Beyond general arousal: Effects of specific emotions on memory
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Beyond general arousal: Effects of specific emotions on memory

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This research examined the effects of happiness, anger, and sadness on participants' memory for different types of information in a narrative. Happiness and negative emotions were evoked in undergraduates (N = 263) by randomly assigning grades of “A” or “D” on a surprise quiz. Immediately afterwards, subjects participated in what they believed to be an unrelated study during which they heard and recalled a narrative and described their emotional state. Participants in the positive emotion condition recalled more of the narrative as a whole than did participants in the negative emotion condition. Analyses based on self-reported emotions indicated that happiness had a general facilitative effect on recall, whereas anger and sadness were associated with enhanced recall of information concerning goals and outcomes respectively. These findings indicate that specific emotions differ in their effects on memory and that negative emotions may facilitate selective encoding of functional information.

Research on the effects of emotions on memory has increased dramatically in recent years, but the upshot of this body of research remains unclear. Several studies have shown that autobiographical events associated with intense emotion are recalled in greater detail than are less emotional events (Bohannon, 1992; Brown & Kulik, 1977; Goodman, Hirschman, Hepps, & Rudy, 1991; Pillemer, 1984). A recall advantage for emotionally-arousing material over neutral material has also been shown in a number of laboratory studies (Cahill, Prins, Weber, & McGaugh, 1994; Heuer & Reisberg, 1990; for reviews, see Bradley, 1994; Christianson, 1992; Heuer & Reisberg, 1992). Whereas these findings

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suggest that emotional arousal enhances memory, the claim that emotional arousal disrupts memory has also been supported (Deffenbacher, 1983, 1991; Ellis & Ashbrook, 1988; Loftus & Burns, 1982; Peters, 1997). Still other research has shown no effect of emotional arousal on recall (Howe, Courage, and Peterson, 1995; Neisser et al., 1996).

To address these inconsistencies, researchers have begun to examine differences in the types of information that people are asked to recall. For example, Christianson and Loftus (1987, 1991) found that emotion facilitates memory for important or "central" information at the expense of less important or "peripheral" information (see also, Burke, Heuer, & Reisberg, 1992; Easterbrook, 1959). Research on mood-congruent memory also takes into account the type of information being recalled. If material is congruent with an individual’s current mood, emotional arousal may enhance encoding and retrieval; if incongruent, emotional arousal may lead to poorer encoding and retrieval (Bower, 1981; for conflicting findings see Isen, 1985; Parrott & Sabini, 1990; for reviews see Blaney, 1986; Singer & Salovey, 1988).1

Although a great deal of progress has been made in specifying the conditions under which emotional arousal enhances or disrupts memory, current approaches may still be too general. As Neiss (1988) persuasively argues, people may feel elated, challenged, enraged, or helpless—but they are never just “aroused.” In research on memory for life events, however, emotion is typically equated with general arousal and measured on a single scale ranging from “not at all” to “very” stressed or aroused. The vast majority of studies on mood-congruent memory contrast positive and negative moods but neglect distinctions within these categories (Blaney, 1986; Forgas & Bower, 1987; for exceptions see Laird, Cuniff, Sheehan, Shulman, & Strum, 1989).

A separate line of theory and research has focused on identifying the functions that specific emotions fulfill within the cognitive system (Frijsda, 1987; Lazarus, 1991; Mandler, 1984; Oatley & Johnson-Laird, 1987; Roseman, 1991; Scherer, 1984; Stein & Levine, 1987, 1990; Weiner, 1985). According to these cognitive models of emotion, people experience emotions when their goals are attained or thwarted and it becomes necessary to revise prior beliefs and construct new plans. Once evoked,

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1. Recent research also indicates that emotions are most likely to facilitate recall when the information to be recalled concerns the self (Bower & Mayer, 1989); when the information is self-generated rather than given by the experimenter (Eich, 1995; Eich & Metcalfe, 1989); when the information has little structure (Mayer, McCormick & Strong, 1995); when memory tests provide few cues (Eich, 1995; Eich & Metcalfe, 1989); and when memory is tested after a delay (Burke, Heuer, & Reisberg, 1992).
emotions direct attention to aspects of a situation that are functional; that is, relevant to solving the types of problems that evoked the emotion. There is now a great deal of evidence indicating that specific emotions are evoked by different interpretations of events and are associated with different problem-solving strategies (Levine, 1995, 1996; Roseman, 1991; Smith & Ellsworth, 1985; Smith & Lazarus, 1993; Stein & Levine, 1989). These findings suggest that specifying the effects of arousal on memory may require moving beyond the notion of general arousal to an examination of the effects of specific emotions. Similarly, it may be necessary to go beyond classifying to-be-remembered material as central or peripheral, mood-congruent or incongruent. Emotions may enhance memory for central information at the expense of peripheral information, but the types of information that are central in one emotional state may not be central in another. This approach suggests an alternative hypothesis: emotions enhance recall of relevant or functional information.

What types of information are relevant in specific emotional states? Research on cognitive models of emotion suggests that happiness may be associated with attention to a broad range of incoming information whereas negative emotions may lead to a focus on specific aspects of problematic situations. People feel happy when they attain a goal or avoid an undesirable state (Roseman, 1991; Scherer, 1984; Stein & Levine, 1987). Several investigators have argued that feelings of happiness serve as a signal that all is well and that no immediate need exists for problem-solving or for careful monitoring of the environment or the self (Bless, Clore, Schwarz, Gollisano, Rabe, and Wolk, 1996; Frijda, 1988; Schwarz & Clore, 1983). Happiness should thus be associated with a general freeing-up of attentional resources that may then be directed toward new tasks. This freeing of attentional resources should result in a general facilitation of the encoding and recall of incoming information. In contrast to happiness, negative emotions such as anger and sadness are evoked when people fail to attain their goals. Negative emotions thus signal the presence of a problem and the need for increased attention to specific features of the self and the environment (Bless et al., 1996; Frijda, 1988; Schwarz & Clore, 1983; Wyer & Srull, 1989).

The types of information to which people attend should differ depending upon the specific negative emotion experienced. One of the primary functions of anger is thought to be the marshalling of plans to remove obstacles to a person's well-being (Ellsworth & Smith, 1988; Levine, 1995, 1996, 1997; Oatley & Johnson-Laird, 1987; Scherer, 1984; Stein & Levine, 1987). When recalling or describing anger, people tend to focus attention on the goal that has been obstructed and on the agent or cause of the obstruction (Averill, 1982; Levine, 1996; Stein & Levine, 1989; Weiner,
Attention to goals, and to the agents obstructing those goals, may be functional in an angry state because this information facilitates the construction of plans to change negative situations and to reinstate threatened goals. Unlike anger, sadness is typically the response when people view the failure of their goals as irrevocable (Scherer, 1984; Smith & Lazarus, 1993). When recalling or describing sadness, people tend to dwell upon negative outcomes that cannot be changed (Levine, 1996, 1997; Smith & Lazarus, 1993; Stein & Levine, 1989). According to Stein and Levine (Levine, 1995, 1996; Stein & Levine, 1987, 1990), sadness motivates efforts to come to terms with irrevocable outcomes by revising beliefs and expectations that are inconsistent with these outcomes. When people fail to attain a goal, and cannot reinstate it, little is gained by attending to the original goal and to the agents who caused its failure. An understanding of the outcomes that have resulted, however, is essential for revising prior beliefs and forming realistic expectations for the future.

In sum, cognitive models of emotion suggest that specific emotions should differ in their effects on memory. Happiness should lead to a general facilitation of the encoding of incoming information. Anger should be associated with attention to, and enhanced recall of, goals and the agents who obstructed goals. Sadness should be associated with attention to, and enhanced recall of, event outcomes. The intensity of a person’s emotional response depends in large part on the importance of the goal that has been attained or threatened (Oatley, 1992; Wyer & Srull, 1989). Thus, as the intensity of an emotion increases, its effects on attention and memory would be expected to become more pronounced. With increasing intensity, happiness should be associated with greater information-processing capacity; anger with a heightened focus on reinstating threatened goals; and sadness with a heightened focus on understanding the implications of the outcomes resulting from goal failure.

Consistent with the hypothesis that happiness facilitates encoding, the overall trend in autobiographical memory research is for events that evoked happiness (pleasant events) to be recalled better than events that elicited negative emotions or a neutral mood state (Matlin & Stang, 1978; Thompson, Skowronski, Larsen, & Betz, 1996). An encoding advantage for pleasant stimuli has also been demonstrated for word lists and stories (Matt, Vazquez & Campbell, 1992) and for pictures and sounds (Bradley, 1994). Happiness has also been shown to influence decision-making and attitude formation. When tasks call for creative and flexible problem-solving strategies, happy participants often do better than those in negative or neutral moods (Isen, 1984, 1993).
Findings inconsistent with the hypothesis that happiness facilitates encoding have also been reported. In comparison to people in negative or neutral moods, happy people have been found to make decisions more quickly and based on less information (Isen & Means, 1983), relying more heavily on heuristic strategies than on careful analysis of the problem under consideration (Mackie & Worth, 1989, 1991). Mackie and Worth (1989, 1991) argue that happy people use heuristic information-processing strategies for solving problems because happiness is associated with a decrease in attentional resources. Because positive material is thought to be more extensive and interrelated in memory than negative material (Isen, 1993; Matlin & Stang, 1978), positive affect may lead to the simultaneous activation of a large amount of material in memory. According to Mackie and Worth (1989, 1991), the simultaneous accessibility of this material may facilitate performance on tasks requiring creative or flexible problem-solving, but disrupt a person's ability to maintain the disciplined attentional focus demanded in capacity-intensive tasks.

The hypothesis that anger and sadness lead to selective encoding of specific types of information is consistent with the research showing emotion-specific biases in appraisals and memory. For example, Stein and Levine (1989) asked children and adults to predict and explain protagonists' emotional responses to goal failure (e.g., the loss of a favorite toy). The same participants often attributed both anger and sadness in response to a single event. When explaining why protagonists felt angry, however, participants typically focused on the protagonists' goals and on the agents keeping them from attaining their goals (e.g., "Jimmy wants to play with his toy car, but his friend broke it"). Explanations for sadness included less information about goals and agents, and more information about the outcomes that had resulted (e.g., "Jimmy's sad because his toy car is broken and now he can't race cars with his friends") (see also Levine, 1995). In autobiographical accounts of events that evoked anger, people typically include an agent responsible for obstructing their goals; when describing events that evoked sadness, people tend to emphasize irrevocable outcomes (Averill, 1982; Ellsworth & Smith, 1988; Levine, 1996, 1997; Smith & Ellsworth, 1985; Stein & Liwag, 1996; Weiner, Graham, & Chandler, 1982; see also Keltner, Ellsworth, and Edwards, 1993).

In sum, cognitive models of emotion and past research suggest that happiness, anger, and sadness may have differing effects on the encoding of incoming information. Alternative explanations exist, however, for the memory and appraisal differences observed. These differences may simply reflect characteristics of the events, or interpretations of
events, that evoke happiness, anger, and sadness. Pleasant events and materials may be more memorable or familiar than unpleasant events and materials, leading to enhanced recall (Bradley, 1994; Thompson et al., 1996). Anger-eliciting events may feature prominent agents; sad events may have more serious outcomes. To isolate the effects of specific emotions on encoding, identical material should be presented to individuals while they are in a happy, angry, or sad state. The material to be recalled should include information expected to be relevant in different emotional states (such as goals, agents, or outcomes).

The current study examined the effects of happiness, anger, and sadness on the encoding of information expected to be relevant in these emotional states. Emotions were evoked in undergraduates in an introductory psychology course by randomly assigning grades of “A” or “D” on a surprise quiz. Participants who received an “A” were expected to feel primarily happy. Those who received a “D” were expected to feel a range of negative emotions, including anger and sadness. Immediately after receiving their grades, students participated in what they believed to be an unrelated study. In the course of this study, they first listened to and then recalled a narrative, and next answered questions about their emotional state. The narrative was constructed to include information expected to be relevant in different emotional states. We predicted that happy participants would show enhanced recall for the narrative as a whole. Angry participants were expected to demonstrate enhanced recall for the protagonist’s goals, and for the agents who facilitated or obstructed those goals. Sad participants were expected to show enhanced recall for event outcomes. These effects were expected to be more pronounced for intense emotional responses than for mild emotional responses.

The emotion-induction technique used was chosen in order to avoid two problems faced in past emotion and memory research. First, the most commonly used emotion-induction techniques selectively prime different types of information and confound subsequent memory assessments (The Veltan Mood Induction technique, recalling past emotion-eliciting events). Although posing facial expressions is an exception, this technique tends to evoke very short-lived and mild moods. Receiving a good or poor grade is a frequent and natural cause of happiness and negative emotions in undergraduates. To avoid selectively priming the types of information expected to be relevant in angry versus sad states, the separation of participants into angry and sad groups was based on participants’ self-reports concerning which emotion they felt most intensely. Second, mood-congruent memory research has yielded differing results depending upon whether or not
participants were aware that their moods were relevant to the memory task. These findings raise concerns about the demand characteristics of the studies (Parrot & Sabini, 1990; for a review see Ucros, 1989). In the current study, participants were unaware of the relevance of their emotional state to the memory task.

METHOD

PARTICIPANTS

Undergraduates in an introductory psychology class at the University of California, Irvine participated in the study. Two students who were present in the classroom when the recall portion of the study was conducted chose not to participate. Because lack of fluency may influence the accuracy of recall, the data from 11 participants who reported that they were not completely fluent in English were excluded from the analyses. Of the remaining 263 participants, 57 students (22%) received an “A” on a surprise quiz and 127 (48%) received a “D.” Seventy students (27%) who were not present for the surprise quiz were informed that they would receive no credit, and nine students (3%) did not report their quiz grade. A total of 81 men and 182 women participated in the study. In both the group of students that received an “A,” and the group that received either a “D” or no credit, 32% of participants were male and 68% were female. Participants’ ages ranged from 17 to 29 years ($M = 19$ years). Participants’ ethnicities approximated the demographics of the University of California, Irvine; Asian (45%), Caucasian (27%), Latino (19%), African-American (2%), and Other (7%).

DESIGN

The study had two between-subject variables: quiz grade and gender. Participants were randomly assigned grades of “A” or “D” on a surprise quiz with the provision that each group contained equal proportions of males and females. One third of the participants who were present on the day that the quiz was given were assigned to the “A” group, and two-thirds were assigned to the “D” group. More “D’s” were given than “A’s” because we anticipated a broader range of negative than positive emotional responses to the quiz grades, and wished to elicit anger and sadness in sufficient numbers for analysis. All participants listened to the same narrative, which incorporated the following within subject variables: positive/negative episode, academic/non-academic episode, central/peripheral details, and information type (setting, goal, agent,
outcome, consequence). The narrative is described in the materials section below.

PROCEDURE

Students in the first author's introductory psychology course were given a surprise quiz covering assigned readings. They were also informed that another professor would be conducting a short study during the next class meeting. Two days later, at the beginning of class, students' quiz answer sheets were returned with the number of correct responses indicated. Students were then given the opportunity to participate in what they believed to be an unrelated study. They were told that participation was voluntary, and that those who wished to participate would receive one point of course credit. As sealed materials were being handed out for the study, a student confederate asked about the grade equivalents of the quiz scores. Students then learned their quiz grades all at the same moment when the first author displayed an overhead transparency with the grade ranges on it. The transparency also indicated that the quiz was worth 5% of students' final course grade and that those who had missed the quiz would receive no credit.

Immediately after participants received their grades, the memory portion of the study began. Participants were told that they would be listening to a taped account of a student's first quarter in college, and would then answer some questions. After listening to the narrative, participants spent four minutes answering distraction questions in written form (quickly listing as many U.S. states, and as many of the world's countries, as they could recall). The purpose of these questions was to prevent rehearsal and to ensure that the narrative was no longer in short-term memory. Participants were then asked to write down as much of the narrative as they could recall. The exact instructions were, "A few moments ago, you heard a description of some events that occurred during a student's first quarter in college. In the space below, please write down what you heard in as much detail as you possibly can. Be sure to write down absolutely everything you can remember."

After participants had recalled the narrative, they were asked a set of questions about their emotional state just before they began the study. They were asked to choose the emotion that best described how they were feeling from the following list: happy, sad, angry, fearful, okay/neutral, and other. They rated the intensity of this primary emotional response on a 4-point scale ranging from "a little" to "very much." They were also asked to explain briefly why they were feeling that way. Since people often have complex emotional responses to situations,
participants were then asked to rate the intensity with which they had felt each of the emotions, (happy, angry, sad, fearful, surprised, and other) on 5-point scales ranging from "not at all" to "very much." Finally, they were asked to indicate the grade they had received on the surprise quiz and their grade point averages (GPAs).

To be certain that no student left class early believing that he or she had received a poor grade, assistants were posted outside each exit throughout the study to debrief any student who might choose to leave early. None did. Within 15 minutes of receiving their grades, all students were fully debriefed and the purpose of the study was explained. For the rest of that class period, and in the following week's lectures, students' responses to their quiz grades served as a concrete and vivid example for discussions of theories of emotion. All students who either took the surprise quiz, or participated in the recall portion of the study, received course credit.

MATERIALS

Participants listened to, and were later asked to recall, a tape recording of a brief narrative that described events that occurred during a student's first quarter at college. In the course of the narrative, the protagonist experienced two positive events (going on a ski trip, receiving an "A" on a final exam) and two negative events (having to miss a concert, receiving a failing grade on a class presentation). Both positive and negative events were included to allow an assessment of whether recall was mood-congruent. Half of the events concerned academic goals and half concerned nonacademic goals. Academic goals were included to find out whether material that closely resembled the emotion-eliciting event would be better recalled. The description of each event within the narrative included the types of information expected to be relevant in happy, sad, and angry emotional states. Specifically, each episode included: (a) the setting or context; (b) the protagonist's goal; (c) the agent who caused that goal to succeed or fail; (d) the outcome, that is, whether the protagonist attained or failed to attain the goal; and (e) consequences of that outcome for related goals. The statement of each of these types of information included both central and peripheral details. For example, the setting statement in the first episode was the following: "In Mary's humanities class, students have to prepare a 15-minute speech with an assigned partner." The fact that Mary had to give a speech is central setting information; the fact that it was in humanities class, and that it was a 15-minute speech, are more peripheral. Table 1 lists the complete narrative in the order in which it was heard by participants. Table 1 also
TABLE 1. Narrative Indicating Episode and Information Types with Central Information Highlighted

<table>
<thead>
<tr>
<th>Setting</th>
<th>Negative/Academic</th>
<th>In Mary’s humanities class, students have to prepare a 15 minute speech with an assigned partner.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Mary wants her speech to be really good.</td>
<td></td>
</tr>
<tr>
<td>Agent</td>
<td>Mary works hard on her half of the speech but her partner does almost nothing.</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>They receive a bad grade on the speech,</td>
<td></td>
</tr>
<tr>
<td>Consequence</td>
<td>and now Mary is afraid that she won’t pass the class.</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td>Positive/Non-Academic</td>
<td>Mary is scheduled to work double shifts at her cafeteria job through the holidays.</td>
</tr>
<tr>
<td>Goal</td>
<td>Mary really wants to go on a ski trip for the holidays.</td>
<td></td>
</tr>
<tr>
<td>Agent</td>
<td>Another student who works with her volunteers to cover her shifts during the break.</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>Now, Mary can go on the ski trip,</td>
<td></td>
</tr>
<tr>
<td>Consequence</td>
<td>and she becomes close friends with the student who volunteered to cover her shifts.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setting</th>
<th>Negative/Non-academic</th>
<th>Tonight, a famous rock group is playing at the stadium downtown.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Mary really wants to go to the concert.</td>
<td></td>
</tr>
<tr>
<td>Agent</td>
<td>When she is ready to leave, she finds that her roommate has borrowed her car for the evening without asking.</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>Now Mary can’t go to the concert,</td>
<td></td>
</tr>
<tr>
<td>Consequence</td>
<td>and she feels that she can’t trust her roommate.</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td>Positive/Academic</td>
<td>Mary has a difficult chemistry exam tomorrow that is worth 50% of her grade.</td>
</tr>
<tr>
<td>Goal</td>
<td>Mary really wants to do well on the exam.</td>
<td></td>
</tr>
<tr>
<td>Agent</td>
<td>The T.A. for the class spends several hours helping Mary review the material.</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>Mary gets one of the highest grades in the class on the exam,</td>
<td></td>
</tr>
<tr>
<td>Consequence</td>
<td>and now she’ll be on the Dean’s list.</td>
<td></td>
</tr>
</tbody>
</table>

indicates episode types, information types within episodes, and central information.

Coding. Researchers who coded the recall data were blind to the emotion condition and emotion ratings of participants. To code the recall data, the original narrative was divided into short phrases, and coders recorded whether the information in each phrase was present or absent. To be counted as present, the information could be recalled exactly as stated in the narrative, or as a synonym or closely related phrase. For example, participants who wrote that Mary had to prepare a speech...
“with another student” received credit for having recalled the phrase “with an assigned partner.” When ambiguities arose, decision rules were formulated as a group; all of the recall data was then re-coded to be consistent with the new rule. The second author independently coded the recall data from 40 participants. Yule’s $Y$ coefficient, an index of coder agreement, was 96%.

Recalled information that was not in the narrative was also coded. Based on the types and frequencies of intrusions observed, the following categories were used: (a) positive intrusions (“Mary is happy,” “The T.A. was wonderful,” “Fortunately”); (b) negative intrusions (“Mary was very worried,” “She flunked out,” “Sadly”); (c) added or exaggerated actions of the protagonist (“Mary studies very hard,” “She asked around and found someone to cover her shift,” “Mary asked her for the keys”); (d) miscellaneous intrusions (“a girl named Jenny,” “In her first year of school,” “The T.A. who’d been helping her”). Based on coding 40 narratives, Yule’s $Y$ was 87%.

RESULTS

As a general estimate of differences in motivation and memory skills, participants were asked to report their GPAs. As expected, since quiz grades were randomly assigned, no significant differences were found between the mean GPAs of participants who received an “A” versus a “D” or no credit on the quiz, $t(252) = 0.12$, $ns$.

EFFECTIVENESS OF EMOTION MANIPULATION

Participants reported their primary emotional responses as neutral ($n = 85$), happy ($n = 62$), angry ($n = 29$), sad ($n = 25$), fearful ($n = 10$), and other ($n = 52$). Participants who described their primary emotional response as “other” wrote in a wide range of emotions, including excited, upset, tired, and bored. The frequency with which participants reported happiness, a neutral state, or a negative emotion as their primary emotional response differed depending upon their quiz grade. Participants who received an “A” were more likely to report that they had felt primarily happy (58%) than they were to report a negative emotion (19%) or neutral (23%) as their primary response. In contrast, those who received a “D” or no credit were more likely to report a negative primary emotion (51%) than to report that they felt primarily happy (12%) or neutral (37%), $\chi^2(2, N = 254) = 53.91, p < .001$.

Participants were also asked to rate the intensity of each of the follow-
ing emotions using 5-point scales: happiness, sadness, anger, fear, and surprise. To assess the effects of quiz grade on ratings of emotional intensity, a 2 (quiz grade) × 2 (gender) repeated measures ANOVA was conducted on participants’ intensity ratings for happiness, sadness, and anger. The results revealed a significant main effect of emotion, $F(2, 250) = 48.15, p < .0001$. Overall, participants reported having felt more intensely happy ($M = 1.41, SD = 1.11$) than sad ($M = 0.88, SD = 1.07$) or angry ($M = 0.78, SD = 1.20$). An interaction between emotion and quiz grade was also found, $F(2, 250) = 32.43, p < .0001$. Separate ANOVAs for happiness, sadness, and anger indicated that participants who received an “A” reported greater happiness ($M = 2.23, SD = 1.09$) than did participants who received a “D” or no credit ($M = 1.18, SD = 1.01$), $F(1, 250) = 41.96, p < .0001$. In contrast, participants who received a “D” or no credit reported greater sadness ($M = 1.01, SD = 1.11$) than did participants who had received an “A” ($M = 0.35, SD = 0.61$), $F(1, 250) = 13.09, p < .001$. Similarly, participants who received a “D” or no credit reported greater anger ($M = 0.92, SD = 1.26$) than did participants who had received an “A” ($M = 0.16, SD = 0.59$), $F(1, 250) = 16.13, p < .0001$. No significant gender differences were found.

Receiving a good or poor grade was thus an effective means of evoking happiness, sadness, and anger. Participants who received a positive grade on a quiz were more likely to report happiness as their primary emotion, and reported higher intensities of happiness, as compared to participants who received a negative grade. Participants who received a negative grade were more likely to report having felt primarily sad or angry, and reported higher intensities of sadness and anger, as compared to those who received a positive grade.

EFFECTS OF QUIZ GRADE ON RECALL.

To assess the effects of the emotion manipulation on memory for the narrative, a repeated measures ANOVA was conducted on the proportion of information recalled from the narrative. The between-subject factors were quiz grade and gender. The within-subject factors were positive/negative episode, academic/nonacademic episode, and in-

2. Because of unequal cell sizes, all ANOVAs and ANCOVAs described in this paper were conducted using general linear model (partial sums of squares) analyses. This was done to increase statistical precision and protect against order effects and the associated possibility of inflated Type I error rates.

3. For ease of interpretation, the ANOVAs and ANCOVAs reported were conducted on the proportions of different types of information recalled from the narrative. Preliminary analyses were also conducted based on the total amount of information recalled. All effects reported were also significant in analyses of the total amount of information recalled.
formation type (setting, goal, agent, outcome, consequence). The results revealed significant main effects of quiz grade, $F(1, 250) = 4.15, p < .05$, and gender, $F(1, 250) = 7.69, p < .01$. Participants who received an “A” recalled more of the narrative ($M = .50, SD = .11$) than did participants who received a “D” or no credit ($M = .48, SD = .12$). Women recalled more of the narrative ($M = .51, SD = .11$) than did men ($M = .46, SD = .13$).

Several significant within-subject effects were also found, but no significant interactions were found between the within-subjects factors and either quiz grade or gender. Specifically, significant within-subject effects were found for academic/nonacademic episode, $F(1, 250) = 29.87, p < .0001$, information type, $F(4, 247) = 26.34, p < .0001$, and for the interactions between positive/negative episode and information type, $F(4, 247) = 11.76, p .0001$, academic/nonacademic episode and information type, $F(4, 247) = 176.42, p < .0001$, and positive/negative episode, academic/non-academic episode, and information type, $F(4, 247) = 59.17, p < .0001$. These within-subjects effects indicate that, independent of quiz grade or gender, certain parts of the narrative were recalled better than others.\textsuperscript{4} In sum, participants in the positive emotion condition recalled more information from the narrative as a whole than did participants in the negative emotion condition. Women recalled more of the narrative than did men.

EFFECTS OF PRIMARY EMOTION ON RECALL

To examine the effects of discrete emotions on memory, participants were first divided into four primary emotion groups: The neutral group included all participants who reported “neutral/okay” as their primary emotional response ($N = 85$). The happy group included all participants who reported “happiness” as their primary emotional response ($N = 62$). To maximize the sizes of the angry and sad groups, these groups included all participants who reported a negative primary emotional response, with the exceptions of those who rated their feelings of anger and sadness as equally intense ($N = 30$) and those who reported fear as

\textsuperscript{4} Mean recall proportions for each part of the narrative are available from the first author upon request. To summarize, nonacademic episodes were recalled better than academic episodes; agents and consequences were recalled better than settings, goals, and outcomes. Significant within subject interactions indicated that settings were recalled more poorly from the negative/nonacademic episode than from the other three episodes; agents were recalled more poorly from the positive/nonacademic episode than from the other three episodes; goals were recalled better from nonacademic than from academic episodes; recall of outcomes and consequences did not differ significantly across episodes.
their primary emotional response ($N = 10$). Of the participants who remained, those who reported feeling more intensely angry than sad were assigned to the angry group ($N = 35$); those who reported feeling more intensely sad than angry were assigned to the sad group ($N = 41$). This procedure resulted in the creation of four groups in which a single emotion or a neutral mood state clearly predominated. Table 2 shows the mean intensity ratings for each emotion given by participants in each primary emotion group.

A repeated measures ANCOVA was conducted on the proportion of information recalled by participants who felt primarily happy, angry, sad, and neutral. Because participants were not randomly assigned to primary emotion groups, this analysis controlled for GPA to guard against academic differences between groups that might influence recall. The between subject factors were primary emotion group and gender. The within subject factor was information type (setting, goal, agent, outcome, consequence).

The results showed significant main effects for GPA, $F(1, 214) = 14.47$, $p < .01$, and information type, $F(4, 214) = 3.45$, $p < .05$. An interaction between primary emotion and information type was also found, $F(12, 214) = 2.11$, $p < .05$. This interaction is depicted in Figure 1, which shows the adjusted mean proportion of each type of information recalled by participants in each primary emotion group. Separate ANCOVAs for each type of information revealed a significant effect of primary emotion for goals, $F(7, 215) = 2.74$, $p < .05$, and outcomes, $F(7, 215) = 3.55$, $p < .02$, but not for other types of information. Post hoc $t$ tests indicated that primarily happy participants recalled more goal information (Adj. $M = .49$) than did primarily neutral participants (Adj. $M = .41$), $t(146) = 2.59$, $p < .02$. Primarily angry participants also recalled slightly more goal information (Adj. $M = .47$) than did primarily neutral participants (Adj. $M = .41$). This difference approached, but did not reach, conventional levels of significance, $t(119) = 1.81$, $p < .07$. With respect to outcomes,
primarily sad participants recalled more outcome information (Adj. $M = .58$) than did primarily angry participants (Adj. $M = .41$), $t(75) = 3.17$, $p < .01$, and primarily neutral participants (Adj. $M = .47$), $t(125) = 2.36$, $p < .02$. Primarily happy participants also recalled more outcome information (Adj. $M = .51$) than did primarily angry participants (Adj. $M = .41$), $t(96) = 2.10$, $p < .04$. No other significant effects were found. In sum, happiness was associated with enhanced recall of goals and outcomes, sadness with enhanced recall of outcomes, and anger with a tendency toward enhanced recall of goals.

Some researchers have found that arousal (typically negative emotion) leads to enhanced recall of central information relative to peripheral details (Christianson & Loftus, 1987, 1991). To test this hypothesis, participants were divided into groups depending upon whether their primary emotional response was negative, happiness, or neutral. The proportion of information recalled by each participant was then entered into an ANOVA in which emotion (negative, happiness, neutral) was a between-subject factor, and centrality (central, peripheral) was a within subject factor. The results showed a main effect of centrality, with central information ($M = .69$, $SD = .15$) being recalled more often than peripheral information ($M = .38$, $SD = .12$), $F(1, 260) = 2345.51$, $p < .0001$, and a main effect of emotion, $F(2, 260) = 3.41$, $p < .03$. Primarily happy participants
recalled more of the narrative as a whole ($M = .52, SD = .10$) than did participants reporting primarily negative emotions ($M = .48, SD = .12$), or participants reporting a neutral state ($M = .47, SD = .13$). No significant interaction between centrality and emotion was found.

The finding that happy participants recalled more of the narrative than did participants feeling primarily negative emotions or a neutral state raises a question: Was this facilitating effect of happiness on recall due to feeling happy, or was it due to increased motivation or confidence resulting from having just “aced” a quiz? To address this question, we compared the proportion of the total narrative recalled by two groups of happy participants: those who explained their happy state by referring to academic achievement (on the quiz or on any other task) and those who gave nonacademic reasons for their happiness (“I just ran into my boyfriend before class”). No significant differences were found in the proportion of information recalled between these two groups (academic reasons: $M = .54, n = 32$; nonacademic reasons: $M = .51, n = 30$), $t(60) = 1.07$, ns. This suggests that happiness, rather than academic achievement, was associated with recall accuracy.

EFFECTS OF EMOTIONAL INTENSITY ON RECALL

We predicted that the effects of emotions on the encoding of incoming information would be more pronounced at greater intensities. To test this prediction, regression analyses were conducted examining the effects of emotional intensity on recall for those effects that had been both predicted, and found in previous analyses, to influence memory for the narrative. Three hierarchical (step-wise) regression analyses were conducted. The first analysis was conducted to determine whether greater intensity of happiness was associated with enhanced recall for the narrative as a whole. All participants were included in this analysis. The dependent variable was the total amount of information recalled from the narrative. The predictors were GPA, gender, and the intensities of happiness, sadness, anger, fear, and surprise. The results of this analysis are shown in Part A of Table 3. The total amount of narrative information recalled was significantly predicted by GPA, gender, the intensity of happiness. Greater intensity of happiness was associated with more accurate recall of the narrative, $R^2$ increase for happiness = .02, $F(3, 259) = 5.88, p < .05$.

We predicted that anger would lead to enhanced recall of goals, and that this effect would become more pronounced as the intensity of anger increased. To test this prediction, a second regression analysis was conducted using only those participants who indicated that they had felt
TABLE 3: Summary of Regression Analyses (Stepwise) Predicting Recall of the Total Narrative, Goals, and Outcomes from GPA, Gender, and the Intensities of Happiness, Sadness, Anger, Fear, and Surprise

<table>
<thead>
<tr>
<th>Predictors</th>
<th>$R^2$</th>
<th>$R^2$-inc</th>
<th>$F$</th>
<th>$\beta$</th>
<th>$B$</th>
<th>$SE$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total Narrative: All participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>.05</td>
<td>.05</td>
<td>14.43***</td>
<td>.20</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Gender$^1$</td>
<td>.08</td>
<td>.03</td>
<td>7.48**</td>
<td>-.16</td>
<td>-.04</td>
<td>.02</td>
</tr>
<tr>
<td>Happiness</td>
<td>.10</td>
<td>.02</td>
<td>5.88*</td>
<td>.14</td>
<td>.02</td>
<td>.01</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>.34</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>B. Goals: Angry participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>.06</td>
<td>.06</td>
<td>6.15*</td>
<td>.28</td>
<td>.06</td>
<td>.02</td>
</tr>
<tr>
<td>Anger</td>
<td>.12</td>
<td>.06</td>
<td>6.01*</td>
<td>.24</td>
<td>.31</td>
<td>.13</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>1.37</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td>C. Outcomes: Sad participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>.06</td>
<td>.06</td>
<td>8.49**</td>
<td>-.24</td>
<td>-.31</td>
<td>.11</td>
</tr>
<tr>
<td>GPA</td>
<td>.08</td>
<td>.02</td>
<td>2.18</td>
<td>.12</td>
<td>.04</td>
<td>.03</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>3.23</td>
<td>.80</td>
<td></td>
</tr>
</tbody>
</table>

Note: $^1$ male, 0 = female. $R^2$ = squared multiple correlation; $R^2$-inc = increment to the squared multiple correlation; $F$ = $F$ value for the change in $R^2$. The table includes all variables that met the 0.15 significance level for entry into the model.

*p < .05. **p < .01. ***p < .001. Total narrative model $F(3, 259) = 9.52, p < .0001$; Goals model $F(2, 95) = 6.25, p < .01$; Outcomes model $F(2, 134) = 5.37, p < .01$.

at least "a little" angry (ratings of the intensity of anger were greater than 0; "not at all"; $N = 95$). The dependent variable was the amount of goal information recalled from the narrative. The predictors were identical to those used in the previous analysis. The results of this analysis are shown in Part B of Table 3. The amount of goal information recalled was predicted by GPA and by the intensity of anger reported, $R^2$ increase for anger = .06, $F(2, 95) = 6.01, p < .05$.

We also predicted that sadness would lead to enhanced recall of outcomes, and that this effect would become more pronounced as the intensity of sadness increased. To test this prediction, a final regression analysis was conducted using only those participants who indicated that they had felt at least "a little" sad ($N = 137$). The dependent variable was the amount of outcome information recalled from the narrative. The predictors included were identical to those used in the previous regression analyses. As Part C of Table 3 shows, the amount of outcome information recalled was significantly predicted only by the intensity of anger, $R^2$ increase for anger = .06, $F(2, 134) = 8.49, p < .01$. The greater the intensity of anger reported, the less outcome information participants recalled. No relationship was found between the intensity of sadness and recall of outcomes. A negative relationship between the intensity of
anger and recall of outcomes is consistent with the possibility that specific emotions enhance recall of functional information at the expense of other types of information that may be less relevant in a particular emotional state. This finding must be viewed with caution, however, because no significant association between anger and recall of outcomes was found in the regression analysis described above, which included only angry participants.

Some investigators have argued that arousal has a general effect on recall, independent of the specific emotion felt. To test this hypothesis, a Pearson correlation was computed between the intensity of participants' primary emotion (for any emotion other than neutral) and recall of the narrative. No relationship was found between this measure of general arousal and recall of the narrative as a whole, $r(176) = -0.02$, ns. Finally, participants sometimes recalled phrases that were not presented in the narrative ($M = 2.42$, $SD = 1.50$). A $2 \times 2$ (quiz grade) $\times 2$ (gender) repeated measures ANOVA was conducted on the number of positive, negative, protagonist action, and miscellaneous intrusions made. No significant effects of grade or gender were found.

**DISCUSSION**

The vast majority of studies on emotion and memory contrast positive and negative moods but neglect distinctions within these categories. Moreover, little attention has been paid to how the information to be remembered relates to the concerns of individuals in different emotional states. Research motivated by cognitive models of emotion has demonstrated that discrete emotions are associated with different interpretations of events and different problem-solving strategies (Levine, 1995, 1996; Oatley & Johnson-Laird, 1987; Roseman, 1991; Scherer, 1984; Smith & Lazarus, 1993; Stein & Levine, 1989). Emotion-specific biases in memory and judgment have also been demonstrated (Averill, 1982; Ellsworth & Smith, 1988; Keltner, Ellsworth, and Edwards, 1993; Levine, 1996, 1997; Stein & Liwag, 1996; Weiner, Graham, & Chandler, 1982). These findings led to the hypothesis that specific emotions differ in their effects on memory, enhancing the encoding of information relevant to the circumstances or problems that typically evoke the emotions. To test this hypothesis, we examined the effects of happiness, anger, and sadness on the encoding of information expected to be relevant in these emotional states. The results showed that happiness was associated with enhanced memory for the narrative as a whole. Anger and sadness were associated with enhanced recall for specific types of information: angry participants recalled more information.
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concerning goals and sad participants recalled more information concerning event outcomes. Some researchers have argued that emotional arousal enhances memory for central information at the expense of peripheral information (Christianson & Loftus, 1987, 1991). The current findings suggest that the types of information that are central in one emotional state may not be central in another.

Several findings indicated that happiness was associated with better memory for the narrative as a whole. Participants in the positive-emotion condition recalled more of the narrative as a whole as compared to participants in the negative-emotion condition. Greater intensity of happiness was also associated with more accurate recall of the narrative as a whole. This enhancement of memory appears to have been due to feeling happy rather than to increased motivation or confidence resulting from academic achievement. Participants who gave nonacademic reasons for feeling happy ("I just ran into my boyfriend before class") were just as accurate in their recall of the narrative as those who cited academic achievement as the reason for their happiness.

The overall trend in research on autobiographical memory and in laboratory experiments has been to find a slight recall advantage for pleasant events and stimuli over neutral or unpleasant events and stimuli (Bradley, 1994; Matlin & Stang, 1978; Thompson et al., 1996). This advantage could be due to the emotions elicited by the material or to the greater familiarity or memorability of pleasant material. In the current study, identical material was presented to all participants. The results thus indicate that happiness can lead to enhanced memory independent of the positive or negative tone of the material to be recalled.

Past research has also shown that, in comparison to people in negative or neutral moods, happy people tend to rely on heuristic problem-solving strategies rather than on careful analysis of the problem under consideration (Bless et al., 1996; Isen & Means, 1983; Isen, 1993; Mackie & Worth, 1989, 1991). Mackie and Worth (1989, 1991) argue that heuristic problem-solving strategies are used because happiness leads to a decrease in information-processing capacity (Mackie & Worth, 1989, 1991). The current finding of enhanced recall by happy individuals is not consistent with this explanation. Research by Bless and his colleagues (1996) also indicates that happiness does not decrease information-processing capacity. They found that happy participants relied more on schematic knowledge than did sad participants when recalling a narrative. This heuristic strategy did not disrupt recall, however, and was associated with superior performance on a secondary task—a standardized test measuring concentration. Happiness is typically evoked when people attain a goal or valued state (Lazarus,
1991; Mandler, 1984; Stein & Levine, 1987). According to Schwarz and Clore (1983), happy feelings signal that the environment is benign and that no problems require immediate attention (see also Bless et al., 1996; Frijda, 1988). Thus, happy feelings may be associated with a freeing up of attentional resources that can then be directed toward incoming information. Further research is needed to identify the conditions under which happy people are motivated to engage in systematic processing of incoming information or choose to rely on heuristic information-processing strategies.

In contrast to happiness, which was associated with enhanced recall of the narrative as a whole, anger and sadness were associated with selective recall of specific types of information. Participants who felt primarily angry recalled slightly more goal information than did participants who felt primarily sad (“Mary really wanted to go to the concert”). The greater the intensity of anger reported, the more goal-related information participants remembered. Participants who felt primarily sad recalled more information concerning event outcomes than did participants who felt primarily angry or neutral (“Mary can’t go to the concert”). No relationship was found between the intensity of sadness and recall, however. Numerous studies have shown that anger is associated with renewed attempts to attain thwarted goals, whereas sadness is associated with ceasing such attempts (Izard, 1991; Lewis, Allesandri, & Sullivan, 1990; Scherer, 1984) and adjusting expectations to accommodate to the outcomes that result (Levine, 1995, 1996; Stein & Levine, 1989). Selective attention to goals when angry, and to outcomes when sad, may facilitate the different problem-solving strategies associated with these two emotions. The failure to find an association between anger and enhanced recall of the agents who caused goal failure requires further exploration.

Testing other hypotheses concerning the effects of emotions on memory, no relationship was found between general emotional intensity (independent of the type of emotional response) and the amount of information recalled. Rather, greater emotional intensity was associated with enhanced recall for happiness (for the narrative as a whole) and for anger (for goals), but not for sadness (for related findings see Laird et al., 1989). Participants recalled central information in the narrative better than peripheral details, irrespective of whether they reported feeling negative emotions, happiness, or a neutral state. As in many other studies in which participants have been asked to recall highly structured or experimenter-generated materials, mood-congruent recall was not observed (Eich, 1995).

This study thus provides evidence that happiness, anger, and sadness
facilitate the encoding of different types of information. Given that we assessed the influence of emotions on memory for new information, the effects were modest, but several features of the design increase our confidence in their generalizability. Receiving a good or poor grade is a frequent and natural cause of happiness, anger, and sadness in students, so the effects of the resulting emotions should generalize to everyday emotional experience. By using a single event to elicit negative emotions and then sorting participants into angry and sad groups based on their primary emotional response, anger and sadness were elicited without selectively priming the different types of information expected to be relevant in these two emotional states. Participants were also unaware that their emotions were relevant to the study until after they had completed the recall task, thereby reducing concerns about demand characteristics. Finally, assessing memory for a narrative, rather than for the emotion-eliciting event, allowed for careful control over the types of information to be recalled.

Two limitations of this study also should be addressed. First, because participants may differ in their tendencies to react to negative events with anger or sadness, the possibility cannot be ruled out that individual differences influenced the types of information recalled. Previous studies have shown, however, that the same individuals focus more on goals when recalling or explaining events that elicited anger and focus more on outcomes when recalling or explaining events that elicited sadness (Levine, 1995; Stein & Levine, 1989; Stein & Liwag, 1996; see also Weiner, 1985). In the current study, these differences emerged when angry and sad individuals were asked to recall identical events. Taken together, these findings suggest that the emotional states of anger and sadness are associated with selective attention to different types of information. Second, this study was primarily a test of the effects of emotions on the encoding of incoming information. The information to be recalled was presented immediately after the emotion manipulation. Because the recall test occurred after an interval of only four minutes, however, some participants' emotions may have persisted throughout the task and influenced retrieval as well as encoding. In future studies, researchers might provide a longer delay period before the memory test to isolate encoding effects, or present the material to be recalled before eliciting emotions in order to explore the extent to which specific emotions also enhance the retrieval of functional information.

In summary, the diversity of research findings on the effects of emotional arousal on memory indicates that emotions may have multiple effects. The current findings suggest that emotions enhance memory for information that is functional or relevant in particular emotional
states. Making generalizations about the effects of arousal on memory, then, may be a bit like creating a cake without understanding the properties that distinguish flour, sugar, and salt. They are all white powders but they do very different things for the cake. Specific emotions also differ in their functions and appear to have different effects on memory.

REFERENCES

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