ANXIOUS MOOD AND MEMORY

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Summary—Influenced by Bower (Am. Psychol. 36, 129–148, 1981) and Lang (Anxiety and the Anxiety Disorders, Erlbaum, Hillsdale, N.J., 1985), we tested three hypotheses concerning anxious mood and memory: (1) the mood state dependent hypothesis which states that memory retrieval will be greater when mood at encoding and at recall are the same than when they are different; (2) the encoding mood congruent hypothesis which states that information semantically related to mood at encoding is retrieved more readily than information unrelated to mood at encoding; and (3) the recall mood congruent hypothesis which states that information semantically related to mood at recall is retrieved more readily than information unrelated to mood at recall. We induced anxiety in speech anxious students by informing them that they would be delivering a speech during the experiment. Mood could be either anxious or nonanxious at encoding, recall, both, or neither. Hence, there were four groups: Anxiety-Anxiety, Anxiety-Nonanxiety, Nonanxiety-Anxiety, and Nonanxiety-Nonanxiety. Subjects were asked to rate the self-descriptiveness of anxiety (e.g. NERVOUS) and nonanxiety adjective (e.g. POLITE) during the encoding phase, and to recall them later. Anxious mood was measured by self-report scales and by heart rate. No support was obtained for any of the three hypotheses. However, post-hoc analyses indicated that anxiety words were recalled least often in subjects whose heart rate increased from encoding to recall. This suggests that attention to threat information may diminish in aroused nonclinical subjects.

Beck (1976) proposed that cognitive schemata provide the basis for depressive thoughts, memories, expectations, and evaluations. The ubiquity of unpleasant thoughts, he suggested, maintains depressed mood which further promotes the accessibility of negative thoughts. Inspired, in part, by Beck's theory, Teasdale and Russell (1983) have conducted a series of studies to examine the effects of mood on cognition (for review, see Blaney, 1986). Teasdale and Fogarty (1979) used the Velten (1968) procedure to induce happy or depressed moods in normal volunteers who were then asked to recall either pleasant or unpleasant memories. Retrieval latency for pleasant memories was longer in depressed than in elated mood, suggesting that depression reduces the accessibility of positive cognitions. In a subsequent study, Teasdale, Taylor and Fogarty (1980) found that induction of depressed mood increased the probability of recalling unhappy memories, and decreased the likelihood of recalling happy memories. The results were reversed for happy mood. Similar findings were reported by Bower (1981) who induced either a state of happiness or sadness via hypnosis. While under hypnosis, subjects were asked to recall events from a diary they had recorded prior to the mood induction. Again, the probability of recalling unpleasant events was enhanced by depressed mood whereas pleasant events were more often remembered during happy mood.

Adopting the incidental recall paradigm (Isen, Clark, Shalker and Karp, 1978), Teasdale and Russell (1983) further investigated the effects of depressed mood on memory. While in neutral mood, college students were presented with a list of positive and negative personality trait words. They were later asked to recall these words during induced depressed or happy moods. Consistent with the earlier findings, more negative trait words were recalled under depressed than under happy mood; the opposite was found for the recall of positive trait words.

Bradley and Mathews (1983) presented positive and negative personality trait words to depressed patients and to normal controls. Subjects rated each word with respect to whether the word described themselves, a significant other, or an acquaintance. Patients recalled more negative than positive trait words, but only in the self-referent condition; no differences were found for normals. These results suggest that clinical depression and experimentally-induced depressed mood have similar effects on memory, thereby indicating the relevance of the analogue research for psychopathology.

As apparent from the studies discussed above, depression enhances recall of negative memories. Teasdale (1983) explained this mood congruent recall effect in terms of mood state dependent
learning. Accordingly, negative material is readily retrieved under depressed mood because it was originally encoded during this emotional state; reinstatement of depression via mood induction cues the recall of this material. Evidence consistent with Teasdale's (1983) explanation has been provided by Bower and his associates who have demonstrated mood state dependent learning (for review, see Bower, 1981). In a typical experiment, subjects learned word lists while in hypnotically-induced states of happiness or depression, and then attempted to recall these words while in the same or in a different mood. The results indicated that subjects remembered more words when their mood at recall was the same as their mood at encoding, suggesting that mood functions as a retrieval cue.

Mood congruent and mood dependent recall effects are conceptually distinct. The former refers to enhanced recall of information similar with current mood state, irrespective of mood at encoding. In contrast, mood state dependent learning refers to enhanced recall when encoding and retrieval moods are the same irrespective of the content of the information recalled.

Most research on mood and memory has involved depression (for review, see Blaney, 1986). If anxious mood also facilitates the recall of fearful memories, and inhibits the recall of nonanxious memories, then this mechanism may partly explain the persistence of pathological fear in the same manner as it explains persistence of depression. That is, if memories of frightening experiences "come to mind" more readily when a person is anxious, then those who are anxious often will be preoccupied with thoughts of anxious content (Beck, Laude and Bohnert, 1974; Butler and Mathews, 1983).

The above theorists have proposed semantic similarity as the basis for mood-memory effects. In contrast, Lang (1985) suggests that similarity between physiological responses occurring at encoding and retrieval mediate these effects. In the present experiment, we examined mood congruent and mood state dependent memory effects in speech anxious volunteers.

**METHOD**

*Subjects*

Thirty-six undergraduate psychology, and 13 first-year medical students participated in the experiment. All Ss scored in the upper quartile on the Personal Report of Confidence as a Speaker (PRCS; Paul, 1966) which was administered in a group testing session. Ss were paid $15 for their participation. There were 31 women and 18 men with a mean age of 21.4 years and a mean score on the Beck Depression Inventory (BDI; Beck, 1972) of 8.5.

*Design*

A $2 \times 2$ design was employed: (1) mood at encoding [anxious (A) vs nonanxious (NA)], and (2) mood at retrieval [anxious (A) vs nonanxious (NA)]. Ss were randomly assigned to one of four groups: anxiety-anxiety (A-A); anxiety-nonanxiety (A-NA); nonanxiety-anxiety (NA-A); and nonanxiety-nonanxiety (NA-NA). Nine Ss were dropped because the mood manipulation, as determined by composite scores of the State Anxiety Scale, VAMS anxiety, and VAMS arousal scale was unsuccessful. These Ss were included in subsequent analyses in which group assignment was ignored.

*Materials and apparatus*

*Self-report measures.* Self-report of Ss' moods was assessed via computerized Visual Analog Mood Scales (VAMS; Bond and Lader, 1974) and the Self Assessment Mannequin (SAM; Hodes, Cook and Lang, 1985). VAMS scales were presented as horizontal lines on a screen labeled "not at all" (0) at one end, and "very much" (10) at the other. For each of the six moods, Ss responded to "how (mood), e.g. anxious, do you feel right now" by moving a cursor along each scale to indicate mood intensity. The moods were: anxiety, depression, drowsiness, relaxation, happiness, and alertness.

SAM collected information on how aroused, happy, and in control Ss felt. Each of these ratings consisted of a computerized image that could be manipulated to represent the continuum of each feeling (i.e. happiness—figure goes from large smile to large frown). Again Ss depressed a button at the point that it represented their feelings.
A shortened version of the State form of the State-Trait Anxiety Scale (Spielberger, Gorsuch and Lushene, 1970) was used as an additional measure of anxiety. Developed by Smith, Ingram and Brehm (1983), this scale consists of the 10 odd-numbered items from the State form with scores ranging from 10 to 40.

**Physiological measures.** A Grass Model 7 polygraph recorded heart rate (HR) through two Beckman Standard silver/silver chloride 8 mm electrodes filled with EKG Sol electrolyte and attached with adhesive collars to the lower left and right ribs. Electrode sites were cleaned and slightly abraded with alcohol. HR was reduced by a Terak computer, and expressed as beats/min. Baseline data were obtained during the last minute of a 10-minute adaptation period. Three min of data, collected immediately following Mood Induction 1 and Mood Induction 2, were used as physiological measures of mood.

The **Encoding List** comprised 48 words (obtainable from the first author). It contained 20 anxiety words (e.g. nervous) selected from *Roget's Thesaurus* (Roget, 1962), 20 nonanxiety words (e.g. cheerful) selected from among the 100 most liked personality words of Anderson's (1968) list, and eight neutral words (e.g. conventional) selected from those ranking between 227 and 327 on Anderson's list. The 48 words were randomly arranged into 10 sequences (each of which was presented one time per group) with the following constraints: the first four and last four words were buffers used to counter primary and recency effects; and among the remaining words, no more than two of the same type (anxiety or nonanxiety) occurred consecutively.

For each S, the number of anxiety words recalled was divided by the number of total words recalled to obtain an anxiety memory bias index, indicating the percentage of words recalled that were anxiety words.

**PROCEDURE**

Upon arrival at the laboratory, Ss were told that they would participate in a study on "the effects of mood on cognitive processes". After signing the consent form and completing the BDI, the experimenter instructed the Ss in the use of the computerized VAMS and SAM ratings. Ss then completed the baseline VAM, SAM, and STAI Scales. Electrodes were then attached and Ss were asked to sit quietly for a 10 min adaptation period. Physiological data collected during the final minute were designated as baseline heart rate.

**Mood Induction I**

Ss in the anxiety–anxiety (A–A) and in the anxiety–nonanxiety (A–NA) groups received anxiety-arousing instructions during the first mood induction period. Ss in the nonanxiety–anxiety (NA–A) and nonanxiety–nonanxiety (NA–NA) groups received nonanxiety instructions during this period.

The **Anxiety Instructions** for the A–A and the A–NA groups were as follows:

"In a few minutes, I'll be unhooking the physiological monitors and we'll be going into the video room next door. At that time, I'll ask you to give a brief, five minute speech about yourself. You can include information about your personality, your goals, your life history, or whatever, in your speech. The videotape of your speech will be viewed later by three clinical psychologists who will rate your performance in terms of poise, ease of delivery, nervousness, and some other measures. First, I'd like you to complete a few more brief tasks. I'm going to go next door and get the material ready. I'll be back in just a couple of minutes. Okay?"

The **Nonanxiety Instructions** were as follows:

"In a few minutes, I'll be unhooking the physiological monitors and we'll be going into the video room next door. At that time, I'll ask you to perform several brief tasks involving a word processor. But first I'd like you to complete a few more brief pencil and paper tasks. I'm going to go next door and get the material ready. I'll be back in just a couple of minutes. Okay?"

Immediately following this mood induction, 3 min of physiological data were collected. Ss then completed the VAM, SAM, and STAI for the second time. The data are reported as Post Mood Induction I.

Ss next completed a word-rating task requiring self-referent processing. This processing mode increases word encoding (Smith et al., 1983). The task was explained as follows: "There are now going to be some slides appearing on the screen in front of you. Please look at each slide until it
disappears from the screen. Then watch the monitor and rate how well you think that word describes you.” Following the presentation of each slide, a “not at all” to “very much” (anchors 0 and 10) scale appeared on the computer monitor. Ss moved a cursor on the video screen to indicate the degree to which each word described them.

Mood Induction II

Following the presentation and rating of the 48 words, the experimenter returned to the S room to induce the second mood. Ss in the A-A and NA-A groups received anxiety-arousing instructions. Those in the NA-NA and A-NA groups received nonanxiety instructions. These instructions are given below.

A-A Ss were reminded of their impending speech:

“In a few more minutes, you’ll be delivering your speech about yourself. Remember, you can include information about your personality, your goals, your life history, or whatever. But first, we’ve got a couple more tasks to complete.”

NA-A Ss were told for the first time that they would be giving a speech:

“We have several more cognitive tasks to complete including a speech task. In a few minutes, I’ll be asking you to deliver a brief, five-minute speech about yourself in front of a video camera. You can include information about your personality, your goals, your life history, or whatever, in your speech. The videotape of your speech will be viewed later by three clinical psychologists who will rate your performance in terms of poise, ease of delivery, nervousness, and some other measures.

NA-NA Ss were reminded of the video task:

“In a few more minutes, we’ll be going into the video room next door to do the word processing task. But first, we’ve got a couple more tasks to complete.”

A-NA Ss were told that their speech has been cancelled:

“I’m sorry, but I made an error in randomizing the groups. You will not be giving a speech. You’ve actually been assigned to the other group. Instead of asking you to give a speech, I’ll be asking you to perform several brief tasks on the word processor next door.”

Immediately following the manipulation, 3 min of physiological data were collected followed by the completion of the VAM, SAM, and STAI ratings to assess effects of Mood Induction II. After Ss completed the final computerized rating, they were told: “In the next three minutes, write down as many of the words from the slides as you can.”

RESULTS

Nine Ss were excluded from the initial analyses because they failed to respond to the mood manipulations. That is, they failed to either show increase (or decrease) in anxiety as measured by the STAI and the VAMS anxiety scales.

Effects of mood induction

Means and standard deviations were calculated separately for the four experimental groups at each of the following occasions: at baseline, post Mood Induction I, and post Mood Induction II. For HR, the following was recorded: the last minute of resting period was defined as baseline; the final minute of the 3-min period following pre-encoding mood induction; and the final minute of the 3-min period following the pre-recall induction. Table 1 includes the means and standard deviations by group for HR and self-report measures of anxiety and arousal.

Baseline

Self-report measures. There were no significant differences on any measures among groups.

Heart-rate. There were no significant differences among groups.

Pre-encoding

Self-report measures. As predicted, the results on the STAI and on the VAMS anxious scale indicated that the A-A and A-NA groups scored significantly higher than did the NA-A and NA-NA groups \[ F(3,36) = 8.60, P < 0.001; F(3,36) = 5.28, P < 0.004 \], respectively. However, the groups did not differ on the remaining VAMS or SAM scales.
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Table I. Means and standard deviations for the four experimental groups on physiological and self-report measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1, A-A</th>
<th>Group 2, A-NA</th>
<th>Group 3, NA-A</th>
<th>Group 4, NA-NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>78.34 (11.30)</td>
<td>69.83 (8.41)</td>
<td>70.63 (11.15)</td>
<td>76.76 (9.28)</td>
</tr>
<tr>
<td>VAMS Anxiety</td>
<td>0.48 (0.17)</td>
<td>0.42 (0.25)</td>
<td>0.41 (0.25)</td>
<td>0.50 (0.32)</td>
</tr>
<tr>
<td>SAM Arousal</td>
<td>0.35 (0.16)</td>
<td>0.28 (0.27)</td>
<td>0.27 (0.21)</td>
<td>0.43 (0.30)</td>
</tr>
<tr>
<td>STAI</td>
<td>18.50 (4.25)</td>
<td>21.40 (1.72)</td>
<td>21.20 (3.46)</td>
<td>21.00 (6.82)</td>
</tr>
</tbody>
</table>

Heart rate. We predicted that group A-A and A-NA would evidence greater HR response (greater increase in HR from baseline) than would NA-A and NA-NA. The results indicated that the groups did not differ on this variable.

Self-report measures. We predicted that the A-A and the NA-A groups would show higher scores on the VAMS Anxious subscale and on the STAI than would the remaining groups. The results indicated that the groups differed on the STAI \( F (3,36) = 4.42, P < 0.01 \), but not on the VAMS anxious subscale \( F (3,36) = 1.99, P < 0.134 \). Post-hoc analysis by the Duncan method on the STAI revealed that Group 4 differed from the other three groups at a 0.05 level.

Heart rate. We hypothesized that groups A-A and NA-NA would not differ on HR at pre-encoding and pre-recall. A significant increase was predicted for the NA-A group and a decrease for the A-NA groups. The hypotheses were not confirmed.

Effects of mood state dependence on memory

A 2 (pre-encoding mood: A vs NA) x 2 (pre-recall mood: A vs NA) ANOVA was performed on the total words recalled irrespective of their content. It was predicted that the A-A and the NA-NA groups would recall more words than would the A-NA and the NA-A groups. There were no significant state dependent memory effects. Contrasts comparing Groups A-A and NA-NA with Groups A-NA and NA-A also did not yield significant effects.

Effects of mood congruence on memory

Two hypotheses were tested. First, if anxious mood at encoding promotes recall of anxiety-related material, then more anxiety words would be recalled by the A-A and A-NA groups than by NA-A and NA-NA groups. If anxious mood at recall facilitates retrieval of anxiety-related material, then the A-A and the NA-NA groups will recall higher percentages of anxious words than will the A-NA and the NA-NA groups. To test these hypotheses, we performed planned comparisons on anxiety-bias scores of the four groups. Anxiety bias scores for the groups were as follows: A-A, 0.42 (SD = 0.14); A-NA, 0.40 (SD = 0.13); NA-A, 0.39 (SD = 0.15); and NA-NA, 0.47 (SD = 0.17). There were no significant differences among groups.

Further analyses

The failure to find the predicted effects may be attributable to the manipulation failing to affect HR in the predicted direction (see Table 1). If HR mediates state dependence and mood congruence effects, as suggested by Clark, Milberg and Ross (1983), and by Lang (1985), then this failure makes it impossible to test these hypotheses with the original design.

In order to test the effects of heart rate on recall, we divided Ss into three groups: those whose HR increased between pre-encoding and pre-recall (Group 1, \( N = 15 \)), those whose HR decreased (Group 2, \( N = 7 \)), and those whose HR stayed the same (Group 3, \( N = 12 \)). To test the mood
Table 2. Relationship between changes in HR (pre-coding to pre-recall) and recall of anxiety words

<table>
<thead>
<tr>
<th>Group</th>
<th>Heart rate baseline</th>
<th>Heart rate at pre-coding</th>
<th>Heart rate at pre-recall</th>
<th>Number of anxiety words recalled</th>
<th>Anxiety bias scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasers</td>
<td>71.83</td>
<td>74.21</td>
<td>83.74</td>
<td>4</td>
<td>0.36</td>
</tr>
<tr>
<td>( N = 15 )</td>
<td>( 11.94 )</td>
<td>( 12.27 )</td>
<td>( 12.06 )</td>
<td>( 4.59 )</td>
<td>( 0.11 )</td>
</tr>
<tr>
<td>Decreasers</td>
<td>75.79</td>
<td>85.79</td>
<td>77.87</td>
<td>8</td>
<td>0.47</td>
</tr>
<tr>
<td>( N = 7 )</td>
<td>( 9.20 )</td>
<td>( 15.77 )</td>
<td>( 14.60 )</td>
<td>( 3.63 )</td>
<td>( 0.14 )</td>
</tr>
<tr>
<td>No changers</td>
<td>76.22</td>
<td>79.31</td>
<td>79.09</td>
<td>8</td>
<td>0.50</td>
</tr>
<tr>
<td>( N = 12 )</td>
<td>( 8.42 )</td>
<td>( 9.79 )</td>
<td>( 9.56 )</td>
<td>( 2.11 )</td>
<td>( 0.15 )</td>
</tr>
</tbody>
</table>

dependence hypothesis, we performed a one-way ANOVA with number of words recalled as the dependent variable. Table 2 shows the mean HR across occasions, mean number of anxiety words recalled, and anxiety bias scores for each of the three groups. The results indicated a significant effect of group on the number of words recalled; \( F(2,31) = 7.14, \ P < 0.003 \). Duncan post-hoc tests \( (\tau = 0.10) \) revealed differences between Groups 1 and 2, and between Groups 2 and 3.

To test for mood congruence, we performed a one-way ANOVA and planned comparisons on anxiety bias scores. Significant differences were found between groups on the anxiety bias measure; \( F(2,31) = 4.28, \ P < 0.03 \). Planned comparisons between Group 1 (highest HR at Time 2) and Groups 2 and 3 combined yielded a significant effect \( t(2,31) = 2.76; \ P < 0.01 \).

**DISCUSSION**

Three hypotheses were examined in the present study: (1) the mood state dependent hypothesis which states that memory retrieval will be greater when mood at encoding and at recall are the same than when they are different; (2) the encoding mood congruent hypothesis which states that information semantically related to mood at encoding is retrieved more readily than information semantically unrelated to mood at encoding; and (3) the recall mood congruent hypothesis which states that information semantically related to mood at recall is retrieved more readily than information semantically unrelated to mood at recall. We found no evidence for any of these hypotheses.

Although mood dependence effects have been found with noninterference paradigms such as ours (e.g. Bartlett and Santrock, 1977, Leight and Ellis, 1981), these effects are most often obtained with interference paradigms where Ss learn two word lists, each under a different mood, and then attempt to recall these words under either mood (e.g. Schere, Lisman and Spear, 1984). Perhaps mood congruence effects with anxiety would have been obtained using an interference paradigm.

Our failure to use an interference paradigm does not explain why we did not obtain mood dependence effects with self-report indices of mood. There are several possible explanations for these null findings. Perhaps anxious mood, in contrast to depression and happiness, influences perception but not memory, was argued by Mogg, Mathews and Weinman (1987). Alternatively, anxious mood, unlike depression and happiness, may fail to persist after induction, because anxiety dissipates more readily. Finally, fearful individuals may tend to avoid fear-relevant information, whereas depressed and happy individuals may be attuned to mood-congruent information. Thus, our speech fearful volunteers may have been successful in attenuating their fear, or they may have avoided fear-relevant information. In contrast, individuals with panic disorder are less successful in keeping their fear structures inactive as evidenced by their chronically elevated arousal (Roth, Telch, Taylor, Sachitano, Gallen, Kopell, McLenahan, Agras and Pfefferbaum, 1986). Indeed, they show more recall of fear information than do normals, especially when physiologically aroused (McNally, Foa and Donnell, 1989).

Anxiety has been conceptualized as a multi-system construct indexed by loosely intercorrelated measures of self-report, psychophysiology, and behavior. It is therefore possible that the mood–memory effects are not mediated by semantic elements but rather by physiological responses of anxiety (e.g. heart rate), as suggested by Clark et al. (1983) and Lang (1985). Consistent with this hypothesis are the results we obtained by regrouping the Ss according to heart rate. The group that exhibited decreased heart rate between pre-encoding and pre-recall recalled more anxiety words than did the group that showed a large HR decrease between the two occasions. However, subjects who experienced an increase in heart rate from pre-encoding to pre-recall did not differ
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from those who did not change. These results are consistent with the hypothesis that normal individuals, when anxious, successfully defend against anxiety information. The Ss in this study were normal volunteers with sub-clinical speech anxiety rather than anxiety-disordered patients with chronically activated fear structures.

The results reported here indicate that physiological measures should be used as indicators of anxious mood state. Indeed, self-report measures proved insensitive to mood–memory effects. It is conceivable that individuals showing synchrony between self-report and physiological measures will exhibit enhanced mood–memory effects. Such synchrony may indicate a fuller activation of the fear schema, thereby facilitating recall of anxiety information. Ss who exhibited synchrony on multiple measures of fear improved more on behavior therapy than those who did not (Lang, Melamed and Hart, 1970). Since fear activation is believed necessary for clinical improvement, it follows that synchrony reflects fuller activation than desynchrony.

Mood congruence effects in anxiety are not as consistent as mood congruence effects in depression. It is clear that depressed mood increases recall of sad material and inhibits recall of happy material. In contrast, anxious mood seems to inhibit recall of anxiety information in normal controls but not in panic-disordered patients (McNally et al., 1987). This suggests that normals are more successful at avoiding anxiety information than are panic-disordered patients who experience chronic activation of their fear structures.

Since anxiety seems to inhibit recall of anxiety information in some cases, and facilitates it in others, researchers need to elucidate variables responsible for the varied effects of anxious mood on memory.

REFERENCES
