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Karl-Heinz Bäuml and Christof Kuhbandner

Psychological Science 2007 18: 111
DOI: 10.1111/j.1467-9280.2007.01857.x

The online version of this article can be found at:
http://pss.sagepub.com/content/18/2/111
Remembering Can Cause Forgetting—but Not in Negative Moods

Karl-Heinz Bäuml and Christof Kuhbandner

Regensburg University, Regensburg, Germany

ABSTRACT—Repeated retrieval of a subset of previously observed events can cause forgetting of the nonretrieved events. We examined how affective states experienced during retrieval modulate such retrieval-induced forgetting by inducing positive, negative, and neutral moods in subjects immediately before they attempted to retrieve studied items. On the basis of recent work, we hypothesized that positive moods encourage relational processing, which should increase interference from related events and thus enhance retrieval-induced forgetting. By contrast, negative moods should encourage item-specific processing, which should reduce interference and thus reduce such forgetting. Our results are consistent with these predictions. When subjects were in negative moods, repeated retrieval did not cause forgetting of the nonretrieved material, whereas when subjects were in positive and neutral moods, they showed reliable retrieval-induced forgetting. Our findings suggest that the emotions involved during interrogation of a witness can affect the result of repeated interrogations.
Remembering Can Cause Forgetting

(MacLeod, 2002; Shaw, Bjork, & Handal, 1995). Whether as a result of personal relationships, important social issues, or some positive or negative evaluation of the original event, emotions are likely to be involved in such repeated interrogations. Thus, knowledge about how affective states experienced during retrieval influence forgetting may provide information on whether mood can affect the result of repeated interrogations.

Results from prior work suggest that emotions can influence how information is processed. In particular, there is evidence that negative emotions result in predominantly item-specific processing, and positive emotions result in predominantly relational processing. Item-specific processing involves processing events by their features and distinctive qualities; relational processing involves processing events in relation to other concepts in memory (e.g., Hunt & McDaniel, 1993). False memories that result from spreading activation to a critical concept (Roediger, Balota, & Watson, 2001; Roediger & McDermott, 1995), for instance, are reduced if individuals are forced to process events in an item-specific way (Hege & Dodson, 2004). Likewise, such false memories are reduced when subjects are in negative moods, compared with positive moods, which suggests that negative emotions enhance item-specific processing and positive emotions enhance relational processing (Storbeck & Clore, 2005; for further evidence, see Bless et al., 1996; Fiedler, 2001; or Isen & Daubman, 1984).

Mood may affect retrieval-induced forgetting as well. Retrieval-induced forgetting presupposes relational processing. During retrieval of to-be-practiced items (e.g., fruit-ap___), only related items (fruit-banana) should interfere and be inhibited to reduce interference (Anderson, 2003). Consistently, retrieval-induced forgetting has been found to be eliminated if individuals process events in an item-specific way (R.E. Smith & Hunt, 2000). If negative moods experienced during retrieval induce item-specific processing, then negative moods may reduce interference and thus may reduce inhibition and later forgetting of the nonretrieved information. By contrast, if positive moods are experienced during retrieval and relational processing is induced, then positive moods may lead to an increase in interference and thus may enhance forgetting. As a result, positive and negative moods may have opposing effects on retrieval-induced forgetting, enhancing it in the one case and reducing it in the other.

This study examined the role of affective states in retrieval-induced forgetting. Subjects studied episodic material and then were asked to repeatedly retrieve a subset of the material. Immediately before retrieval, positive, negative, or neutral moods were induced. We examined whether mood affected later recall of the nonretrieved material.

METHOD

Subjects

Twenty-seven students at Regensburg University, Germany, participated in the experiment. They were tested individually.

Materials

We constructed six word lists, each consisting of items from three semantic categories. For each category, six emotionally neutral words were selected from published norms (Battig & Montague, 1969; Mannhaupt, 1983). The initial letter of each word was unique within its category.

Ten positive, 10 negative, and 10 neutral pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999), a series of pictures with standardized ratings for valence and arousal. The pictures showed people with diseases, mutilated bodies, erotic scenes, babies, scenery, or objects. Mean arousal for positive (M = 6.1) and negative (M = 6.4) pictures was equated and differed from that for the neutral pictures (M = 2.6), F(1,28) = 157.8, p<.001, η² = .85. Positive and negative pictures of the IAPS can effectively induce emotions (e.g., Erk et al., 2003; A.P.R. Smith, Henson, Dolan, & Rugg, 2004). To assess the success of the emotion induction in the present experiment, we used the affect grid (Russell, Weiss, & Mendelsohn, 1989), which permits subjects to express their emotional experience on a nine-by-nine matrix varying along the dimensions of valence and arousal.

Design

We used a 3 × 3 design with the within-subjects factors of mood (positive, negative, neutral) and word type (practiced, unpracticed, control). For each subject, two of the six word lists were assigned to each of the three mood conditions. For each single list, the experiment consisted of four main phases: a study phase, a mood-induction phase, a retrieval-practice phase, and a final test phase. With the exception of the mood-induction phase, the phases were identical across lists. In the mood-induction phase, material of positive, negative, or neutral valence was presented depending on the mood condition. The assignment of the six lists to the three mood conditions was balanced across subjects. For each subject, the order of the six lists was determined by blocked randomization. Each of the two blocks contained one list from each mood condition. The mean position of each mood condition was equated across subjects. The subjects were presented all six lists within one experimental session.

For each of the six lists, in the retrieval-practice phase, subjects repeatedly attempted to retrieve half of the items from two of the three categories. In this way, three types of words were created: words that were retrieval practiced (P+ words), unpracticed words belonging to the same two categories as the practiced words (P− words), and unpracticed words from the unpracticed category, which served as control words (C words). Which categories and which exemplars within a category were practiced was counterbalanced across subjects.

1Lang et al. assessed the emotion evoked by the IAPS photographs using Likert-type rating scales ranging from 1 (extremely negative) to 9 (extremely positive) for the dimension of affective valence and from 1 (low arousal) to 9 (high arousal) for the dimension of emotional arousal.
Procedure
The procedure was the same for each list. In the study phase, each word on a list was displayed on a computer screen for 5 s together with its category name. The order of presentation within a list was determined by blocked randomization. A random sequence of six blocks, each consisting of one randomly selected exemplar from each of the three categories, was presented to the subjects. After a 30-s distractor task, the mood-induction phase began. During this phase, the subjects were successively shown five pictures of the same valence and were told to let the pictures influence their emotional state. Each picture was presented for 6 s.

The retrieval-practice phase followed directly after the presentation of the last picture. The subjects were presented the word stem of each P+ word together with its category name and were asked to complete the stem with a studied word. The subjects were tested orally. Each word stem was presented twice at an exposure rate of 2.5 s per stem. The order was determined by blocked randomization, resulting in two blocks with six different word stems each. Subsequently, mood was measured using the affective grid. After another 3-min distractor task, the final test phase began. The subjects were provided with the (unique within the category) first letter of each studied word together with its category name and were again asked to name the appropriate word. The order of presentation was blocked by category. Mean testing position of practiced and unpracticed categories was equated, as was mean testing position of P+ and P− words within the practiced categories.

The test phase was followed by a break of 30 s before the study phase of the next list began. After the first block of three lists, there was a longer break of 5 min.

RESULTS
Manipulation Check
Across conditions, subjects varied reliably in mood, as indicated by the valence measure (positive mood: M = 6.4; negative mood: M = 5.4; neutral mood: M = 5.9), F(2, 52) = 12.5, p < .001, η² = .24. Arousal in the positive and neutral conditions (M = 4.2 and M = 4.0, n.s.) differed reliably from arousal in the negative condition (M = 4.9), t(52) = 5.7, p < .001, η² > .15.

Retrieval-Practice Phase
Retrieval success in the retrieval-practice phase was high and did not vary reliably across mood conditions (positive mood: M = 85.2%; negative mood: M = 82.3%; neutral mood: M = 79.0%), t(52) = .55.

Final Recall Test
Recall rates in the final test phase are shown in Figure 1. To determine whether mood affected the beneficial effect of retrieval practice on recall of P+ words, we conducted a 2 (word type: P+ words, C words) × 3 (mood: positive, negative, neutral) analysis of variance. The analysis revealed a significant main effect of word type, F(1, 26) = 155.7, p < .001, η² = .86, showing that retrieval practice enhanced later recall of the practiced words. There were no other significant effects, p > .05.

To examine whether mood affected the detrimental effect of retrieval practice on recall of P− words, we conducted another 2 (word type: P− words, C words) × 3 (mood: positive, negative, neutral) analysis of variance. The analysis showed a significant main effect of mood condition (neutral, positive, or negative) and word type (retrieval-practiced words, unpracticed words from the same categories as the retrieval-practiced words, or control words from unpracticed categories). The error bars represent standard errors.

Fig. 1. Percentage recalled in the final test phase as a function of mood condition (neutral, positive, or negative) and word type (retrieval-practiced words, unpracticed words from the same categories as the retrieval-practiced words, or control words from unpracticed categories).
DISCUSSION

Affect can influence retrieval-induced forgetting. When negative affect was experienced in the retrieval-practice phase, retrieval practice did not cause forgetting of the nonretrieved words from the practice categories; in contrast, reliable forgetting was found when subjects experienced positive and neutral moods in the retrieval-practice phase. The result for the negative-mood condition is consistent with recent findings indicating that negative emotions induce predominantly item-specific processing (Bless et al., 1996; Storbeck & Clore, 2005). During the retrieval-practice phase, such item-specific processing may reduce or even eliminate interference from related events and thus reduce or eliminate inhibition and retrieval-induced forgetting. Indeed, this is exactly what the present results revealed.

Recent findings have also indicated that positive emotions induce predominantly relational processing (Isen & Daubman, 1984; Storbeck & Clore, 2005). During the retrieval-practice phase, such relational processing may enhance interference from related events and thus may increase inhibition and retrieval-induced forgetting. Our results show a tendency for more forgetting in the positive-mood than in the neutral-mood condition, although the difference was not significant. The lack of a significant difference may be due to the fact that establishing a true affective neutral point is often problematic; neutral and positive moods often lead to similar behavior and similar neural patterns (Baker, Frith, & Dolan, 1997; Diener & Diener, 1996). Also, the relational processing that underlies retrieval-induced forgetting in neutral moods may be the default mode for any nonnegative state, so interference may already have reached ceiling in the neutral-mood condition (see Storbeck & Clore, 2005, for a related conclusion regarding false memories). In this case, our results primarily demonstrate the influence of negative moods on retrieval-induced forgetting, indicating that a change from the (default) relational mode to an item-specific mode of retrieval can eliminate the forgetting.

The present results suggest that mood may influence eyewitness testimony. Using meaningful stimuli that could be experienced under eyewitness situations, previous studies showed that repeated interrogations can reduce later recall of the nonretrieved events (MacLeod, 2002; Shaw et al., 1995), and false recollections may be induced if misinformation regarding the nonretrieved events is provided after interrogation (Saunders & MacLeod, 2002). The present results suggest that these two effects may arise if the witness is in a neutral or positive mood. If the witness is in a negative mood, however, these effects may be reduced, if not eliminated.

This study addressed the question of whether the affective state experienced during retrieval influences forgetting, independently of the valence of the contents being retrieved. In contrast, two previous studies addressed the question of whether retrieval-induced forgetting differs for emotional and neutral content, independently of people’s affective state during retrieval. One of those studies used positive and negative autobiographical memories as the stimuli (Barnier et al., 2004), and the other examined memory for positive and negative social words in social phobics and nonanxious control subjects (Amir et al., 2001). For social phobics, no retrieval-induced forgetting arose for negative social words, a result that mimics the present finding. For all other individuals, in the two studies, retrieval-induced forgetting was present for positive and negative words. The effect of emotion on retrieval-induced forgetting thus appears to be largely restricted to the affective states experienced during retrieval. At least when people are in negative moods, their affective states can prevent remembering from causing forgetting.

Acknowledgments—The research reported here was supported by a grant from the German Research Foundation (DFG) to Karl-Heinz Bäuml (Ba 1382/7-1).

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(Received 3/30/06; Revision accepted 5/19/06; Final materials received 6/5/06)