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Mood and Retrieval-induced Forgetting of Positive and Negative Autobiographical Memories

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SUMMARY

In two experiments, we examined the effects of high and low levels of dysphoria on retrieval-induced forgetting (RIF) of positive and negative autobiographical memories. In Experiment 1, participants took part in an RIF procedure that was adapted for autobiographical memories. Regardless of level of dysphoria, participants showed facilitation for both negative and positive memories; they only showed RIF for negative memories. Differences in baseline memories were responsible for this effect: Participants recalled more positive than negative baseline memories. Experiment 2 was conducted to address these baseline differences, and also focused only on participants with high levels of dysphoria. Again, high dysphoric participants showed facilitation for both positive and negative memories; they only showed RIF for negative memories. Recall also varied depending on the content of practiced memories and individual differences in anxiety. Overall, these results suggest that retrieval-practice might have different outcomes for different kinds of autobiographical memories, that these outcomes may depend on individual memory biases and memory valence, and that practicing positive memories may assist mood repair. Copyright © 2010 John Wiley & Sons, Ltd.

Autobiographical memory serves many functions; one of which is to make people feel better about themselves and their lives. People often repeatedly recall past positive autobiographical experiences because remembering those events makes them feel happy (see for example, Singer & Salovey, 1996). Another function is to learn from past mistakes; for example, people may repeatedly recall past negative experiences to try to work out what went wrong. This repeated recall of negative events is one component of rumination, which is a maladaptive cognitive process that is linked to the onset and maintenance of depression (Nolen-Hoeksema, 1991, 2000). In two experiments, we examined how repeated retrieval of either positive or negative autobiographical memories might influence recall of related positive and negative memories.

Retrieval-induced forgetting

The retrieval-induced forgetting paradigm (RIF; Anderson, Bjork, & Bjork, 1994) provides an experimental methodology for indexing the impact of repeated retrieval on both

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practiced and unpracticed memories. In the standard procedure, participants study a series of category cue-exemplar pairs (e.g. fruit—apple, fruit—banana, colour—blue, colour—red). During the critical phase, participants perform repeated directed retrieval practice (RP) of half the exemplars from half the categories (e.g. fruit—a__). Finally participants are presented with the category cues (e.g. fruit, colours) and asked to recall all the exemplars for each one. The impact of RP is indexed by comparing both the recall of practiced words (Rp+; e.g. apple) and unpracticed words from the same category (Rp−; e.g. banana) to the baseline recall of unpracticed words from a different category (Nrp; blue, red). The general finding is that Rp+ words are more likely to be remembered than Nrp words (*facilitation*), while Rp− words are more likely to be forgotten than Nrp words (RIF; Anderson et al., 1994; Anderson, Bjork, & Bjork, 2000). It has been suggested that this forgetting is caused by retrieval competition between related memories (Anderson & Spellman, 1995; but see MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003 for a non-inhibitory account).

Mood and biases in memory

While RIF is a robust effect, RP might have different effects for different kinds of material, because people have memory biases that influence recall. Numerous experiments have shown that people generally recall more positive than negative information; that is, people exhibit a positivity bias in memory (Walker, Skowronski, & Thompson, 2003). However, some people have difficulty forgetting negative memories (e.g. in certain clinical populations). Depressed individuals do not show the typical positivity bias; instead, they are likely to recall more negative than positive information (for reviews see Burt, Zembar, & Niederehe, 1995; Dalgleish & Cox, 2000; Serrano, Latorre, & Gatz, 2007). That is, research has suggested that memory might be mood congruent—people in positive moods recall more positive information and people in negative moods recall more negative information. However, other research has suggested just the opposite: That people in negative moods are motivated to improve their mood and thus selectively recall positive, mood incongruent information (Josephson, Singer, & Solovey, 1996; Parrott & Sabini, 1990).

Biases in goal-directed forgetting

The role of mood congruency and incongruency biases in influencing what is remembered and forgotten can be investigated using a range of paradigms that index goal-directed forgetting (Bjork, Bjork, & Anderson, 1998). Bjork et al. (1998) defined goal-directed forgetting as 'forgetting that serves some implicit or explicit personal need' (p. 103). One approach is to compare remembering and forgetting of neutral, positive or negative stimuli. An alternative approach is to compare remembering and forgetting in clinical *vs*. control participants. These approaches are often combined to examine whether valence and individual differences interact. However, these paradigms have used a broad range of materials and have yielded conflicting findings, with some results consistent with a mood congruency bias and other results inconsistent with such a bias.

In terms of the emotional valence of the stimuli, using the directed forgetting (DF) paradigm where participants are instructed to intentionally forget certain items, certain researchers have found that DF occurs for neutral stimuli but not for emotional stimuli (Geraerts, Smeets, Jelicic, Merckelbach, & van Heerdan, 2006; Payne & Corrigan, 2007)

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In contrast, Wessel and Merckelbach (2006) found DF effects for both emotional and unemotional words. Focusing on clinical populations, Power, Dalgleish, Claudio, Tata, and Kentish (2000) found that depressed patients showed more DF of positive words than negative words. This is consistent with a mood congruent, negativity bias in these depressed patients. In contrast, other researchers have reported that clinical populations show more forgetting of negative material. For example, Moulds and Bryant (2002) found that patients with acute stress disorder showed more DF for trauma-related words than controls (Moulds & Bryant, 2002). Similarly, using Anderson and Green's (2001) think/no-think paradigm (TNT), Joormann, Hertel, Brozovich, and Gotlib (2005) found that depressed participants showed more forgetting of negative than positive words.

Using the RIF paradigm, Moulds and Kandris (2006) found that both high and low dysphoric participants showed RIF for neutral but not negative words, suggesting a negativity bias in recall. Similarly, Kuhbandner, Bäuml, and Stiedl (2009) found that the more intensely negative a picture was, the less likely participants were to show RIF, and this effect was stronger for participants in a negative mood. Amir, Coles, Brigidi, and Foa (2001) found that people with generalised social phobia did not show RIF for negative social words. Taken together, these results for RIF are consistent with a negativity bias, particularly for participants in a negative mood. However across research using DF, TNT and RIF procedures, it remains unclear whether people demonstrate a mood congruency bias in goal-directed forgetting.

RIF for autobiographical memories

We were interested in whether these mood congruency and incongruency biases would extend to autobiographical material. Autobiographical memories are different from word list stimuli because they are emotional, inter-related, often significant, and associated with identity (Conway, 2005). Theoretical accounts of autobiographical memory emphasise the goal directed and selective nature of autobiographical remembering and forgetting (Conway, 2005; Conway & Pleydell-Pearce, 2000; Harris, Barnier, Sutton, & Keil, 2010). These theoretical accounts suggest that people are motivated to recall memories, relevant to their sense of self, and to forget memories that conflict with their sense of self (Conway, 2005). Barnier, Hung, and Conway (2004) previously demonstrated that the RIF paradigm can be extended to examine forgetting of positive, negative and neutral autobiographical memories. In their procedure, participants generated four memories to each of a number of cues such as 'happy', 'tidy' and 'sickness', practised half the memories for half the cues, and attempted to recall all the memories they had generated. Barnier et al. (2004) found that participants demonstrated facilitation of Rp+ memories and RIF of Rp− memories relative to Nrp memories. However, in contrast to RIF research using words and other simple materials, Barnier et al. (2004) found that memory valence did not influence the RIF effect. Rather, independent of RP, participants were simply less likely to generate and more likely to forget emotional than unemotional memories. In a follow-up study, Wessel and Hauer (2006) focused on participants who practiced recalling specific details about positive or negative events during RP (e.g. who, what). Unlike Barnier et al., Wessel and Hauer (2006) found RIF for negative but not positive memories, a finding that is consistent with a positivity bias. This result contrasts with the findings described above for emotional words, and suggests that negative memories are sometimes forgotten in the RIF paradigm.

The current experiments

We were interested in whether repeated retrieval of positive and negative memories would have an impact on later recall for participants with low and high levels of dysphoria. In Experiment 1, we used the RIF paradigm to investigate whether RP of positive and negative memories would result in RIF for competing memories of the same valence. Participants generated 10 negative and 10 positive autobiographical memories before repeatedly retrieving half of their negative or half of their positive memories. After a brief distracter task, participants attempted to recall all of their memories. We predicted that participants with low levels of dysphoria would recall events consistent with a positivity bias, that is they would remember more positive than negative memories, and positive memories might be immune from RIF. We predicted that participants with high levels of dysphoria would recall events consistent with a mood congruent, negativity bias; that is, they would remember more negative than positive memories, and negative memories might be immune from RIF.

EXPERIMENT 1

Method

Participants and design

Fifty undergraduate psychology students (32 females, 18 males) with a mean age of 18.9 years ($SD = 1.71$) participated in return for course credit. All undergraduate psychology students completed the BDI-II as a screening measure at the beginning of the academic semester. We invited people who scored high and low on the screening to come into the laboratory for our experiment, and then re-administered the BDI-II at the beginning of the experimental session. We used this second BDI-II score as the inclusion criterion. Twenty-five participants were categorised as high dysphoric (BDI-II ≥ 14) and 25 as low dysphoric (BDI-II ≤ 6; consistent with the cut-off scores used by Moulds and Kandris, 2006). Participants who scored between 6 and 14 completed an alternative experiment. We adopted a $2 \times 2 \times (2) \times (3)$ mixed model design (see Table 1). The two between-subjects factors were dysphoria status (high *vs*. low) and RP condition (positive *vs*. negative). We assigned high and low dysphoric participants to each RP group, such that there was an *n* per cell of 12 or 13. The two within-subjects factors were item valence (positive *vs*. negative) and item type (Rp+ *vs*. Nrp *vs*. Rp−).

Procedure

We adapted the autobiographical memory RIF procedure developed by Barnier et al. (2004), resulting in six experimental phases: (1) assessment; (2) generation; (3) learning; (4) retrieval-practice; (5) distraction and (6) final recall. In the initial assessment phase,

Table 1. Experiment 1 conditions

	RP group	Rp+	Nrp	Rp−
Low dysphoria	Positive RP ($n = 13$)	5 positive	10 negative	5 positive
	Negative RP ($n = 12$)	5 negative	10 positive	5 negative
High dysphoria	Positive RP ($n = 13$)	5 positive	10 negative	5 positive
	Negative RP ($n = 12$)	5 negative	10 positive	5 negative

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participants completed the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), the Beck Anxiety Inventory (BAI; Beck & Steer, 1990) and the Ruminative Response Scale of the Response Styles Questionnaire (RRS; Nolen-Hoeksema & Morrow, 1991).

Generation. Participants generated 10 positive and 10 negative memories in response to the cue words 'positive' and 'negative', which appeared in a random order 10 times each on the computer screen. For the cue 'positive', participants were instructed to recall specific events that made them feel good to think about. For the cue 'negative', participants were instructed to recall specific events that did not make them feel good to think about. For each event, participants pressed the space bar as soon as they had a specific memory in mind, which allowed us to record their response latency. Participants briefly described their memory, estimated their age at the time of the event and rated the memory's valence (from 1 = *very negative* to 7 = *very positive*) and clarity (from 1 = *very vague* to 7 = *extremely vivid*). Participants then typed a single 'personal word' that reminded them of the event (e.g. the word 'hospital' for the event 'visited grandma in hospital the day before she died').

Learning. Next, participants saw each cue word (either *positive* or *negative*) and one of the associated personal words on the screen for 20 seconds. The experimenter read aloud the memory associated with this cue/personal-word pair. Presentation order of the associations was random.

Retrieval practice. Participants completed three RP cycles: Depending on RP condition, they practiced half of their positive memories *vs.* half of their negative memories three times each in a random order (see Table 1). In this phase, participants saw cue/personal-word pairs one at a time on the computer screen. For each one, they pressed the space bar as soon as they recalled the corresponding memory, then described the memory in as much detail as possible and verbally answered questions designed to mimic the process of rumination. Over the three RP cycles, these questions were: (1) what were the causes of the event; (2) what were the consequences of the event and (3) what was the personal meaning of the event. If participants could not respond within 1 minute, the experimenter read aloud the memory that went with that cue/personal-word pair. After RP, participants completed a distraction phase where they performed two filler tasks for a total of 20 minutes.

Cued recall. Finally, participants saw the cue words *positive* and *negative* one at a time, on the computer screen. For each cue word, participants attempted to recall all of the memories that they had generated earlier for that cue. Participants continued to recall until blocked, and were allowed a maximum of 5 minutes per word. Presentation order was counterbalanced across participants, and equal numbers of participants recalled positive memories *vs.* negative memories first.

Results and discussion

Assessment

Participants classified as high dysphoric had an average BDI-II score of 20.24 ($SD = 5.09$), and those classified as low had an average score of 3.16 ($SD = 1.99$). A series of one-way ANOVAs confirmed that high dysphoric participants scored significantly higher than low dysphoric participants on both the BAI (high $M = 36.24$, $SD = 6.13$; low: $M = 24.92$, $SD = 2.72$) and the RRS (high $M = 36.76$, $SD = 6.57$; low: $M = 26.70$, $SD = 6.05$), all $F\text{s} > 30.31$, all $p\text{s} < .01$.

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Generation

All participants generated 10 positive and 10 negative memories. Participants rated their positive memories as more positive ($M = 6.11$, $SD = 0.54$) than their negative memories ($M = 2.39$, $SD = 0.53$). A 2 (dysphoria) × 2 (RP group) × (2) (valence) mixed model ANOVA on participants' valence ratings revealed a main effect of valence, $F(1, 46) = 913.03$, $p < .001$, $\eta_p^2 = .95$. There was a non-significant trend for high dysphoric participants ($M = 4.15$, $SD = 0.33$) to rate their memories as more negative than low dysphoric participants ($M = 4.32$, $SD = 0.26$), $F(1, 46) = 3.79$, $p = .058$, $\eta_p^2 = .08$. No other main effects or interactions were significant, all Fs < 3.05, all ps $> .08$.

Participants took an average of 12.27 seconds ($SD = 5.39$) to generate each memory. They were faster to generate positive memories ($M = 11.09$, $SD = 5.09$) than negative memories ($M = 13.46$, $SD = 5.68$). A 2 (dysphoria) × 2 (RP group) × (2) (valence) mixed model ANOVA revealed a main effect of valence, $F(1, 45) = 13.26$, $p < .001$, $\eta_p^2 = .22$. There were no effects associated with dysphoria or RP group on generation latency, all Fs < 1.34, all ps $> .25$.

Participants reported their age in years for each memory that they generated. We calculated the age of each memory by subtracting participant's reported age from their current age. Participants primarily generated memories of recent events; events were an average of 2.29-years-old ($SD = 1.41$). Age depended on both valence and dysphoria: A 2 (dysphoria: high *vs*. low) × 2 (RP group: positive *vs*. negative) × (2) (valence: positive *vs*. negative) mixed model ANOVA yielded a main effect of valence, $F(1, 46) = 36.52$, $p < .001$, $\eta_p^2 = .44$, which was moderated by an interaction between valence and dysphoria, $F(1, 46) = 6.65$, $p = .013$, $\eta_p^2 = .13$. Follow-up *t*-tests indicated that participants with low dysphoria generated negative memories that were older ($M = 3.18$, $SD = 1.77$) than their positive memories ($M = 1.48$, $SD = 0.98$), $t(24) = 7.03$, $p < .01$, $d = 5.85$. Participants with high dysphoria also generated negative memories that were older ($M = 2.59$, $SD = 1.83$) than their positive memories ($M = 1.92$, $SD = 1.60$), but for these participants the difference was smaller, $t(24) = 2.22$, $p = .036$, $d = 1.55$. There were no other significant main effects or interactions, all Fs $< .79$, all ps $< .37$.

On average, participants rated their memories as clear ($M = 5.67$, $SD = 0.80$), but memory clarity depended on valence and dysphoria: A 2 (dysphoria) × 2 (RP group) × (2) (valence) mixed model ANOVA revealed a significant main effect of valence, $F(1, 46) = 19.41$, $p < .001$, $\eta_p^2 = .30$, which was moderated by an interaction between valence and dysphoria, $F(1, 46) = 4.37$, $p = .042$, $\eta_p^2 = .09$. Follow-up *t*-tests indicated that low dysphoric participants had clearer positive ($M = 6.00$, $SD = 0.71$) than negative memories ($M = 5.45$, $SD = 0.75$), $t(24) = 4.37$, $p < .001$, $d = 2.04$. High dysphoric participants had similarly clear positive memories ($M = 5.72$, $SD = 0.85$) and negative memories ($M = 5.52$, $SD = 0.88$), $t(24) = 1.79$, $p = .086$. There were no other significant main effects or interactions, all Fs < 1.73, all ps $< .19$.

Retrieval practice

During RP, participants recalled the correct memory on .99 ($SD = 0.04$) of trials. A 2 (dysphoria: high *vs*. low) × 2 (RP group: positive *vs*. negative) × (2) (valence: positive *vs*. negative) mixed model ANOVA revealed no main or interaction effects, all Fs < 1.80, all ps $> .18$.

Overall recall

We scored participants' memories as correctly recalled if their descriptions were sufficient to identify that they were referring to the same specific episodic memories as at generation.

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At final recall, participants recalled .81 ($SD = 0.09$) of their memories. A 2 (dysphoria) × 2 (RP group) × (2) (valence) mixed model ANOVA revealed a significant main effect of valence, $F(1, 46) = 8.62$, $p = .005$, $\eta_p^2 = .16$, which was moderated by an interaction between valence and RP group, $F(1, 46) = 5.31$, $p = .026$, $\eta_p^2 = .10$. Participants in the positive RP group recalled significantly more of their positive memories ($M = 0.85$, $SD = 0.11$) than their negative memories ($M = 0.77$, $SD = 0.15$), $t(49) = 2.94$, $p < .001$, $d = 0.66$. Participants in the negative RP condition recalled a similar number of positive or negative memories, $t(23) = 0.48$, $p = .638$.

Facilitation

Participants showed facilitation: They recalled more Rp+ items ($M = 0.95$, $SD = 0.11$) than Nrp items ($M = 0.78$, $SD = 0.15$; see Figure 1). A 2 (dysphoria) × 2 (RP group) × (2) (item type: Rp+ *vs*. Nrp) mixed model ANOVA on participants' final recall revealed a main effect of item type, $F(1, 46) = 47.62, p < .001, \eta_p^2 = .51$. This main effect was moderated by an interaction between RP group and item type, $F(1, 46) = 8.13$, $p = .007$, $\eta_p^2 = .15$. We conducted follow-up tests to compare the performance of the two groups separately for each item type. Both groups recalled a similar number of Rp+ items, $t(48) = 0.94$, $p = .350$, but participants in the negative Rp group (for whom Nrp was positive) recalled more of these Nrp memories than participants in the positive Rp group (for whom Nrp was negative), $t(48) = 2.57, p = .013, d = 0.39$. That is, baseline positive memories were more memorable than baseline negative memories, regardless of mood (see Figure 1). There were no other main effects or interactions, all Fs < 2.04, all ps $> .16$.

Retrieval-induced forgetting

Participants also showed RIF, but only when they were in the negative RP group (see Figure 1). A 2 (dysphoria) × 2 (RP group) × (2) (item type: Rp− *vs*. Nrp) mixed model ANOVA yielded an interaction between RP group and item type, $F(1, 46) = 6.30, p = .016$, $\eta_p^2 = .12$. We conducted follow-up tests to compare the performance of the two groups separately for each item type. These analyses suggested that the groups recalled a similar number of Rp− items, $t(48) = 1.39$, $p = .17$, but that baseline positive memories were more memorable than baseline negative memories, as described in the previous section. There were no other significant main effects or interactions, all Fs < 1.41, all ps $> .24$ (see Figure 1).

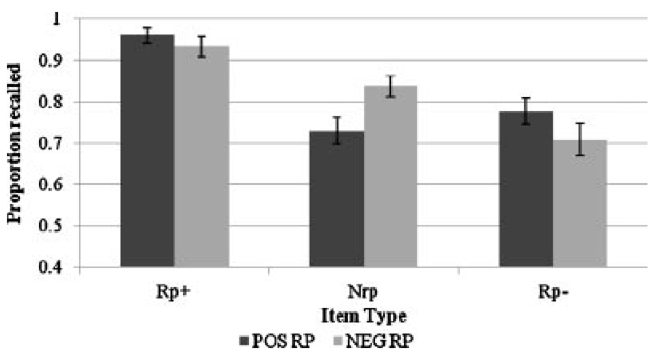

Figure 1. Experiment 1: Proportion of Rp+, Nrp and Rp− memories recalled by participants in the positive and negative RP groups. Error bars represent the standard error of the mean for each group

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Overall, participants demonstrated RIF for negative memories but not for positive memories. However, this effect was largely driven by differences in recall of baseline, Nrp memories. Consistent with the positivity bias found in previous memory research, participants recalled more positive Nrp memories than negative Nrp memories. Interestingly, this bias did not impact on facilitation of Rp+ memories or on RIF of Rp− memories. It is possible that the competition between memories was powerful enough to overcome emotional, motivational effects on remembering and forgetting. Contrary to our expectations, all participants demonstrated a positive memory bias, regardless of dysphoria level.

EXPERIMENT 2

In Experiment 1, differences between positive and negative memories emerged for baseline Nrp memories, but not for Rp+ and Rp− memories. This made it difficult to accurately assess the relative effects of memory valence and RP. Further, in Experiment 1, we examined whether practicing certain memories resulted in forgetting of same valenced memories. However, this design may not have truly captured the biased RP that occurs in everyday life, particularly in clinical populations. For instance, depressed individuals tend to recall and ruminate extensively about the negative aspects of an event, very likely at the expense of positive aspects (Brewin, 2006). Consistent with this notion, Brewin (2006) proposed that cognitive behavioural therapy alleviates psychological symptoms by altering 'the relative activation of positive and negative representations such that the positive ones are assisted to win the retrieval competition' (p.765).

In Experiment 2, we examined whether selectively rehearsing positive *vs*. negative memories influenced participants' recall of competing, oppositely valenced memories. To do this, we modified the procedure so that the valence of Rp+ and Rp− was matched to the valence of Nrp memories. We also focused on participants with high levels of dysphoria to conduct a more targeted examination of mood, and we examined whether individual differences within this group might be associated with differences in RIF.

Method

Participants and design

Twenty-nine participants (22 females, 7 males) took part in Experiment 2. Participants were aged between 17 and 42 years ($M = 22.41$, $SD = 5.61$). We advertised for participants who were currently experiencing a diagnosed depressive episode, by displaying a notice on our Department's research participation website as well as posters around campus. Seventeen participants were undergraduate psychology students who participated in return for course credit; 12 participants were recruited through posters and were reimbursed AU $20 for their participation. All participants had high levels of dysphoria (BDI-II ≥ 18). We adopted a $2 \times 2 \times (4)$ mixed models design (see Table 2). The two between-subjects factors were RP condition (positive *vs*. negative) and RP category (work/study *vs*. home/family). We assigned participants to each RP group, such that there was an *n* of 7 or 8 per cell. RP category was a counterbalancing variable, and we had intended to collapse across conditions so that there was an *n* of 14 or 15 per cell. However, we included RP category in our analyses (reported shortly) to determine whether categories were equivalent or not. The within-subjects factor was item type (Rp+ *vs*. Nrp positive *vs*. Nrp negative *vs*. Rp−).

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Table 2. Experiment 2 conditions

RP group	RP category	Rp+	Nrp pos	Nrp neg	Rp−
Positive RP	Work RP ($n = 8$)	5 positive work	5 positive home	5 negative home	5 negative work
	Home RP ($n = 7$)	5 positive home	5 positive work	5 negative work	5 negative home
Negative RP	Work RP ($n = 7$)	5 negative work	5 positive home	5 negative home	5 positive work
	Home RP ($n = 7$)	5 negative home	5 positive work	5 negative work	5 positive home

Materials

As in Experiment 1, participants completed the BDI-II, BAI and RRS. Additionally, instead of the cue words *positive* and *negative*, participants generated memories in response to the cue words *work* and *home*.

Procedure

The study contained six phases: (1) assessment; (2) generation; (3) learning; (4) retrieval-practice; (5) distraction and (6) final recall. The procedure was very similar to that of Experiment 1, with one exception. Participants generated 10 memories (5 positive, 5 negative) to the cue word *work* and 10 memories (5 positive, 5 negative) to the cue word *home*. The experimenter told participants 'work' memories were associated with work or study, and 'home' memories were associated with home or family. Additionally, the experimenter told participants that each cue would be accompanied by the word *positive* or *negative*; the description of positive and negative memories was identical to that in Experiment 1. The cue words appeared in a random order 10 times each on the computer screen, accompanied by either the word positive or negative below in smaller font. As in Experiment 1, participants briefly described their memory, estimated their age at the time of the event, and rated the memory's valence and clarity. In Experiment 2, participants also rated how personally important the memory was to them (from 1 = *not at all important* to 7 = *extremely important*).

The remaining phases were identical to Experiment 1, except that the cue words *work* and *home* appeared instead of the cue words *positive* and *negative* (see Table 2). In the RP phase, the cue/personal-word pairs were presented to indicate which memory was to be practiced. In the final recall phase, the cue words *work* and *home* appeared once each, and participants attempted to recall all the memories that went with each cue. Presentation order was counterbalanced across participants, and equal numbers of participants recalled work memories *vs*. home memories first. The words *positive* and *negative* did not appear in any phase other than the generation phase.

Results and discussion

Generation

Participants had an average BDI-II score of 26.62 ($SD = 7.17$), an average BAI score of 39.14 ($SD = 9.40$) and an average RRS score of 43.34 ($SD = 8.58$). All participants generated 10 positive and 10 negative work and home memories. They rated their positive memories as more positive ($M = 5.99$, $SD = 0.53$) than their negative memories ($M = 2.11$, $SD = 0.61$). A

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(2) (valence: positive *vs*. negative) × (2) (category: work *vs*. home) within-subjects ANOVA on participants' valence ratings revealed a main effect of valence, $F(1, 28) = 526.90, p < .001$, $\eta_p^2 = .95$, as well as a main effect of category, $F(1, 28) = 7.09, p = .013$, $\eta_p^2 = .20$. These main effects were moderated by a significant interaction between valence and category, $F(1, 28) = 5.13$, $p = .031$, $\eta_p^2 = .16$. While participants rated positive work memories ($M = 5.99$, $SD = 0.12$) and positive home memories ($M = 5.99$, $SD = 0.11$) similarly in terms of valence, they rated negative home memories as more negative ($M = 1.88$, $SD = 0.14$) than negative work memories ($M = 2.33$, $SD = 0.13$), $t(28) = 3.31$, $p = .003$, $d = 1.20$.

We calculated the age of each memory by subtracting participant's reported age from their current age. Participants' memories were an average of 3.38-years-old ($SD = 2.70$). A (2) (valence: positive *vs*. negative) × (2) (category: work *vs*. home) within-subjects ANOVA on participants' age ratings revealed only a main effect of category, $F(1, 28) = 20.48$, $p < .001$, $\eta_p^2 = .42$. Work memories were significantly more recent ($M = 2.12$, $SD = 2.10$) than home memories ($M = 4.63$, $SD = 3.82$). No other main effects or interactions were significant, all Fs < 2.66, all ps $> .11$.

On average, participants rated their memories as clear ($M = 5.63$, $SD = 0.70$). A (2) (valence: positive *vs*. negative) × (2) (category: work *vs*. home) within-subjects ANOVA on participants' clarity ratings revealed no effects of valence or category, all Fs $< .36$, all ps $> .55$.

A (2) (valence: positive *vs*. negative) × (2) (category: work *vs*. home) within-subjects ANOVA on participants' importance ratings revealed a significant main effect of valence, $F(1, 28) = 7.59$, $p = .010$, $\eta_p^2 = .21$, which was moderated by a significant interaction between valence and category, $F(1, 28) = 7.68$, $p = .010$, $\eta_p^2 = .22$. Participants rated positive work memories as significantly more important ($M = 5.11$, $SD = 1.34$) than positive home memories ($M = 4.69$, $SD = 1.39$), $t(28) = 3.64$, $p < .001$, $d = 1.77$. Participants rated negative work ($M = 4.15$, $SD = 1.34$) and negative home memories ($M = 4.38$, $SD = 1.43$) as similarly important, $t(28) = 1.24$, $p = .227$. The main effect of category was not significant, $F(1, 28) = 0.51$, $p = .48$.

Overall recall

During RP, participants recalled the correct memory on all trials. On final recall, participants recalled .82 ($SD = 0.13$) of their memories. A 2 (dysphoria) × 2 (RP group) × (2) (valence) mixed model ANOVA on total proportion recalled revealed no significant main or interaction effects, all Fs < 1.62, all ps $> .21$. Overall, participants recalled a similar number of positive and negative, work and home memories.

Individual differences in recall

To examine individual differences in recall, we conducted partial correlations between scores on the self-report measures (BDI-II, BAI and RRS) and the proportion of Rp+, Nrp pos, Nrp neg and Rp− items participants recalled, while controlling for scores on the other two measures. This analysis indicated that, independent of BDI-II and RRS scores, BAI scores were significantly and strongly negatively correlated with Rp− recall, $r(25) = -.45$, $p = .019$: The higher participants' anxiety, the lower their Rp− recall. However, BAI scores were not correlated with recall of any other item type, and BDI and RRS scores were not correlated with recall, all rs $< .32$, all ps $> .10$.

Facilitation

Participants showed facilitation: They recalled .93 ($SD = 0.11$) of their Rp+ memories and .80 ($SD = 0.15$) of their Nrp memories (see Figure 2). A 2 (RP group: positive *vs*.

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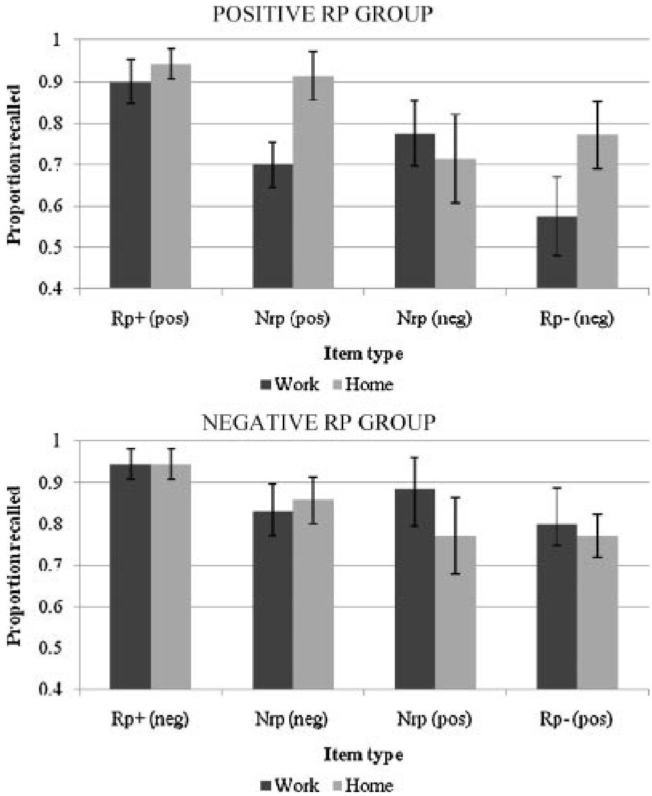

Figure 2. Experiment 2: Proportion of Rp+, Nrp and Rp− memories recalled by participants in the work and home RP groups. Error bars represent the standard error of the mean for each group

negative) × 2 (RP category: work *vs*. home) × (3) (item type: Rp+ *vs*. Nrp pos *vs*. Nrp neg) mixed model ANOVA yielded a main effect of item type, $F(1,\ 27) = 5.91$, $p = .005$, $\eta_p^2 = .19$. Follow-up contrasts indicated that, across conditions, participants recalled more Rp+ memories than both positive and negative Nrp memories, $F(1, 25) = 19.36$, $p < .001$, $\eta_p^2 = .44$. There was no difference between positive and negative Nrp memories, $F(1,\ 25) = 0.22$, $p = .641$. This was moderated by a marginally significant three-way interaction, $F(2,\ 24) = 3.08$, $p = .055$, $\eta_p^2 = .11$, such that patterns of facilitation tended to differ across memory valence and category conditions (see Figure 2). There were no other main effects or interactions, all Fs < 1.15, all ps > .29 (see Figure 2). Participants demonstrated facilitation of practiced memories regardless of whether they practiced positive or negative memories, and regardless of memory category (i.e. work or home; see Figure 2).

Retrieval-induced forgetting

Participants showed RIF; that is, they recalled .72 ($SD = 0.23$) of their Rp− memories and .80 ($SD = 0.15$) of their Nrp memories. However, a 2 (RP group: positive *vs*. negative) × 2 (RP category: work *vs*. home) × (3) (item type: Rp− *vs*. Nrp pos *vs*. Nrp neg) mixed model ANCOVA including BAI scores as a covariate, yielded a significant three-way interaction, $F(1,\ 23) = 3.38$, $p = .042$, $\eta_p^2 = .12$. There were no other main effects or interactions, all Fs < 2.34, all ps > .13. We conducted follow-up pairwise comparisons of Rp− and Nrp

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items of the same valence separately for each RP group and Rp category, to determine which conditions demonstrated significant RIF of their Rp− memories. We found significant RIF in only one group: Participants who practiced their positive work memories recalled fewer of their unpracticed, negative work memories than baseline negative memories, $t(7) = 3.06$, $p = .018$, $d = 3.05$. For the remaining three groups, there was no significant difference between the recall of Rp− memories and Nrp memories of the same valence, all ts < 1.16, all ps $> .28$ (see Figure 2), although the power to detect such differences is low. However, the pattern of means did not suggest an RIF effect in the other conditions (see Figure 2).

Overall, in Experiment 2, we found that participants with high levels of dysphoria demonstrated facilitation of practiced memories regardless of memory valence. However, they only demonstrated RIF for negative work memories, not negative home memories or positive memories of either category. This finding is somewhat consistent with the positivity bias we found in Experiment 1. In sum, practicing positive memories resulted in forgetting of related, negative memories, but this effect was only observed for certain memory categories.

GENERAL DISCUSSION

Across two experiments, we found evidence that people show a positivity bias when they remember and forget autobiographical memories in the RIF paradigm. Regardless of mood, participants showed RIF for negative but not positive memories. In Experiment 1, this was mostly due to a positivity bias in baseline memories. In Experiment 2, participants only showed RIF for negative Rp− memories; they did not show RIF for positive memories. These results suggest that the impact of RP depends on the content of the material being remembered, and that some kinds of memories are more susceptible to RIF than others.

Our results are consistent with a positivity bias; that is, the tendency for people to recall more positive than negative information (Dalgleish & Cox, 2000; Serrano et al., 2007). This bias accords with evidence that people have a general motivation to remember their past experiences in positive rather than negative ways (see Walker et al., 2003 for a review). Our findings are also consistent with Wessel and Hauer's (2006) results, where participants showed RIF for negative but not positive autobiographical memories. Thus, this general positive motivation might have reduced RIF for positive memories.

However, our results contrast with RIF studies that have used word lists, in which negative material has generally been less likely to be forgotten (e.g. Moulds and Kandris, 2006). Additionally, our findings are inconsistent with prior research suggesting that people in negative moods exhibit a mood congruency bias in memory recall, and are more likely to remember negative events. We found no evidence for such a mood congruency bias; in fact, mood had no effect on RIF for negative and positive autobiographical memories. It is possible that our high dysphoric participants did not show RIF for positive memories because they were motivated to recall them in order to improve their mood (Josephson et al., 1996; although see Joormann & Siemer, 2004). A number of studies have suggested that people may attempt to improve their mood by recalling positive, mood incongruent information (Parrott & Sabini, 1990; Sakaki, 2007). Whether participants recall mood congruent or incongruent information when they are in a negative mood may depend on the severity of the negative mood (Josephson et al., 1996). Our findings suggest

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that even people with high levels of dysphoria may demonstrate this mood incongruency bias in their recall of autobiographical memories.

Another possibility is that the retrieval competition created in the RIF paradigm may override a bias towards remembering negative memories in dysphoric participants. Our data suggest that when high dysphoric participants repeatedly practice positive memories, they may forget related negative memories. This finding is consistent with Brewin's (2006) argument that cognitive behavioural therapy may be interpreted in terms of retrieval competition, where positive information is facilitated at the expense of negative information (see also Joormann et al., 2005). In Experiment 2, we found evidence suggesting that this process may occur in dysphoric samples, and future research could focus on the possibility of creating competition between positive and negative memories in clinically relevant samples.

An alternative possibility is that our high dysphoric participants were not depressed enough to show any differences from our low dysphoric participants. This explanation is unlikely, however, given research showing that high dysphoric samples are appropriate analogues to patients with clinical depression, and perform comparably to clinically depressed patients on experimental tasks (see Cox, Enns, Borger, & Parker, 1999). In Experiment 2, while we did not formally assess participants' clinical depression (e.g. by administering a structured interview), we advertised for participants who were currently experiencing a clinically diagnosed, depressive episode. Future research could follow up this issue with a more formal diagnostic procedure to confirm the presence of depression, as well as any additional Axis I comorbidity.

In Experiment 2, only negative work memories were forgotten following RP, while neither positive nor negative home families were forgotten following RP. Despite our intention of equivalent memory categories, there were some pre-existing differences between the memories generated in response to each category cue. Specifically, work memories were more recent, negative work memories were less negative than home memories, and positive work memories were more personally important than home memories. However, it seems unlikely that these differences explain our pattern of results. For each participant, we coded which memories were recalled and not recalled, and calculated average age, clarity valence and importance ratings for memories that were recalled *vs*. memories that were not recalled on the final recall task. Analyses indicated that there were no differences in the qualities of recalled *vs*. not recalled memories, so these factors did not seem to determine whether memories were remembered or forgotten following RP.

Another possibility for the surprising category differences is that work memories were more strongly linked to their category cue than home memories. Previous research has suggested that strong links between categories and exemplars are required for RIF (e.g. fruit guava does not result in RIF whereas fruit apple does; Anderson et al., 1994). Future research could examine the kinds of memories generated to different cues by different populations. However, it is difficult to control the content of autobiographical memories generated to cues. For instance, Wessel and Hauer (2006) asked subjects to generate memories in response to negative situations and negative traits before practicing half of their situation or trait memories. Interestingly, 'trait' participants recalled more Nrp memories than 'situation' participants—similar to the pattern of results that we found in Experiment 1. Taken together, our results and Wessel and Hauer's (2006) demonstrate the difficulty in equating two categories of autobiographical memories to act as a baseline for one other.

Overall, our results suggest that different types of information might be more or less likely to be forgotten in the RIF paradigm. In the current study, positive memories were less susceptible to forgetting, consistent with a positivity bias in which people are motivated to remember the positive and forget the negative events of their lives. A positivity bias may serve important functions, particularly for those in negative moods, and may be one way that some people overcome dysphoria. This may be particularly relevant in the practice of cognitive behaviour therapy (Brewin, 2006). Additionally, our results illustrate the challenges that arise when extending experimental paradigms to autobiographical material. Controlling all aspects of the stimuli in order to match conditions becomes very difficult, and surprising differences can emerge. Nonetheless, overall our findings suggest that focusing on positive memories may have clinical benefits in conditions that are characterised by the experience of persistent negative memories.

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