor of negative autobiographical recall: Individuals who exhibited low levels of retrieval-induced forgetting were significantly more likely to recall negative autobiographical events than were individuals who exhibited high levels of retrieval-induced forgetting. This finding was replicated in Experiment 2 and, moreover, was observed regardless of whether participants attempted to recall negative events from childhood or the previous month. The fact that the same relationship was observed in all three negative-recall conditions (the general negative condition in Experiment 1 and the negative conditions for the previous month and childhood in Experiment 2) suggests that individuals exhibiting low levels of retrieval-induced forgetting have a general tendency to remember negative memories more than do other people.

The correlation between retrieval-induced forgetting and negative autobiographical recall was observed even when we limited our sample to participants who did not report even a mild level of depression. This observation is important because it suggests that depression cannot in itself explain the correlation. That is, individuals who exhibited low levels of retrieval-induced forgetting did not recall more negative memories than did individuals who exhibited high levels of retrieval-induced forgetting simply because they were more depressed. Another potential concern is the possibility that participants exhibiting different levels of retrieval-induced forgetting attempted to recall different types of autobiographical memories. This possibility seems unlikely, however, because measures of clarity, detail, and emotionality were consistent across levels of retrieval-induced forgetting. Although low-RIF participants recalled more negative memories than did high-RIF participants, the qualities (clarity, detail, and emotionality) of the memories they recalled did not appear to differ. Finally, it also seems unlikely that individuals exhibiting more retrieval-induced forgetting have a general memory impairment. Prior work has shown that individuals exhibiting greater levels of retrieval-induced forgetting perform better on tasks measuring other aspects of memory (e.g., Aslan & Bäuml, 2011). More important, the autobiographical-memory deficit observed in the current study was specific to negative memories. Participants exhibiting higher levels of retrieval-induced forgetting were, if anything, better at remembering positive autobiographical memories.

The current results support and extend evidence for the inhibitory account of retrieval-induced forgetting. Retrieval cues have the power to activate many items in memory, and researchers have argued that inhibition helps keep irrelevant and unwanted items from being retrieved. In the retrieval-induced

forgetting paradigm, inhibition is believed to reduce the accessibility of nontarget items in order to keep those items from interfering with the recall of target items (Anderson, 2003; Storm, 2011). In autobiographical memory, a predisposition toward positivity may make negative memories more likely to be deemed inappropriate, targeted by inhibition, and thus rendered inaccessible to consciousness. Without such a mechanism, people might find themselves increasingly inundated by disruptive, and often painful, autobiographical memories (Anderson, 2001; E. L. Bjork, Bjork, & Anderson, 1998).

We speculate that retrieval-induced forgetting could be an even stronger predictor of negative autobiographical recall in older adults. Research has shown that older adults have stronger emotion-regulation goals than do younger adults, and those goals make them particularly inclined to avoid negative information in the environment and in memory (Carstensen, Isaacowitz, & Charles, 1999; Mather & Carstensen, 2005). Given this inclination, individual differences in inhibitory ability among older adults may have greater capacity to influence whether negative autobiographical memories are recalled.

If inhibition is responsible for reducing access to negative autobiographical memories, then it stands to reason that such memories should be susceptible to observable effects of retrieval-induced forgetting. Recent work has tested this possibility by having participants recall autobiographical memories and then practice retrieving a subset of those memories in a modified version of the retrieval-induced forgetting paradigm (Barnier, Hung, & Conway, 2004; Wessel & Hauer, 2006). In both studies, retrieving negative memories caused the retrieval-induced forgetting of other negative memories. It is noteworthy that Wessel and Hauer did not observe a corresponding effect with positive autobiographical memories.

Given the observed relationship between retrieval-induced forgetting and depression (Groome & Sterkaj, 2010), a reasonable hypothesis might be that, compared with individuals who have normal retrieval-induced forgetting, individuals with impaired retrieval-induced forgetting are less capable of inhibiting negative thoughts and memories associated with depression, and that this lesser capability may in turn make them vulnerable to becoming even more depressed (Joormann, 2010). Although speculative, this hypothesis would be consistent with evidence that depressed individuals are more likely to ruminate on negative memories and to experience persisting intrusive thoughts (e.g., Nolen-Hoeksema, 1991). Moreover, if depression exacerbates the inhibitory deficit, negative thinking and poor inhibition may cycle so that depressive episodes become particularly difficult to escape. We found some evidence supporting this possibility when we examined the 29 participants reporting at least a mild level of depression (BDI-II scores > 13). Among these individuals, those who exhibited less retrieval-induced forgetting reported being significantly more depressed ($r = -.39, p = .04$).

The results of the current study suggest that individuals exhibiting higher levels of retrieval-induced forgetting have a greater ability to inhibit negative events in autobiographical

memory. It is worth noting, however, that even if inhibition does make individuals forget negative memories, the memories are not forgotten permanently. Intrinsic to the concept of inhibition is the idea that an item can be rendered inaccessible momentarily but retain its potential accessibility for a later time or another context (R. A. Bjork, 1989; Brunton, 1883). In accord with this conjecture, research on retrieval-induced forgetting has shown that forgetting can be eliminated following a delay (e.g., M. D. MacLeod & Macrae, 2001) or reexposure (e.g., Storm et al., 2008). Thus, by inhibiting negative autobiographical memories, people may have the ability to hold onto such memories without being repeatedly, and unpleasantly, reminded of them.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Note

1. A significant negative correlation was observed between retrieval-induced forgetting and negative autobiographical recall when the entire sample, including participants reporting above-minimal levels of depression, was analyzed ($r = -.27, p < .01$). Moreover, when scores from the BDI-II and retrieval-induced forgetting were simultaneously included in a regression model predicting negative autobiographical recall, BDI-II scores failed to account for a significant portion of the variance ($pr = .08, p = .42$), although retrieval-induced forgetting did ($pr = -.26, p = .01$). This finding is quite surprising because it suggests that a person's propensity to recall negative autobiographical memories is better predicted by that person's retrieval-induced forgetting than by his or her current BDI-II score.

References

- Anderson, M. C. (2001). Active forgetting: Evidence for functional inhibition as a source of memory failure. *Journal of Aggression, Maltreatment & Trauma, 4*, 185–210.
- Anderson, M. C. (2003). Rethinking interference theory: Executive control and the mechanisms of forgetting. *Journal of Memory and Language, 49*, 415–445.
- Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 1063–1087.
- Anderson, M. C., & Green, C. (2001). Suppressing unwanted memories by executive control. *Nature, 410*, 366–369.
- Aslan, A., & Bäuml, K.-H. T. (2010). Retrieval-induced forgetting in young children. *Psychonomic Bulletin & Review, 17*, 704–709.
- Aslan, A., & Bäuml, K.-H. T. (2011). Individual differences in working memory capacity predict retrieval-induced forgetting. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37*, 264–269.
- Barnier, A. J., Hung, L., & Conway, M. A. (2004). Retrieval-induced forgetting of autobiographical episodes. *Cognition & Emotion, 18*, 457–477.
- Bäuml, K.-H. T. (2002). Semantic generation can cause episodic forgetting. *Psychological Science, 13*, 356–360.
- Bäuml, K.-H. T., & Kuhbandner, C. (2007). Remembering can cause forgetting—But not in negative moods. *Psychological Science, 18*, 111–115.
- Bäuml, K.-H. T., Pastötter, B., & Hanslmayr, S. (2010). Binding and inhibition in episodic memory—Cognitive, emotional, and neural processes. *Neuroscience & Behavioral Review, 34*, 1047–1054.
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corp.
- Berntsen, D. (1996). Involuntary autobiographical memories. *Applied Cognitive Psychology, 10*, 435–454.
- Bjork, E. L., Bjork, R. A., & Anderson, M. C. (1998). Varieties of goal-directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 103–137). Hillsdale, NJ: Erlbaum.
- Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. L. Roediger, III, & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 309–330). Hillsdale, NJ: Erlbaum.
- Bjork, R. A., & Bjork, E. L. (1992). A new theory of disuse and an old theory of stimulus fluctuation. In A. Healy, S. Kosslyn, & R. Shiffrin (Eds.), *From learning processes to cognitive processes: Essays in honor of William K. Estes* (Vol. 2, pp. 35–67). Hillsdale, NJ: Erlbaum.
- Blaney, P. H. (1986). Affect and memory: A review. *Psychological Bulletin, 99*, 229–246.
- Brunton, T. L. (1883). On the nature of inhibition, and the action of drugs upon it. *Nature, 27*, 419–422.
- Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist, 54*, 165–181.
- Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language, 53*, 594–628.
- Eich, E., Macaulay, D., & Ryan, L. (1994). Mood dependent memory for events of the personal past. *Journal of Experimental Psychology: General, 123*, 201–215.
- Groome, D. H., & Grant, N. (2005). Retrieval-induced forgetting is inversely related to everyday cognitive failures. *British Journal of Psychology, 96*, 313–319.
- Groome, D. H., & Sterkaj, F. (2010). Retrieval-induced forgetting and clinical depression. *Cognition & Emotion, 24*, 63–70.
- Joormann, J. (2010). Cognitive inhibition and emotion regulation in depression. *Current Directions in Psychological Science, 19*, 161–166.
- MacLeod, C. M., Dodd, M. D., Sheard, E. D., Wilson, D. E., & Bibi, U. (2003). In opposition to inhibition. In B. H. Ross (Ed.), *The psychology of learning and motivation* (Vol. 43, pp. 163–214). San Diego, CA: Academic Press.
- MacLeod, M. D., & Macrae, C. N. (2001). Gone but not forgotten: The transient nature of retrieval-induced forgetting. *Psychological Science, 12*, 148–152.
- Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences, 9*, 496–502.

- Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*, 569–582.
- Schacter, D. L. (2001). *The seven sins of memory: How the mind forgets and remembers*. Boston, MA: Houghton Mifflin.
- Soriano, M. F., Jiménez, J. F., Román, P., & Bajo, M. T. (2009). Inhibitory processes in memory are impaired in schizophrenia: Evidence from retrieval-induced forgetting. *British Journal of Psychology, 100*, 661–673.
- Storm, B. C. (2011). Retrieval-induced forgetting and the resolution of competition. In A. S. Benjamin (Ed.), *Successful remembering and successful forgetting: A festschrift in honor of Robert A. Bjork* (pp. 89–105). New York, NY: Psychology Press.
- Storm, B. C., & Angello, G. (2010). Overcoming fixation: Creative problem solving and retrieval-induced forgetting. *Psychological Science, 21*, 1263–1265.
- Storm, B. C., Bjork, E. L., & Bjork, R. A. (2008). Accelerated relearning after retrieval-induced forgetting: The benefit of being forgotten. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*, 230–236.
- Storm, B. C., & Levy, B. J. (2012). A progress report on the inhibitory account of retrieval-induced forgetting. *Memory & Cognition, 40*, 827–843.
- Storm, B. C., & White, H. A. (2010). ADHD and retrieval-induced forgetting: Evidence for a deficit in the inhibitory control of memory. *Memory, 18*, 99–114.
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 10*, 193–210.
- Waldfoegel, S. (1948). The frequency and affective character of childhood memories. *Psychological Monographs, 62*(Whole No. 291).
- Walker, W. R., Skowronski, J. J., & Thompson, C. P. (2003). Life is pleasant—and memory helps to keep it that way! *Review of General Psychology, 7*, 203–210.
- Wegner, D. M. (1994). Ironic processes in mental control. *Psychological Review, 101*, 34–52.
- Wessel, I., & Hauer, B. J. A. (2006). Retrieval-induced forgetting of autobiographical memory details. *Cognition & Emotion, 20*, 430–447.