

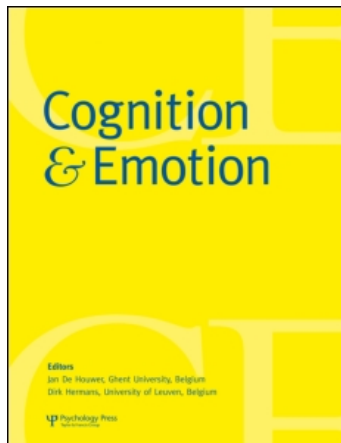
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Access details: Access Details: [subscription number 915031380]

Publisher Psychology Press

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## Cognition & Emotion

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713682755>

### Motivational biases in memory for emotions

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First published on: 19 February 2009

**To cite this Article** Lench, Heather C. and Levine, Linda J.(2010) 'Motivational biases in memory for emotions', Cognition & Emotion, 24: 3, 401 – 418, First published on: 19 February 2009 (iFirst)

**To link to this Article:** DOI: 10.1080/02699930802650788

**URL:** <http://dx.doi.org/10.1080/02699930802650788>

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# Motivational biases in memory for emotions

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This research examined how individuals' motivations and goals were related to their memory for past emotional experiences. In two studies, participants rated how happy and anxious they felt while completing a challenging anagram task and later recalled their emotions. Bias in memory for emotions was predicted by the combination of participants' general motivation (approach BAS vs. avoidance BIS) and the specific goal they set for the task (approach vs. avoidance). Participants with approach motivation and goals overestimated happiness more, and showed a stronger relation between peak and remembered happiness, than other participants. Participants with avoidance motivation and goals overestimated anxiety more, and showed a stronger relation between peak and remembered anxiety, than other participants. Thus motivational factors known to influence attention to valenced information also predict how emotional experiences will be remembered.

*Keywords:* Motivation; Memory; Approach; Avoidance; Emotion.

Memories for past emotional experiences allow people to navigate a world filled with almost endless choices. Whether we seek out or avoid experiences such as a social gathering, a challenging task at work, or a long-term relationship is partly determined by our memory of how happy or anxious similar experiences made us feel in the past (e.g., Safer, Levine, & Drapalski, 2002; Wirtz, Kruger, Scollon, & Diener, 2003). Although we rely on memories of past emotions to make decisions, these memories are often inaccurate.

People typically exaggerate the intensity of past emotions, remembering a pleasant vacation as more enjoyable, and a challenging task as more anxiety provoking, than they actually were at the time (e.g., Lench & Levine, 2008; Wirtz et al., 2003; see Levine, Safer, & Lench, 2006, for a review). Which emotions people exaggerate, and the extent to which they exaggerate, however, may depend on whether people are motivated to attend to positive or negative information. In other words, some individuals may remember experiences as

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Support was provided for this study by an American Psychological Association dissertation award and a School of Social Ecology fellowship. Portions of this manuscript were presented at the International Society for Research on Emotions conference, Atlanta, GA.

Thanks to Roxane Silver and Jutta Heckhausen for their support and to Sarah Strader, MaryAnn Profeta, Nicole Navi, Marissa Fortunato, Jenna Tanaka, Cassandra Wiley, and Erika Siegel for assistance with data collection and entry.

better than they actually were while others remember similar experiences as worse than they actually were. The purpose of the present investigation was to investigate the relation between motivation and bias in memory for emotions.

### Sources of bias in memory for emotion

Most research on memory for emotion has shown positive correlations between the intensity of emotion initially reported and the intensity recalled ( $r = .50$  or higher, considered a large correlation in the social sciences; Levine et al., 2006). Relative accuracy across individuals does not guarantee accurate recall for any one individual, however, and biases in explicit memory for emotion have been demonstrated for many types of experiences. Typically, the direction of bias has been toward overestimating the intensity of past emotions (see Levine et al., 2006; Robinson & Clore, 2002, for reviews). Examples include the overestimation by depressed patients of the intensity of past feelings of depression (Schrader, Davis, Stefanovic, & Christie, 1990), overestimation of negative emotion at the time of their first relapse by smokers trying to quit (Shiffman et al., 1997), overestimation by blood donors of pre-donation anxiety (Breckler, 1994), and overestimation of emotions experienced on vacation (Wirtz et al., 2003). The tendency to overestimate past emotions has been found, both when people recall how they felt during a single event (e.g., donating blood; Breckler, 1994), and when people recall the overall emotional impact of a series of events that spanned longer time periods (e.g., Fredrickson, 2000; Thomas & Diener, 1990). In one study, for example, college students completed multiple emotional assessments while on spring break vacation and later recalled the overall intensity of their positive and negative emotions. Relative to their initial reports, students overestimated the intensity of both the positive and negative emotion they had experienced on vacation.

To estimate the overall emotional impact of an experience, people must rely on strategies to combine or summarise across instances of varying emotional intensity. The need for estimation

strategies is clear when people are asked to provide multiple ratings of emotional intensity over a period of time, and later are asked to recall the overall emotional impact of an experience (e.g., Fredrickson & Kahneman, 1993; Thomas & Diener, 1990; Wirtz et al., 2003). Even single events (such as donating blood), however, occur over a period of time and typically include moments of greater and lesser emotional intensity. Thus the strategies people use (with or without awareness) to estimate overall emotional intensity may provide cues as to when and why people exaggerate past emotions. One such strategy is focusing on instances of greatest emotional intensity.

The most salient instances of past events are often those that elicited the most intense emotions (Frijda, Ortony, Sonnemans, & Clore, 1992). When people remember how they felt over an extended experience, they are particularly likely to focus on the instance of peak intensity (Fredrickson, 2000). As a result, peak emotion disproportionately contributes to memories for past emotional experience. In one study, for example, participants viewed a series of emotional clips and completed repeated measurements of the intensity of their emotional reaction (Fredrickson & Kahneman, 1993). The most intense reaction to a film clip disproportionately contributed to their later recall of the overall intensity of their emotions during the task. Thus allocating greater attention to instances of peak emotional intensity partially accounts for people's tendency to exaggerate past emotional experience (Fredrickson, 2000; Fredrickson & Kahneman, 1993; Morewedge, Gilbert, & Wilson, 2005; Wirtz et al., 2003).

*General motivation.* If peak emotional experience biases memory for emotion as a result of capturing attention, then other factors that direct attention during emotional experiences may also bias memory for emotion. One such factor is people's motivation to attend to positive versus negative stimuli. Gray (1972) identified basic differences with respect to whether people respond to information signalling potential reward

via a *behavioural activation system* (BAS), or to information signalling potential punishment via a *behavioural inhibition system* (BIS). Based on this work, other investigators have noted individual differences in people's motivation to attain positive outcomes or avoid negative outcomes, and these general motivations have been found to be associated with differences in attention, emotion, and behaviour (e.g., promotion vs. prevention, Higgins, Shah, & Friedman, 1997; approach vs. avoidance, Heimpel, Elliot, & Wood, 2006). The tendency to be motivated by positive stimuli versus negative stimuli appears to represent a categorical difference between individuals, such that individuals demonstrate strong motivations to approach positive stimuli and experience happiness or avoid negative stimuli and experience anxiety (Carver & White, 1994; Gray, 1972; Lang, 1995). These basic tendencies drive attention to relevant positive or negative information. For example, Derryberry and Reed (1994) found that extroverts (characterised by approach motivation) were relatively slow to shift attention away from positive stimuli, whereas introverts (characterised by avoidance motivation) were slow to shift attention away from negative stimuli. Motivational states that direct attention to positive versus negative stimuli may result in biases in memory for positive and negative emotions.

*Specific goals.* Although stable individual differences have been shown in people's tendency to be motivated by positive and negative outcomes, all people are capable of setting goals in specific situations to attain positive outcomes or avoid negative outcomes (e.g., Gray, 1972). Approach or avoidance goals determine a person's orientation in a particular situation and can also influence attention (Heimpel et al., 2006). It is important to examine both general motivations and specific goals because specific goals in any particular situation may reinforce or mitigate the effects of people's general motivations on attention. Thus the present investigation assessed both people's general motivations and the goals they set for a particular situation.

*Predictions.* People with approach motivation who also set approach goals were expected to be especially likely to exaggerate the intensity of past positive emotion. Moreover, their remembered emotion was expected to be strongly related to peak positive emotion. Conversely, people with avoidance motivation who also set avoidance goals were expected to be especially likely to exaggerate the intensity of past negative emotion. Their remembered emotion was expected to be strongly related to peak negative emotion. In other words, we predicted that there would be an interaction between individual differences in motivation and the goals set for a specific situation. We predicted an interaction between trait motivation and goals, rather than two main effects, because past research has demonstrated that trait characteristics do not necessarily predict cognition and behaviour for any particular task. For example, although trait optimists generally expect positive outcomes, they do not judge positive outcomes more likely to occur in all situations (e.g., Lipkus, Martz, Panter, Drigotas, & Feaganes, 1993). Thus, we expected memory bias when individuals' general motivation as well as their specific goals for a task both encouraged a focus on either positive or negative information.

### The present investigation

Participants' general motivation (approach BAS/avoidance BIS) was assessed as well as their specific goals (approach/avoidance) during a difficult anagram task (unscrambling letters to form words; Lench & Levine, 2008). Specific approach and avoidance goals were self-reported in Study 1 and experimentally manipulated in Study 2. Participants rated their emotions during the task and recalled their emotions afterward. Participants with approach motivation and approach goals were expected to exaggerate past positive emotion more than other participants. Participants with avoidance motivation and avoidance goals were expected to exaggerate past anxiety more than other participants.

## STUDY 1

Study 1 examined the degree to which individual differences in motivation and self-reported goals for a task related to bias in remembered emotions.

### Method

#### *Participants*

Participants were 76 undergraduate students who received partial course credit for involvement in the study. Seven participants were excluded due to computer failure and missing data. Participants' average age was 20.9 years ( $SD = 2.3$ ) and 65% were female.

#### *Procedure*

Participants self-reported their demographic characteristics, BAS/BIS motivations, and goals for an anagram task. They also reported their emotions during the anagram task and recalled them shortly afterward.

*General motivation.* Participants completed BAS/BIS scales as measures of their general tendency to be motivated by positive or negative outcomes (Carver & White, 1994). The most reliable and valid subscale within the BAS scale was used (Reward Responsiveness,  $\alpha = .50$ ), which assesses people's tendency to respond to information signalling potential reward. This scale consists of five items, such as: "When good things happen to me, it affects me strongly". The BIS scale ( $\alpha = .73$ ), which assesses people's tendency to respond to information signalling potential punishment, consists of seven items, such as: "I worry about making mistakes". Scores on these two scales were compared and participants were categorised as primarily motivated by positive situations (higher BAS scores;  $n = 25$ ) or primarily motivated by negative situations (higher BIS scores;  $n = 51$ ). BAS approach motivation and BIS avoidance motivation were not significantly correlated,  $r(74) = -.10$ ,  $p = .38$ , and only three participants reported equal approach and avoidance motivation.<sup>1</sup>

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<sup>1</sup> Creating dichotomous variables from continuous measures can create bias in estimates and it is generally recommended that researchers avoid this procedure and instead rely on regression analyses (e.g., Cohen, 1983; Maxwell & Delaney, 1993; Tellegen & Lubinski, 1983). The discussion of potential bias has made clear that this procedure lowers the power to detect significant differences and wastes information and can, in cases where multiple variables are dichotomised with a median split, lead to erroneous rejection of the null hypothesis for main effects (Maxwell & Delaney, 1993). We chose to dichotomise measures of approach and avoidance motivation and goals in the present research for several reasons. First, examination of potential bias created by dichotomising continuous variables has focused on median and mean splits. This was not the procedure used in the present investigation. Rather, participants were classified according to whether scores on one variable were higher than scores on another. In addition, our predictions focused on interaction terms and not main effects. Second, the concern that important differences between individuals are ignored by treating participants in each group as if they were the same is less likely to be relevant to approach versus avoidance motivation and goals. The classification of individuals as primarily approach or avoidance is consistent with both theory and empirical findings that only the approach or avoidance system can be activated at a particular point in time (they are mutually inhibitory and the activation in one reduces activation in the other) and that individuals reliably differ in terms of which system they find most motivating (e.g., Gray, 1972; Lang, 1995). Thus, theoretically, individuals who are motivated primarily by one motive or goal are qualitatively different from individuals with other motivation or goals. This theoretical proposition is supported in the present investigation by findings that very few individuals reported being equally motivated by both (across both studies, a total of five participants, or 2.5%, reported equal BAS/BIS scores and these individuals scored perfectly neutral on the scales, indicating that they may not have been responding carefully to the items). Third, there is no alternative analytic procedure that would allow for full consideration of the data. If approach and avoidance motivations and goals were included as continuous measures, other critical information would by necessity be lost or rendered uninterpretable. Depending on the alternative analytic procedure, the consequences of using a different analytic procedure range from only considering remembered emotion rather than bias in remembered emotion to only considering some interactions (e.g., approach goals and motivation vs. avoidance goals and motivation, ignoring those who set goals contrary to their typical motivation) to the need to analyse difference scores as dependent variables (which is accompanied by potential bias), to an inability to interpret the five-way interaction effects that would be the foci of some analyses. While dichotomising continuous predictor variables is not generally recommended, we judged that it was the best analytic strategy in this particular investigation.

*Goals.* Participants rated, on 7-point scales, the extent to which they wanted to get answers correct and wanted to succeed on the anagrams. These two questions were combined to form a measure of approach goals ( $\alpha = .81$ ). Participants also rated the extent to which they wanted to avoid errors and wanted not to fail on the anagrams. These two questions were combined to form a measure of avoidance goals ( $\alpha = .63$ ). Participants were classified according to whether they primarily endorsed approach goals ( $n = 53$ ) or primarily endorsed avoidance goals ( $n = 23$ ). Participants were considered to primarily endorse a particular goal when their mean endorsement for that goal was greater than their mean endorsement for the other goal. Approach and avoidance goals were not significantly correlated,  $r(74) = .15$ ,  $p = .18$ , and no participants reported being equally motivated by approach and avoidance goals.

*Experienced emotion.* Participants were informed that they would complete three sets of five-letter anagrams for the next 25 minutes that measured different forms of verbal intelligence (e.g., Aspinwall & Richter, 1999). All participants were first presented with 7 unsolvable anagrams followed by 14 solvable anagrams. For the solvable anagrams, moderately difficult anagrams were chosen based on pilot testing, with 50–60% solved correctly. Initial pilot testing indicated that this combination of tasks reliably elicited negative emotional reactions and that there was sufficient variation in emotion present to reasonably investigate the impact of individual differences (Lench & Levine, 2008). Specifically, in the pilot investigation, participants ( $N = 37$ ) reported experiencing equivalent intensities of happiness ( $M = 2.83$ ,  $SD = 1.42$ ) and anxiety ( $M = 2.56$ ,  $SD = 1.26$ ) while completing the anagrams,  $t(75) = 1.29$ ,  $ns$ .

All standard deviations were greater than one scale point indicating variation between participants' experiences. The elicitation of negative emotional reactions was important because prior research has demonstrated that the impact of motivation on cognition is most evident under conditions that are potentially stressful (e.g., Gray, 1972; Higgins et al., 1997; Lench & Levine, 2008). Although anagram performance was not a focus of this investigation, prior research using this task revealed that participants' emotional reaction to initial unsolvable anagrams was related to their persistence on subsequent solvable anagrams, but not to their emotional reactions to the solvable anagrams (Lench & Levine, 2008).<sup>2</sup>

Between each anagram, participants rated how intensely they felt happiness and anxiety on a scale ranging from *not at all* (1) to *extremely* (7). These two emotions were measured separately because, according to Gray (1972), people with BAS motivations and approach goals are particularly likely to experience happiness whereas people with BIS motivations and avoidance goals are particularly likely to experience anxiety. In addition, although positive and negative reactions are frequently negatively correlated, they appear to be orthogonal and it is generally recommended that they be measured using separate scales (Watson, Wiese, Vaidya, & Tellegen, 1999). Lench and Levine (2008) have provided a detailed analysis of performance on the anagram task.

*Remembered emotion.* After the anagram task, participants completed a brief distraction task that consisted of sorting playing cards for five minutes. They then recalled the average intensities of happiness and anxiety they had experienced during the anagram task using the same scale described for experienced emotions.

<sup>2</sup> Additional analyses were conducted to ensure that the proposed relationships between motivations and goals were not due to differences in experienced emotion between the first set of unsolvable anagrams and subsequent sets. ANCOVAs were conducted for happiness and anxiety with Set (unsolvable, solvable) as a repeated measure and Motivation (BAS/BIS) and Goal (approach, avoidance) as between-subject factors. These analyses indicated that there was no difference in experienced happiness or anxiety during the unsolvable and solvable sets for participants with various motivations and goals for the task,  $F(1, 72) = 0.05$ ,  $ns$ , and  $F(1, 72) = 0.40$ ,  $ns$ , respectively. Further, Study 2 replicates the findings of Study 1 with manipulated goals.

## Results

The results are presented in two sections. We first examined how participants' general motivation (approach BAS/avoidance BIS) and goal for the anagram task (approach/avoidance) were related to their memory for their emotions during the anagram task. We then assessed whether peak emotions predicted memory for emotions. Eta-squared effect sizes are reported for all analyses of variance (ANOVAs; .01 is considered small, .09 medium, and .25 large in the social sciences; Cohen, 1992) and Cohen's  $d$  effect sizes are reported for all post-hoc  $t$ -tests (0.20 is considered small, 0.50 medium, and 0.80 large in the social sciences; Cohen, 1992).

### Remembered emotions

Table 1 shows the mean intensities (and standard deviations) of happiness and anxiety that participants experienced during the anagram task and remembered afterwards. To find out whether individuals with different combinations of motivations and goals overestimated or underestimated emotions, we conducted paired sample  $t$ -tests comparing experienced and remembered happiness. As can be seen in Table 1, past happiness was significantly overestimated by individuals with BAS motivation and approach goals,  $t(17) = 2.42$ ,  $p < .05$ ,  $d = 1.17$ . Past happiness was significantly underestimated by individuals

with BAS motivation and avoidance goals,  $t(6) = 3.92$ ,  $p < .01$ ,  $d = 3.92$ , and by individuals with BIS motivation and approach goals,  $t(34) = 3.01$ ,  $p < .01$ ,  $d = 1.03$ . No significant difference between experienced and remembered happiness was found for individuals with BIS motivation and avoidance goals,  $t(15) = .76$ ,  $ns$ .

Paired sample  $t$ -tests comparing experienced and remembered anxiety showed no significant differences for individuals with BAS motivation and approach goals,  $t(17) = 1.84$ ,  $ns$ , or avoidance goals,  $t(6) = 1.57$ ,  $ns$ . Individuals with BIS motivations and approach goals, however, significantly overestimated past anxiety,  $t(34) = 3.14$ ,  $p < .01$ ,  $d = 1.08$ , as did those with BIS motivations and avoidance goals,  $t(15) = 4.15$ ,  $p = .001$ ,  $d = 2.14$ . This pattern of findings provides evidence of bias in remembered emotion, but these analyses do not directly compare the extent of memory bias between groups with different motivations and goals. Thus, additional analyses were conducted to contrast the groups directly.

To more directly examine the relationship between motivation and goals and memory for emotion, we conducted analyses of covariance (ANCOVAs) separately for happiness and anxiety, with Time as the repeated factor (experienced vs. remembered emotion) and Motivation (approach BAS vs. avoidance BIS) and Goal (approach vs. avoidance) as between-subject factors. Because actual performance might be expected to

Table 1. Means and standard deviations for experienced, peak, and remembered emotions by group in Study 1

Variable	BAS motivation		BIS motivation	
	Approach goals ( $n = 18$ ) M (SD)	Avoidance goals ( $n = 7$ ) M (SD)	Approach goals ( $n = 35$ ) M (SD)	Avoidance goals ( $n = 18$ ) M (SD)
<i>Happiness</i>				
Experienced	3.02 (1.64)	3.38 (2.02)	3.10 (1.36)	2.18 (0.82)
Peak	4.22 (1.93)	5.29 (1.50)	5.00 (1.53)	4.38 (1.75)
Remembered	3.33* (1.75)	2.86** (2.12)	2.71** (1.41)	2.00 (1.10)
<i>Anxiety</i>				
Experienced	1.99 (1.14)	2.99 (1.56)	2.49 (1.16)	3.27 (1.38)
Peak	3.00 (1.88)	4.14 (2.19)	4.03 (1.72)	5.00 (1.75)
Remembered	2.33 (1.78)	3.29 (1.60)	3.00** (1.64)	4.63*** (1.89)

Note: Significance is given for paired sample  $t$ -tests comparing experienced emotion to remembered emotion. Experienced emotion was the average of participants' ratings of happiness or anxiety across all anagrams. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

influence memory for emotion, these analyses controlled for the number of anagrams solved correctly. The interaction of Time, Motivation, and Goals was of special interest, because an interaction would indicate that a combination of motivation and goals predicted bias in memory for emotion.

For happiness, a marginally significant main effect of Time was found,  $F(1, 71) = 3.65$ ,  $p = .06$ ,  $\eta^2 = .05$ . Overall, participants tended to remember less happiness ( $M = 2.72$ ,  $SD = 1.55$ ) than they reported having felt during the anagram task ( $M = 2.92$ ,  $SD = 1.44$ ). In addition, the predicted three-way interaction was found between Time, Motivation, and Goals,  $F(1, 71) = 6.02$ ,  $p < .05$ ,  $\eta^2 = .08$ . Post hoc  $t$ -tests on difference scores between experienced and remembered emotion confirmed that, as predicted, participants with approach motivation and goals overestimated past happiness more ( $M = 0.31$ ,  $SD = 0.54$ ) than did participants with approach motivation and avoidance goals ( $M = -0.52$ ,  $SD = 0.35$ ),  $t(23) = 3.73$ ,  $p < .005$ ,  $d = 1.56$ , participants with avoidance motivation and approach goals ( $M = -0.39$ ,  $SD = 0.76$ ),  $t(51) = 3.45$ ,  $p < .001$ ,  $d = 0.97$ , and marginally more than participants with avoidance motivation and avoidance goals ( $M = -0.18$ ,  $SD = 0.97$ ),  $t(32) = 1.86$ ,  $p = .07$ ,  $d = 0.66$ . No other significant effects were found. Thus, participants with approach motivation and goals tended to overestimate happiness more than other participants.

The analysis of anxiety showed a main effect of Time,  $F(1, 71) = 12.09$ ,  $p < .001$ ,  $\eta^2 = .15$ . Overall, participants remembered more anxiety ( $M = 3.21$ ,  $SD = 1.87$ ) than they reported having felt during the anagrams ( $M = 2.58$ ,  $SD = 1.55$ ). A main effect of Goals was also found,  $F(1, 71) = 8.05$ ,  $p < .01$ ,  $\eta^2 = .10$ . As can be seen in Table 1, participants with avoidance goals both experienced and remembered more anxiety than did participants with approach goals. The predicted three-way interaction between Time, Goals and Motivation was also found,  $F(1, 71) = 3.71$ ,  $p = .05$ ,  $\eta^2 = .05$ . Post hoc  $t$ -tests on difference scores between experienced and remembered emotion showed that participants with avoidance

motivation and goals overestimated past anxiety ( $M = 1.36$ ,  $SD = 1.31$ ) more than did participants with avoidance motivation and approach goals ( $M = 0.51$ ,  $SD = 0.95$ ),  $t(49) = 2.63$ ,  $p < .05$ ,  $d = 0.75$ , participants with approach motivation and avoidance goals ( $M = 0.30$ ,  $SD = 0.50$ ),  $t(21) = 2.06$ ,  $p = .05$ ,  $d = 0.90$ , and participants with approach motivation and approach goals ( $M = 0.35$ ,  $SD = 0.80$ ),  $t(32) = 2.75$ ,  $p < .05$ ,  $d = 0.97$ . No other significant effects were found. Thus, participants with avoidance motivation and goals overestimated past anxiety more than other participants.

In summary, consistent with prior research showing that people tend to exaggerate the intensity of past negative experiences, participants remembered having felt less happiness and more anxiety than they reported experiencing during the anagram task. These relationships were qualified, however, by individual differences in motivation and in the goals set for the anagram task. Participants with approach motivation and goals actually overestimated, rather than underestimated, how happy this unpleasant task had made them. In contrast, participants with avoidance motivation and goals both experienced more anxiety, and overestimated more in recalling how much anxiety they had experienced, relative to other participants.

#### *Peak emotions and memory*

Next, we assessed the relation of peak emotion to remembered emotion, and whether this relation differed depending on people's motivation and goals. Peak emotion was defined as the highest intensity rating for an emotion across the entire set of anagrams. When entered alone, consistent with previous research (Fredrickson, 2000), peak happiness predicted greater remembered happiness,  $\beta = .43$ ,  $t = 4.08$ ,  $p < .001$ , and peak anxiety predicted greater remembered anxiety,  $\beta = .87$ ,  $t = 15.00$ ,  $p < .001$ . To examine the predicted interaction between motivation and goals, we conducted separate hierarchical regression analyses for happiness and anxiety. Remembered emotion was regressed on peak emotion, average emotion, end emotion, motivation (dummy

coded), and goals (dummy coded). End emotion was included in these analyses because the end of an emotional experience has been shown to predict bias in remembered emotion (e.g., Fredrickson, 2000; Fredrickson & Kahneman, 1993). These analyses also included two-way interactions and the three-way interaction of peak emotion, motivation, and goals.

As shown in Table 2 (top), the predicted three-way interaction was found for happiness. To depict this interaction, Figure 1 shows regression coefficients for the relation between peak happiness and remembered happiness for each combination of motivation and goals. Independent *t*-tests were conducted to compare the size of the four regression coefficients (for this analytic strategy see Paternoster, Brame, Mazerolle, & Piquero, 1998; Wright, 1978). The results indicated that peak happiness predicted remembered happiness more strongly for participants with approach motivation and goals than for other participants, including those with approach motivation and avoidance goals,  $t(21) = 2.31, p < .05, d = 1.01$ , avoidance motivation and approach goals,  $t(49) = 9.60, p < .001, d = 2.74$ , and avoidance motivation and avoidance goals,  $t(30) = 11.50, p < .001, d = 4.20$ . As can be seen in

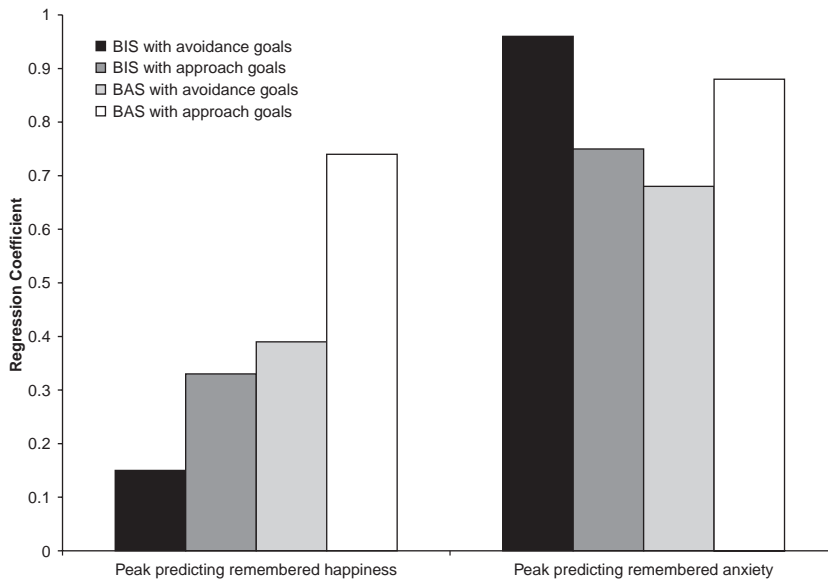
Figure 1, then, greater peak happiness predicted greater remembered happiness for all groups, but peak happiness was most strongly related to remembered happiness for participants with approach motivation and goals. In addition, peak happiness was less predictive of remembered happiness for participants with avoidance motivation and avoidance goals than for participants with avoidance motivation and approach goals,  $t(47) = 3.79, p < .01, d = 1.11$ , but not for participants with approach motivation and avoidance goals,  $t(19) = 1.45, p = .16, d = 0.67$ . To summarise the critical analysis, the strongest relationship between peak happiness and remembered happiness was found for those participants who would be expected to attend most to rewarding information; namely, those with both approach motivation and goals.

As shown in Table 2 (bottom), with respect to anxiety, the predicted three-way interaction was also found. Figure 1 shows the regression coefficients for the relation between peak anxiety and remembered anxiety for each combination of motivation and goals. Independent *t*-tests were used to compare the size of regression coefficients. The results indicated that the positive association between peak anxiety and remembered anxiety

**Table 2.** Regression analyses predicting remembered emotion in Study 1

Variable	$R^2$	<i>B</i>	( <i>SE</i> )	$\beta$	<i>t</i> -value
<i>Remembered happiness</i>	.80***				
Peak happiness		-.22	.10	-.24	2.07*
Average happiness		1.07	.10	.99	11.15***
End happiness		-.02	.06	-.02	.28
Motivation		-.54	.52	-.17	1.04
Goals		.15	.56	.04	.26
Motivation $\times$ Goal $\times$ Peak		.18	.08	.24	2.34*
<i>Remembered anxiety</i>	.80***				
Peak anxiety		.64	.15	.65	4.20***
Average anxiety		.67	.19	.46	3.56**
End anxiety		-.24	.09	-.21	2.61*
Motivation		-.12	.46	-.03	.27
Goals		-.29	.55	-.07	-.53
Motivation $\times$ Goal $\times$ Peak		.25	.10	.21	2.43*

*Note:* The table presents the third step in hierarchical regression analyses. Main effects were entered on the first step, two-way interactions on the second step, and the three-way interaction on the third step. Two-way interactions are not presented in the table and were not significant predictors in any of the steps. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



**Figure 1.** Regression coefficients for the relation between peak emotional intensity and remembered emotion for each combination of motivation and goals in Study 1.

was stronger for participants with avoidance motivation and goals than for other participants, including those with avoidance motivation and approach goals,  $t(47) = 5.97$ ,  $p < .001$ ,  $d = 1.74$ , approach motivation and approach goals,  $t(30) = 1.95$ ,  $p = .07$ ,  $d = 0.71$ , and approach motivation and avoidance goals,  $t(19) = 4.29$ ,  $p < .01$ ,  $d = 1.97$ . Unexpectedly, the relationship between peak and remembered anxiety was also relatively strong for participants with approach motivation and goals compared to those with avoidance motivation and approach goals,  $t(49) = 4.52$ ,  $p < .001$ ,  $d = 1.29$ , and approach motivation and avoidance goals,  $t(21) = 4.30$ ,  $p < .01$ ,  $d = 1.88$ .

In summary, the strongest relationship between peak happiness and remembered happiness was found for participants who would be expected to attend most to positive information: those with approach motivation and goals. The strongest relationship between peak anxiety and remembered anxiety was found for those participants who would be expected to attend most to negative information: those with avoidance motivation and goals. It was not clear why peak anxiety

also predicted remembered anxiety for participants with approach motivation and goals compared to participants with mixed motivations and goals. It may be that these participants were particularly surprised to find the anagram task so anxiety provoking. Indeed, prior evidence indicates that, compared to other participants, those with approach motivation and goals expected to be less anxious during the task than did other participants (Lench & Levine, 2006).

## STUDY 2

Study 1 showed that individual differences in motivation and self-reported goals for the anagram task related to bias in remembered emotion and to the extent to which peak emotion predicted remembered emotion. It is possible, however, that remembered emotions influenced the goals that participants set for the task. For example, individuals who tend to exaggerate their negative emotions and underestimate their positive emotions may be more likely to report

avoidance goals. Therefore, in Study 2, we manipulated approach and avoidance goals for the anagram task in order to further examine how individual differences in motivation and specific goals are related to bias in remembered emotion.

## Method

### *Participants*

Participants were 144 undergraduate students who received partial course credit for involvement in the study. Fifteen participants were excluded due to computer failure and missing data and two participants were excluded because they reported equal intensities of approach and avoidance motivations. Participants' average age was 20.2 years ( $SD = 2.1$ ) and 73% were female.

### *Procedure*

The procedure was almost identical to that reported in Study 1. Participants completed the BAS/BIS scale (Carver & White, 1994), and were scored as holding either primarily BAS motivation ( $\alpha = .65$ ) or primarily BIS motivation ( $\alpha = .70$ ). As in Study 1, motivations were not significantly correlated,  $r(142) = .04$ ,  $p = .60$ , and only two participants were equally motivated by both. Participants then completed the anagram task described previously and reported their emotions after each anagram. After a brief distraction task, participants reported their remembered emotions.

The primary difference between Studies 1 and 2 was that goals were manipulated prior to the anagram task. Participants were randomly assigned to one of two conditions. In the Approach condition ( $n = 71$ ), participants were introduced to the anagrams as, "the three sets of anagrams measure your *strengths* on three different forms of verbal intelligence" (emphasis added). In addition, these participants were instructed to "try to attain success" immediately before beginning the anagram task. In the Avoidance condition ( $n = 73$ ), participants were introduced to the anagrams as, "the three sets of anagrams measure your *weaknesses* on three different forms of verbal intelligence" (emphasis added) and participants were

told to "try to avoid failure" immediately before beginning the anagrams. This method has been used successfully to encourage approach and avoidance goal setting, respectively (Higgins et al., 1997). These instructions were given within a set of instructions about the task and the computer program read by an experimenter.

## Results and discussion

The results are presented in three sections. We first assessed the results of the goal manipulation. We then examined how participants' general motivation (approach BAS/avoidance BIS) and goals for the anagram task (approach/avoidance) were related to their memory for how they felt during the anagram task. Finally, we assessed whether peak emotions predicted memory for emotions. As in Study 1, effect sizes are reported for analyses.

### *Manipulation check*

As a manipulation check after completion of the anagrams, participants reported their approach and avoidance goals for the anagram task using the same items described in Study 1. Participants in the approach goal condition reported that they held greater approach goals ( $M = 5.97$ ,  $SD = 0.95$ ) than participants in the avoidance condition ( $M = 5.16$ ,  $SD = 1.32$ ),  $t(142) = 4.23$ ,  $p < .001$ ,  $d = 0.71$ . Participants in the avoidance condition reported greater avoidance goals ( $M = 5.56$ ,  $SD = 1.02$ ) than participants in the approach condition ( $M = 5.04$ ,  $SD = 1.26$ ),  $t(142) = 2.72$ ,  $p < .01$ ,  $d = 0.46$ . Thus, the goal manipulation was effective.

### *Remembered emotions*

Table 3 shows the mean intensities (and standard deviations) of happiness and anxiety that participants experienced during the anagram task and remembered afterwards. To find out whether individuals with different combinations of motivations and goals overestimated or underestimated emotions, we conducted paired sample  $t$ -tests comparing experienced and remembered happiness. As can be seen in Table 3, individuals with

**Table 3.** Means and standard deviations for experienced, peak, and remembered emotions in Study 2

Variable	BAS motivation		BIS motivation	
	Approach goals ( <i>n</i> = 29) M (SD)	Avoidance goals ( <i>n</i> = 16) M (SD)	Approach goals ( <i>n</i> = 43) M (SD)	Avoidance goals ( <i>n</i> = 57) M (SD)
<i>Happiness</i>				
Experienced	3.32 (1.42)	2.56 (1.35)	2.74 (1.23)	2.68 (1.21)
Peak	5.07 (1.44)	3.88 (1.82)	4.07 (1.45)	4.18 (1.54)
Remembered	3.82* (1.39)	2.25 (1.53)	2.42* (1.42)	2.51 <sup>†</sup> (1.34)
<i>Anxiety</i>				
Experienced	2.37 (1.44)	2.10 (0.93)	2.65 (1.28)	2.69 (1.14)
Peak	3.54 (1.93)	3.38 (1.82)	3.74 (1.73)	4.28 (1.51)
Remembered	2.68 (1.59)	2.19 (1.47)	3.12* (1.43)	3.74*** (1.49)

Note: Significance is given for paired sample *t*-tests comparing experienced emotion to remembered emotion. Experienced emotion was the average of participants' ratings of happiness or anxiety across all anagrams. <sup>†</sup>*p* = .06; \**p* < .05; \*\*\**p* < .001.

BAS motivation and approach goals significantly overestimated their past happiness,  $t(27) = 2.56$ ,  $p < .05$ ,  $d = 0.98$ . In contrast, individuals with BIS motivation and approach goals underestimated their past happiness,  $t(42) = 2.53$ ,  $p = .02$ ,  $d = 0.78$ ; and individuals with BIS motivation and avoidance goals marginally underestimated their past happiness,  $t(56) = 1.89$ ,  $p = .06$ ,  $d = 0.51$ . No significant difference between experienced and remembered happiness was found for individuals with BAS motivation and avoidance goals,  $t(42) = 1.02$ , *ns*.

Paired sample *t*-tests that compared experienced and remembered anxiety revealed no significant differences for individuals with BAS motivation and approach goals,  $t(27) = 1.27$ , *ns*, or avoidance goals,  $t(15) = 0.26$ , *ns*, but individuals with BIS motivations and approach goals significantly overestimated their past anxiety,  $t(42) = 2.71$ ,  $p < .05$ ,  $d = 0.84$ , as did individuals with BIS motivations and avoidance goals,  $t(56) = 8.31$ ,  $p < .001$ ,  $d = 2.22$ . Although this pattern of results is again suggestive and provides evidence that there were biases in remembered emotion, the analyses do not directly compare the extent of bias in memory for individuals with different motivations and goals and thus additional analyses were conducted to address this potential relationship.

To more directly examine the relationship between motivation and goals and memory for emotion, as in Study 1, we conducted ANCOVAs separately for happiness and anxiety, with Time as the repeated factor (experienced vs. remembered emotion) and Motivation (approach BAS vs. avoidance BIS) and Goal (approach vs. avoidance) as between-subject factors. These analyses controlled for the number of anagrams solved correctly. The interaction of Time, Motivation, and Goals was of interest, because an interaction would indicate that a combination of motivation and goals predicted bias in memory for emotion.

For happiness, a main effect of Goals was found,  $F(1, 139) = 6.33$ ,  $p < .05$ ,  $\eta^2 = .04$ . As shown in Table 3, participants with approach goals experienced and remembered more happiness than participants with avoidance goals. The predicted three-way interaction between Time, Motivation, and Goals was also found,  $F(1, 139) = 8.62$ ,  $p < .01$ ,  $\eta^2 = .06$ . Post hoc *t*-tests on differences scores between experienced and remembered emotion showed that participants with approach motivation and goals overestimated past happiness more ( $M = 0.50$ ,  $SD = 1.04$ ) than did participants with approach motivation and avoidance goals ( $M = -0.31$ ,  $SD = 1.23$ ),  $t(42) = 2.34$ ,  $p < .05$ ,  $d = 0.71$ , participants with avoidance motivation and approach goals

( $M = -0.33$ ,  $SD = 0.85$ ),  $t(69) = 3.69$ ,  $p < .001$ ,  $d = 0.89$ , and participants with avoidance motivation and avoidance goals ( $M = -0.18$ ,  $SD = 0.70$ ),  $t(83) = 3.56$ ,  $p < .005$ ,  $d = 0.78$ . Thus, participants with approach motivation and goals overestimated past happiness more than other participants.

For anxiety, a main effect of Motivation was found,  $F(1, 139) = 8.68$ ,  $p < .005$ ,  $\eta^2 = .06$ , such that participants with BIS avoidance motivation reported more anxiety ( $M = 3.07$ ,  $SD = 1.24$ ) than participants with BAS approach motivation ( $M = 2.39$ ,  $SD = 1.27$ ). As shown in Table 3, the analysis for anxiety also revealed the predicted three-way interaction between Time, Goals and Motivation,  $F(1, 139) = 3.70$ ,  $p = .05$ ,  $\eta^2 = .03$ . To further examine this interaction, post hoc  $t$ -tests on the difference between remembered and experienced emotion were conducted. The results showed that participants with avoidance motivation and goals overestimated past anxiety ( $M = 1.05$ ,  $SD = 0.95$ ) more than did participants with avoidance motivation and approach goals ( $M = 0.47$ ,  $SD = 1.14$ ),  $t(98) = 2.75$ ,  $p < .01$ ,  $d = 0.56$ , participants with approach motivation and avoidance goals ( $M = 0.08$ ,  $SD = 1.29$ ),  $t(71) = 3.29$ ,  $p < .005$ ,  $d = 0.78$ , and participants with approach motivation and approach goals ( $M = 0.31$ ,  $SD = 1.28$ ),  $t(83) = 2.99$ ,  $p < .005$ ,  $d = 0.66$ . Thus, participants with avoidance motivation and goals overestimated past anxiety more than other participants.

In summary, as in Study 1, bias in remembered emotional experience was related to individual differences in motivation and to the goals that participants set for the anagram task. Relative to other participants, participants with approach motivation and goals again overestimated how happy this unpleasant task had made them and participants with avoidance motivation and goals overestimated how anxious they had felt.

### *Peak emotions and memory*

Next, we assessed the relation of peak emotion to remembered emotion, and whether this relation differed for participants with differing motivations

and goals. Peak emotion was again defined as the highest intensity rating for an emotion across the entire set of anagrams. Consistent with previous research, peak happiness predicted greater remembered happiness,  $\beta = .58$ ,  $t = 8.50$ ,  $p < .001$ , and peak anxiety predicted greater remembered anxiety,  $\beta = .66$ ,  $t = 10.37$ ,  $p < .001$ . As in Study 1, separate hierarchical regression analyses were conducted for happiness and anxiety. Remembered emotion was regressed on peak emotion, average emotion, end emotion, motivation (dummy coded), and goals (dummy coded). These analyses also included two-way interactions and the three-way interaction of peak emotion, motivation, and goals.

As shown in Table 4 (top), the predicted three-way interaction was found for happiness. To depict this interaction, Figure 2 shows regression coefficients for the relation between peak emotional intensity and remembered emotion for each combination of motivation and goals. Independent  $t$ -tests were conducted to compare the size of the four regression coefficients (Paternoster et al., 1998; Wright, 1978). The results indicated that peak happiness predicted remembered happiness more strongly for participants with approach motivation and goals than for other participants, including those with approach motivation and avoidance goals,  $t(43) = 2.45$ ,  $p < .05$ ,  $d = 0.75$ , avoidance motivation and approach goals,  $t(69) = 2.93$ ,  $p < .01$ ,  $d = 0.71$ , and avoidance motivation and avoidance goals,  $t(84) = 2.62$ ,  $p < .05$ ,  $d = 0.57$ . No other contrasts were significant. In brief, peak happiness predicted remembered happiness most strongly for participants with approach motivation and goals relative to other combinations of motivation and goals.

As shown in Table 4 (bottom), with respect to anxiety, the predicted three-way interaction was also found. Figure 2 shows the regression coefficients for the relation between peak anxiety and remembered anxiety for each combination of motivation and goals. Again, to examine the interaction, independent  $t$ -tests were used to compare the size of regression coefficients. The results indicated that the positive association

**Table 4.** Regression analyses predicting remembered emotion in Study 2

Variable	$R^2$	$B$	(SE)	$\beta$	$t$ -value
<i>Remembered happiness</i>	.66***				
Peak happiness		.09	.09	.10	1.06
Average happiness		.86	.09	.74	9.30***
End happiness		.04	.07	.05	.67
Motivation		.90	.48	.28	1.89 <sup>†</sup>
Goals		.75	.44	.25	1.70 <sup>†</sup>
Motivation $\times$ Goals $\times$ Peak		.25	.07	.36	3.39**
<i>Remembered anxiety</i>	.53***				
Peak anxiety		.36	.12	.40	3.02**
Average anxiety		.68	.18	.53	3.84***
End anxiety		-.06	.10	.07	-.67
Motivation		-.22	.46	-.07	-.49
Goals		.58	.46	.19	1.28
Motivation $\times$ Goals $\times$ Peak		.21	.10	.22	2.03*

Note: The table presents the third step in hierarchical regression analyses. Main effects were entered on the first step, two-way interactions on the second step, and the three-way interaction on the third step. Two-way interactions are not presented in the table and were not significant predictors in any of the steps. <sup>†</sup> $p < .10$ ; \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

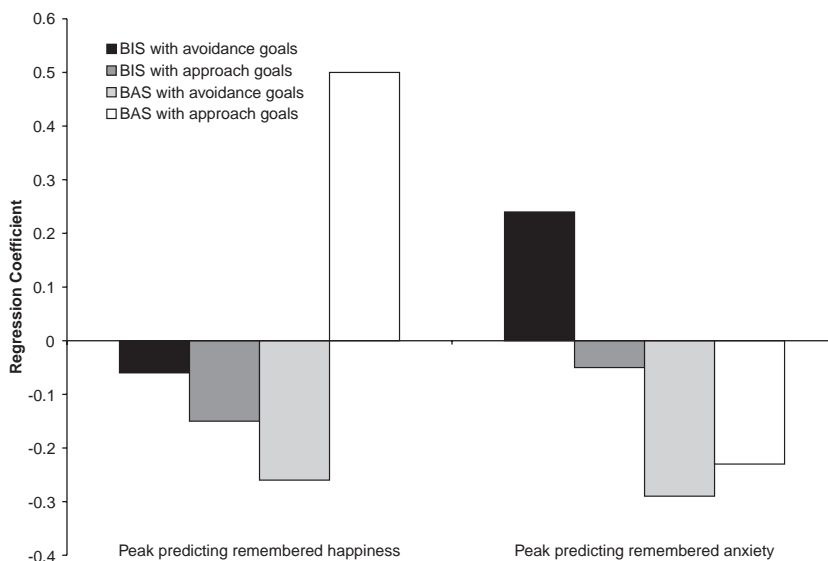
between peak anxiety and remembered anxiety was stronger for participants with avoidance motivation and goals than for participants with approach motivation and goals,  $t(84) = 2.11$ ,  $p < .05$ ,  $d = 0.46$ , and approach motivation and avoidance goals,  $t(71) = 2.03$ ,  $p < .05$ ,  $d = 0.48$ . The positive association between peak anxiety and remembered anxiety was also stronger for participants with avoidance motivation and goals than for participants with avoidance motivation and approach goals, but this difference did not reach statistical significance,  $t(97) = 1.51$ ,  $p = .13$ ,  $d = 0.31$ . Thus peak anxiety predicted remembered anxiety more strongly for participants with avoidance motivation and goals than for participants with approach motivation.

In summary, participants with approach motivation and approach goals exaggerated past happiness and participants with avoidance motivation and avoidance goals exaggerated past anxiety. In addition, the relationship between peak emotion and remembered emotion was also related to individual motivation and goals. These findings from Study 2, in which goals were experimentally manipulated, were similar to those of Study 1, in which participants self-reported their goals.

## GENERAL DISCUSSION

People frequently overestimate the intensity of their past emotions, remembering their reactions to events as having been more intense than they reported at the time (see Levine et al., 2006, for a review). In the current investigation, participants were informed that their performance on a difficult task was indicative of their verbal intelligence. Moreover, although they were not informed of this possibility, some of the anagrams they had been asked to solve had no solution. As a result, participants found the task unpleasant. Participants were fairly accurate in their memory for their past emotional experience, but within this general backdrop of accuracy there was evidence of systematic biases. Consistent with prior research, when remembering their emotions, participants underestimated how happy they had felt and overestimated how anxious they had felt (e.g., Breckler, 1994; Schrader et al., 1990; Shiffman et al., 1997). Overall, then, they recalled their emotions during the task as having been worse than they actually experienced.

Moving beyond the simple finding of overestimation, however, the current investigation



**Figure 2.** Regression coefficients for the relation between peak emotional intensity and remembered emotion for each combination of motivation and goals in Study 2.

examined individual differences in memory for emotion. Specifically, we examined whether people's tendency to exaggerate positive versus negative emotion was related to their general motivation, and the goals they set for a specific task, to attain positive outcomes or avoid negative ones. Recent evidence suggests that people differ in the extent to which they attend to positive versus negative information. Individuals who are typically motivated by positive outcomes spend more time attending to positive information whereas individuals who are typically motivated by negative outcomes spend more time attending to negative information (e.g., Derryberry & Reed, 1994). The present findings extend this work and suggest that motivational factors influence not only attention, but also memory for emotions during potentially stressful situations.

Bias in remembered emotion was expected to relate to individual differences in motivation and goals for a specific task. As predicted, we found that the combination of approach motivation and approach goals was associated with greater overestimation of happiness compared to other combinations of motivation and goals. Conversely, the

combination of avoidance motivation and avoidance goals was associated with greater overestimation of anxiety compared to other combinations of motivation and goals. This investigation is the first to show that people's orientation toward positive versus negative outcomes is related to distinct biases in their memory for positive versus negative emotion. These findings have implications for understanding how personality influences people's choices and interactions with the world. People often base their choices to pursue or avoid situations on their memory for how similar experiences made them feel in the past (e.g., Levine et al., 2006; Wirtz et al., 2003). Because motivation and goals influence memories for past experiences, they are also likely to influence choice.

Biases in memory for emotion occur in part because memory for emotion tends to be strongly influenced by peak emotions during an experience. Thus, the most intense period during an emotional experience disproportionately influences how people later remember the experience (Fredrickson, 2000; Morewedge et al., 2005). The present findings demonstrate that motivation and

goals can determine which peak experiences are important. Fredrickson (2000) suggested that peaks may relate to memory because they capture the overall importance of the event. The present findings are consistent with this suggestion. Motivation and goals focus attention on particular aspects of experiences. Peak instances of those emotions that are most relevant to motivation and goals were most likely to predict bias in remembered emotion.

Consistent with predictions, peak happiness was especially predictive of remembered happiness for participants with approach motivation and goals compared to other participants. Peak anxiety was especially predictive of remembered anxiety for participants with avoidance motivation and goals compared to other participants. In Study 1, the relationship between peak and remembered anxiety was also strong for participants with approach motivations and goals. As mentioned, it may be that these participants were especially taken by surprise when the task was difficult. Prior evidence indicated that, during similar anagram tasks, participants with approach motivation and goals expected to be less anxious during the task than other participants (Lench & Levine, 2006). Overall, these findings suggest that it is the combination of general motivation and specific goals that is important for understanding the influence of peak emotion on memory. Participants were especially likely to remember past emotions as consistent with peak emotions when they were dispositionally sensitive to that type of emotion and when they were pursuing specific goals to which the emotion was relevant.

Prior research suggests that people frequently give biased estimates of past emotional experiences because they must estimate their emotion rather than simply recall their previous ratings (e.g., Fredrickson, 2000; Fredrickson & Kahneman, 1993; Robinson & Clore, 2002; Wirtz et al., 2003). Robinson and Clore (2002) distinguished between different types of information that people can rely upon to report their emotions. They suggested that people have experiential knowledge only of their current emotional experience and

thus must rely on other information to recall past emotions. One source of information is episodic memory, whereby people reconstruct past experiences by relying on portions of that experience. In the present investigation, participants rated their emotions multiple times over the course of an emotional experience and later gave a global estimate of how intense their emotions were during the task. The results of the present investigation suggest that participants were relying on episodic memory to estimate their past emotional experiences because peak instances of emotion predicted bias in recalled emotion.

### Limitations

One limitation of the present investigation was the small sample size in Study 1, which resulted in small cell sizes for some groups. In particular, few participants with approach motivation set avoidance goals for the anagram task. This limitation was partially addressed by Study 2, which used larger groups and experimentally manipulated participants' goals. In addition, the analytic techniques used (Type III Sum of Squares ANOVAs) tend to be robust with unbalanced designs. Though the results were highly consistent across the two studies, larger samples may be necessary in future investigations.

Another limitation of this investigation is that it does not speak to the specific memory processes that resulted in bias. We have suggested that motivations and specific goals are related to people's memory for past emotional experiences because they influence the attention people give to either positive or negative experiences. Differential attention could affect the information encoded, rehearsed, or retrieved, however. For example, approach motivations and goals may lead people to attend to positive experiences as they occur, rehearse positive experience (e.g., "I was really happy about solving that difficult anagram") or to retrieve positive experiences that are congruent with their current positive mood. Similarly, avoidance motivations and goals may lead people to attend to negative experiences as they occur, rehearse negative experience (e.g., "That

was really hard—I can't believe I didn't solve it") or to retrieve negative experiences that are congruent with their current negative mood. Additional studies are needed to tease apart potential mechanisms through which motivations and goals may bias people's memories for their past emotional experiences.

### Memory bias as emotion regulation

One feature of bias in memory for emotion that has mystified investigators is why people *consistently* exaggerate past emotional experiences (e.g., Wilson & Gilbert, 2005). Surely they should learn from their mistakes as their expectations are repeatedly disconfirmed. People who repeat an experience, only to find that the experience is not as thrilling or devastating as they remembered, should logically become better estimators of past experiences over time. But this does not seem to be the case. Further, memories of experiences are often better predictors of future decisions to repeat experiences than the actual emotions experienced (Safer et al., 2002; Wirtz et al., 2003).

One reason that remembered emotions may continue to be exaggerated is that the bias facilitates people's efforts to attain their goals. Traditionally, the goal of emotion regulation was thought to be the reduction of negative emotion (e.g., Lazarus & Folkman, 1984). The concept of emotion regulation has been extended, however, to include processes that increase or decrease the experience of positive or negative emotions (Gross, 1998; Mayer & Salovey, 1995; Ochsner & Gross, 2005; Parrott, 1993). This up- or down-regulation of emotion can facilitate goal attainment by promoting attention to goals and increasing motivation to attain goals (Parrott, 1993) and frequently occurs through control of attention and cognitive interpretation of events (e.g., Ochsner & Gross, 2005). The utility of remembered positive and negative emotions is likely to vary depending on whether people are motivated by positive or negative aspects of situations. People with approach motivation who are also pursuing approach goals may remember the task as more pleasant than it actually was in

order to motivate themselves in similar future situations (Fredrickson, 2000; Levine & Pizarro, 2004). People with avoidance motivation who are also pursuing avoidance goals may remember the task as more stressful than it actually was in order to motivate themselves to avoid similar situations or work harder in the future (Norem & Illingworth, 2004). The present investigation demonstrated that individual differences in motivation and goals were related to bias in memory for specific emotions, but additional research is needed to determine whether these biases promote goal pursuit during stressful situations.

By suggesting that bias in remembered emotion can be functional in facilitating an individual's goal pursuits, we do not intend to imply that this bias will always lead to optimal decisions. For example, people motivated by negative situations who hold the goal of avoiding discomfort may remember past medical visits as more stressful than they actually were. This bias could discourage regular appointments with their physician, potentially putting them at risk for health problems. In some situations, however, bias in memory may promote goal attainment or maintenance. For example, wives who overestimated how dissatisfied they had been with their marital relationship ten years in the past reported greater current satisfaction (Karney & Coombs, 2000). In keeping with the common belief that good relationships improve and deepen over time, remembering their marriage as less satisfying than it actually was may have allowed the wives to view their current relationship as relatively more satisfying, promoting a lasting relationship. In sum, although memory accuracy is often considered a benchmark for effective decision-making, bias in remembered emotion may be part and parcel of everyday goal pursuit.

### Conclusion

The results of the present studies indicate that memories for specific emotional experiences are biased by people's motivation and goals. Overall, the findings suggest that motivation and goals must be considered when examining biases in

remembered emotion. The direction and magnitude of bias in memory appears to be determined, not only by cognitive factors, but by motivational factors.

Manuscript received 23 May 2008

Revised manuscript received 24 November 2008

Manuscript accepted 24 November 2008

First published online 16 February 2009

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