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# MOOD DEPENDENT LEARNING

by

PAUL DOUGLAS YOUNG

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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Supervisor

External Examiner

Date 16 May 84

# Dedication

This is dedicated to the ones I love, who suffered my constant absence willingly and supported me always-- Debbie and Amanda.

Abstract

The state-dependent learning hypothesis (Swanson and Kinsbourne, 1979; Bower, 1981; Baddeley, 1982a) holds that material learned in one state is better recalled if the state is re-established for testing. Three experiments were done to see if Velten-established mood state could serve such a cuing function.

In the first experiment, sixty women learned 16 words in one mood, then 16 more words in a second mood. After an interpolated task, they tried to recall all of the words in one of the moods. Limited support was found for the SDL hypothesis in recall testing, and slightly stronger support in followup recognition testing.

In the second experiment, randomly-generated line drawings were substituted for the word lists, in an attempt to minimize interactive coding of mood state cues and learned material. Forty men learned the designs in one mood, and then tried to reproduce them in either the same mood or a different mood. Results supported the SDL hypothesis for recall but not for recognition, supporting the contention that interactive coding of mood state and designs had not taken place.

In the third experiment, the line drawings were divided into sets. Sixty women learned one set in one

mood, the other set in the same or a different mood, and then tried to reproduce both sets in one of the previous moods. The SDL hypothesis was supported for the recall scores of the first set and for the recognition scores of the second set, possibly reflecting a greater chance for deliberate interactive coding as the subjects became more familiar with the learning task.

The results of these experiments were interpreted as generally supporting the mood-SDL hypothesis, and as strengthening the evidence for SDL in recognition if there is a basis for interactive coding of mood state and learned material.

## Acknowledgement

I gratefully acknowledge the long-distance help and encouragement provided by my supervisory committee, Professors Howarth, Nelson and Lechelt. I am especially thankful to Dr. Howarth for continuing to work with me even while on sabbatical leave.

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## Mood dependent learning

Increasing attention has been given in personality research of recent years to the role of fluctuating personal states in the determination of behavior. This has opened new areas of experimental research on the effects of personality variables on behavior, research which was previously correlational in nature (Crowne, 1979). The variable nature of personality states means that they are, in principle, manipulable, and as techniques for altering them have become available, states have been used as independent variables in experimental research.

Among the state variables so employed has been mood. Of special interest in this project have been those studies which investigate the relationships between mood and learning, particularly state dependent learning.

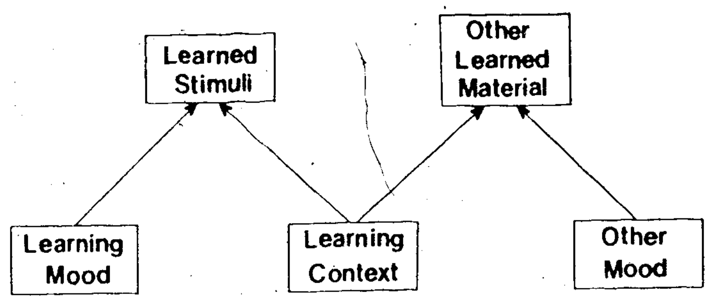
The typical paradigm for demonstration of state-dependent learning (SDL) has the subject learn material in one internal state and then demonstrate that learning through recall or performance in another state similar or dissimilar to the original state. SDL effects are demonstrated if recall or performance is superior when the testing state is similar to the learning state. Internal state is used here generally to include the set of conditions extant within the individual at a given point in time. The internal state includes the "psychic state" and the "physiological state" (Bower, 1981); the "affective state" (Bartlett and Santrock, 1979); and the "emotional state" (Leight and Ellis, 1981). Internal state is sometimes called simply "state" (Leight and Ellis, 1981).

Most SDL theorists (Swanson and Kinsbourne, 1979; Leight and Ellis, 1981; Bower, 1981) suggest that the internal state serves as a cue to the learned material, having been associated with it through temporal contiguity. Thus, when the internal state is re-established for the test, it serves as a cue for recall. When the internal state at recall differs from that present during learning, the absence of the state cue leads to poorer performance.

Of course, the internal state present during learning is not the only cue to be associated with the learned material. The learning situation-- the context -- also provides cues which may or may not be present in the test phase. Context refers to the complex of external stimuli-- sometimes called "background" or "noise"-- which prevails during presentation of material to be learned. In 1972, Bower included interoceptive stimulation in his definition of context, but by 1981 he found it necessary to separate emotional or mood stimuli from context cues in his network theory of state dependent retrieval. That is, the context cues are specific, readily and quickly manipulable stimuli such as location or semantic questions; while state cues are general, slowly- changing complexes of internally-generated stimuli. The distinction is not absolute. Context cues may be broadly situational rather than specific: the context of "school days," for example. In such circumstances, the context may function as a state, playing the same role in SDL as does the psychic or affective state. Baddeley(1982a), for example, has repeatedly demonstrated SDL effects by manipulating the situational state of divers-- above or below water.

The network theory of state dependent retrieval (Bower, 1981) argues that material to be learned in a mood-state dependent learning study is connected in memory to two nodes-- the context node and the emotion node. When a subject is asked (context cue) to recall events learned in a particular context, "activation spreads out from the context node as the subject searches for relevant items. But Context 1 is a weak, overloaded cue because it is associated with many things, so any one connection is subject to heavy interference" (p.136). If the emotion node is also activated, however, the activation spreading from it will summate with that from the context node, so that recall is best if testing occurs in the same mood as learning. This theory also predicts that SDL effects are most likely under free recall conditions, where the strength of the context cue is minimal, forcing greater reliance upon emotion node cues. This is in accordance with the suggestion by Eich (1977) that SDL does not occur when retrieval is mediated by an overt cue. A model of Bower's network theory appears as figure 1.

Figure 1. Simplified network theory of SDL.




As seen in figure 1, the context cues activate a plethora of associations, including learned stimulus material and other learned material. Recall of stimuli is thus subject to intrusions from other material learned in that context: the context cue is overloaded. If the mood at recall is the same as it was during learning, then its activation of stimulus material will summate with that from the context, making the stimuli more accessible to recall. If the mood at recall is different from that during learning, no such summation occurs, and performance suffers.

In addition to the internal state and the context, other cues to learning may be active in a particular experiment. For example, the experimenter may provide deliberate cues to learning which she then makes available at the recall session, as in paired associates learning tasks; and the subject may also utilize self-generated cues such as organizational strategies and various mnemonic tricks to improve recall. Nonetheless, the cues provided by the internal state are potentially useful as aids to recall.

Swanson and Kinsbourne (1979), reviewing the state of SDL research, observe that most of these studies use drugs, as the means of inducing particular internal states, including cortical arousal, depression and disinhibition. Among the fairly consistent findings of those studies reviewed are the following:

1. A state-dependent learning effect can be reliably found.

2. SDL effects are most reliable in experiments which test learning as uncued or free recall.

3. The previous experience of the participants with the drug employed influences the magnitude of SDL,

probably as a function of drug tolerance.

4. The difficulty of the task to be learned influences the likelihood of SDL. If the task is too easy, a ceiling effect of 100% learning for all subjects eliminates the possibility of the differential effects predicted by the SDL hypothesis. If the task is too hard, many subjects score at or near zero, and the resulting "floor effect" minimizes the possibility of the differential SDL effects.

While the drug-induced SDL phenomenon has been heavily studied over the past twenty years (Swanson and Kinsbourne, 1979), other means of manipulating the internal state have not been completely examined. Theoretically, any means of producing two or more distinct states should be capable of inducing an SDL effect similar to that so reliably elicited through the use of certain drugs. These effects "are as theoretically interesting and practically important as drug-produced SDL" (Swanson and Kinsbourne, 1979, p. 277).

Among the variables that have been tested in SDL experiments are sleep (Evans, Gustafson, O'Connell, Orne and Shor, 1966, 1970); time of day (Halloway, 1977; Jones, 1974); arousal level (Fischer and Landon, 1972); mental illness (Weingartner, 1977); and situational context (Godden and Baddeley, 1975; Pan, 1926).

The set of studies in which I am interested at present are those SDL experiments which alter the internal state by manipulating mood during learning and recall. These studies assume mood to be a relevant aspect of the internal state, and attempt to demonstrate SDL effects through mood manipulation techniques which do not include the use of drugs. In fact, it has been suggested that the effectiveness of drug-related SDL is dependent on the mood-altering properties of certain drugs (Bower, 1981). Drugs with no mood-altering potential are ineffective in SDL studies. (Physostigmine might be considered an exception.)

The study of mood state as a cue in SDL must be distinguished from two other areas of mood-performance assessment. First, many researchers have studied the relationship between mood and quality of performance, typically by manipulating mood and testing concomitant performance on a variety of psychomotor and intellectual tasks. This area of study is generally referred to as the mood-performance hypothesis (good mood yields good performance), and it has been adequately surveyed by Blomkvist (1982).

The other related area of study surrounds what may be called the mood consonance hypothesis. This suggests that material learned in a particular mood is more readily remembered if the material and the mood are consonant. That is, sad stories are more easily remembered if they are learned and/or recalled while the learner is in a sad mood than if he or she is in a happy mood; happy material is better recalled if learned in a happy mood than in a sad mood; and so on.

These two hypotheses-- mood-performance and mood consonance-- are of secondary interest in the present study.

None of the studies to be reviewed here make any qualitative distinction among the terms mood, emotion and affect. Blomkvist (1982) states that there are no useful differences among the terms, and the others simply use them interchangeably. While this appears to be the position taken in mood-state dependent research, it is not accepted universally.

As early as 1908, Titchener was lamenting "the unsettled state of the psychology of feeling" (pp. 4-5). By 1961 things were no better, as Young decried the "confusion and uncertainty about fundamental concepts and definitions" (p. 351). Plutchik (1962) listed 21 definitions of emotion gleaned from the psychological literature, including his own "patterned bodily reaction...brought about by a stimulus" (p. 176). Izard

(1965) agreed with Young that "the present state of our knowledge permits no systematic differentiation" of terms like affect, emotion, feeling, mood and sentiment (p. 19).

Arnold (1960), however, argued that mood differs from emotion in being a response to an extended and continued change in organismic functioning, one which "will persist as long as the change in functioning lasts" (p.78). Nowlis (1965) amplified the idea of mood being extended in time: "The phenomena from which we infer mood have some stability through periods lasting minutes or, at the most, hours" (p. 385). That is, moods occupy temporal spans of moderate duration and influence a large repertoire of behavior and experience.

Candland, Fell, Keen, Leshner, Plutchik and Tarpy (1977) included longer duration as a feature distinguishing moods "from the other <u>types</u> of emotions" (p, 102, emphasis added). Moods also differ in this analysis by the absence of definable precipitating stimuli, and by their diffuse and general nature and lack of focus on people, objects or events.

Wessman (1979) argues that moods are longer-lasting, but less intense than emotions, and agrees with Candland et al (1977) that their origins seem vague.

None of these writers make qualitative distinctions between mood and emotion, so the failure to do so in mood-SDL research seems innocuous. The majority opinion seems to be that moods are somewhat longer-lasting than emotions, enduring at least for several minutes, and it is this feature which is important for research in mood-SDL. The mood must be established and maintained long enough for learning and testing to take place, without being so long-lasting that it resists change to another mood when required by the experiment.

Mood-SDL studies

If we assume, as the experimenters did, that the threat of electrical shock influences a subject's mood, then the first effort in this area appears to be a series of experiments conducted by Macht, Spear and Levis in 1977. They asked subjects to learn a list of words under the threat of electrical shock or with no threat, and then tested recall, again under threat or no threat. This 2 x 2 design is similar to the standard SDL design articulated by Swanson and Kinsbourne, used in Experiment II of the present study. The Macht et al. results offered only tentative support for mood-related SDL, and will not be considered further here.

The first study to deliberately manipulate mood in an

SDL paradigm used the relaxation and eye-closure method of hypnosis (Bower, Monteiro and Gilligan (1978) Subjects were selected for their high scores on the Stanford Hypnotic Susceptibility Scale, producing a bias which limits the generality of their results (Bower, 1981). Further, the excessive compliance of suggestible subjects increases the tenability of a demand characteristic interpretation in certain aspects of these experiments.

Bower et al (1978) conducted three experiments. In the first two, they found no evidence of mood-SDL, due to lack of forgetting, ceiling effects, and paucity of participants.

Since Bower et al attributed the failure of the second experiment to its 2 x 2 design, the third experiment had 24 subjects learn one list of words in each of two mood states, either the same or different, and then attempt to recall both lists in one of the learning moods. This interference design maximized the theoretical value of mood as a cue to recall, since context cues for the two lists were very similar.

The results were as predicted. When subjects were required to recall a list which they had learned in a mood opposite to the test mood, interference was at a maximum for both lists. When tested in the same mood as that prevailing during learning, interference was minimal.

Subjects in the control groups showed intermediate recall scores.

In none of the three experiments was there evidence of a mood consonance effect. That is, "happy subjects were not more likely to recall happy words, and sad subjects were not more likely to recall sad words" (p.576).

The next study to deal specifically with mood-state dependent learning was conducted by Bartlett and Santrock (1979). Working with 32 five-year-old children, one experimenter told three stories, each of which contained six test words-- concrete nouns, such as truck, ball, and squirt gun. Half of the children were told sad stories, and half were told happy stories. The experimenter maintained the corresponding affect throughout her contact with each child. After each story, the child's mood was assessed by showing him or her two stick-figure faces-- one happy, one sad-- and asking, "Does this story make you feel like this or like this?"

Then a second experimenter took over, and induced either the same or the opposite mood by showing either six happy pictures or six sad pictures, and by acting either happy or sad.

Four recall tests followed immediately. The first tested free recall by asking the child to retell the stories. The second test was cued, with the experimenter mentioning the main character in each story and stating the category of the words to be recalled, eg toys. The third test measured recognition by presenting the six target words in a list of twelve words, and asking if each word was from the corresponding story. The fourth test, also of cued recall, was not reported.

Bartlett and Santrock found support for the mood state dependent learning hypothesis only on the free recall test, in accordance with the general results of drug induced SDL studies (cf Eich, Weingartner, Stillman and Gillin, 1975). It is interesting to note that unlike Bower et al, Bartlett and Santrock obtained an SDL effect in a 2 x 2 design with minimal time elapsed between learning and recall. Their subjects were children, and the task was not presented as a memory task: those may explain part of the difference. That is, the ceiling effect which complicated the work of Bower et al (1978) was eliminated in Bartlett and Santrock by the use of naive subjects-- five- year-old children presumably use few mnemonic strategies-- and by the absence of instructions to cue the subject that the material was to be learned.

The third SDL study (Leight and Ellis, 1981) manipulated mood in an SDL experiment using Velten's (1967) mood-induction procedure. They induced either a neutral mood or a depressed mood in each of two groups of 40 female volunteers. Validity of induced mood was assessed using a Depression Adjective Check List (DACL). (It is interesting that this was the first study to verify induced mood with a mood adjective check list, the traditional means of assessing mood).

In the induced mood, subjects were presented with a series of eight 6-letter groupings (hexagrams). After asking the subjects to remember as much as possible for a later written recall test, the experimenter presented the list visually, one hexagram at a time, at the rate of two seconds per hexagram. The list was presented four times, followed by a written recall test. This procedure--four presentations followed by one recall-- was repeated four more times, to comprise the learning phase.

In addition to the mood manipulation, Leight and Ellis also manipulated the way in which the letters were grouped within each hexagram. One-half of the subjects in each mood group received the list with the size of the letter groupings constant from hexagram to hexagram (eg BO NK ID; RE PG ON). The rest of the subjects received the list with the size of the letter groupings varied from hexagram to hexagram (eg B ONK ID; REP GON). The former represents constant input; the latter, varied input.

Twenty-four hours later, subjects were put into either the same or the opposite mood and tested, first in free recall, and then in a multiple-choice recognition test.

Depressed mood had a negative effect on simple recall overall, but no SDL effect was found. The only SDL-like effect obtained was for the constant-input subjects, and only on the recognition test!

Leight and Ellis argue that the constant-input task was actually harder to learn, and thus more likely to show an SDL effect than the varied-input task. They also announce that they have demonstrated an SDL effect for recognition, an apparent addition to previous knowledge, while ignoring the fact that their failure to find SDL on the recall task while finding it on recognition is contrary to earlier research results. Their results must be held tenuously, especially as they interact with the type of input (constant vs varied).

It may be that mood as a cue to recall is rather low on a hierarchy of cues, and that it is likely to be most influential in the absence of such higher-level cues as experimenter-provided associates or overlearned associations. Bower's (1981) network theory of state dependent retrieval incorporates this idea.

Published in the same year, Leight and Ellis were not cited by Bower, and their contradictory result is difficult to integrate with previous research and theory. It may be that the learning task in Leight and Ellis was so short that a floor effect was produced. With only eight items to recall, the mean number of items remembered by the constant-input groups was 1.7 (range 1.1 to 2.8). A longer list might facilitate higher recall scores, with room for recall to be inhibited by a dissonant mood state. On the recognition task, mean recall for the constant-input group was 6.1, and the range of 4.5 to 7.0 indicated greater variability of recall across the four groups. It was on precisely this task for these subjects that an SDL effect was found. Thus, I suggest that Leight and Ellis's failure to find SDL in free recall was a function of limited room to vary: a floor effect on a too-short recall learning task. The task was long enough for a recognition memory task, and Leight and Ellis's finding of an SDL effect here may be important.

Summary

It seems, then, that it is possible to find an SDL-like effect by manipulating mood states. That effect is more likely to be found in situations where other cues to recall are of little value, as is commonly the case in free recall tasks. It is also apparent that the task must be of sufficient difficulty that it is not overlearned, and sufficiently long so that scores on recall are well above zero.

It also appears that mood consonance effects--increased recall of emotionally- linked material which is consistent or compatible with the mood state-- are real and must be controlled. One way to do this is to counterbalance the emotional association value of the stimuli, as Bower et al (1978) did in each of their experiments. Another approach would be to minimize the mood consonance effect by using stimuli with low emotional association value, the approach used in the second and third experiments here.

## The Present Study

With these principles in mind, the current study was designed to induce moods and test for a mood-state dependent learning effect on a task which 1) was hard enough to eliminate overlearning, 2) was long enough and easy enough to avoid a floor effect, and 3) eliminated the potentially confounding variable of mood consonance. (The possibility that increased recallability of material consonant with the mood of learning might interfere with the SDL effect was controlled in experiments II and III by using stimuli with low emotional association value.)

The mood manipulation procedure chosen was that of Velten (1967). This procedure has been used in mood-state dependent learning studies (Leight and Ellis, 1981), and it avoids some of the problems faced by other techniques. Unlike hypnosis, it is effective with most subjects. Unlike the story-face technique of Bartlett and Santrock, it is well-validated (Velten, 1968; Leight and Ellis, 1981). In addition, it is potentially multi-dimensional (Velten, 1968), which is important in the light of criticism of mood studies as being overly unidimensional--see, for example, Polivy (1981).

The Velten statements--60 designed to produce depressed mood, 60 elated, and 60 neutral--are read silently and then aloud, and serve as stimuli to direct and help the participant to establish the desired mood. The statements are self- referent, and are arranged progressively from mild emotional content, like "I feel a little low today", to profound depression or high elation, like "I want to go to sleep and never wake up" or "I feel great!"

The success of this technique in producing the appropriate affect was demonstrated by Velten (1967, 1968). It has since been confirmed in SDL studies by

Leight and Ellis (1981) and by Bower (1984); and in mood-congruence studies by Natale and Hantas (1982) and by Teasdale and Fogarty (1979).

The Velten procedure offers three directions of mood influence. Mood may be elated, depressed, or held neutral. In order to simplify their design, Leight and Ellis chose only two of these: depressed and neutral. As they observed in their general discussion, the neutral state was a poor choice. Lacking distinctiveness, it was not an effective cue in the learning phase. Consequently, when subjects who had learned in a neutral state were tested in a depressed state, no deficit was observed. For example, neutral learn-neutral test yielded a recognition score of 7.0, while neutral learn-depressed test yielded a score of 6.9 . As Leight and Ellis put it, "A neutral mood during training...did not provide a state distinctive enough to function effectively as a retrieval cue during the retention test" (p. 264). To minimize this potential problem, the present study used the mood-depressing and mood-elating statements of Velten.

Of course, it is still possible that the two moods--elation and depression-- differ in intensity or salience, a point which will be addressed as the results of the experiment are discussed.

In the learning phases of the present study, subjects were given either the mood- elating or the mood-depressing statements; in the recall phase, they were given either the same set of statements or the other set. Any SDL effect would appear as a difference in recall between same-set subjects and different-set subjects, with the different-set subjects scoring more poorly.

As a manipulation check, the Howarth Mood Adjective Check List (HMACL4, Howarth, 1982a) was administered following each set of mood statements. The HMACL4 scores also provided the necessary data to investigate the multidimensionality of mood-state influences using point-biserial correlation between mood manipulation and the multidimensional mood instrument.

Further, multidimensional mood assessment made possible at least a partial answer to Polivy's (1981) criticism of laboratory mood manipulation studies. She states that "The evidence seems to indicate that, in general, arousing one emotion (at least in the laboratory) may actually result in changes in several emotions" (p. 805). (Polivy uses emotion, affect and mood interchangeably).

Since the Velten procedure was verbal, a verbal learning task might yield confounding interactions. Consequently, a verbal learning first experiment was followed by two experiments using non-verbal learning stimuli (line drawings of simple figures not commonly seen, judged to be of low emotional association value).

Experiment I was similar in design to the successful third experiment of Bower et al (1978), substituting Velten's mood-manipulation procedure for the hypnotic techniques used by Bower et al.

Experiment II was similar in design to the second experiment of Bower et al, to Bartlett and Santrock, and to Leight and Ellis in its 2 x 2 structure, summarized in Table 1.

Table 1. Design and predicted levels of recall, experiment II.

| | Mood During Learning | |
|---|---|---|
| Recall Mood | Elated | Depressed |
| Elated | High | Low |
| Depressed | Low | High |

However, unlike Bower et al (1978), experiments I and II used a sufficient number of subjects (10 per cell) to yield adequate statistical power; unlike Leight and Ellis (1981) they used only the salient independent variable of mood; and unlike Bartlett and Santrock (1979), they used the same mood manipulation procedure for both learning and recall sessions.

Experiment III was designed to replicate the finding of Bower et al (1978) that SDL-like effects were more likely to be found in a multilist learning situation, where context cues were less reliable and mood cues therefore of greater relative importance. While the design in experiment III replicated that of Bower et al's experiment III, the mood manipulation, manipulation check, and learning tasks were considered more adequate to a pure test of the SDL hypothesis, as already argued.

Finally, to give Leight and Ellis's (1981) finding of an SDL effect in recognition due consideration, the free recall test in each experiment was followed by a multiple-choice recognition test.

Predictions.

1. Material learned in a particular mood state will be more frequently recalled when recall is tested in a similar mood state than when it is tested in a different mood state (SDL). This will be assessed by a directional t-test comparing same-mood with changed-mood groups, and by the interaction of learning and recall mood effects in a 2 x 2 ANOVA design.

2. Material learned under elated mood conditions will

be more frequently recalled than that learned under depressed mood conditions (main effect for mood of learning).

3. Recall under depressed mood conditions will be poorer than recall under elated mood conditions (main effect for mood of recall).

4. If Bower's (1981) network theory of state-dependent retrieval is correct, any SDL effect on the recognition tests should be much smaller than that found on the free recall tests.

5. Similarity of assessed mood on the HMACL4 between learning and testing phases should correlate significantly with measures of recall, and to a lesser extent, recognition.

6. In the design used in experiments I and III, three levels of interference are predicted. Interference includes intrusions of material from one list or set into the recall of the other, and recall of extraneous material from without the experiment. Minimum interference is predicted when recall mood is the same as the target list learning mood but different from the other list learning mood (eg EDD for list 2). Intermediate interference is predicted when the mood information is the same for learning and recall of both lists (EEE and DDD). That is,

the re-establishment of the target list learning mood at recall also facilitates recall of the other list, increasing the number of intrusions. Maximum interference is predicted when the recall mood is the same as the other list learning mood, but different from the target list learning mood (eg DED for list 2).

7. The same pattern of overall interference effects are predicted for intrusion errors. The greatest number of intrusions from the other list into recall for the target list will be found when the recall mood duplicates the other list learning mood but not the target list learning mood. The fewest intrusions from the other list into recall for the target list will be found when recall mood duplicates the target list learning mood but not the other list learning mood. If the recall mood matches the learning mood of both lists, intrusion error frequency will be intermediate.

Intrusion errors are expected according to the network theory, since the mood cue will activate all material associated with it, namely, all material learned in that mood state. To the extent that that material is also activated by the context cues, then it will be recalled while attempting to recall other material from the context activation. If that material is from the wrong list, then it will intrude upon recall of the correct list to the extent that it cannot be suppressed by more accurate recall. Thus, where learning is poor, intrusions will be more likely. When the recall mood for the target list is dissonant with the learning mood for the target list, then recall will suffer the absence of appropriate mood-cue activation. The context cue, by activating all material learned in that context, will activate the other list material, and that will summate with the activation produced by the mood cue, yielding increased recall of material from the wrong list.

8. In experiment I, half of the words to be learned are happy and half are sad. Happy words, if recognized and intentionally processed as happy, will be consonant with an elated mood. Thus, participants learning words in an elated mood will concentrate more on the happy words than on the sad words, in an attempt to maintain the elated mood. Likewise, at recall, subjects who are elated will be more likely to recall happy words than sad words, and especially so if they learned them in an elated mood. The greatest recall of happy words, then, will be found among participants who learn and recall in an elated mood. If the mood is elated only at learning or recall, then recall of happy words will be poorer than if mood is elated both times. If the mood is depressed both times, no special processing advantage is accorded to the happy words, and their recall will be poorest.

Sad words, if recognized and intentionally processed as sad, will be consonant with a depressed mood. While subjects are not likely to focus on sad words in an attempt to maintain a depressed mood, it has been repeatedly shown (Madigan and Bollenbach, 1982; Snyder and White, 1982; Nasby and Yando, 1982; Laird, Wagener, Halal and Szegda, 1982; Bower, Gilligan and Monteiro, 1981; Teasdale, Taylor and Fogarty, 1980) that sad material is more likely to be recalled in a depressed mood than is happy material, and that the mood during encoding is a significant factor in this effect (Snyder and White, 1982). Consequently, it is predicted that mood-consonance effects for sad words and depressed moods will parallel those predicted for happy words and elated moods: greatest recall of sad words if both learning and recall moods are depressed; poorer recall of sad words if only one of the moods is depressed; and poorest recall of sad words if both learning and recall are done in elated moods.

All of this (prediction 8) presupposes that subjects recognize the words as happy or sad and intentionally record the affect of the words in the semantic coding process. If the affect-value of the words is not recognized or is processed incidentally, mood-consonance effects are not likely to be found.

## Experiment I

### Method

Subjects. Sixty female undergraduate students, aged 18 to 22, were recruited from the introductory psychology classes at Houghton College and assigned at random to one of six experimental groups, resulting in ten women per group. Each woman received course credit for participating in the experiment.

Apparatus and Materials. Two Sony cassette tape recorders, model TC-60A; two 16-word lists of abstract words (rated between 2.0 and 3.0 on concreteness in Paivio, Yuille and Madigan, 1968). In each list, half of the words were "happy", and half were "sad". Rating of the words as happy or sad was done *a priori* by the experimenter, following Bower et al (1978). All words which fit the concreteness criterion were abstracted from Paivio et al (1968), and these were further selected to have a frequency of greater than five per million by the Thorndike-Lorge count. The resulting words were classified as happy, sad or affectively neutral by trichotomous judgment of the affect value of the face meaning of the words. Sixteen of the happy words and sixteen of the sad words were then selected and assigned to lists at random. These word lists were randomly designated as list A and list B. Examination of the resulting lists showed them to be similar to those used by Bower et al (1978). The deletion of low frequency words (less than five per million) was an attempted improvement in the present study. The lists are presented in Appendix A. Also used were the Howarth Mood Adjective Check List (HMACL4); the elation and depression mood statements from Velten (1967); and a multiple-choice word-recognition task. On the word-recognition tests, each of the 16 words of a particular list was combined with three distractors was determined randomly in each case. One of the distractors was a correct word from the other list. The other distractors were similar to the correct responses in concreteness (between 2.0 and 3.0 in Paivio et al, 1968), with an equal number of words being "happy" and "sad", over the whole test. Twenty of the distractors were neutral in affective tone. The use of neutral words was made necessary by the limited number of happy and sad words with concreteness ratings between 2.0 and 3.0 .

Procedure: Participants were brought individually into the room and seated at a table in a swivel-type office chair. On the table were one copy of the HMACL4 and a sharpened pencil. Each person was immediately informed that "the purpose of this study is to learn something about your feelings and reactions. However, you will not be subject to any painful or uncomfortable experiences." As Howarth and Schokman-Gates (1982) observed, such a disclaimer is an important precaution to alleviate mood-altering tension induced by expectations about the experimental procedure. The experimenter then continued,

> In this study, you will be asked to answer a questionnaire several times, and you will also be asked to memorize some simple words. I emphasize that your participation here is voluntary, and any information you give will be held in confidence. Are you willing to proceed with the study?

If the student agreed to participate, she was asked to sign a consent form. (A copy of the consent form appears as Appendix B.) She was then asked to complete one copy of the HMACL4, with these and all following instructions presented by a tape recording of the experimenter's voice. The script of the instructions for this experiment appears in appendix C.

Upon completing the HMACL4, subjects were given the instructions for the Velten procedure, followed by either the elating or the depressing statements. Then, after being asked to maintain the induced mood, they filled out a second HMACL4. This completed the first mood manipulation.

The participants were then instructed on the word learning task, and the first list of words was presented by tape recording, twice through in different orders, at the rate of one word every three seconds. This was followed by a recall test, and by a second study-recall cycle with the same words in new random orders. The recall scores on this second cycle were considered to be the original learning scores for list 1 (OL1 in table 3).

After a minute's rest, a second set of Velten statements was administered using the same instructions. One-half of the subjects read the same mood statements as on the first administration, and one-half read the opposite mood statements. Thus, in the learning phases, four groups were established: elated-elated, elated-depressed, depressed-elated, and depressed-depressed.

The subjects were instructed to try to maintain the mood, and the HMACL4 was administered. The second list of words was then presented, using the same procedure as was followed for the first list. Recall scores for the second cycle were recorded as original learning scores for list two (OL2 in table 3). This completed the learning phase of the experiment.

After an eight-minute interpolation task (described in Appendix C), the Velten procedure was used a third time. One-half of the subjects received the same mood statements as they had for learning the first list and one-half received the same statements as they had for learning the second list. This produced the six experimental groups presented in table 2. (The other two possible groups, Elated- Elated- Depressed and Depressed- Depressed- Elated, have the subject trying to recall in a mood which was not used during the learning of either list, which is outside the purview of this study.)

Again, the subjects were instructed to maintain the mood, and were tested on the HMACL4.

Table 2. The six experimental groups of experiment I.

| Induced Mood State | | |
|---|---|---|
| Learn List 1 | Learn List 2 | Posttest |
| Elated | Depressed | Depressed |
| Depressed | Elated | Elated |
| Elated | Elated | Elated |
| Depressed | Depressed | Depressed |
| Elated | Depressed | Elated |
| Depressed | Elated | Depressed |

Two free-recall tests followed, one for each list, with list order counterbalanced. Three minutes were allowed for each list, and the responses were recorded as the posttest recall scores (PR in table 3).

Finally, a multiple-choice word-recognition test was given for each list, with the order of the two tests counterbalanced across subjects. Three minutes were allowed for each test.

After both tests had been completed, the Velten elated-mood statements were given once more. The purpose of the experiment was explained, and all questions were answered frankly. The subject was then thanked and excused. The debriefing script appears in appendix C.

## Results

In discussing the results of these experiments, effects will be examined as they fall in two ranges: Those which meet traditional significance criteria, with p less than or equal to .05; and those with slightly higher p-values, the nearly significant.

Statistical analyses were done using Biomedical Computer Programs P-series programs 2V and 8D (Dixon and Brown, 1979), revised December, 1979. These programs were developed at the Health Sciences Computing Facility, UCLA, which was sponsored by NIH Special Resources Grant RR-3.

### Recall

Average recall scores (group means) at the point of original learning of each list and at the time of the recall posttest are reported in table 3. Retention or recall scores are also presented as the percentage of original learning recalled at posttest (retention % = posttest score /original learning score x 100).

Table 3. Original learning (OL), posttest recall (PR), and retention percentage (%) scores for the six groups on the two word lists. List 1 scores are for the list which was presented first, and list 2 scores are for the list which was presented second.

| | List 1 | | | List 2 | | |
|---|---|---|---|---|---|---|
| Group | OL | PR | % | OL | PR | % |
| DEE | 10.3 | 3.6 | 35.4 | 10.1 | 8.0 | 79.5 |
| EDD | 10.5 | 4.9 | 47.7 | 8.7 | 6.9 | 81.0 |
| DDD | 11.1 | 5.7 | 48.7 | 9.3 | 8.0 | 85.7 |
| EEE | 11.4 | 4.7 | 40.4 | 9.3 | 7.4 | 80.0 |
| DED | 11.4 | 5.1 | 44.6 | 11.0 | 9.8 | 85.6 |
| EDE | 10.9 | 4.4 | 38.3 | 9.9 | 7.7 | 77.6 |

Difference in recall for the two list positions was assessed by an analysis of variance on the percentage recall scores (arc sine transformations). The obtained $F$ $(1,59)$ of 120.93 ($p = .0001$) was significant, with the second list (mean = 7.97) being recalled better than the first list (mean = 4.73). Consequently, the two lists were considered separately.

SDL in recall

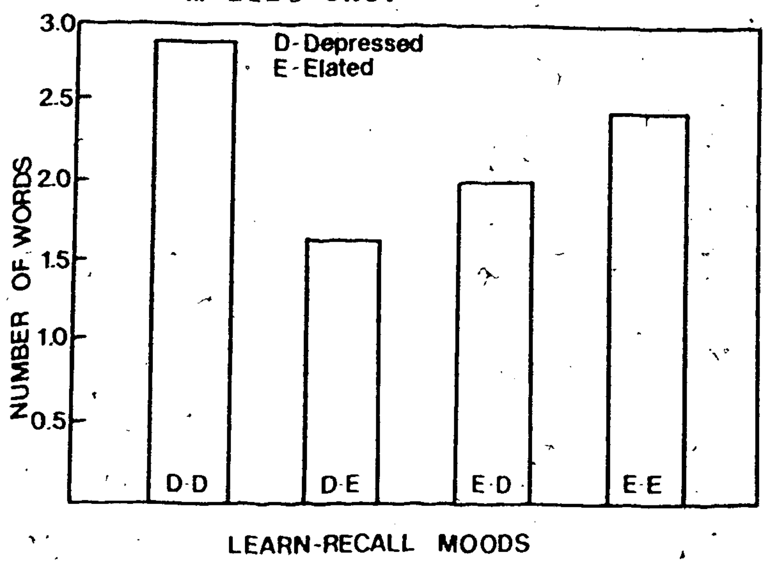
To test the SDL hypothesis, separate 2 x 3 analyses of variance were done on the two lists, with two levels of mood of learning the particular list, and three levels of predicted interference. No significant or nearly significant main effects or interactions were found.

Two further analyses of variance were done on these data, this time crossing predicted level of interference with mood of recall rather than mood of learning. Again, none of the main effects were significant, nor were the interactions. However, for the first list, mood of recall produced an effect which approached significance ($F(1, 54) = 3.13$, $p = .08$). The difference in means, however, was in the direction opposite to that hypothesized, with the mean recall score for depressed mood of recall (47%) being higher than the mean score for elated mood of recall (38%). The means for the second list differed in the same direction--depressed recall mean was 84% and elated recall mean was 79%. This will be considered further as it relates to the mood-performance hypothesis.

In a third series of analyses, the mood of learning a particular list was crossed with the mood during recall of that same list, in a 2 x 2 factorial design. For analyses of each of the two lists, recall scores were divided into happy and sad words recalled. For happy words recalled from the first list, the SDL-interaction of mood of learning and mood of recall yielded an $F$ ratio of 2.91 ($df = 1,56$; $p = .09$).

The mean differences were in directions which supported an SDL hypothesis. They are plotted in figure 2.

Figure 2. Interaction of mood of learning and mood of recall, effect on number of happy words recalled from list one.




Recognition

Average recognition test scores (group means) for each list are presented in table 4, subdivided into happy and sad words recognized.

Table 4. Recognition test scores for each list.

| | List 1 | | | List 2 | | |
|---|---|---|---|---|---|---|
| Group | Happy | Sad | Total | Happy | Sad | Total |
| DEE | 5.9 | 5.8 | 11.7 | 5.9 | 4.7 | 10.6 |
| EDD | 5.2 | 5.7 | 10.9 | 5.2 | 5.1 | 10.3 |
| DDD | 6.4 | 6.5 | 12.9 | 6.2 | 6.2 | 12.4 |
| EEE | 6.0 | 6.7 | 12.7 | 6.2 | 5.4 | 11.6 |
| DED | 6.9 | 6.5 | 13.4 | 6.1 | 6.2 | 12.3 |
| EDE | 5.8 | 6.2 | 12.0 | 5.2 | 5.7 | 10.9 |

Differences in recognition for the two lists were assessed by analyses of variance on happy words recognized, sad words recognized, and total words recognized.

While there was no significant effect of list position in the recognition of happy words, list position did affect recognition of sad words (F (1,59) = 8.14, p = .01) and total words (f (1,59) = 9.90, p = .01).

What is interesting is that in both cases, the first list was recognized better than the second list, an effect opposite to that found for recall.

For sad words recognized, the mean for the first list was 6.23, while that for the second list was 5.55. For total words recognized, the first list mean was 12.27, and the second list [illegible]as 11.35. Furthermore, the means for happy wor[illegible] rec[illegible]d, while not significantly different, varied i[illegible]the s[illegible]e manner-- first list mean was 6.03, and second lis[illegible] mea[illegible] was 5.92.

SDL in [illegible]cognition

To test [illegible]e SDL hypothesis for recognition scores, separate 3 [illegible] 2 analyses of variance were done on recognition sco[illegible]es for happy words, sad wo[illegible] and total words for each of the two lists.

First list. F[illegible] ecognition of happy words, the main effect of mood of learning was significant at the .05 level ($F(1,54) = 4.13$). Examination of the means showed that depressed mood of learning (mean = 6.4) produced recognition scores higher than elated mood of learning (mean = 5.7), an effect opposite in direction to that hypothesized.

For recognition of sad words, neither the main effects nor the interaction were significant at the .05 level.

For total words recognized, neither the main effects nor the interaction were significant at the .05 level. However, the F-ratio for predicted level of interference approached significance ($F(2, 54) = 2.75$, $p = .07$), with the maximum predicted interference group showing the greatest interference.

The mean for the maximum predicted interference group was 11.3, that for the intermediate group was 12.8, and that for the minimum group was 12.7.

Accordingly, the means were compared using Duncan's multiple range test, with alpha set at .05. The results are presented in table 5.

Table 5. Results of Duncan's multiple range test on total recognition scores for the first list, comparing groups on the basis of predicted level of interference. For the purpose of Duncan's test, A represents the maximum predicted interference group, B the intermediate group, and C the minimum group.

| Group | Means | B | C | Shortest Significant Ranges |
|---|---|---|---|---|
| A | 11.3 | 1.5 | 1.4 | R2 = 1.506 |
| B | 12.8 | | 0.1 | R3 = 1.431 |
| C | 12.7 | | | |

It can be seen that the differences between the maximum predicted interference group and each of the intermediate and minimum interference groups were in the hypothesized direction, and were very close to being significant. The difference between the intermediate and minimum groups was not significant.

Second list. No significant differences were found for number of happy words, sad words, or total words recalled from the second list. However, in recognition of sad words from the second list, the main effect of predicted level of interference approached significance ($F(2, 54) = 2.51$, $p = .09$). The mean differences were in a direction opposite to that hypothesized. The minimum interference group had a mean of 4.90, the intermediate group a mean of 5.80, and the maximum group had a mean of 5.95. The results of Duncan's multiple range test, with alpha set at .05, are summarized in table 6.

Table 6. Duncan's multiple range test on recognition of sad words from the second list, grouped by predicted level of interference. A represents the maximum predicted interference group, B the intermediate group, and C the minimum group.

| Group | Means | B | C | Shortest Significant Ranges |
|---|---|---|---|---|
| A | 5.95 | .15 | .90 | R2 = 1.014 |
| B | 5.80 | | .90 | R3 = 1.067 |
| C | 4.90 | | | |

The difference between the minimum predicted interference group and the maximum predicted interference group was very close to being significant, but, as already mentioned, it was in the direction opposite to that hypothesized: those subjects for whom maximum interference was predicted actually recognized more of the sad words in the second list than did those for whom minimum interference was predicted. The other pairwise comparisons did not approach significance.

The preceding six analyses of variance (three on each word list) were repeated substituting mood during recall for mood during learning. No significant or near-significant effects were found for mood of recall or its interaction with predicted level of interference.

Intrusions

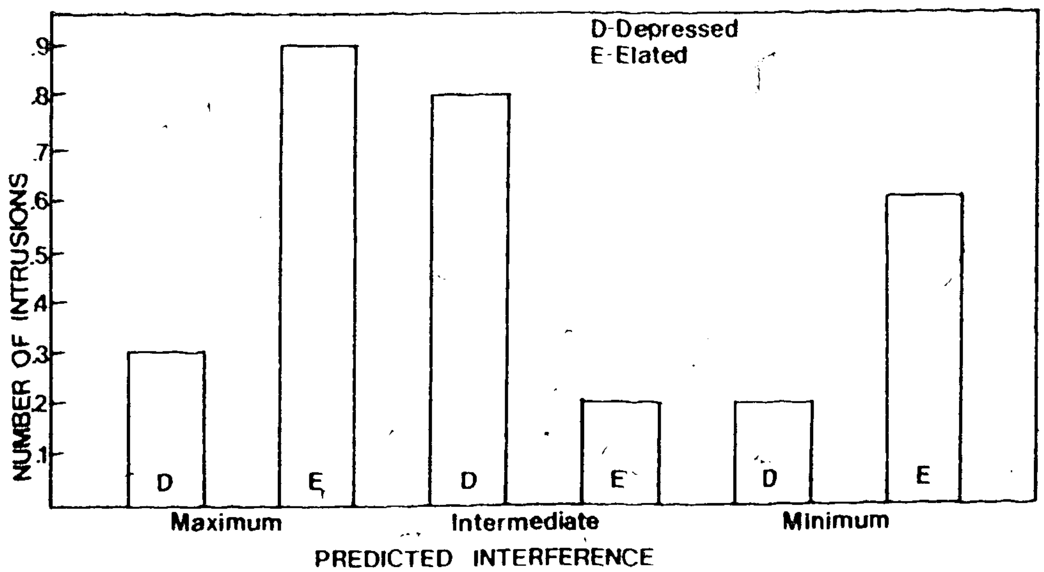
In addition to the recall and recognition scores surveyed already, the number of intrusions from one list into the other in both recall and recognition tests were determined. A word was considered to be an intrusion if it was given in the wrong list without also being given in its correct list--thus, duplicates which were a product of guessing were not counted as intrusions.

3 x 2 analysis.

First, twelve analyses of variance were done, each crossing the level of predicted interference with the mood during recall, testing for effects in intrusions into recall or recognition of sad, happy, and total words for both lists. Significant or near-significant effects were found for the number of happy words from list one intruding in the recall of list two; the number of happy words from list two intruding in the recognition of list one; the number of sad words from list two intruding in the recognition of list one; the total number of words from list two intruding in recognition of list one; and the number of sad words from list one intruding in recognition of list two. These effects are summarized below.

Recall. The only significant intrusion effect in the recall tests was the interaction of predicted level of interference with the mood of recall for happy words intruding in recall of list two ($F$ (2,54) = 3.47, $p$ = .04). The interaction is plotted in figure 3.

Figure 3. Interaction of predicted level of interference and mood of recall, effect on intrusions of list one happy words into recall of list two.




Those who attempted to recall list two in an elated mood had more intrusions of list one happy words than those who recalled in a depressed mood if the mood was switched between the learning of the two lists (groups EDE and DEE were better than groups DED and EDD). However, if the mood remained constant throughout the experiment (groups DDD and EEE), those who recalled in a depressed mood showed more intrusions than those who recalled in an elated mood.

Recognition. In the recognition tests for list one words, happy words from list two intruded more frequently in the direction which supported the SDL hypothesis (F

(2,54) = 3.77, p = .03).

Duncan's multiple range test was applied to the mèan differences in predicted level of interference, with alpha set at .05. The difference between the minimum and maximum interference groups was significant, with the minimum mean of .35 being lower than the maximum mean of 1.10. The results are summarized in table 7.

Table 7. Duncan's multiple range test on intrusions of list two happy words into recognition testing for list one, grouped by predicted level of interference. A represents the maximum predicted interference group, B the intermediate group, and C the minimum group.

| Group | Means | B | C | Shortest Significant Ranges |
|---|---|---|---|---|
| A | 1.10 | .40 | .75 | R2 = .546 |
| B | .70 | | .35 | R3 = .574 |
| C | .35 | | | |

The differences between the intermediate predicted interference group and each of the maximum and minimum groups were not significant.

The number of intrusions of sad words from list two into the recognition of list one was affected by mood of test to an extent which approached significance (F (2,54)

= 3.56, p = .06).

The nearly significant effect of mood of test was such that those tested in an elated mood (mean = .93) showed more intrusions than those tested in a depressed mood (mean = .50), an effect which might be considered consonant with the mood-performance hypothesis to be discussed later.

The total number of words from list two which intruded into list one recognition test results was significantly affected by the predicted level of interference, in a manner which supported the SDL hypothesis (F (2,54) = 3.55, p = .04).

Duncan's multiple range test showed that the maximum predicted interference group showed significantly more intrusions than the minimum predicted interference group. Differences between the intermediate group and each of the maximum and minimum groups were non-significant. The results are summarized in table 8.

Table 8. Duncan's multiple range test on intrusions of list two words into the recognition test results for list one, grouped by predicted level of interference. A represents maximum predicted interference, B represents intermediate interference, and C represents minimum interference.

| Group | Means | B | C | Shortest Significant Ranges |
|---|---|---|---|---|
| A | 1.95 | .50 | 1.05 | R2 = .789 |
| B | 1.45 | | .55 | R3 = .830 |
| C | .90 | | | |

Finally, the number of intrusions of sad list one words into the recognition testing for list two showed a significant effect of predicted level of interference ($F(2,54) = 3.72$, $p = .03$).

Duncan's multiple range test showed significant pairwise differences between the minimum predicted interference group (mean = .9) and each of the intermediate (mean = .4) and maximum (mean = .4) groups, alpha = .05. The intermediate and maximum groups did not differ. The results of Duncan's multiple range test are summarized in table 9. Note, however, that the direction is opposite to that predicted.

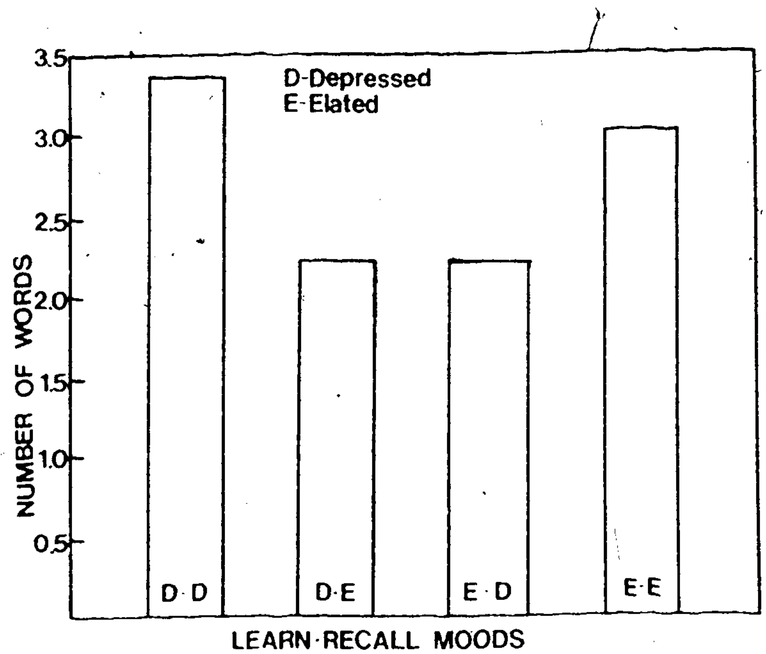
Table 9. Duncan's multiple range test on intrusion of sad words from list one in the recognition test results for list two. A represents maximum predicted interference, B represents intermediate predicted interference, and C represents minimum predicted interference.

| Group | Means | B | C | Shortest Significant Ranges |
|---|---|---|---|---|
| A | .4 | 0 | .5 | R2 = .424 |
| B | .4 | | .5 | R3 = .446 |
| C | .9 | | | |

MMFR scores. To test for interactions between mood of learning and mood of recall, which would indicate an SDL effect, 2 x 2 analyses of variance were also conducted on the total number of words recalled, which was the sum of the words correctly recalled from a list plus the intrusions from that list into the recall of the other list. This scoring procedure makes these recall scores analogous to those obtained in a multi-list, multi-mood free recall experiment (the MMFR test, Schare, M.L., Lisman, S.A. and Spear, N.E., 1983; Bower, 1984).

An SDL effect using the MMFR scoring procedure was close to being significant for happy words from list one. The obtained F-ratio for the interaction of mood of learning and mood of recall was 3.74 (1,56 df; p = .06). The interaction is presented graphically in figure 4.

Figure 4. Interaction of mood of learning and mood of recall; total number of happy words recalled from list one in either recall attempt.




It can be seen that more words were recalled under MMFR conditions if learning and recall took place under the same mood than if they took place under different moods.

For sad words on the first list and for sad or happy words on the second list, no SDL effect was found using MMFR scores.

Mood consonance.

To test the hypothesis that happy words will be recalled better in a happy mood and sad words better in a sad mood, a variety of analyses were done. First, original learning scores were divided into happy and sad scores, and the mood of learning the first list was crossed with the mood of learning the second list in 2 x 2 analyses of variance. A significant effect was found for the second list, but none were found for the first list.

For the original learning scores (OL in table 3) of happy words from list two, mood of learning the second list produced a significant effect ($F(1, 56) = 6.31$, $p = .01$). People who were in an elated mood showed higher original learning scores for happy words than did those who were in a depressed mood (mean of 5.43 and 4.37, respectively).

So, in the original learning of the second list, an elated mood led to greater learning of happy words. To see if this effect carried over into recall, a second set of analyses of variance was done on happy and sad words from each list during recall. This time, two levels of mood of learning the list were crossed with two levels of mood of recall of the particular list, in a 2 x 2 design.

Again, a significant effect of mood of learning was found for happy words recalled from list two ($F(1, 56) = 6.15$, $p = .02$). The depressed-while-learning group recalled an average of 3.47 happy words at posttest, while the elated-while-learning group recalled an average of 4.60 happy words.

In addition, for sad words recalled from list one, the effect of mood of recall produced an effect that approached significance and in a direction which was consonant with the mood-congruence hypothesis ($F(1,56) = 3.35$, $p = .07$). The mean number of sad words recalled in the depressed condition was 2.67, and the mean in the elated condition was 2.07 .

Using MMFR scoring, more happy words from the second list were recalled if the mood of learning had been elated (mean = 4.93) than if the mood of learning had been depressed (mean = 4.03), providing further support for the mood- congruence hypothesis ($F(1,56) = 3.90$, $p = .05$).

No significant mood effects were found for recall of happy words list one, or for recall of sad words from list two.

Mood performance

The hypothesis that performance is generally better if learning takes place in a good (elated) mood rather than a bad (depressed) mood was tested by comparing the mood of learning effect on total number or words learned during each learning phase.

No signific effect was found for learning scores on the first , but on the second list, the total number of words recalled in the first learning phase was significantly higher for the elated group (mean = 7.53) than for the depressed group (mean = 6.30; F(1, 56) = 4.35, p = .04).

This effect had disappeared by the time of the second phase of learning the second list. In the recall phase, a mood-performance effect was suggested by the analysis of first list percentage recall, arcsine transformations, mentioned on page 27. The effect of mood of recall on total recall produced an F ratio (1, 54) of 3.13, p = .08. As mentioned earlier, the difference in the means was in a direction opposite to that hypothesized, with a depressed recall group mean of 47% and an elated recall group mean of 38%.

Mood manipulation.

Point biserial correlation coefficients were calculated between the Velten mood induction procedure used and the HMACL4 scale scores (table 10).

Table 10. Point-biserial correlation coefficients, Velten mood induction by corresponding HMACL4 scores. Positive coefficients indicate a direct relationship with elation mood induction, negative coefficients indicate a positive relationship with depression mood induction.

| | List 1 Mood | List 2 Mood | Recall Mood |
|---|---|---|---|
| UP MOODS | | | |
| CN | .53 | .70 | .71 |
| CO | .47 | .59 | .61 |
| PT | .49 | .61 | .58 |
| OP | .58 | .69 | .70 |
| DOWN MOODS | | | |
| SL | -.65 | -.70 | -.81 |
| DP | -.57 | -.62 | -.72 |
| AG | -.46 | -.38 | -.50 |
| SC | -.37 | -.39 | -.38 |
| AX | -.28 | -.31 | -.28 |
| NEUTRAL | | | |
| CL | -.03 | .27 | .05 |

It is apparent that the mood-induction procedures were consistently successful when we examine the up-mood scales [illegible] (concentration), CO (cooperation), PT (pote[illegible] (optimism); and the down-mood scales like [illegible] SL (sleepiness), and AG (anger).

Goodness-of-fit scores were then obtained by comparing, between mood of learning a particular list and mood of recall, the four HMACL4 scales which showed the pattern of highest correlation with the Velten procedure (CN, DP, SL, and OP). The differences between the corresponding scale scores at learning and at recall were determined for each list, and the four difference scores were summed to provide a goodness-of-fit index. The more similar the HMACL4 scores on the two tasks, the lower the index would be.

Then, the goodness-of-fit scores for each list were correlated with the corresponding recognition and recall scores, with significant negative coefficients of correlation indicating support for an SDL effect. That is, the lower the goodness-of-fit score, the greater the similarity between the two moods; and the greater the similarity between the two moods, the greater the recall or recognition scores were predicted to be.

The resulting correlations provided no evidence of the hypothesized effect in recall. Only two coefficients were significant: goodness-of-fit and recall of happy words from the second list ($r = .31$), and between goodness- of-fit and total recall (MMFR scoring) of happy words from the second list ($r = .29$), and both of these were in the direction opposite to that hypothesized.

For recognition scores, the correlation between goodness-of-fit and sad words recognized from the first list was a significant -.27. All other correlations were non-significant.

It appears, then, that the goodness-of-fit scoring procedure yielded no additional support for the SDL hypothesis.

## Discussion

SDL in recall.

Support for the SDL hypothesis in recall in this experiment was exceedingly weak. The only area in which an SDL effect in accurate recall was indicated was for the number of happy words recalled from the first list (figure 2).

When the results were analyzed for intrusions and MMFR, the SDL hypothesis in recall fared only slightly better. The number of words from each list incorrectly recalled in the test for the other list--the intrusions--did not show a pattern which supported the SDL effect. Only for the MMFR score--intrusions plus accurate recall--was SDL evident (figure 4). Here, more happy words from the first list were reproduced overall if the learning and testing took place in the same mood than if they took place in a different mood, at a probability level of .06.

The general failure to find an SDL effect in what was in large measure a replication of Bower et al (1978) is problematic. A number of reasons may be suggested.

First, it has been noted in past research that a ceiling effect due to overlearning may mitigate an SDL effect (Bower et al, 1978; Swanson and Kinsbourne, 1979;

Baddeley, 1982a, 1982b; Cermak and Reale, 1978). Table 3, however, indicates that neither ceiling nor floor effects were active in the present experiment: number of words learned ranged (across groups) from 8.7 to 11.4, and recall percentages varied from 35.4 to 85.7. So, while the word lists used here were not exactly the same as those used by Bower et al (1978)--there was major overlap, see appendix A--the learning and recall scores were very similar.

A second reason might be that the mood manipulation procedure here used-- Velten mood statements--was not as effective in inducing appropriate affect as was the hypnotic suggestion approach used by Bower et al (1978). Bower (1984) presents evidence to support this contention. However, even though the present study was conducted using unselected subjects rather than the highly susceptible participants of Bower et al's experiment, the point-biserial correlation coefficients reported in table 10 show that the procedure used was highly effective and appropriate to test the SDL hypothesis. Furthermore, Bower (1984) followed a very similar Velten procedure and was again successful in demonstrating SDL.

A third reason might be the shortening of the interpolation procedure from approximately 15 minutes in Bower et al (1978) to approximately eight minutes in this study. Thus, it could be argued that insufficient time was allowed to elapse for adequate forgetting to occur. This argument fails, however, when we examine recall scores in table 3. Some forgetting from the second list was evident, and forgetting from the first list was obvious. Since SDL was investigated in each list separately, the shortened interpolation procedure could not have been responsible for the failure to find SDL for the first list, in which forgetting was more than adequate to demonstrate any SDL effect. On the other hand, the only evidence for SDL in recall was obtained for the first list, so inadequate forgetting might be a factor for the second list.

A fourth reason revolves around the time which elapsed between the induction of a mood and the completion of the relevant learning or recall task. Since the moods induced in this study--elation and depression--were in some sense extreme, it can be argued that maintenance of the mood over time gave way to the effects of regression toward the mean. Thus, with the passage of time during HMACL4 mood assessment and learning or testing, the singularity of the mood state diminished. The result, according to this line of reasoning, was that the mood states extant during the bulk of learning and testing activities was essentially the same, making this an inadequate test of the SDL hypothesis. (See Bower, 1984, for a similar rationale for the failure of his anger manipulation.) Of course, if this rationale were true, we would expect the control groups--EEE and DDD-- to produce the greatest similarity across conditions of learning and testing, and thus to show the highest level of recall for both lists. Examination of table 3 shows that this was indeed the case, although the effect was far from significant.

If failure to maintain the mood induced was basic to the failure to find SDL, why was this not a problem in Bower et al (1978)? Three factors may be involved.

First, Bower et al (1978) used a hypnotic suggestion procedure with suggestible subjects. Obviously, the hypnotic induction may be more resistant to diminution with the passage of time, especially since it is usually accompanied by instructions to remain in the hypnotic state until a signal is given. Further, it has been suggested (Bower, 1981) that suggestible individuals are more compliant, and thus more likely to try to maintain mood under instructions to do so, than are people in general.

Second, Bower et al (1978) used no manipulation check to determine success of hypnosis other than to observe facial expressions and tone of voice. In the present study, the HMACL4 was administered immediately after each mood induction. This may have had three effects. One is that the time required to fill out the HMACL4--from two to five minutes--contributed to the decay of the induced mood. Post-experimental interviews with several subjects indicated that this was so. The varying amounts of time taken to fill out the HMACL4 also certainly contributed to variation in the extent of forgetting, and increased the error variance. The second effect of the HMACL4 is that it may have interfered with maintenance of the mood by focussing the participant's attention upon the mood state. Being made thus aware of the mood state, the subject was faced with the task of maintaining a mood while studying the mood--analogous to trying to follow the instruction, "Do not think about pink elephants." Third, the mood-related words of the HMACL4 may have served as cues or associates to the words being recalled in the posttest. The low level of recall of list one words mitigates that argument, however. It is important to note here that Leight and Ellis (1981), who also failed to find SDL in recall, also used a mood adjective check list to assess the mood manipulation before the learning and recall phases of the study were introduced. Their failure may have been for the same reasons as those just cited.

The third difference in mood maintenance between the present study and that of Bower et al (1978) is that Bower and his colleagues were regularly able to remind their hypnotized subjects to maintain the mood they had established. In the present study, instructions to maintain mood were given only at the end of each Velten procedure, a technique which is obviously less powerful than frequent reminder.

There seems a considerable basis, then, for the argument that failure to find SDL in recall in the present study was due to insufficient tenacity of induced mood states, such that the SDL hypothesis was not given a fair test.

The near-significant SDL effects for happy words from list one found in recall and MMFR are not implausible in the light of the foregoing discussion. They may, of course, be considered chance effects, since neither produced an F-ratio significant at the .05 level. Alternatively, it may be that the SDL hypothesis is true, and that only for happy words from the first list was the effect strong enough to remain when the moods had decayed to the levels of learning and testing. It is not incredible that mood-state dependent learning might be stronger for one category of words than for another.

Nonetheless, in the face of overwhelming contrary evidence, the near-significant SDL effects must be considered extremely vulnerable, and held, if at all, tenuously.

SDL in recognition.

It will be recalled that while Leight and Ellis (1981) failed to find SDL in recall, as did the present study, they did find SDL in recognition. So did the present study.

The recognition scores for list one (except for happy words) were significantly higher than for list two. This is directly opposite to the relationship found for recall, and indicates that while recall scores may have declined more for the first list than for the second, the first list was learned at least as well. Since the recognition tests presented each correct word with a paired distractor from the other list, this result may also indicate that the list context coding was more effective for the first list than for the second. Now, Bower (1981, 1984) has suggested that the value of mood as a cue increases as the value of the list node cue decreases. If, as the immediately preceding argument suggests, the list cue was effective for list one, then SDL effects are less likely to be found, and we have a further contribution to the failure to find SDL in recall. The failure of SDL in list two cannot be explained in the same way, but could perhaps be explained as inadequate forgetting. The evidence of a ceiling effect, for example, was much more tenable for list two than for list one (table 3).

SDL effects in recognition were indicated for the first list. The overall F-ratio for words recognized was close to significance (p = .07), and Duncan's multiple range test showed the difference between the maximum interference group and the intermediate interference group to be very close to significance (table 5). No support for recognition SDL was found in the second list.

When intrusions were considered, SDL-supporting effects were found, again only for the first list. Happy words and the total of happy and sad words were more likely to intrude from the second into the first list in accordance with the SDL hypothesis, both significant at the .05 level. Duncan's multiple range test showed this to be a difference between maximum predicted interference groups and minimum predicted interference groups, with the control groups intermediate.

Support for SDL in recognition is considerably stronger than it is for SDL in recall, in this study. While the SDL-recognition effects are not overwhelming, they are strong enough to resist dismissal. This brings up the difficulty which was faced by Leight and Ellis (1981): if general SDL research is generalizable to mood-state dependency, and if Bower's network-theory is accurate, how do we reconcile these findings?

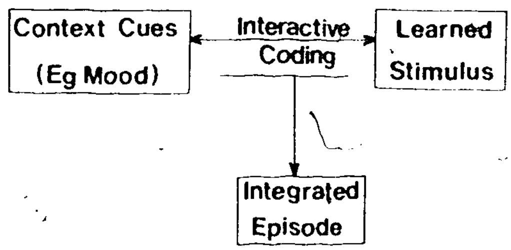
Recently, Bower (1984) has reiterated his theory of mood-state dependent learning, and has impressively demonstrated it in experiments using Velten mood manipulation. He found SDL in recall, and not in recognition, in accordance with his theory. The contrary findings by Leight and Ellis and in this study must be reconciled with Bower's theory and his results. Although Bower (1984) twice cites Leight and Ellis, he does not mention their finding of an SDL effect in recognition.

Bower does engage the possibility of SDL in recognition by referring to Baddeley's (1982) hypothesis that "if the subject is able to relate the context and stimulus in an interactive way, then context will influence both recall and recognition performance" (p. 716).

Thus, if the mood-manipulation procedure is verbal, and if the stimuli to be learned are not only verbal but are mood-related, then it is not unreasonable to expect a mood-state dependent effect in recognition as well as in recall. If learning has been such that a ceiling effect in recognition is not a problem, then interactive coding of context cues--the Velten statements--and stimuli to be recognized--mood-related words--could lead to an SDL effect in recognition. That is, as Baddeley (1982a) points out, if the material is "sufficiently compatible to allow a new integrated episode to be created" then interactive contextual effects may produce SDL in recognition.

A model of Baddeley's hypothesis is presented as figure 5.

Figure 5. Model of Baddeley's (1982a) interactive coding hypothesis.




If the context cue (for Baddeley, context cues may be anything but the learned stimulus) is intentionally coded interactively with the learned stimulus, then the two may be fused into a unitary memory of an integrated episode, such that recall of any part of the episode leads to recall of its entirety. Consequently, SDL effects may be found even for recognition memory.

Baddeley's model does not contradict Bower's. In fact, they are highly compatible. The advantage of Baddeley's model lies in its ability to define the necessary circumstances for SDL effects in recognition, effects which are a problem for Bower's theory (Bower, 1984).

Of all the researchers in the field, only Leight and Ellis (1981) and I appear to have avoided the ceiling effect while testing for both recall and recognition mood-SDL effects on the same learned material in the same experiment. Bower et al (1978) and Bower (1981) tested word-list learning only by recall. In Bower (1984), the fourth experiment failed to demonstrate SDL in recognition while finding it in recall, but as he noted, recognition memory was too high to rule out a ceiling effect limiting possible differences between conditions. Also in Bower (1984), a fifth experiment tested only recognition, but the material learned was faces, rather than words.

Leight and Ellis (1981) used verbal material as well as Velten's verbal mood manipulation, and they found a mood-SDL effect only in recognition. On the surface, there seems to be a lower likelihood of an explanation of their results in terms of interactive coding since the material to be learned was not common words but grouped hexagrams. However, the likelihood of an interactive coding explanation increases when we remember that the mood-SDL effect was found only for the constant-input group, in which the grouping of the letters within each hexagram remained fixed across the <u>16</u> presentations of the stimulus material to each subject. With repeated presentation of the material to be learned, it seems likely that the subject would attempt a variety of coding processes, including interactive coding, and an SDL effect in recognition becomes plausible. Indeed, as one examines the examples of stimuli used by Leight and Ellis (1981), it becomes apparent that even hexagrams can have obvious mood associations. BON KID is a happy hexagram of a good or pretty child; REP GON is a sad hexagram of a depraved character. The likelihood of interactive coding is further increased when one realizes that the stimuli used by Leight and Ellis were chosen to be of high meaningfulness and pronounceability.

In the present study, a basis for interactive coding is even more apparent. Subjects learned words like trouble, chaos, and misery after reading statements like "It often seems that no matter <u>how</u> hard I try, things still go wrong" and "I have too many bad things in my life"--like trouble, chaos, and misery, an obvious example of interactive coding.

It appears, then, that when the mood manipulation procedure is verbal and when the material learned is not only verbal but mood-related, interactive coding is likely to take place, leading, as Baddeley (1982a) suggests, to SDL effects in recognition.

This argument does not explain everything, however. Baddeley's (1982a) hypothesis suggests that context or SDL effects are plausible, if interactive coding takes place, in both recall and recognition, yet Leight and Ellis (1981) and I found these effects only for recognition, and not for recall.

There is an important parallel between the study by Leight and Ellis (1981) and the present study which may explain this. In both studies, a mood-manipulation check using a mood-adjective check list came between each mood-manipulation and each of the learning and recall phases. The time required to fill out the check list almost certainly led to some decay of the induced mood. Further, in both studies, the recognition task always followed the recall test. Consideration of these parallels leads to two explanations for the results.

First, it may be that where interactive coding takes place, recognition is actually a more sensitive test of mood-state dependent learning than is recall. That is, the decay of the mood state prior to recall was sufficient to minimize mood-group differences and thus an SDL-effect in the recall test. Bower (1984) presents evidence that the intensity and duration of mood states is directly related to the magnitude of the SDL effect in recall. If recognition is a more sensitive measure of mood-state SDL, then the mood even in its further state of decay at the time of the recognition test might produce group differences sufficiently large to yield SDL effects.

Second, since in Leight and Ellis (1981) and in the present study the recognition task always followed the recall test, the recall test may be considered to be another learning phase. In fact, in the actual learning phases of both studies, recall testing was a component. As the subject strives to recall material during the recall phase, she may experience what Bower et al (1978) called the "tip-of-the-tongue" phenomemon--almost able to recall the words, but unable to articulate them. It seems reasonable that to the extent that recall testing brought up these almost-reponses, recognition testing immediately following should benefit. Furthermore, errors in recall are more likely to be associates of correct words than not, and when the correct word is made available in the recognition test, the availability of the associate from the immediately preceding recall test makes its correct selection highly likely.

I contend, then, that it is not irrational to find an SDL effect in recognition but not in recall under the circumstances extant in this study. It then becomes important to separate these effects from those predicted by the association network theory of Bower (1982; 1984).

There are at least two ways of doing this. One approach which appears regularly in the literature, is to eliminate interactive coding by making the context manipulation incompatible with the material learned, so that the two cannot be fused into a single episode. This method is used, for example, by Baddeley and his colleagues, when they manipulate context by having divers learn words underwater and recall them above water (Baddeley, Cuccare, Egstrom, Weltman and Willis, 1975; Davis, Baddeley and Hancock, 1975; Godden and Baddeley, 1975). Here, the likelihood of interactive coding of words and watery context is slight, and context dependent learning is found for recall but not for recognition.

Another technique is to continue to use a mood-manipulation procedure, even a verbal procedure like Velten, and eliminate interactive coding by using as learning materials stimuli which are not mood related. Experiments II and III of the present study use this method, employing as stimuli line drawings which are not only mood-irrelevant but also novel, so that prior associations of any consistent type are unlikely. To my knowledge, this is the first attempt to do this.

Mood consonance.

If interactive coding is taking place in this experiment, such that mood statements and their effects are being associated with mood-related words, we would expect support for the old mood consonance hypothesis--we are more likely to recall material consonant with our mood state, happy words when happy, sad words when sad.

Since interactive coding requires the subject to "integrate stimulus and context into a new and unitary episode" (Baddeley, 1982a, p. 717), interactive coding should be easier if the material to be learned is consonant with the mood state than if it is dissonant.

In this study, mood consonance effects were found in accordance with this prediction for happy words from the second list and for sad words from the first list. No such effects were found for happy words recalled from the first list, and it will be remembered that SDL in recall was found only for happy words from the first list. Furthermore, SDL in recognition for the first list was not found for happy words, but only for sad words and words overall. It appears that where evidence for interactive coding is provided by mood consonance effects (sad words from list one, happy words from list two), SDL in recall is not found, and where SDL in recall is found (happy words from list one), there is no mood-consonance support for interactive coding and there is no SDL effect in recognition. SDL in recognition (happy words from list two intruding into recognition for list one, table 11) was found when the mood consonance evidence favored the interactive coding interpretation.

The pattern of SDL effects in both recognition and recall mesh very nicely with evidence for interactive coding provided by significant mood-consonance effects.

The words used in this experiment-- and in that by Bower et al (1978)-- were grouped as either happy or sad by the experimenter. That is, from the list of words which had the appropriate concreteness rating in Paivio et al (1968), words were judged to be happy, sad, or mood-irrelevant. No attempt was made to equate the emotional valence of the words in the two lists, and it is certainly possible that the mood-consonance effects found here reflect a lack of symmetry in mood-relevance of the words. Since only sad words from list one and happy words from list two yielded mood consonance effects, it may be that only these words, or a majority of them, were perceived as happy or sad. This may also have contributed to the failure to find mood-consonance effects in Bower et al, since our word lists were similar (see appendix A).

Mood performance.

In this study, the mood-performance hypothesis (better mood = better performance) was supported only for the first phase of the learning procedure for the second list. The effect quickly disappeared, and by the second learning phase of the same list-- three minutes later-- it was gone. This failure to consistently demonstrate support for the mood-performance hypothesis is in line with recent research (eg, Bower et al, 1978; Bower, 1981; 1984). The mood-performance hypothesis appears to be untenable, at least for this type of learning task, a conclusion similar to that reached by Blomkvist (1982).

Mood manipulation.

Point biserial r. The point-biserial correlation coefficients reported in table 10 provide strong evidence that the mood-manipulation procedures were accompanied by relevant changes in mood state. Depressed mood induction was followed by high HMACL4 scores on depression, sleepiness, and anger, while elated mood induction yielded higher scale scores on concentration, cooperation, potency, and optimism.

However, these results indicate only that the induction of the desired mood was successful. The maintenance of the mood through the learning task was not directly assessed, but the general failure to find SDL effects in an experiment so similar to that of Bower et al (1978) may be due to a failure to maintain mood through the learning and recall tasks. Future research should remove this problem by delaying the mood assessment until after the learning or recall phase, thus keeping the task as close in time as possible to the mood induction, minimizing the effects of mood decay. This procedure was employed in experiments II and III of the present study.

Another procedure which deals with this problem uses a very short mood-manipulation check. Bower (1984) simply asked his subjects to rate their mood on a 21-point scale immediately after the mood-manipulation and again after the learning or recall task. This made assessment of mood decay possible, as well as minimizing its effects. What is lost with such a procedure, of course, is the richness and breadth of an adjective check list assessment. With the HMACL4 in the present study, changes in ten different mood-states were assessed, and confidence that the mood manipulation was effective was thereby increased. When an elating manipulation is shown to increase concentration, cooperation, potency and optimism, the level of confidence is certainly higher than if we show that after an elating manipulation, subjects rate themselves as (generally) happier.

There is an apparent conflict here. If we want to avoid mood decay, we are forced either to use a weak manipulation check or to delay the manipulation check until after learning or testing. The delay approach seems more appropriate, and is likely to yield more valuable data in the long run. Accordingly, it was selected for use in experiments II and III of the present study.

Goodness-of-fit. Examination of the correlations between posttest scores on both recall and recognition showed that similarity of induced mood, as measured by HMACL4 scores, was unrelated to level of recall and recognition. This indicates either that the SDL hypothesis is wrong, or, as already argued, that the mood which obtained during HMACL4 assessment was not retained through learning and/or testing.

Other considerations.

Possible confounding of mood and cognitive state. In this and in the following two experiments, all 60 of the Velten statements for each mood were used at each mood induction procedure. As Bower (1984) observed, this opens one up to the charge that it is the cognitive state, rather than the mood state, which is responsible for any SDL effect. That is, when the statements are read a second or third time, the cognitive state of the first reading is reestablished, providing a cognitive rather than an affective context.

Bower et al got around this problem in 1978 by instructing their subjects to recall different mood-related scenes and events on successive mood manipulations, and in 1984 Bower evaded the problem by dividing the Velten statements into two groups, one set of statements used for the first mood induction and the other for any repetition of that mood.

Bower (1984) did face the problem that the half-set Velten procedure did not induce mood change as deeply as he would have liked, especially for the anger manipulation. In the experiments of the present study, use of all 60 Velten statements at the time of each mood induction was followed by strong evidence of mood alteration. There is a trade-off here. Of course, one could devise a parallel set of 60 different Velten-type statements for each mood, but this is easier said than done. Bower's construction of anger-inducing statements, with limited success in inducing appropriate affect, is a case in point.

On the other hand, repetition of the same 60 statements may not be problematic. The cognitive or semantic theme of the statements varies tremendously, while the relevant mood-state is consistent. One would be hard put to argue that a consistent cognitive state is being established and reestablished which is as strong as or stronger than the demonstrably powerful induced mood state. The use of 60 different statements also makes it unlikely that the subject, on one reading, will establish a sufficiently strong memory trace of cognitive content for a later reestablishment of a unitary cognitive state. In fact, I had subjects ask me if the mood statements really were the same from trial to trial.

In addition, if the repeated use of the same statements leads to results similar to those obtained when the statements are changed, as in Bower (1984), the tenability of a cognitive-state context interpretation is dramatically diminished. Is it likely that an SDL effect with differing statements is due only to mood, while an SDL effect with repeated statements is due to cognitive state? Nonetheless, Bower's warning should be given due consideration in future research. Carefully validated construction of parallel sets of Velten-type statements is called for.

The pacing of the presentation of the Velten statements should also be given consideration here. The statements were presented such that a new card was laid down after the participant finished reading the preceding card aloud, as Velten had done for the instruction cards. Since the statements varied in length and complexity from card to card, this procedure allowed greater time for longer and more complex cards, without requiring subjects to sit and wait after reading a card with a short, emphatic statement. This technique also compensated for variations in reading ability. With an average exposure time of seven seconds per card, the total exposure time for each set of mood statements was longer than that in Bower (1984), who exposed sets of 25 cards for 15 seconds each.

That the mood-induction procedure used here was successful was indicated by a series of analyses of variance in which the two moods induced prior to a particular HMACL4 assessment were compared as to their effects on each of the ten subscales of the HMACL4. The elated mood statements consistently elicited higher scores on concentration, cooperation, potency, and optimism; and the depressed mood statements consistently elicited higher scores on depression and sleepiness; all significant at the .001 level. Compatible effects were also consistently found for anxiety (p less than .05), anger (p less than .01) and scepticism (p less than .01), although the F-ratios were smaller.

Only for control were the effects not consistent. On the first and third administrations, control scores were not significantly different for the two groups. On the second administration, control scores were higher for the elated group than for the depressed group ($F(1, 58) = 4.72$, $p$ less than .05).

The consistency of the mood effects supports the contention that the Velten procedure as employed in this study yielded the desired changes in the moods of the participants.

The mood state, as manipulated by the Velten procedure, includes all of the HMACL4 indicators with the possible exception of control. An elated Velten state, then, consists of high levels of concentration, cooperation, potency and optimism; and low levels of depression, sleepiness, anxiety, anger, and scepticism. A depressed Velten state consists of high levels of depression, sleepiness, anxiety, anger and scepticism; and low levels of concentration, cooperation, potency and optimism. As Velten (1968) suggested, the mood effects of his procedure are multi-dimensional.

## Experiment II

This second experiment attempted to eliminate the possibility of interactive coding and mood consonance effects, both of which seemed to interact with SDL in experiment I. The material to be learned was changed from emotion-linked words to novel, mood-irrelevant line drawings, not subject to mood consonance effects and probably very difficult to code interactively with mood. The change was effective, with results quite different from those of experiment I.

### Method

Subjects. Forty male undergraduates, aged 18 to 22, were recruited from the introductory psychology classes at Houghton College and assigned at random to one of four experimental groups, resulting in 10 men per group. Each man received course credit for participating in the experiment.

Apparatus and Materials. Tachistoscopically controlled Kodak Carousel slide projector, model 800H; twenty slides of line drawings formed randomly on a predetermined grid (see appendices D and E); the Howarth Mood Adjective Check List (HMACL4); the elation and depression mood statements from Velten (1967); a multiple-choice design recognition test; two Sony cassette tape recorders model TC-60A.

Procedure. Participants were brought individually into the room and seated at a table in a swivel-type office chair. On the table were one copy of the HMACL4 and a sharpened pencil. Each subject was immediately informed that "The purpose of this study is to learn something about your feelings and reactions. However, you will not be subject to any painful or uncomfortable experiences." Again, this was a precaution to alleviate mood-altering tension induced by expectations about the experimental procedure. The experimenter then introduced the experiment similarly to experiment I. The specific instructions are reported in the experimental protocol in appendix C.

Participants who agreed to continue were asked to sign a consent form. They were then asked to complete one copy of the HMACL4. All of the remaining instructions in the experiment were presented by playing a tape recording of the experimenter's voice.

Upon completing the HMACL4, the subject was told about the learning task, and any questions were answered. The first mood was induced using the Velten procedure, terminated by an additional instruction card which read, "I will try to maintain the mood I have just established while I do the next part of the experiment." This took the place of the oral encouragement in Bower et al (1978) and in experiment I of the present study.

One-half of the participants were given the depressed mood statements, and the other half were given the elated mood statements. All read the statements silently, then aloud. The first mood manipulation was now complete.

Upon completing the Velten procedure, the participant was shown the designs.

The designs chosen for the learning task were prepared on grids two cm square, and were transferred to 35mm slides using a Thermofax process. Each design was projected on a screen located 2m directly in front of the subject, and the size of the frame when projected was approximately 22.5 x 31.5 cm. The designs were on grids of equal size, which, when projected, were approximately 18 cm square. The projection screen was placed 120 cm away from the centre of the front of the projection lens. The line of projection met the plane of the screen at an angle of 77 degrees. That is, the projection line ascended 13 degrees from the horizontal. Thus, the projected grids were only approximately square.

The exposure time of two seconds per slide was predetermined using an electronically controlled tachistoscope shutter, which was automatically activated by the advance mechanism of the slide projector. Time elapsed between exposures was equivalent to the slide-projector switching time, 1.3 seconds.

Three complete sets of the 20 slides were presented sequentially, with the order on each presentation randomly varied. Each subject received the same 60-slide sequence.

A blank grid frame preceded each set of 20 different designs in 60-slide series, providing the subject with a location cue for the rest of the slides, and with information that the designs would then be repeated.

Once the designs had been presented, the HMACL4 was administered a second time, with no oral instructions. Then, the Velten procedure was used again. This time, one-half of the subjects who previously had been given the elated-mood statements were given the depressed mood statements (group ED), and one-half of the subjects who had previously been given the depressed mood statements were given the elated mood statements (group DE).

The rest of the subjects received the same statements they had been given previously (groups DD and EE). Each of the four resulting groups had ten subjects. The first two groups mentioned were considered to be mood dissonant, while the latter two were labeled mood consonant. The resulting 2 x 2 design is displayed in table 11.

Table 11. The four experimental groups, with numbers of subjects in parentheses.

| | | | |
|---|---|---|---|
| Mood | | Consonant | Dissonant |
| Induced | Elated | EE(10) | ED(10) |
| for | | Dissonant | Consonant |
| Learning | Depressed | DE(10) | DD(10) |
| | | Elated | Depressed |
| | | Mood Induced for Test | |

Following this second mood induction, the subjects were given a sheet of white paper on which 20 blank grids were printed, and were asked to draw as many of the designs as they could remember. Five minutes were allowed to complete this task.

If the participant attempted to hand in the answer sheet before the five minutes had elapsed, the experimenter said, "Please keep trying."

After the recall task, the HMACL4 was administered a third time.

Then, each subject was presented with a 20-item multiple choice (recognition) test. Each item contained one of the experimental designs and three distractors. The sequence of the designs was again randomly different from the three sequences used in presentation.

This completed experiment II. Before the debriefing procedure, all subjects were given the Velten elated mood statements to read. The purpose of the experiment was explained, and any questions were answered frankly. Each subject was then thanked and excused. The text of the debriefing appears in appendix C.

## Results

Due to the difficult nature of the reproduction task, four different scoring procedures, varying in leniency, were prepared. Then the recall reproductions were scored on the four variables.

Scoring was done blind with respect to the experimental group to which each subject belonged. First, the number of perfect reproductions was determined by comparison with a key of the twenty drawings. One point was assigned for each correct reproduction, for a maximum of 20 points.

A 2 x 2 factorial analysis of variance revealed the F-ratios summarized in table 12.

Table 12. Analysis of variance summary table for number of perfect reproductions.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| Mood During Learning | 2.50 | 1 | 2.50 | 2.84 | .10 |
| Mood During Recall | 1.60 | 1 | 1.60 | 1.82 | .19 |
| Interaction (SDL) | 2.50 | 1 | 2.50 | 2.84 | .10 |
| Error | 31.80 | 36 | .88 | | |

The means of the four groups--DD, DE, ED and EE-- are shown in table 13. It can be seen that the differences were in a direction congruent with the SDL hypothesis. The F-ratio for the SDL interaction term has a probability of .10. The difference due to mood of learning (A) produced an F-ratio identical to that of the interaction, but examination of the means in table 13 shows that it was in the opposite direction to that which was originally hypothesized. That is, a depressed mood of learning produced better performance than an elated mood.

Table 13. Group means for number of perfect reproductions.

| MOOD DURING RECALL | | Depressed | Elated |
|---|---|---|---|
| | Depressed | 1.50 | .50 |
| | Elated | .60 | .60 |
| | | MOOD DURING LEARNING | |

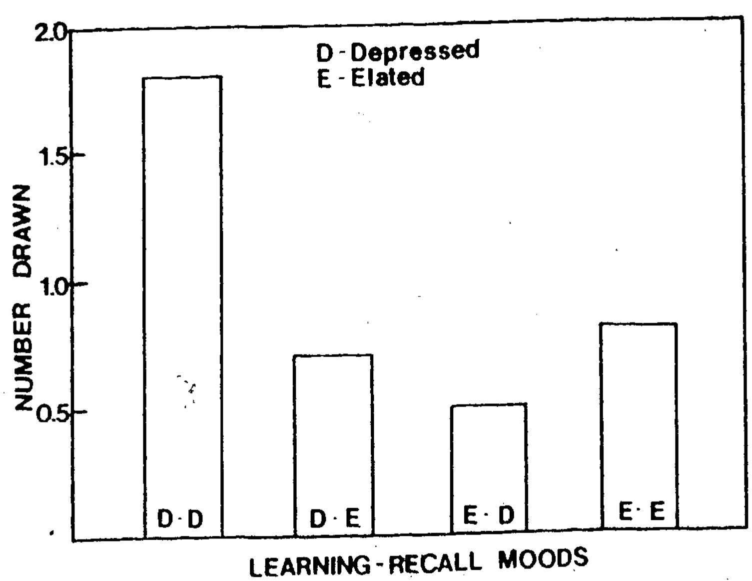
As stated in the first prediction for these experiments (p.22), subjects whose mood was the same at learning and at recall were expected to perform better than those whose moods changed. Accordingly, a directional t-test was conducted on the difference between the same-mood groups taken together (DD and EE) and the different-mood groups taken together (DE and ED). The resulting t (38 df) of 1.63 ($p = .06$) was close to being significant.

The second variable analyzed included not only the number of perfect reproductions, but also the number of reproductions which were correct but rotated, reflected, or with an extra line. Again, one point was assigned for each reproduction which was correct by these more lenient criteria; for a maximum of 20 points.

A 2 x 2 factorial analysis of variance revealed an interaction of mood of learning and mood of recall (F 1, 36 = 3.28, p = .08), with no significant main effects.

Again, the means of the four groups were in a direction which supported the SDL hypothesis, as shown in figure 6. A directional t-test on the SDL effect (DD and EE minus DE and ED) showed a significant t-value of 1.78 (38 df, p = .05).

Figure 6. Interaction of learning mood and recall mood, sum of perfect, rotated, reflected and extra-line reproductions.



The third variable measured the proportion of the lines in the designs which were correctly reproduced. If a reproduction contained at least half of the lines of a design correctly drawn, it was scored for proportionate correctness by dividing the number of grid blocks correctly traversed in the reproduction by the total number of grid block lines in the design. A grid block line was defined as the length, width, or diagonal of a grid block in the 3 x 3 unit design grid. Thus, a horizontal line completely crossing the grid was scored as three grid block lines long, as was a full vertical line and the longest diagonal lines. Other diagonal lines were one or two grid blocks long. After duplicates were eliminated, the proportion scores were added up, and the proportional sum (total number of grid lines correctly drawn divided by number of grid lines in the designs attempted) served as the third variable for analysis. (The scoring procedure is more completely described in Appendix H.)

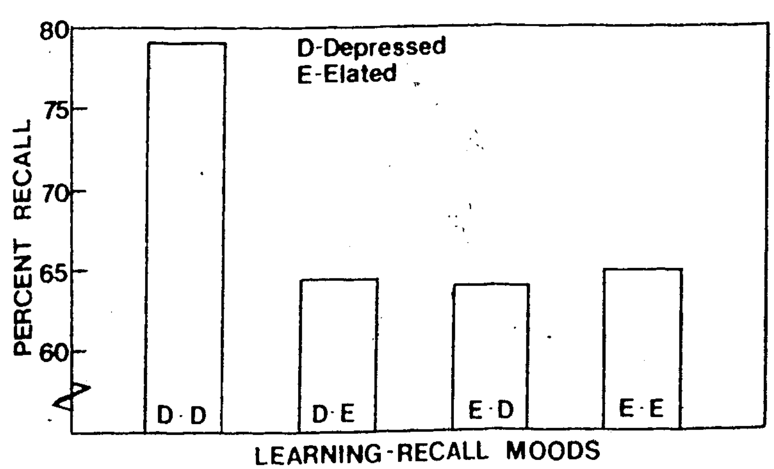
Again, the SDL effect was supported. The F-ratio for the interaction of mood of learning by mood of recall was 6.62 (df = 1, 36, p = .02). The main effects of mood of learning and mood of recall also yielded significant F-ratios, as summarized in table 14.

Table 14. Analysis of variance summary table for proportional accuracy of reproduction. Factor A is mood during learning, factor B represents mood during recall, and the A x B interaction measures the SDL effect.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 442.23 | 1 | 442.23 | 5.53 | .02 |
| B | 390.63 | 1 | 390.63 | 4.89 | .03 |
| AxB | 497.03 | 1 | 497.03 | 6.22 | .02 |
| Error | 2877.50 | 36 | 79.93 | | |

The t-test for the specific one-tailed SDL comparison yielded a value of 2.26 (38 df, p = .03), again supportive of the SDL hypothesis. Figure 7 shows the interaction graphically.

Figure 7. Interaction of learning mood and recall mood, proportional accuracy recall.



In an attempt to control further for guessing, a fourth variable was constructed. For each of the reproductions with at least 50% of the lines correctly drawn, the number of grid blocks incorrectly traversed was subtracted from the number correctly traversed, and overall proportional accuracy was again determined, as for the preceding variable. ( Again, scoring details appear in Appendix H).

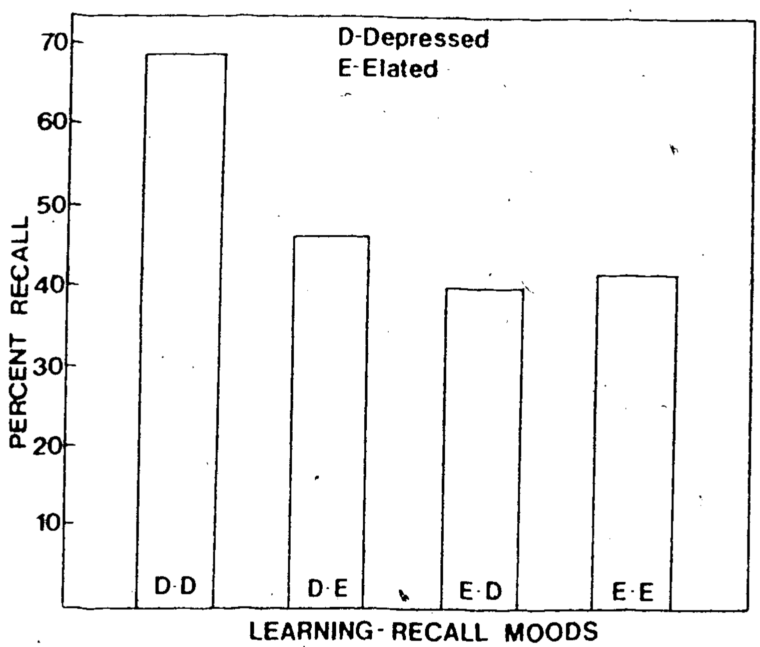
Analysis of variance on these more strict right minus wrong scores also supported the SDL hypothesis, with the interaction F-ratio (1, 36 df) of 6.52 significant at the .05 level. The main effects for mood of learning and mood of recall also yielded significant F-ratios, as summarized in table 15. The interaction is graphed as figure 8.

Once more, the <u>t</u>-test between same-mood groups and different mood groups supported the SDL hypothesis, with the one-tailed <u>t</u> of 2.15 (38 df) significant at the .05 level.

Table 15. Analysis of variance summary table for corrected proportional accuracy of reproduction (right minus wrong). Factor A is mood during learning, factor B represents mood during recall, and the A x B interaction measures SDL.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2755.6 | 1 | 2755.6 | 12.68 | .01 |
| B | 1040.4 | 1 | 1040.4 | 4.79 | .04 |
| AxB | 1416.1 | 1 | 1416.1 | 6.52 | .02 |
| Error | 7823.8 | 36 | 217.3 | | |

Figure 8. Interaction of learning mood and recall mood, corrected proportional accuracy.




For the number of scoreable attempts, no significant or near-significant differences were found.

On the multiple-choice recognition test, the number of correct identifications was taken as the score, out of a maximum of 20. No significant or near-significant differences were found.

A t-test of the directional SDL hypothesis (same mood vs. different mood) also yielded a non-significant value of 0.28 (38 df, p = .78).

A goodness-of-fit score or index was determined for each subject by comparing HMACL4 scores after each Velten mood induction procedure. Negative coefficients of correlation indicate a positive relationship between concordance of mood states and performance measures. The results are presented in table 16.

Table 16. Coefficients of correlation between goodness-of-fit scores (reciprocal of concordance) and measures of recall and recognition.

| | Goodness of Fit |
|---|---|
| Perfect Reproductions | -.23 |
| Rotations and Reflections | -.10 |
| Proportional Accuracy | -.23 |
| Corrected Accuracy | -.32 |
| Recognition | .02 |

The only statistically significant coefficient of correlation here is that between goodness-of-fit and corrected proportional accuracy (significant at the .05 level).

## Mood manipulation

Point biserial coefficients of correlation were calculated between the mood induced by the Ve procedure and each of the ten HMACL4 scores on the immediately following administration. The results appear as table 17.

Table 17. Point biserial correlation coefficients between Velten-induced mood and HMACL4-assessed scale scores. Velten moods were scaled so that positive coefficients show a positive relationship with elation.

| Scale | Learn Mood | Recall Mood |
|---|---|---|
| UP MOODS | | |
| CN | .66* | .48* |
| CO | .76* | .56* |
| PT | .61* | .53* |
| CL | .38* | .23 |
| OP | .77* | .56* |
| DOWN MOODS | | |
| DP | -.64* | -.72* |
| SL | -.69* | -.68* |
| AG | -.37* | -.48* |
| SC | -.16 | -.41* |
| NEUTRAL | | |
| AX | -.05 | -.18 |

Those coefficients marked with an asterisk are significant at the .05 level.

It should be noted that the positive relationships between such HMACL4 scales as CN (concentrating), CO (cooperative) and OP (optimistic) and elated Velten mood declined markedly in strength from the first Velten administration to the second, while the negative relationships (which are positive with depressed Velten mood) with scales like DP (depressed), SL (sleepy), and AG (angry) remained stable or increased slightly.

Interscale correlation coefficients were calculated for each administration of the HMACL4, and these are presented in appendix E.

The differential effects of the Velten procedures were assessed by conducting analyses of variance on each of the ten HMACL4 scale scores, comparing the two induced mood groups prior to each administration of the HMACL4.

For the first administration, differences in the expected direction significant at the .0001 level were found for concentration, depression, cooperativeness, sleepiness, potency, and optimism. Control and anger were significantly different at the .02 level. Anxiety and scepticism did not differ significantly.

Except for the marginally affected variables, the pattern was identical to that found in experiment I.

For the second administration, the same pattern was found, except that control and scepticism traded positions. In addition, the magnitude of the effects for the up-mood indicators declined, while the size of the down-mood effects remained stable or increased.

## Discussion

### SDL in recall

Support for the SDL hypothesis in recall in this experiment was strong. (It was, however, mainly a function of the depressed mood state, with the DD group consistently scoring highest, and the EE group considerably lower on all variables.) Even for the strictest scoring procedure of perfect reproductions, which limited variation drastically to the bottom end of the scale (the mean score was 0.8 out of 20 diagrams accurately reproduced), the difference between same-mood and opposite-mood groups was very close to being significant. When the reproductions were scored in any of three more lenient fashions, significant differences in support of the SDL hypothesis emerged.

The finding of an effect so strong as to overcome floor effects in such a difficult task is exhilarating. While previous studies using verbal material had shown SDL to be sensitive to both floor and ceiling effects (Leight and Ellis, 1981; Bower, 1984), the present study, with non-verbal stimulus material, shows the power of the SDL phenomemon.

The unique aspect of this experiment lies in the demonstration of mood- SDL in material which is not obviously related to mood. With randomly-generated line drawings, the probability of interactive coding with the mood statements of the Velten procedure is very low. That is, the line drawings were constructed to convey a minimum of both meaning and emotional valence. The random nature of the production of arbitrarily-defined nonsense figures reduced the likelihood of their having meaning and strong association value, and those which resembled figures of known meaning and affect-- letters, numerals, and common shapes-- were eliminated. Further, the affect value of the diagrams had been rated in a pilot study, and those which were identified as having more than minimal mood-association value were eliminated.

Not all figures with no obvious meaning or mood associations are nonsense figures, however, as Nelson and Ladan (1976) point out in their study of Chinese characters. However, their discovery that asymmetrical-simple Chinese characters produced fewer associations than asymmetrical- complex or symmetrical- simple symbols is important here because the designs used in the present study were asymmetrical and, based on four lines, were analogous to simple Chinese characters. This increases my confidence that these symbols were not high in meaning or mood associations.

Of course, it is still possible that some or all of the diagrams had some mood or meaning associations, especially for individual subjects. Even so, for subjects to develop interactive coding strategies for stimuli which were presented non-verbally would require tremendous manipulation of the affective meaning of the diagrams. The affective meaning of the diagrams would have to be coded in memory in addition to the visual coding. All of this points to a rather arduous and time-consuming process, unlikely in the 1.3 seconds between slides. (Nelson and Ladan's subjects saw each character for 30 seconds, and had another 30 seconds to respond with meaning associations.) The interactive coding hypothesis here seems untenable.

If indeed the mood state consequent upon the Velten procedure is coded independently of the design information, then this experiment constitutes a highly adequate test of the association network theory. It is unlikely that even the most sophisticated subject would deliberately link design and mood information together during the encoding process, with the limited exposure provided during learning in this experiment. The demonstration of mood-SDL effects here, then, supports the contention that when the strong cue--the experimental situation-- is overloaded and hence inadequate to aid in the retrieval task, the congruency of the mood state becomes an effective retrieval cue.

These results are compatible with those of Baddeley and his colleagues (Baddeley et al, 1975; David et al, 1975; Godden and Baddeley, 1975) who separated state and learned material by manipulating state with divers above or below water while learning. The results also fit with the drug-SDL research surveyed by Swanson and Kinsbourne (1979) and Eich (1980), which also make interactive coding an unlikely event by using a non-verbal manipulation of state.

The present study appears to be the only one which manipulates mood using a verbal procedure, and then assesses the SDL effect in recall of non-verbal material. Bower (1984) measured SDL in recognition of faces--he found none-- but this was not a recall task, and the faces displayed evidence of mood states, which increases the likelihood that they were mood-encodable.

Another success of the present experiment is the demonstration of SDL in recall with the single-list, 2 x 2 design. Bower (1984), in his survey of the literature, argued that single-list learning and recall, in the traditional 2 x 2 design of the SDL drug studies, rarely yields evidence for mood state dependent recall.

SDL in recognition

The strength of the evidence for mood-SDL in recall is totally reversed in recognition. Here, no evidence whatsoever could be adduced to support mood-SDL. The interaction F-ratio, which measured SDL, was a miniscule 0.08, $p = .78$.

This result is in accordance with the interactive coding hypothesis offered by Baddeley (1982). If the context can be coded interactively with the material learned, then the context effect is likely to be found in both recall and recognition. As already argued, the likelihood of interactive coding in this study is very low, since randomly- generated, novel designs rarely have mood association value. Consequently, we expect to see any context effect only in recall, and not in recognition. That was precisely our result. In fact, the failure to find SDL in recognition when it was found in recall supports the contention that interactive coding did not take place, buttressing the earlier argument.

The failure to find SDL in recognition also supports Bower's association network theory (Bower, 1981, 1984), according to which the presentation of the stimulus in the recognition test makes other cues--phonic and visual--available, relegating the mood-state to a status of redundancy and even irrelevance. Thus, if the mood cue is lost in the noise of recognition testing, no SDL effect is predicted.

Bower's theory, however, has some difficulty explaining the results of Leight and Ellis (1981) and experiment I of the present study, which indicated mood-SDL in recognition but not in recall. However, the possibility of interactive coding in both studies makes SDL more likely to be demonstrated for recognition than it is in experiment II of this study. That difference is nicely accounted for by Baddeley's interactive coding hypothesis, while Bower's theory seems to ignore it. By accounting for these variations in the data, Baddeley's appears to be the more adequate thesis.

A caveat is in order here. As in experiment I, in this experiment the recognition task always followed the recall task. If, as in experiment I, I argue that the recall task in this study served as another learning trial for the recognition task, then better recognition performance would be expected. This was indeed the case. However, if in this experiment recognition performance were strongly dependent on recall performance, would we not expect the mood- state effects to be similar? In fact, they appear totally unrelated. That is, if recall testing improved recognition performance, the improvement was not according to the SDL hypothesis, as it was in experiment I.

The delay in time between mood induction and recognition testing does suggest that SDL effects on recognition should be diminished by the decay of the mood, as argued in experiment I. However, the HMACL4 assessment which followed the five-minute recall test, but preceded the recognition test, showed that the mood effects were extant at least at the beginning of the recognition test. That, coupled with the brevity of the recognition test--approximately two minutes--militates against the decay interpretation of recognition-SDL failure. A more adequate conclusion of the question of SDL in recognition awaits further study. For the moment, the data of the present experiment accord very nicely with the predictions derivable from Bower (1981; 1984) and Baddeley (1982).

Another point raised by the failure of SDL in recognition but not in recall is that subject compliance becomes a highly unlikely explanation. Thus, if participants had guessed the experimental hypothesis, and attempted to be "good subjects" by providing data consonant with that hypothesis, they should have been even more successful in the recognition task than in the recall task (Bower, 1984). In the present experiment, that was not the case, so a conformity explanation seems to be ruled highly unlikely.

## Mood consonance

The hypothesis that mood state has a selective influence on what material is learned and recalled was not tested in this experiment, since the material learned was lacking in mood associations. The absence of evidence for interactive coding provided by the total failure to find SDL in recognition also makes a mood consonance effect theoretically implausible. That is, to the extent that mood consonance effects depend upon interactive coding, where interactive coding is unlikely, mood consonance effects are equally unlikely.

## Mood performance

The mood performance hypothesis, however, was thoroughly tested, both as learning mood and as recall mood. Evidence for a mood-performance effect was not consistent.

In each case where a significant F-ratio was found for the effect of mood directly upon recall, it was accompanied by a significant interaction. Examination of the means showed that the mood-performance effect was a by- product of the interaction. Since the DD group (depression on both learning and recall) always produced the highest recall scores of the four groups, this frequently yielded higher scores for depression when grouped according to mood of recall or mood of learning. Thus, the significant effects of mood of learning and mood of recall are by-products of the significant interaction, reflecting the SDL effect, and must be interpreted in that light.

Even without consideration of the confounding effect which the significant interaction had upon mood-performance assessment, it is apparent that elated mood did not lead to better performance. If anything, the opposite is the case, since the group with the best recall was the group which was depressed both at learning and at recall. This will be discussed further in the general discussion of this paper.

Failure of the mood-performance hypothesis was not unexpected, in the light of Bower (1981; 1984), Blomkvist (1982), and the first experiment of the present study.

## Mood manipulation

### Point biserial *r*

The point-biserial correlations between induced mood state and HMACL4 scales, reported in table 25, show that the Velten procedure was successful in inducing the appropriate mood state. Elated mood induction showed high positive correlation coefficients with concentration, cooperation, potency, and optimism, while depressed mood induction correlated positively with depression, sleepiness, and anger. These results parallelled those found in experiment I.

An interesting variation appeared in this experiment. It will be recalled that in experiment I, the correlation between induced mood and the relevant HMACL4 scales increased across the administrations of Velten and HMACL4 procedures. In experiment II, however, while the correlations with depressed mood increased, the correlations with elated mood decreased. This suggests that the similarity of mood states between learning and recall was higher if both induced moods were depressed than if they both were elated. This would lead to a stronger SDL effect for the DD group than for the EE group, which was in fact the case.

In experiment II, the mood assessment followed the learning or recall phase. Thus, we now have a measure of the extent to which the mood was retained through a task. The evidence from the point-biserial studies done here increases the confidence that the Velten procedure is capable of inducing moods with some resistance to decay. Whether this resistance to decay can be generalized to experiment I is, of course, moot.

The pattern of scale correlations in experiment II was compatible with that found for experiment I. It is becoming apparent that the Velten elating statements increase optimism, cooperation, concentration, and potency, while the depressing statements increase depression and sleepiness, and to a lesser extent, anger. For the male participants in this study, it appears that a second mood manipulation was more successful if it was depressing, and less successful if it was elating.

Goodness-of-fit

The correlations between goodness-of-fit scores and the four recall measures were disappointingly low, but in the right direction to lend further support to the mood-SDL hypothesis. The relationship between induced mood similarity and recall scored as corrected proportional accuracy was a significant -.32: that is, the less similar the two moods were by the goodness-of-fit measurement, the lower the recall score.

The correlation between goodness-of-fit and recognition was essentially nil ($r = .02$), indicating in another way the failure to find mood-SDL in recognition.

Other correlational analysis

It should be noted (appendix E) that the interscale correlation coefficients among the up mood indicators (CN, CO, PT, CL and OP) increased as the HMACL4 was repeatedly administered. For example, the relationship between CN and CO on the first administration, before any Velten procedure, was r = .41. After the first Velten procedure, the r rose to .72, and after the second Velten, it was .84.

These changes were parallelled in the down mood indicators, especially DP and SL.

These changes indicate the mood-solidifying or unifying effects of the Velten procedures, and are a demonstration of the effectiveness of the mood manipulation in inducing mood changes, which last through the learning phase into the following HMACL4 assessment.

Experiment III

Like experiment I of the present study, this third experiment used an interpolation procedure in an attempt to introduce retroactive interference. One set of slide-projected designs was learned in induced mood 1 (elated or depressed), a second set of designs was learned in induced mood 2 (elated or depressed), and recall was tested in induced mood 3 (elated or depressed). To test Leight and Ellis's contention that SDL can also be found in a recognition task, a multiple choice recognition test was also employed.

If Bower et al were correct in their finding that the interpolation procedure was necessary to find mood-related SDL, then an SDL effect for recall should be stronger in this experiment than in experiment II. However, if their failure to find an SDL effect in the 2 x 2 design of their experiment II was, as I suspect, due to the small number of subjects (four per cell), then SDL should be found in both experiments of the present study.

Had Bower et al been consistent across experiments in the use of a certain number of subjects, then their results would have suggested at least that the interpolation procedure of their experiment III would produce a stronger SDL effect than the crossed-mood procedure of their experiment II. Such a prediction cannot be deduced from their results. Bower's (1981) network theory of state-dependent retrieval, however, does suggest just such a prediction. Since the value of context cues increases as they are linked to a specific response, then the more responses linked to a context node, the lower the value of that context as a cue for a specific response. In the interpolation procedure, two complete tasks are learned in the same experimental context. This increases the associational load on the context node, and thus lowers the probability that the context will cue the one set of appropriate responses. Thus, as the cue value of the context decreases, the cue value of the relevant mood state node increases relatively.

Therefore, the additional prediction was offered that the SDL effect in experiment III would be stronger than that obtained in experiment II.

## Method

Subjects. The design employed in study III of Bower et al (1978) was followed. Ten female subjects were randomly assigned to each of six groups. Participants ranged in age from 17 to 22 years, with a mean age of 19.

Apparatus and Materials. The same apparatus and materials used in experiment II were employed. The set of 20 slides of different designs was divided randomly into two sets of ten slides each, with the restriction that they were balanced for the number of grid blocks covered by the design lines, to control for complexity.

Procedure. Each subject was introduced to the experimental situation, informed of the purpose of the study, and given a consent form. The HMACL4 was introduced (but not administered) to consenting parties, and the first mood was induced. To reduce subject resistance to the Velten instruction procedure (observed in the repeated applications of Velten in experiment I) and to shorten the duration of the experiment, shortened instructions for the Velten procedure were used in experiment III, and these appear in appendix G. After the first mood induction, the first slide series was presented, the HMACL4 was administered, and the second mood was induced, all following the corresponding procedures of experiment II. Prior to induction of each mood, however, the design learning task was introduced with these instructions:

> Immediately after you finish reading these cards, I shall begin projecting on the screen, one at a time, a series of ten simple designs which you are to commit to memory. The designs are drawn

on a background graph paper grid. Later, I shall ask you to draw as many of the designs as you can remember. The series of ten designs will appear three times, each series preceded by a blank grid. Do you understand?

After the Velten procedure was completed, the designs were presented with these reminders: "Here are the designs I told you about. Please try to memorize them. The first slide will show only the background grid, to help you orient yourself."

The method of slide presentation was identical to that used in the first experiment, with the exception that the time between slides was increased to 2.4 seconds, in an attempt to increase retention.

Following presentation of each set of designs, the HMACL4 was administered, without repeating the oral instructions. Then, a third mood-- either elated or depressed-- was induced using Velten. This mood induction was followed by 1) a free recall test for each set of diagrams, 2) the third HMACL4, and 3) a recognition test as used in experiment II, for each set of diagrams. Half of the subjects were asked to recall design series 1 followed by design series 2, while the other half were asked to recall design series 2 followed by design series

1. (Bower et al omitted this counterbalancing). The order of the recognition tests was also counterbalanced, and the recognition counterbalancing sequence was counterbalanced with the recall counterbalancing sequence.

Termination of experiment III followed the same steps outlined for experiment II.

## Results

The same four scoring procedures employed in experiment II were used here. As before, scoring was done blind. Recall scores and recognition scores were analyzed first for differences between position of sets of diagrams- first set vs. second set.

While the means of the second set were higher than those of the first set for every scoring procedure, only for corrected proportional accuracy was the difference significant ($F(1, 59) = 6.89$, $p = .01$). The means are reported in table 18.

Table 18. Means on each measure of recall and recognition for each set of diagrams.

| | First Set | Second Set |
|---|---|---|
| Perfect Reproductions | .18 | .27 |
| Perfect, Rotate, Reflect | .22 | .37 |
| Proportional Accuracy | .57 | .63 |
| Corrected Proportion | .33 | .42 |
| Scoreable Attempts | 2.82 | 3.33 |
| Recognition | 5.27 | 5.53 |

The differences in number of attempts which qualified for scoring (scoreable attempts) was close to being significant ($F(1, 59) = 3.83$, $p = .06$).

In the subsequent analyses, the two sets were considered separately.

SDL in recall

The SDL hypothesis for recall was first tested by conducting analyses of variance on the three predicted levels of interference-- minimum, intermediate, and maximum-- crossed with two levels of learning mood-- depressed and elated. Separate analyses were conducted for each set of diagrams on each measure of recall.

First Set. When recall was assessed as the number of perfect reproductions, no evidence for SDL was found. The F ratio for predicted level of interference was 1.05 (df = 2, 54; p = .36).

Scoring recall as the number of perfect reproductions plus perfect rotations or reflections or the inclusion of an extra line improved the picture somewhat, with the resulting F-ratio (2, 54) rising to 1.97, p = .15.

Proportional accuracy scoring yieded no evidence for SDL (F(2, 54) = 1.45, p = .24). However, corrected proportional accuracy scores (right minus wrong), which controlled for the effects of guessing showed strong evidence for SDL, with an F-ratio for predicted levels of interference of 3.21 (2, 54 df; p = .05). The number of scoreable attempts did not differ significantly (F(2, 54) = .26, p = .77).

The means for each scoring procedure for the first set of diagrams are reported in table 19.

Table 19. Means for each scoring procedure for each predicted level of interference, first set of diagrams.

| | Predicted Level of Interference | | |
|---|---|---|---|
| | Minimum | Intermediate | Maximum |
| Perfect Reproductions | 0.20 | 0.30 | 0.05 |
| Perfect/Rotate/Reflect | 0.20 | 0.40 | 0.05 |
| Proportional Accuracy | 0.60 | 0.60 | 0.51 |
| Corrected Proportion | 0.35 | 0.39 | 0.24 |
| Scoreable Attempts | 2.90 | 2.95 | 2.60 |

None of the scoring procedures yielded a significant effect of either learning mood-- F-ratios were all less than one-- or the interaction of learning mood and predicted level of interference.

Examination of the means in table 19 shows that the scores for the intermediate interference group were generally highest, followed closely by those for the minimum interference group. The maximum interference group showed the lowest scores. The differences were tested using Duncan's multiple range test. For perfect reproductions and for proportional accuracy, none of the mean differences were significant. For perfect, rotated, reflected and extra-line reproductions, the difference between the maximum interference group and the intermediate interference group approached significance at the .05 level, with an actual range of .35 and a critical range of .37. Corrected proportional accuracy means did differ significantly at the .05 level, with the intermediate interference group scoring better than the maximum interference group. The minimum interference group showed a score superiority over the maximum interference group which approached a significant level. The results of Duncan's multiple range test are presented in table 20 for corrected proportional accuracy.

Table 20. Duncan's multiple range test, corrected proportional accuracy scores, first set. A represents the maximum interference group, B the intermediate interference group, and C the minimum interference group.

| Group | Means | A | B | C | Shortest Significant Ranges |
|---|---|---|---|---|---|
| A | .24 | | .15 | .11 | R1 = .12 |
| B | .39 | | | .04 | R2 = .13 |
| C | .35 | | | | |

None of the differences in scoreable attempts approached significance.

Second set. Here, evidence for state-dependent recall was weaker than it was for the first set. When recall was assessed as the number of perfect reproductions, the F-ratio for levels of interference was 2.05 (df = 2, 54; p = .14). The F-ratio for perfect plus rotated or reflected or extra-line reproductions was 2.54 (df = 2, 54; p = .09). For proportional accuracy, the F-ratio dropped below 1 (F(2, 54) = 0.20, p = .82), and for corrected proportional accuracy, it was no better (F(2, 54) = 0.46, p = .63). The number of scoreable attempts also showed no significant differences (F(2, 54) = 0.03, p = .97).

The means for each scoring procedure for the second set of diagrams are reported in table 21.

Table 21. Means for each scoring procedure for each predicted level of interference, second set of diagrams.

| | Predicted Level of Interference | | |
|---|---|---|---|
| | Minimum | Intermediate | Maximum |
| Perfect Reproductions | 0.15 | 0.45 | 0.20 |
| Perfect/Rotate/Reflect | 0.20 | 0.60 | 0.30 |
| Proportional Accuracy | .62 | .65 | .62 |
| Corrected Proportion | .40 | .46 | .41 |
| Scoreable Attempts | 3.30 | 3.30 | 3.40 |

Examination of the means in table 22 shows, again, that the means for the intermediate interference group were generally the highest, especially for the first two variables. However, unlike the results for the first set of diagrams, these results showed that the minimum interference group scored at or below the level of the maximum interference group.

Mean differences were tested using Duncan's multiple range test. For perfect reproductions, no significant differences were found. However, the difference between minimum interference group and the intermediate interference group approached significance, with an actual range of .30 compared to a critical range of .32.

For perfect reproductions plus rotations, reflections and extra-line drawings, the intermediate interference group scored significantly higher than the minimum interference group at the .05 level. The results are presented in table 22.

Table 22. Duncan's multiple range test for perfect, rotated, reflected and extra-line drawings, second set. A represents the maximum predicted interference group, B the intermediate predicted interference group, C the minimum predicted interference group.

| Group | Means | A | B | C | Shortest Significant Ranges |
|---|---|---|---|---|---|
| A | .30 | | .30 | .10 | R1 = .37 |
| B | .60 | | | .40 | R2 = .39 |
| C | .20 | | | | |

None of the other mean differences (proportional accuracy, corrected proportional accuracy, or scoreable attempts) approached significance at the .05 level.

Intrusions. Like experiment I, the two-list learning in this experiment made possible an analysis of intrusions predicted by the SDL hypothesis. Only perfect reproductions were scored as intrusions, and these were analyzed for each set of diagrams, first as separate variables and then were added to the category of rotated, reflected and extra-line reproductions for a second analysis.

First set. No significant differences were found for number of diagrams from the first set intruding into the recall of the second set. However, when those intrusions were added to the number of reproductions which were perfect, rotated, reflected, or which had an extra line, the effect of predicted levels of interference approached significance ($F(2, 54) = 2.57$, $p = .09$).

The ensuing application of Duncan's multiple range test showed that the intermediate interference group scored significantly better than the maximum interference group, at the .05 level. The results are reported in table 23.

Table 23. Duncan's multiple range test, perfect reproductions plus rotations, reflections and extra-line drawings, first set, plus first-set intrusions into the second set. A represents the maximum predicted interference group, B the intermediate predicted interference group, and C the minimum predicted interference group.

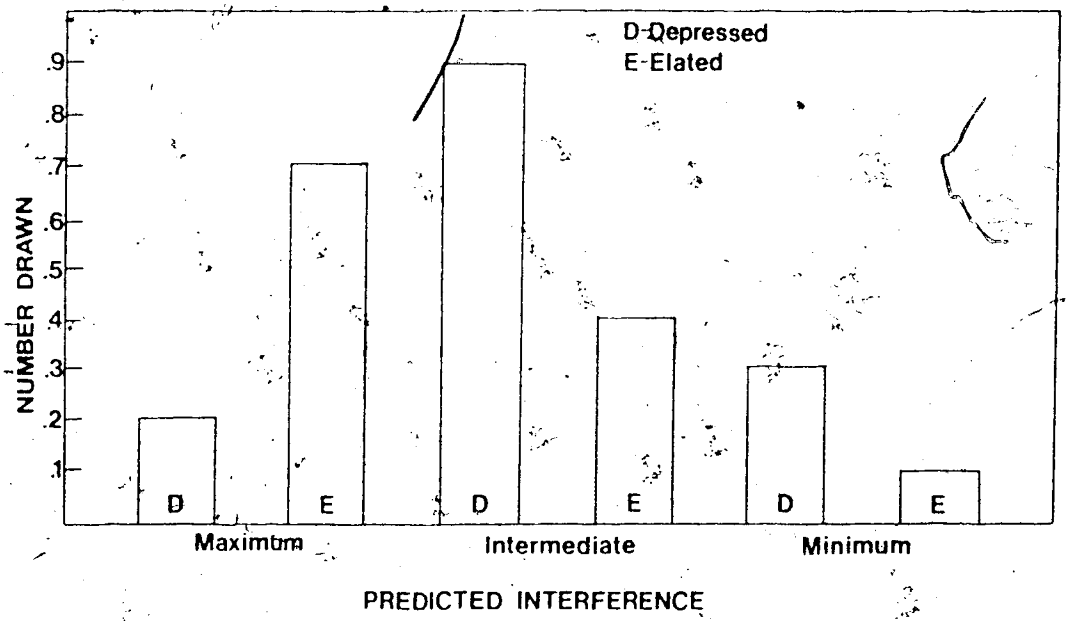
| Group | Means | B | C | Shortest Significant Ranges |
| --- | --- | --- | --- | --- |
| A | .05 | .45 | .20 | R1 = .40 |
| B | .50 | | .25 | R2 = .42 |
| C | .25 | | | |

Second set. A similar pattern was found for the second set, with no significant differences found for the number of intrusions of second set items into the recall of the first set, but near-significant effects when those intrusions were added to the number of reproductions which were perfect, rotated, reflected, or contained an extra line. In addition, the interaction between predicted level of interference and learning mood was significant for this combination variable. The results of the analysis are summarized in table 24, and the interaction is plotted in figure 9.

Table 24. Analysis of variance summary, diagrams from set two reproduced perfectly, or as rotations, reflections, with an extra line, or in the wrong recall task. Factor A represents predicted level of interference, factor B represents learning mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2.03 | 2 | 1.02 | 2.50 | .091 |
| B | 0.07 | 1 | 0.07 | 0.16 | .687 |
| AxB | 2.63 | 2 | 1.32 | 3.23 | .047 |
| Error | 22.00 | 54 | 0.41 | | |

Figure 9. Interaction of predicted level of interference and mood of learning, total of intrusions from set two into recall of set one plus set two diagrams reproduced perfectly, or as rotations, as reflections, or with an extra line.




It appears from figure 9 that the pattern of recall scores found thus far in experiment III (intermediate predicted interference group scoring highest) continued for the depressed groups, but not for the elated groups.

Keeping the significant interaction in mind, Duncan's multiple range test was done for the main effect of level of interference predicted. The minimum predicted interference group scored significantly lower than the intermediate predicted interference group, as summarized in table 25.

Table 25. Duncan's multiple range test, diagrams from the second set reproduced perfectly in either recall task, plus rotations, reflections, and designs with an extra line. A represents the maximum interference group, B the intermediate interference group, and C the minimum interference group.

| Group | Means | A | B | C | Shortest Significant Ranges |
|---|---|---|---|---|---|
| A | .45 | | .20 | .25 | R1 = .40 |
| B | .65 | | | .45 | R2 = .42 |
| C | .20 | | | | |

2 x 2 analyses

It was obvious from the foregoing results that the intermediate predicted interference group scored consistently as the highest. The intermediate predicted interference group was composed of subjects who had the same mood induced three times in the experiment. Consequently, a high level of recall was expected for both sets, higher than what was predicted when mood of learning did not match mood of recall.

Only where an interference effect is involved, as it was in Bower et al (1978), should performance on the intermediate group be poorer than that on the minimum group. Apparently, same-mood interference was not a factor in the present experiment. Accordingly, a second set of analyses were done, this time crossing learning mood with recall mood in a 2 x 2 design similar to that employed in experiment II.

First set. Here, with SDL effects measured by the interaction of learning and recall moods, support for the SDL hypothesis was even stronger than it was in the 3 x 2 analyses already reported.

Means of each of the four cells for the various recall measures are reported in table 26.

Table 26. Cell means for each recall measure, first set of diagrams.

| | DD | DE | ED | EE |
|---|---|---|---|---|
| Perfect Reproductions | .25 | .00 | .10 | .25 |
| Rotate, Reflect, etc. | .30 | .00 | .10 | .30 |
| Proportional Accuracy | .63 | .49 | .54 | .58 |
| Corrected Proportion | .39 | .22 | .26 | .35 |
| Scoreable Attempts | 3.00 | 2.50 | 2.70 | 2.85 |

All of the mean differences were in a direction compatible with the SDL hypothesis. The interaction F-ratios were progressively larger for each of the four scoring procedures.

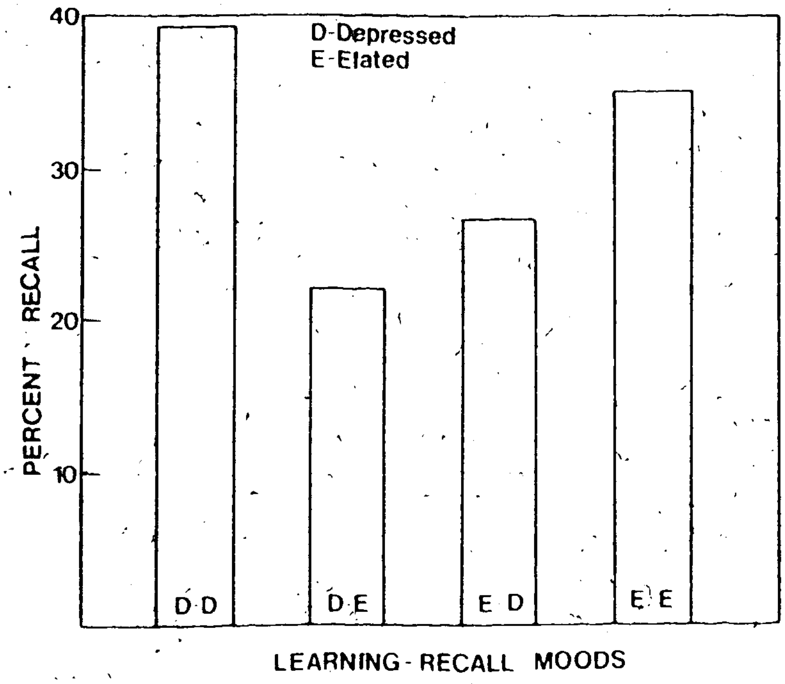
For perfect reproductions, the effects were not significant at the .05 level (F (1,56) = 1.83). However, a directional t-test comparing the same-mood group with the different-mood group yielded a t-value of 1.37 (df = 58, p = .09), with the same-mood group scoring higher. This is consonant with the SDL hypothesis.

For perfect, rotated, reflected and extra-line drawings, the effects were not significant, but the F-ratio for the interaction SDL effect was larger than it was for perfect reproductions (F (1,56) = 2.70, p = .11). In addition, a directional t-test comparing the same-mood group with the different-mood group indicated a superiority of the same-mood group, significant at the .05 level (t = 1.67, df = 58, p = .05). This also supported the SDL hypothesis.

For proportional accuracy, the F-ratio for the interaction SDL effect was close to being significant (F (1,56) = 2.93, p = .09). A directional t-test was conducted to compare same-mood groups with different-mood groups. The resulting t-score (1.73, df = 58) was significant at the .05 level, supporting the SDL hypothesis.

For corrected proportional accuracy, the SDL effect was significant at the .05 level (F (1,56) = 6.10, p = .02). The interaction is plotted as figure 10.

Figure 10. SDL interaction, corrected proportional accuracy, first set.




A directional t-test on corrected proportional accuracy showed that same- mood groups showed higher recall than changed mood groups (t = 2.50, 58 df, p = .01).

No significant differences were found for scoreable attempts, as all F-ratios were less than 1.

In addition, 2 x 2 analysis of intrusions showed no significant differences in number of intrusions taken alone, but for the sum of intrusions and perfect, rotated, reflected or extra-line drawings, the SDL interaction was very close to significance (F(1, 56) = 3.54, p = .06). The relevant directional t-test showed that the same-mood group scored significantly higher than the different- mood group (t = 1.91, 58 df, p = .03).

Second set. The 2 x 2 analyses showed absolutely no support for the SDL hypothesis in the second set of designs, for any of the scoring procedures. All of the F-ratios were less than one.

SDL in recognition

For the first set of diagrams, no evidence of SDL was found for recognition in either 3 x 2 or 2 x 2 analyses. For the 3 x 2 analysis, the F-ratio for predicted level of interference was 1.10 (df = 2, 54; p = .33). For the 2 x 2 analysis, the F-ratio for the SDL interaction was .71 (df = 1, 56; p = .40).

For the second set of designs, however, the story was quite different. In the 3 x 2 analysis, the effect of predicted level of interference produced an F-ratio of 2.60 (df = 2, 54; p = .08). The means here were lined up as predicted, with the maximum predicted interference group mean of 4.90, the intermediate predicted interference group mean of 5.75, and the minimum predicted interference group mean of 5.95. Duncan's multiple range test showed that the maximum interference group scored significantly lower than the minimum interference group at the .05 level, as shown in table 27.

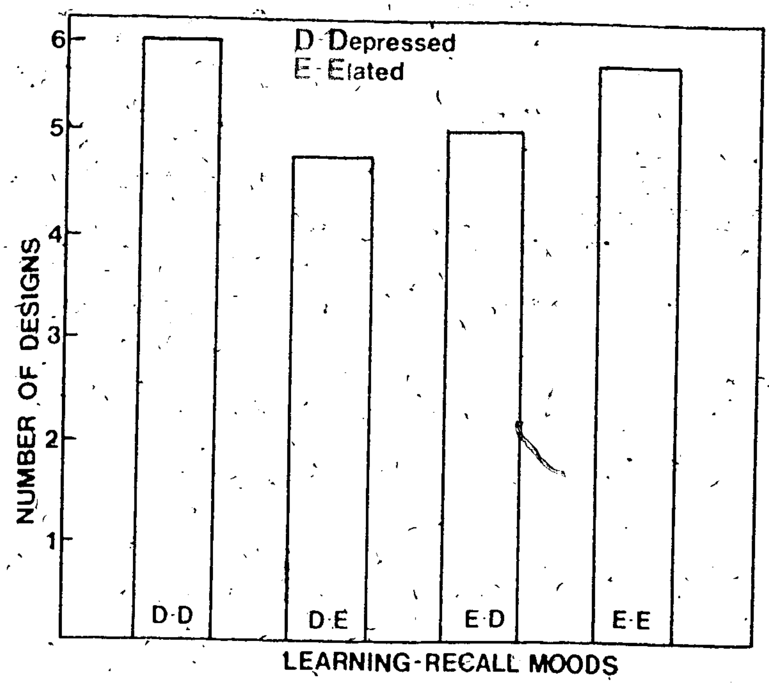
Table 27. Duncan's multiple range test, recognition scores for the second set of designs. A represents the maximum predicted interference group, B represents the intermediate predicted interference group, and C represents the minimum predicted interference group.

| Group | Means | A | B | C | Shortest Significant Ranges |
|---|---|---|---|---|---|
| A | 4.90 | | .85 | .20 | R1 = .98 |
| B | 5.75 | | | 1.05 | R2 = 1.03 |
| C | 5.95 | | | | |

In the 2 x 2 analysis, the recognition-SDL interaction (F (1,56) = 5.17) was significant at the .05 level.

The interaction is plotted in figure 11.

Figure 11. Interaction of mood of learning and mood of recall, recognition scores for the second set of designs.




The same-mood groups recognized significantly more designs from the second set than did the different-mood group ($t$ (58 df) = 2.31, $p$ = .01).

## Mood performance

The series of 2 x 2 analyses of variance also provided evidence regarding the mood-performance hypothesis. That is, the two learning moods were crossed with the two recall moods, and the main effects on recall and recognition performance were assessed.

For the first set of diagrams, none of the recall measures showed any support for the mood-performance hypothesis. All of the relevant F-ratios were less than 1.

The learning mood, however, did affect the recognition performance for the first set ($F(1, 56) = 8.48$, $p = .005$). Here, the elated group (mean = 5.8) scored higher than the depressed group (mean = 4.8).

For the second set, mood of recall produced significant differences in the number of reproductions which were perfect, rotated, reflected or contained an extra line ($F(1,56) = 4.55$, $p = .04$), with the depressed group (mean = .53) scoring higher than the elated group (mean = .20). The depressed group (mean = 3.7) also scored higher than the elated group (mean = 3.0) on the number of scoreable attempts ($F(1,56) = 5.55$, $p = .02$) and on the total of intrusions and perfect, rotated, reflected and extra-line drawings (depressed mean = .63, elated mean = .23, $F(1, 56) = 5.56$, $p = .02$).

In addition, analysis of mood of learning showed that the elated group made more scoreable attempts (mean = 3.6) than the depressed group (mean = 3.1), at a level close to significance ($F(1, 56) = 3.55$, $p = .06$).

Putting all of these effects together, there appears to be some evidence that an elated learning mood and a depressed recall mood improve performance. Furthermore, where an SDL effect was found, in the recall measures for the first set and in the recognition measure for the second set, there was no evidence of mood performance effects, suggesting that the two may be mutually exclusive.

Mood manipulation.

Point-biserial correlations between the Velten mood induction procedure (elated vs. depressed) and the corresponding HMACL4 scale scores appear in table 28.

Table 28. Point-biserial correlation coefficients, Velten mood by HMACL4 scale score. Positive coefficients show a direct relationship with elated mood, negative coefficients show a direct relationship with depressed mood.

| Scale | First Mood | Second Mood | Recall Mood |
|---|---|---|---|
| UP MOODS | | | |
| CN | .81 | .71 | .60 |
| CO | .72 | .69 | .54 |
| PT | .73 | .72 | .50 |
| OP | .79 | .74 | .67 |
| DOWN MOODS | | | |
| DP | -.81 | -.73 | -.47 |
| SL | -.71 | -.72 | -.54 |
| AX | -.38 | -.26 | .06 |
| SC | -.52 | -.33 | -.09 |
| AG | -.52 | -.28 | .05 |
| NEUTRAL | | | |
| CL | .20 | .24 | .16 |

The mood-induction procedures were highly successful for the mood of learning the first set of diagrams, but declined across subsequent administrations. The up-mood indicators, even at their lowest, were high by comparison with the results of experiments I and II. The down-mood indicators, like DP, SL, and especially AG, did show a major decline in point-biserial coefficients, indicating that later mood manipulations were less successful in altering these moods.

As in the earlier experiments, a goodness-of-fit score was obtained, this time using the six fairly consistent variables of concentration (CN), depression (DP), co-operation (CO), sleepiness (SL), potency (PT), and optimism (OP). These goodness-of-fit scores were then correlated with the corresponding recall and recognition scores, such that significant negative coefficients of correlation would indicate support for the SDL hypothesis. None of the resulting correlations were significant at the .05 level.

The pattern of effects of the mood manipulation scales, assessed by analysis of variance on HMACL4 scale scores, was similar to that found in the first two experiments, providing further validation for the Velten procedures as used here.

## Discussion

### SDL in recall

In this third experiment, an SDL effect in recall was found for the first set of diagrams, but not for the second set. The 3 x 2 analyses, comparing predicted levels of interference, demonstrated an SDL effect when recall was scored as corrected proportional accuracy.

Examination of the means of the three levels of interference showed that the intermediate interference group produced the highest level of recall. This was consistent with the results of experiment I, for which the interpretation offered was that for the two consistent-mood groups--EEE and DDD--the greatest similarity was induced across conditions of learning and testing. Consequently, the same groups, which make up the intermediate predicted interference group, should demonstrate the strongest recall, if the SDL hypothesis is accurate.

The notion that the consistent mood groups (EEE and DDD) should produce intermediate interference came from Bower's earlier work (Bower et al, 1978), where they were identified as control groups. The idea was that the similarity of the mood of the two learning phases should contribute to interference more than if the mood changed between the two learning phases. Thus, at the recall p[illegible] mood cue should stimulate recall of both lists, p[illegible] interference the one with the other.

In experiments I and III of the present study, it became obvious that interference was not a significant factor in the consistent-mood groups, being overruled by the list cue ("first" vs. "second"). Two developments in Bower's most recent research support this contention (Bower, 1984). First, he argues that cross-list interference in recall rarely occurs in his studies, although he consistently demonstrates SDL. Thus, it appears that cross-list interference is not the necessary feature in order to demonstrate an SDL effect.

However, he also observes that an SDL effect for mood can be much more reliably demonstrated in a multilist experiment than in the single-list 2 x 2 design typical of drug SDL studies. Why might this be?

Certainly the multilist experiment is more difficult for the subject, in that more information--especially list identifiers--must be learned and kept correlated with the stimulus material in memory. Thus, the more difficult task lowers the ultimate recall scores at posttest, eliminating any problem of a ceiling effect and increasing the probability of reliance upon mood as an access cue in memory.

It may also be, of course, that the greater reliability of mood-SDL effects in multilist studies (specifically, Bower et al, 1978; and Bower, 1984) is an artefact of better experimental design and methodology. The discovery of an SDL effect in experiment II of the present study supports that contention.

The second development in Bower's (1984) work was the elimination of consistent- mood groups from his design: he tested only groups in which there was at least one change of mood, eliminating the control groups of the 1978 study and establishing a symmetrical design. Given the results of the present study--best performance for the consistent-mood group--that course seems to be recommended for future multilist studies in mood-state dependent learning.

Although there was no direct evidence of SDL found in recall for the second set of diagrams, here again the consistent-mood groups (DDD and EEE) showed the highest recall scores. Given this repeated failure to find the hypothesized interfering effect of consistent mood in the multilist experiment, collapsing the 3 x 2 design into a 2 x 2 design for analysis seems defensible.

The 2 x 2 analyses of the first set of diagrams showed consistent support for the SDL hypothesis: marginally for perfect reproductions, and significantly for the other measures of recall. This repetition of the findings in experiment II was indeed encouraging. Again, a mood-SDL effect was found with non-verbal stimulus material.

Furthermore, and unlike experiment II, this experiment showed SDL effects for both elated and depressed moods, showing that the SDL effect is not restricted to depression.

The failure to find an SDL effect for recall in the second set of designs must be explained. Two factors seem to be involved. First, the superior recall scores for the second set of designs indicates that forgetting was greater overall for items from the first set of designs. That is to be expected, since more time had elapsed since learning the first set than had passed since learning the second set. Consequently, cues to memory other than mood were still active for the second set, making mood a superfluous cue. That is, all of what had been learned from the second set was recalled without recourse to the mood cue, the same problem faced by Bower et al (1978) in their first experiment.

The second factor becomes apparent when we examine the correlation coefficients in table 36. The declining correlation coefficients across the three phases showed that the Velten procedure was less effective in inducing the desired mood for the learning of the second set than it was for the first set. That is, the induced moods for learning the first set of diagrams were stronger than they were for learning the second set. Consequently, when a mood-cue was reestablished at the recall phase, albeit relatively weakly, it was a more effective cue for recall of material for which mood had been a salient feature during learning. The diminished salience of the mood cue for the learning of the second set of designs decreased its value in the recall task, and that, coupled with the increased value of other cues for the second set already pointed out, effectively eliminated the SDL effect for the second set of designs.

The salience of the mood cue was pointed out by Leight and Ellis (1981). They had used Velten's neutral mood statements for one of their mood inductions, and found it ineffective in producing a mood state which was sufficiently powerful to serve a cuing function in the learning of material. A similar effect can be seen for the second set of diagrams in the present study: Since the second mood manipulation was not as successful as the first, it was not as likely to produce a significant mood state cue for learning. Thus, even though the mood states on learning the second set and on recall were highly similar, the similarity was with respect to a relatively neutral and therefore non-salient cue.

Herein lies a possible modification to the SDL hypothesis: Similarity of mood is likely to enhance recall only when the learning mood was of sufficient strength to provide a salient, discriminable cue. If the learning mood is strong or unusual, then it will produce an SDL effect at recall even if the two mood states--at learning and at recall--are only somewhat similar.

This is in accord with Baddeley's argument that the context, if it is sufficiently differentiable, is grouped with the learned material in the encoding process. A weak context cue, lacking salience, is not likely to be encoded with the learned material, and thus is not likely to provide a cue for recall, <u>even if the context is perfectly re-established</u>. That is why the neutral statements in Leight and Ellis (1981) were ineffective in the demonstration of mood-SDL effects.

This hypothetical modification also explains why the SDL effect in Bower's 1984 study was weaker than that found in 1978. In 1984, Bower induced mood using the Velten procedure, which, he suggests, was a less successful mood inducer than the hypnotic procedure used in 1978. Consequently, the mood induced was not as extreme, and was less valuable as a cue in the encoding of the learned material.

In addition, although the anger mood induction in

Bower (1984) grew weaker across the three phases of the experiment--similar to the effects in the present experiment-- the salience of the anger state at learning made it a useful cue at recall, and an SDL effect was found. Bower reported his data only for the two lists combined, so it could not be ascertained whether SDL was stronger for the first learned material, when the anger mood was stronger, than for the second learned material.

This may also explain why the SDL effects in the present series of experiments were generally stronger if the mood-state was depressed than if it was elated. That is, depression may be a more salient state than elation. Certainly the depressed state as experienced by the participants was abnormal and undesirable, even noxious. The elated state, however, appeared to have been experienced as normal, real and expected, making it less salient as a discriminating cue for learning. This accords with Nelson (1971), who that in college students over the course of an academic year, cheer is dominant over discouragement or depression, in the order of two or three to one.

Furthermore, if depression lowers distractibility, as suggested by Nelson (1984), then the associational load on the depressed-mood node will be restricted to the material learned, while the load on the elated-mood node will include other stimuli concurrent with the learning stimuli. If such a difference in node load existed, one would expect a stronger SDL effect for the lightly loaded depressed mood node.

The significant interaction of learning mood and predicted level of interference for the total number of diagrams reproduced from the second set, either perfect, reflected, rotated, with an extra line, or in the wrong recall task (table 32; figure 9) is difficult to interpret. It appears that for those who learned the second set of designs in a depressed mood, the recall scores were not inimical to an SDL interpretation, while for those who learned in an elated mood, an SDL effect was contradicted.

It may be interesting to note that a similar pattern was found for the four main recall measures for the second set of diagrams: an SDL-compatible pattern similar to that found for the first set if and only if the learning mood was depressed. The interactions of predicted level of interference and learning mood was not significant for those variables however.

These patterns accord with the above speculation that a depressed mood as induced by the Velten procedure is a more effective means of producing SDL effects than is an elated mood. That suggestion also meshes with the results of Bower (1984), who found that the state- dependent recall score for anger-- a down mood-- was larger than that for happiness (means of .74 and .68 respectively, compared with means of .60 and .56 for the changed-mood groups).

SDL in recognition

The failure to find mood-SDL effects in recognition for the first set of designs was consonant with the results of experiment II, and was not unexpected. Since SDL effects in recognition seem to be dependent upon the use of interactive coding by the subject (Baddeley, 1982), and since interactive coding of mood statements and these designs is unlikely, the failure to find recognition SDL comes as no surprise.

What was surprising was the strong evidence for an SDL effect in the recognition test for the second set of designs. This finding is not compatible with the theories offered by Bower and by Baddeley, but it is consonant with the equally surprising results of Leight and Ellis (1981).

It is possible, of course, that this is a rare chance event. The similarity of the pattern here (Figure 11) to that found for recall of the first list makes such an interpretation unlikely.

It seems more likely that this is a valid case of SDL in recognition, an exception which must be explained.

Bower (1984), failed to find state-dependent recognition in his fourth experiment, the one which most closely parallelled the present study. One reason for this, suggested by Bower, was the problem of a ceiling effect on recognition. In the present study, a ceiling was not a problem in recognition testing for either set of designs, and yet state-dependent recognition was found for the second set and not for the first. Why?

Apparently, mood state served as a useful cue in the second recognition task. It may be that by the time the participants reached the second learning task, they were sufficiently familiar with the experiment as to employ some self-generated interactive coding strategies. It is possible, as proponents of memory training frequently observe, to assign a particular label to any stimulus through the use of imagination. Thus, salient words from the mood statements could have been assigned to particular designs in the second set in a deliberate interactive coding process. This, according to Baddeley, would enable a state- dependent effect to be manifested for recognition. That does not explain, however, why the same interactive coding--if it did occur--failed to produce an

SDL effect for recall.

Another possible interpretation is that for the special circumstances in this study-- a very difficult learning task, coupled with weakening effects of the mood manipulation-- SDL will be found only for recognition. Why might this be?

First, SDL in recognition may be found only if the material is poorly learned. This would explain the failure to find state-dependent recognition in studies which find a ceiling effect in recognition testing. That is, if the material had been poorly learned, one would hardly expect to find recognition performance to be at a maximum, but rather at a level not much above chance responding or guessing.

Second, SDL in recognition may be found only if there is interference during the learning phase coming from previous learning. This would explain why state dependent recognition was found for the second set of designs and not for the first set, and it also accounts for the absence of state dependent recognition in the second experiment reported here.

That is, for the second experiment and for the first set of designs in the third experiment, no material from previously-learned designs was interfering with the learning process. Thus, the participant's full attention could be directed toward memorizing the stimuli, with no separate coding necessary to specify list information. When the second set of designs was being learned, the participant had not only to learn the actual designs, but also code them as distinct from those learned previously. This made the second task more difficult than the first, and set up the circumstances necessary for state-dependent recognition.

During the recall task for the second set of designs, the list membership information encoded during the learning phase was again available, reducing reliance on mood cues and eliminating the SDL effect. In the recognition test, however, the availability of the correct designs and the lack of interfering designs from the first set made the list membership information superfluous, and the relative value of the mood cue increased, producing an SDL effect.

For the first set of designs, there could have been no deliberate, conscious encoding of list membership during the learning phase, since participants did not know that they would be asked to memorize a second set of designs. Consequently, the mood state was the most valuable cue encoded-- perhaps deliberately, since the mood manipulation procedure made mood a salient cue in the experiment-- and it therefore served as a retrieval cue in recall testing, producing evidence for SDL. The novelty of the task while learning the first set of designs may mean that interactive coding was less likely for the first set of designs than for the second, thus explaining in traditional theoretical terms (Baddeley, 1982) the failure to find state dependent recognition for the first task.

A third possible interpretation is the so-called demand hypothesis (Bower et al, 1978; Bower, 1981, 1984). That is, participants may have guessed the hypothesis behind the experiment, and attempted to provide the appropriate responses. For recall, task difficulty made actualization of the demand characteristics impossible, while the recognition task made such helpful responses easy. This hypothesis could explain the results for the second set of designs, but it fails miserably for the first set of designs and for experiment II. If the demand hypothesis was not actualized in the first set of designs simply because the subject was not yet sufficiently familiar with the experiment to know how to provide the demand responses, then it is difficult to understand why an SDL effect should have been found for the recall measures.

The second hypothesis offered here, that SDL in recognition will be found only if the material is poorly learned and subject to interference from previous learning, seems more tenable at the present time. It specifies the parameters for state-dependent recognition more precisely than prior theories have done, and it fits the data.

This hypothesis is also congruent with the finding by Leight and Ellis (1981) of state-dependent retention only for recognition and only for the constant-input group. For the varied-input group, it will be recalled, the groupings of the letters of each hexagram changed from one presentation to the next. Thus, the encoding process during learning involved not only the storage of the stimuli in memory, but also some manipulative comparison of each stimulus with the memory trace for the same stimulus, grouped differently. The coding of this additional information (eg "BO NK ID is the same as BON KID") made another cue available at the time of retention testing for the varied input group. Consequently, the mood context was a less valuable cue. For the constant input group, however, the grouping information was not singled out for separate coding, and was unavailable as a cue for recall, forcing greater reliance on mood context and producing an SDL effect for recognition.

Mood performance

For the first set of designs, the only evidence of mood influencing performance was found in the recognition test, where an elated learning mood led to higher recognition scores. This was the only finding in the entire study which solidly supported the hypothesis that an up mood improved performance.

All of the other mood-performance effects were in the opposite direction, such that an elated mood at recall impaired performance relative to a depressed mood.

Two points for discussion come from this. First, there is now some evidence for the hypothesis that a down mood at recall improves performance relative to an up mood. This may be a function of decreased distractibility and increased concentration on internal processes like memory when a down mood is induced. That is, the down mood manipulation using Velten may have an introverting effect, focussing attention inwardly and improving cognitive performance. In addition, as is pointed out by Nasby and Yando (1982) and by Leight and Ellis (1981), individuals have typically developed strategies for dealing with depressed mood states by the time they reach college age, in order to maintain performance at as high a level as possible. When faced with a depressed mood their strategy is to bear down, to put extra effort and concentration into the task at hand. All of this is in accordance with the self-regulatory model proposed by Mischel, Ebbesen and Zeiss (1973; 1976). The extra effort is then met with improved performance, and the performance improvement leads to a weakening of the depressed mood.

An elated mood does not benefit from such a strategy, the general assumption being that if one is in a good mood, task performance is easier, and requires less attention and effort. It follows, then, that if the task does require a great deal of attention and effort, as it did in this study, then a depressed mood will lead to improved performance.

The notion that depressed mood improves performance in this way is parallelled by Nelson's (1971) finding that discouragement and voluntary effort are positively correlated in college students. Thus, in the present study, depressed students recalled more because they tried harder.

The second point is the observation that in this experiment, mood-performance effects and SDL effects seem to be mutually exclusive. SDL was found for recall for set one, and for recognition for set two; mood-[illegible]ance was found for recognition for set one, and for [illegible] set two.

This suggests that mood-performance effects may represent another factor which interferes with the expression of mood-SDL. Just as the availability of other reliable cues to recall eliminates SDL, so might the improved performance brought about by a particular mood.

Why an effect of mood on performance should interfere with SDL is an open question. It is unlikely that the coping strategies used to deal with a down mood would render that mood a less salient context cue for SDL. If anything, it should be more salient. Furthermore, in both experiments II and III here and in experiment IV of Bower (1984), the groups with the greatest evidence of state-dependent recall were the double down-mood groups--depressed or angry both at learning and at recall.

Future research must address the question of the mutual exclusivity of SDL and mood performance effects. For now, the idea must remain germinal.

Mood manipulation.

Again, the point-biserial correlations between induced mood and HMACL4 scale scores showed that the Velten procedure was an effective technique for the manipulation of mood.

The decline of point-biserial coefficients for each scale was not expected, and is a new finding in this experiment. The major change which may have led to this was the use, for the second and third mood manipulations, of abbreviated instructions which relied on recall of the first, more elaborate set of instructions. It will be recalled that abbreviated instructions were used in an attempt to alleviate boredom, since in the earlier experiments subjects had expressed considerable resistance to reading the same instructions repeatedly.

To the extent that the summarized instructions were less successful than the first set of instructions, the decline in induced mood scores is understandable.

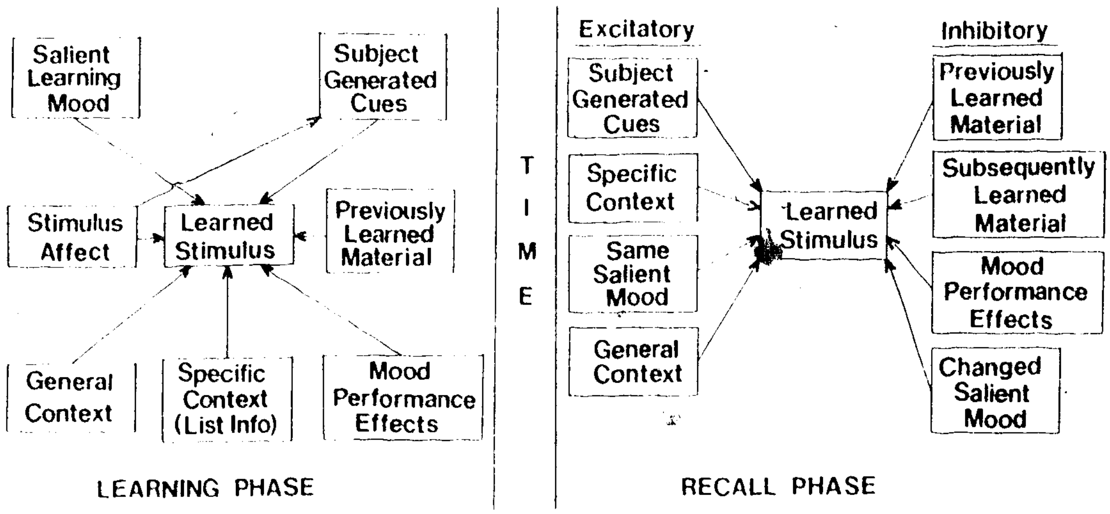
Future research must cope with these problems. One approach might be to write three sets of instructions, parallel in semantic content but varied in presentation. This would attenuate the resistance of the subjects to the boredom of repetition, while keeping the instructions strongly in awareness.

Another approach would be to revert to the previous pattern, using the same instructions repeatedly, and suffering the negative responses of participants gladly, since that procedure is successful in repeatedly inducing the desired mood.

The failure of the goodness-of-fit scoring procedure to indicate any support for the SDL hypothesis again was disappointing. Apparently, the goodness-of- fit score as a sum of scale score differences is too variable an indicator of mood similarity to be a valid measure of context cues. For some subjects, an elated mood induction might yield high scores on concentration and potency coupled with low scores on depression and sleepiness, with the other goodness- of-fit indicators intermediate. For other subjects the same elated mood induction might yield moderately high scores for all of the up-mood indicators and moderately low scores for all of the down-mood indicators. The resulting goodness-of-fit scores would be quite different, even though the success of the mood induction is approximately equal in both cases. Thus, the goodness-of-fit score introduces too much variability into the mood measurement process, and should be abandoned.

The following model (figure 12) is offered as a preliminary synthesis of the results of these experiments and the theories of Bower and Baddeley. It incorporates suggestions by Cartwright (1984).

Figure 12. Provisional model of the variables in mood-SDL.




In the learning phase, the learned stimuli may be paired with experimenter- provided specific context cues, such as paired associates or, as in these experiments, list information (list 1 vs list 2). The subject may also generate cues to be paired with the learned stimuli, including the evaluation of the stimuli as happy or sad (experiment I). Any or all aspects of the general context may be paired with the learned stimuli: laboratory setting, experimenter attributes, season of the year. A salient learning mood may be paired with the learned material, or it may alter the subject's behavior so that mood-performance effects increase or decrease storage of learned stimuli in memory. Finally, previously learned material may be recalled, interfering with current storage or intruding by being stored with the new learned material.

At the recall phase, these many cues may be categorized as exciting or inhibiting accurate performance. On the excitatory side, I have arranged the cues hierarchically from top to bottom. Subject-generated cues and specific context cues seem to be the most important in these experiments, followed by salient mood cues and general context cues. If all of these are operating, recall will be quite good. However, if a different salient mood has been established, either through manipulation or decay, or if characteristics of the mood state have changed (eg emotional cognitions or physiological correlates), the benefit of the salient mood will be lost, and performance will deteriorate to the extent that recall was dependent upon the mood cue. Mood performance effects at recall may interfere with concentration and effort, as elation seems to do, thus lowering recall even if the mood-state is re-established: thus the poorer evidence of SDL under elation than under depression. Finally, as in the learning phase, interference and intrusion of previously learned material may impair performance. In addition, interference from subsequently learned material may also be found at recall, but not during learning.

## General Discussion

Three of the findings of these experiments were novel. First, state-dependent recall was demonstrated for visual, mood-irrelevant simuli, strongly when the mood is depressed, but also when elated. This has at least two major implications.

The first is that mood-state dependent recall can be demonstrated when the material to be learned does not interact with the processing of the mood manipulation. In these findings, the mood state manipulation is verbal, while the material is non-verbal. Thus, the mood cue must be serving as a true context cue, in the tradition of SDL experiments using drugs and situational context. That is, there is little likelihood that the mood is being related deliberately or meaningfully to the stimuli during the encoding process. To my knowledge, these are the first experiments in mood-SDL to successfully separate mood as context from the material to be learned. These experiments therefore provide an adequate test and confirmation of Bower's association network theory. The mood is encoded in memory here purely as a context cue, available to the subject at recall as an aid to retrieval.

The second major implication concerns the finding of mood-SDL for visually- processed material.

Some prior studies demonstrating SDL have presented the stimuli visually. Leight and Ellis (1981), for example, visually presented the hexagrams in constant or varied groupings. However, as they observed, the hexagrams were chosen for high meaningfulness, and furthermore, since they were composed of pairs of CVC trigrams, they were highly pronounceable. It is virtually certain, then, that their stimuli were processed phonically and semantically as well as visually.

The present experiments mark the first successful demonstration of SDL with non-pronounceable, meaning-irrelevant material. The success of mood-SDL for such material suggests that the mood-context, although verbally induced, has a sufficiently pervasive effect to become a useful cue for retrieval of visual material.

The second novel finding in this study was the discovery of state-dependent recognition for visual, non-affective material, where interactive coding was unlikely. As already argued, this may be due to the special circumstances prevailing in this study. Nonetheless, it was not predicted by either the association network theory or the interactive coding hypothesis, and represents a limitation or a need for further modification in those ideas.

The third novel finding was the discovery of superiority in recall performance as a function of depressed mood. This runs directly counter to the expectation that an up-mood improved performance, and serves to direct consideration of mood-performance effects away from the activational effects of mood toward the attentional and directional effects both of mood states and of individual strategies for dealing with mood states.

Since we typically have to continue to perform even when in a down mood-- at school, on the job, or even at home-- we must develop coping strategies. These strategies serve two purposes. First, they enable one to perform well in spite of the down mood. Second, they serve to help us overcome the bad mood, since good performance in the face of a bad mood is contradictory. Then, through the cognitive manipulations upon which the Velten procedure is based, the good performance feedback leads to a decay of the bad mood. According to this line of reasoning, it is not mood which influences performance so much as it is performance which influences mood, a position advocated by Blomkvist (1982).

This result serves to explain why the up-mood indicators in experiments II and III declined after the recall task. Since all subjects performed poorly in the recall tasks, this negative feedback served to reduce any elated mood and increase any depressed mood.

The possibility that performance influences mood, rather than vice versa, does not affect the mood-SDL hypothesis, since mood-SDL is based upon the contextual role of mood rather than on any motivational factor.

Polivy's (1981) comments about the multidimensionality of mood induction procedures were verified in the present study. The HMACL4 assessments after each mood manipulation showed that the Velten procedure was most effective for concentration, depression, cooperation, sleepiness, potency, and optimism; somewhat less effective for anxiety and anger; and virtually ineffective for scepticism and control. However, the elating Velten statements consistently produced significant elevations of the up-mood indicators (concentration, cooperation, potency and optimism), along with parallel depression of the down-mood indicators (depression, sleepiness, anger and anxiety). Analogous effects were produced by the depressing Velten statements-- increased depression, sleepiness, anxiety and anger; and decreased concentration, optimism, co-operation and potency. It seems, then, that the mood-changes induced by the Velten procedures are, while not global, certainly broad-band. It thus is valid to speak of Velten-induced moods of general elation and depression.

Conclusion

The topic of these studies was interesting to me as it meshed with my observations of the behavior of students taking examinations. I saw how inability to recall previously-learned material was parallelled by high levels of anxiety and frustration, and a depressed mood. Nelson (1971) had compared the moods of college students with the typical tasks of an academic semester over a full academic year, and found that the parallels were remarkable. The obvious question arose: What is the relationship between emotional response and memory for previously- learned material?

It appears that the mood-states of elation and depression are effective context cues for recall of affect-irrelevant visual stimuli in both male and female participants, provided the task is not well-learned. Similarity of mood-state from learning to recall results in better performance than does dissimilarity of mood state.

The demonstration of mood-state dependent effects for material with little or no affective valance increases the generality of the effect, supporting the validity of SDL interpretations of psychogenic amnesia, fugue states, and multiple personality (Davison and Neale, 1982) as well as classroom test performance.

Finally, the failure of the good mood-good performance hypothesis provides one more nail in the coffin so well prepared by Blomkvist (1982).

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# Appendix A

The stimulus words used in experiment I of the present study, grouped as happy or sad, are listed below along with the words used by Bower et al, 1978.

| My list | | Bower's list | |
|---|---|---|---|
| Happy words | Sad words | Happy words | Sad words |
| pleasure | hardship | fantasy | disparity |
| distinction | folly | prosperity | predicament |
| affection | discipline | heroism | exclusion |
| heaven | tragedy | charm | demon |
| heroism | misery | gaiety | temerity |
| prosperity | crisis | affection | hostility |
| safety | demon | miracle | atrocity |
| charm | death | amazement | suppression |
| life | sadness | pep | misery |
| victory | hostility | advantage | blandness |
| gaiety | trouble | humor | tragedy |
| agreement | devil | comradeship | impotency |
| miracle | panic | mastery | death |
| humor | fault | intimate | trouble |
| power | chaos | victory | jeopardy |
| fun | adversity | pleasure | irony |

## Appendix B

### CONSENT FORM

BY SIGNING BELOW, I AFFIRM THAT I UNDERSTAND THAT MY PARTICIPATION HERE IS VOLUNTARY, THAT ANY INFORMATION I PROVIDE WILL BE HELD IN CONFIDENCE, AND THAT I MAY WITHDRAW FROM THIS EXPERIMENT AT ANY TIME FOR ANY REASON WITHOUT PENALTY OR PREJUDICE. I HAVE BEEN TOLD THE GENERAL PROCEDURE OF THIS STUDY. IF I COMPLETE THE EXPERIMENT, I HEREBY GIVE THE INVESTIGATORS PERMISSION TO USE IN CONFIDENCE ANY AND ALL DATA PROVIDED BY ME.

______________________________ SIGNATURE

________________ DATE

## Appendix C

Here are the experimental scripts for each of the experiments. They include the detailed procedural steps and a transcript of the instructions given to the subjects. The general debriefing appears at the end of this appendix.

### Experiment I

Each subject was first asked to complete one copy of the HMACL4, with these and all following instructions presented by a tape recording of the experimenter's voice. The experimenter emphasized the instructions by saying,

> Notice the instructions. You are to indicate how you feel <u>right now</u> by using these codes. If you <u>definitely</u> do not feel that way, leave the space blank. If you do not feel that way, put a 1. If you feel that way, put a 2. If you <u>definitely</u> feel that way, put a 3. Do you understand? Good. Go ahead and complete the form, indicating how you feel <u>right now</u>.

Upon completing the HMACL4, the participant was given the instructions for the first Velten mood-manipulation procedure. "Instructions were in the first person, typed entirely in capitals on lineless index cards, and were placed before S [ubject] by E [xperimenter] one by one as

S [ubject] completed reading the previous card" (Velten, 1968, p. 474).

One-half of the participants were given the depressed mood statements, and the other half were given the elated mood statements. All read the statements silently, then aloud.

After reading each set of Velten statements, the participant was asked to "Please try to maintain the mood you have just established while we do the next part of the experiment," after Bower et al (1978).

At that point, the HMACL4 was administered a second time, using the same instructions as before. The first mood manipulation was now complete.

This experiment required the subject to learn two lists of words, in order to introduce retroactive interference. One list of words was learned in induced mood 1 (elated or depressed), a second list of words was learned in induced mood 2 (elated or depressed), and recall was tested in induced mood 3 (elated or depressed).

The sequence of the two word lists was counterbalanced across subjects. One-half of the participants received list A first (as list 1), and the other half received list B first (as list 1).

After the induction and measurement of mood 1, the following instructions were given:

> I will be reading a list of 16 common words to you. I shall read the list through twice, but the order of the words will change. I will read at the rate of one word every three seconds. When I have finished, I will ask you to recall as many of the words as you can. Do you understand?

When the subject understood the instructions, the words were presented in random sequence, twice through, by tape recording. Recall was then requested by the following instructions:

> Now, please recall orally as many of the words from the list as you can remember. You may say the words in any order.

The responses were tape-recorded.

A second such study-recall cycle was carried out using the same word list, this time with the words in new random orders. These instructions were given:

> I am going to say the words again, twice through as before. When I have finished, I shall ask you to recall them again.

The words were presented as before, and again the responses were tape recorded. The recall scores on this second part of the learning task were recorded as the original learning scores (OL) for List 1, and appear in table 3.

After a minute's rest, a second set of Velten mood induction statements was administered, with instructions the same as for the first set. One-half of those who had previously received the elated-mood statements now received the depressed-mood statements, while the other half again read the elated-mood statements. Similarly, one-half of those who had previously received the depressed-mood statements now received the elated-mood statements, and the other half read the depressed-mood statements again. Thus, in the learning phase, four groups were established: elated-elated, elated-depressed, depressed- elated, and depressed- depressed.

The MMACL4 was then administered, followed by a second learning task. The second learning task was introduced with these instructions:

> Now I will read another list of 16 words. I will read the list through twice, in different orders, at the rate of one word every three seconds. When I have finished, I will ask you to recall as many of the words as you can. Do you understand?

The words were then presented in two separate, randomly-determined sequences, by tape recording. The subject was asked to recall the words with the following instructions:

> Now, please recall orally as many of the words from the list as you can remember. You may say the words in any order.

The responses were recorded on paper and on tape for later scoring.

A second study-recall cycle was carried out, as it was for list 1, and the words were presented in two new random sequences. The following instructions were given:

> I am going to say the words again, twice through as before. When I have finished, I shall ask you to recall them again.

Again, the responses were recorded.

An intervening distractor task was then introduced, similar to Bower et al (1978). The participant was given a chapter from _Toward a self-managed life style_ (Williams and Long, 1979), with the following instructions:

> Please spend the next few minutes reading this chapter. Read carefully, as you will be asked

to summarize what you have read.

Five minutes later, the experimenter took back the book and asked for a summary with these instructions:

Now, please tell me in your own words what you learned from your reading. Just tell me the main themes or ideas in what you just read.

Two minutes were allotted for the summary procedure, and the subject's report was tape recorded.

Next, the third Velten mood manipulation procedure was introduced. Again, one- half of the subjects read the elated-mood statements, and one-half read the depressed-mood statements. Allocation of subjects to groups this time was such that one-half of the subjects were given the mood statements they had received for learning list 1, and one-half were given the mood statements they had received for learning list 2.

The HMACL4 was administered, with the same instructions as before. Then, the subject was asked to recall orally, in any order, as many words as she could from one of the previous lists learned. Whether she was asked to recall list 1 or list 2 first was counterbalanced, so that one-half of the participants were asked to recall list 1 first, followed by list 2; and the other half were asked to recall list 2 first followed by list 1. The following instructions were given:

> Now, I would like you to recall orally as many words as you can from the _first_ list (_second_ list) that you learned here today. You may say them in any order. You have three minutes.

Three minutes were allowed, and the responses were recorded on paper and on tape. Then, the subject was asked to recall the other list, with the following instructions:

> Now, I would like you to recall orally as many words as you can from the _second_ list (_first_ list) that you learned here today. You may say them in any order. You have three minutes.

Again, three minutes were allowed, and the subject's responses were recorded.

Each subject was then given a multiple-choice word recognition test for each word list. On each test, each of the 16 words of a particular list was combined with three distractors, yielding a four-choice format. The position of the correct response relative to its distractors was determined randomly in each case. One of the distractors was a correct word from the other list.

The other distractors were similar to the correct responses in concreteness (between 2.0 and 3.0 in Paivio et al, 1968), with an equal number of words being "happy" and "sad", over the whole test.

The order of presentation of the two recognition tests was counterbalanced across subjects. Each recognition test carried the following instructions, which were emphasized by the tape-recorded voice of the experimenter:

> This is a multiple-choice word-recognition test for the first(second) list of words you learned here today. Please go through the list and circle the word in each set of four which you learned in the first(second)list you heard today. You have three minutes.

Three minutes were allowed for each test.

After both tests had been completed, the Velten elated-mood statements were given once more. The purpose of the experiment was explained, and all questions were answered frankly. The subject was then thanked and excused. The debriefing script appears at the end of appendix C.

## Experiment II

Subjects were first asked to complete one copy of the HMACL4. All of the remaining instructions in the experiment were presented by playing a tape recording of the experimenter's voice.

The experimenter emphasized the instructions by saying,

> Notice the instructions. You are to indicate how you feel right now by using these codes. If you definitely do not feel that way, leave the space blank. If you do not feel that way, put a 1. If you feel that way, put a 2. If you definitely feel that way, put a 3. Do you understand? Good. Go ahead and complete the form, indicating how you feel right now.

Upon completing the HMACL4, the subject was given the following instructions prior to the first Velten mood-manipulation procedure.

> Immediately after you finish reading these cards, I shall begin projecting on the screen, one at a time, a series of 20 simple designs which you are to commit to memory. The designs are drawn on a

background graph-paper grid. Later, I shall ask you to draw as many of the designs as you can remember. The series of 20 designs will appear three times, each series preceded by a blank grid. Do you understand?

Then, the Velten procedure was introduced. "Instructions were in the first person, typed entirely in capitals on lineless index cards, and were placed before S[ubject] by E[xperimenter] one by one as S[ubject] completed reading the previous card" (Velten, 1968, p. 474). In experiments II and III, an additional instruction card was placed at the end of each set of mood statements. It read, "I will try to maintain the mood I have just established while I do the next part of the experiment." This took the place of the oral encouragement in Bower et al (1978) and in experiment I of the present study.

One-half of the participants were given the depressed mood statements, and the other half were given the elated mood statements. All read the statements silently, then aloud. The first mood manipulation was now complete.

Since some participants in experiment I had mentioned that it was difficult to maintain the mood evenly through the completion of the HMACL4 and into the next part of the experiment, in experiments II and III the HMACL4 was administered <u>after</u> each learning task was completed.

Upon completion of the Velten procedure, the participant was told, "Here are the designs I told you about. Please try to memorize them. The first slide will show only the background grid, to help you orient yourself."

Once the designs had been presented, the HMACL4 was administered a second time, with no oral instructions. Then, the Velten procedure was used again. This time, one-half of the subjects who previously had been given the elated-mood statements were given the depressed mood statements (group ED), and one-half of the subjects who had previously been given the depressed mood statements were given the elated mood statements (group DE).

The rest of the subjects received the same statements they had been given previously (groups DD and EE). Each of the four resulting groups had ten subjects.

Following this second mood induction, the subjects were given a sheet of white paper on which 20 blank grids were printed, and were asked to draw as many of the designs as they could remember. Five minutes were allowed to complete this task. The instructions read,

> Here is an answer sheet containing 20 blank grids for the 20 drawings. Please reproduce on these

grids as many of the designs as you can remember. You have five minutes.

If the participant attempted to hand in the answer sheet before the five minutes had elapsed, the experimenter said, "Please keep trying."

After the recall task, the HMACL4 was administered a third time.

Then, each subject was presented with a 20-item multiple choice (recognition) test. Each item contained one of the experimental designs and three distractors. The sequence of the designs was again randomly different from the three sequences used in presentation. Participants were asked to "Select from each group of four designs the one which you saw previously projected on the screen. Please indicate your choice by circling it."

This completed experiment II. Before the debriefing procedure, all subjects were given the Velten elated mood statements to read. The purpose of the experiment was explained, and any questions were answered frankly. Each subject was then thanked and excused.

## Experiment III

After the first mood induction, the first slide series was presented, the HMACL4 was administered, and the second mood was induced, all following the corresponding procedures of experiment II. Prior to induction of each mood, however, the design learning task was introduced with these instructions:

> Immediately after you finish reading these cards, I shall begin projecting on the screen, one at a time, a series of ten simple designs which you are to commit to memory. The designs are drawn on a background graph paper grid. Later, I shall ask you to draw as many of the designs as you can remember. The series of ten designs will appear three times, each series preceded by a blank grid. Do you understand?

After the Velten procedure was completed, the designs were presented with these reminders: "Here are the designs I told you about. Please try to memorize them. The first slide will show only the background grid, to help you orient yourself."

The method of slide presentation was identical to that used in the first experiment, with the exception that the time between slides was increased to 2.4 seconds, in an attempt to increase retention.

Following presentation of each set of designs, the HMACL4 was administered, without repeating the oral instructions. Then, a third mood-- either elated or depressed-- was induced using Velten. This mood induction was followed by 1) a free recall test for each set of diagrams, 2) the third HMACL4, and 3) a recognition test as used in experiment II, for each set of diagrams. Half of the subjects were asked to recall design series 1 followed by design series 2, while the other half were asked to recall design series 2 followed by design series 1. The order of the recognition tests was also counterbalanced, and the recognition counterbalancing sequence was counterbalanced with the recall counterbalancing sequence.

Termination of experiment III followed the same steps outlined for experiment II.

Debriefing script

Remember that you started out reading a series of depressed/elated statements, and then tried to learn some words/diagrams. (For experiments I and III:) Then, you read some depressing/elating statements, and tried to learn a second set of words/diagrams. (All experiments:)

Later, you read some elating/depressing statements, and tried to recall the words/diagrams. So when you tried to recall the words/diagrams, you were in the same mood you were in when you learned them/the first set/the second set.

My hypothesis is that material is recalled better if we try to remember it in the same mood we were in when we learned it.

I get that hypothesis from an idea in psychology called state dependent learning. That is the notion that when we learn something, especially if we do not learn it very well, we attach it to some aspect of the state we are in when we learn it.

The state may be a physical state, like a room. That is why it is a good idea to study in a room where we will take an exam. Or, it may be a physiological state. Most of the studies in psychology laboratories have looked at drug-induced states. For example, if we train a rat to run a maze under the influence of certain drugs, when the drug wears off, the rat cannot remember how to run the maze. But, if we give it another shot of the same drug, it remembers how to run the maze. We see the same thing in humans. If someone learns something while he is drunk, when he sobers up, he is frequently unable to remember it. But if he gets drunk again, he can remember what he had previously forgotten.

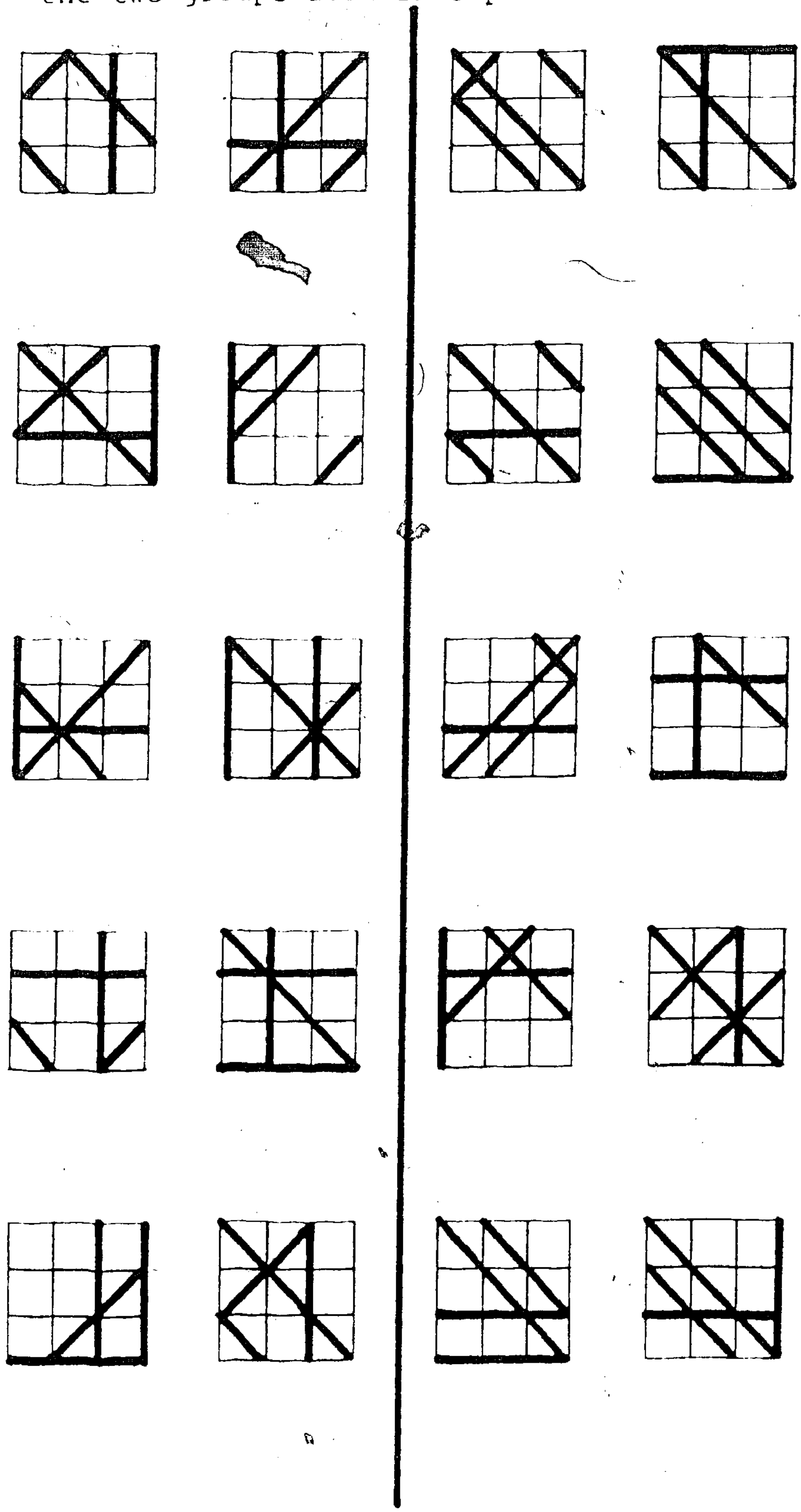
It is as if the state serves as a cue or library code for the memory, and when the state is re-established, the memory is easier to recall.

In this experiment, I am trying to see if mood can serve as a cue to memory.

Do you have any questions or comments?

## Appendix D

Diagrams used in experiments II and III, divided into the two groups used in experiment III.



## Appendix E

Appendix E contains statistical tables presenting the analyses of the three experiments done in this study.

### Experiment I

Table E1. Analysis of variance summary for percentage recall, arcsine transformations, first list. Factor A represents the three levels of predicted interference, and factor B represents the mood in which the list was learned.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.012 | 2 | 0.006 | 0.09 | .91 |
| B | 0.003 | 1 | 0.003 | 0.04 | .84 |
| AxB | 0.250 | 2 | 0.125 | 1.93 | .16 |
| Error | 3.491 | 54 | 0.065 | | |

Table E2. Analysis of variance summary table for percentage recall arcsine transformations, second list. Factor A represents the three levels of predicted interference, and factor B represents the mood in which the list was learned.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.09 | 2 | 0.05 | 0.40 | .67 |
| B | 0.00 | 1 | 0.00 | 0.00 | .99 |
| AxB | 0.11 | 2 | 0.06 | 0.48 | .62 |
| Error | 6.31 | 54 | 0.12 | | |

Table E3. Analysis of variance summary table for the first list percentage recall, arcsine transformations. Factor A represents the three predicted levels of interference, and factor B represents the mood in which the list was recalled.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.012 | 2 | 0.006 | 0.09 | .91 |
| B | 0.202 | 1 | 0.202 | 3.13 | .08 |
| AxB | 0.050 | 2 | 0.025 | 0.38 | .68 |
| Error | 3.490 | 54 | 0.065 | | |

Table E4. Analysis of variance summary table for the second list percentage recall, arcsine transformations. Factor A represents the three predicted levels of interference, and factor B represents the mood in which the list was recalled.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.093 | 2 | 0.046 | 0.40 | .67 |
| B | 0.100 | 1 | 0.100 | 0.86 | .36 |
| AxB | 0.012 | 2 | 0.006 | 0.05 | .95 |
| Error | 6.310 | 54 | 0.117 | | |

Table E5. Analysis of variance summary, number of happy words recalled from the first list. Factor A represents mood during learning, and factor B represents mood during recall.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.01 | 1 | 0.01 | 0.00 | .96 |
| B | 1.88 | 1 | 1.88 | 0.60 | .44 |
| AxB | 9.08 | 1 | 9.08 | 2.91 | .09 |
| Error | 174.55 | 56 | 3.12 | | |

Table E6. Analysis of variance summary for recognition of happy words from the first list. Factor A is predicted level of interference, factor B is mood of learning the first list.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 7.23 | 2 | 3.62 | 1.85 | .167 |
| B | 8.07 | 1 | 8.07 | 4.13 | .047 |
| AxB | 1.23 | 2 | 0.62 | 0.32 | .730 |
| Error | 105.40 | 54 | 1.95 | | |

Table E7. Analysis of variance summary for recognition of sad words from the first list. Factor A is predicted level of interference, factor B is mood of learning the first list.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 7.63 | 2 | 3.82 | 1.83 | .17 |
| B | 0.07 | 1 | 0.07 | 0.03 | .86 |
| AxB | 0.63 | 2 | 0.32 | 0.15 | .86 |
| Error | 112.40 | 54 | 2.08 | | |

Table E8. Analysis of variance summary for recognition of words overall from the first list. Factor A is predicted level of interference, factor B is mood of learning the first list.

| Source | SS | f | MS | F | p |
|---|---|---|---|---|---|
| A | 28.13 | 2 | 14.07 | 2.75 | .07 |
| B | 9.60 | 1 | 9.60 | 1.88 | .18 |
| AxB | 3.60 | 2 | 1.80 | 0.35 | .71 |
| Error | 276.40 | 54 | 5.12 | | |

Table E9. Analysis of variance summary for recognition of happy words from the second list. Factor A is predicted level of interference, factor B is mood learning the second list.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 4.90 | 2 | 2.45 | 0.88 | .42 |
| B | 4.27 | 1 | 4.27 | 1.53 | .22 |
| AxB | 2.23 | 2 | 1.12 | 0.40 | .67 |
| Error | 150.20 | 54 | 2.78 | | |

Table E10. Analysis of variance summary for recognition of sad words from the second list. Factor A is predicted level of interference, factor B is mood of learning the second list.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 12.90 | 2 | 6.45 | 2.51 | .09 |
| B | 0.82 | 1 | 0.82 | 0.32 | .58 |
| AxB | 4.43 | 2 | 2.22 | 0.86 | .43 |
| Error | 138.70 | 54 | 2.57 | | |

*Table E11*. Analysis of variance summary for recognition of all words from the second list. Factor A is predicted level of interference, and factor B is mood of learning the second list.

| Source | SS | df | MS | F | *p* |
|---|---|---|---|---|---|
| A | 25.90 | 2 | 12.95 | 1.82 | .17 |
| B | 1.35 | 1 | 1.35 | .19 | .66 |
| AxB | 12.10 | 2 | 6.05 | .85 | .43 |
| Error | 384.30 | 54 | 7.12 | | |

*Table E12*. Analysis of variance summary for intrusion of list one happy words into the recall of list two. Factor A represents predicted level of interference, and factor B represents mood of recall.

| Source | SS | df | MS | F | *p* |
|---|---|---|---|---|---|
| A | 0.40 | 2 | 0.20 | 0.34 | .72 |
| B | 0.27 | 1 | 0.27 | 0.45 | .51 |
| AxB | 4.13 | 2 | 2.07 | 3.47 | .04 |
| Error | 32.20 | 54 | 0.60 | | |

Table E13. Analysis of variance summary table for happy words from list two intruding in the recognition test for list one. Factor A is predicted level of interference, and factor B is mood of recall.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 5.63 | 2 | 2.82 | 3.77 | .03 |
| B | 0.15 | 1 | 0.15 | 0.20 | .66 |
| AxB | 2.10 | 2 | 1.05 | 1.41 | .25 |
| Error | 40.30 | 54 | 0.75 | | |

Table E14. Analysis of variance summary, intrusions of list two sad words into the recognition test for list one. Factor A is predicted level of interference, and factor B is mood during test.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.93 | 2 | 0.47 | 0.59 | .56 |
| B | 2.82 | 1 | 2.82 | 3.56 | .06 |
| AxB | 1.73 | 2 | 0.87 | 1.10 | .34 |
| Error | 42.70 | 54 | 0.79 | | |

Table E15. Analysis of variance summary for total number of intrusions of list two words into the recognition testing for list one. Factor A is predicted level of interference, and factor B is mood during testing.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 11.03 | 2 | 5.52 | 3.55 | .04 |
| B | 1.67 | 1 | 1.67 | 1.07 | .31 |
| AxB | 6.03 | 2 | 3.02 | 1.94 | .15 |
| Error | 84.00 | 54 | 1.56 | | |

Table E16. Analysis of variance summary for number of sad words from list one intruding into recognition testing for list two. Factor A is predicted level of interference, and factor B represents mood during testing.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 3.33 | 2 | 1.67 | 3.72 | .03 |
| B | .27 | 1 | 0.27 | 0.60 | .44 |
| AxB | .93 | 2 | 0.47 | 1.04 | .36 |
| Error | 24.20 | 54 | 0.45 | | |

Table E17. Analysis of variance summary, total number of happy words recalled from list one during attempted recall of either list (MMFR scoring). Factor A represents mood of learning, factor B represents mood of recall.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.41 | 1 | 0.41 | 0.12 | .730 |
| B | 0.41 | 1 | 0.41 | 0.12 | .730 |
| AxB | 12.68 | 1 | 12.68 | 3.74 | .058 |
| Error | 189.75 | 56 | 3.39 | | |

Table E18. Analysis of variance summary table for happy words remembered at original learning phase for the second list. Factor A represents learning mood for list one, and factor B represents learning mood for list two.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2.41 | 1 | 2.41 | 1.33 | .25 |
| B | 11.41 | 1 | 11.41 | 6.31 | .01 |
| AxB | 0.68 | 1 | 0.68 | 0.37 | .54 |
| Error | 101.25 | 56 | 1.81 | | |

Table E19. Analysis of variance summary, happy words recalled from list two at the posttest. Factor A represents learning mood, and factor B represents mood during recall for list two.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 20.01 | 1 | 20.01 | 6.15 | .02 |
| B | 1.01 | 1 | 1.01 | 0.31 | .58 |
| AxB | 1.41 | 1 | 1.41 | 0.43 | .51 |
| Error | 182.25 | 56 | 3.25 | | |

Table E20. Analysis of variance summary table, sad words recalled from the first list. Factor A represents mood during learning, and factor B represents mood during recall.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.68 | 1 | 0.68 | 0.37 | .54 |
| B | 6.08 | 1 | 6.08 | 3.35 | .07 |
| AxB | 0.21 | 1 | 0.21 | 0.11 | .74 |
| Error | 101.65 | 56 | 1.82 | | |

Table E21. Analysis of variance summary for total number of happy words from the second list recalled at either attempt (MMFR scoring). Factor A represents mood during learning, factor B represents mood during recall.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 12.68 | 1 | 12.68 | 3.90 | .05 |
| B | .68 | 1 | .68 | .21 | .65 |
| AxB | .01 | 1 | .01 | .00 | .96 |
| Error | 182.15 | 56 | 3.25 | | |

Table E22. Analysis of variance summary, total number of words learned from the second list during the first learning phase. Factor A represents mood during learning of list one, and factor B represents mood during learning of list two.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.01 | 1 | 0.01 | 0.00 | .97 |
| B | 20.01 | 1 | 20.01 | 4.35 | .04 |
| AxB | 0.01 | 1 | 0.01 | 0.00 | .97 |
| Error | 257.75 | 56 | 4.60 | | |

*Table E23*. Analysis of variance summary table for recognition of happy words. Factor T represents the two list positions.

| Source | SS | df | MS | F | *p* |
|---|---|---|---|---|---|
| T | 1.63 | 1 | 1.63 | 1.33 | .25 |
| Error | 72.37 | 59 | 1.23 | | |

*Table E24*. Analysis of variance summary table for recognition of sad words. Factor T represents the two list positions.

| Source | SS | df | MS | F | *p* |
|---|---|---|---|---|---|
| T | 14.01 | 1 | 14.01 | 8.14 | .006 |
| Error | 101.49 | 59 | 1.72 | | |

*Table E25*. Analysis of variance summary table for recognition of words overall. Factor T represents the list positions.

| Source | SS | df | MS | F | *p* |
|---|---|---|---|---|---|
| T | 25.21 | 1 | 25.21 | 9.90 | .003 |
| Error | 150.29 | 59 | 2.55 | | |

Experiment II

Table E26. Analysis of variance summary table for number of reproductions which were perfect, rotated, reflected, or contained an extra line. Factor A is mood during learning, factor B represents mood during recall, and the A x B interaction measures the SDL effect.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 3.60 | 1 | 3.60 | 2.42 | .13 |
| B | 1.60 | 1 | 1.60 | 1.07 | .31 |
| AxB | 4.90 | 1 | 4.90 | 3.29 | .08 |
| Error | 53.80 | 35 | 1.49 | | |

Table E27. Group means for number of perfect, rotated, reflected or extra-line reproductions.

| | | | |
|---|---|---|---|
| MOOD | Depressed | 1.80 | .50 |
| DURING | Elated | .70 | .80 |
| RECALL | | | |
| | | Depressed | Elated |
| | | MOOD DURING LEARNING | |

Table E28. Group means for proportional accuracy.

| | | | |
|---|---|---|---|
| MOOD | Depressed | 77.6 | 63.9 |
| DURING | Elated | 64.3 | 64.7 |
| RECALL | | | |
| | | Depressed | Elated |
| | | MOOD DURING LEARNING | |

Table E29. Group means for corrected proportional accuracy of reproduction (right minus wrong).

| | | | |
|---|---|---|---|
| MOOD | Depressed | 68.40 | 39.70 |
| DURING | Elated | 46.30 | 41.50 |
| RECALL | | | |
| | | Depressed | Elated |
| | | MOOD DURING LEARNING | |

Table E30. Analysis of variance summary table for recognition test scores. Factor A is mood during learning, factor B is mood during recall, and the A x B interaction measures the SDL effect.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 6.40 | 1 | 6.40 | 1.24 | .27 |
| B | 1.60 | 1 | 1.60 | 0.31 | .58 |
| AxB | 0.40 | 1 | 0.40 | 0.08 | .78 |
| Error | 186.00 | 36 | 5.17 | | |

Table E31. Pearson product-moment coefficients of correlation between scales on the first administration of the HMACL4 (before the first Velten procedure).

| | CN | DP | CO | SL | AX | SC | PT | CL | AG | OP |
|---|---|---|---|---|---|---|---|---|---|---|
| CN | 1.00 | | | | | | | | | |
| DP | -.22 | 1.00 | | | | | | | | |
| CO | .41 | -.06 | 1.00 | | | | | | | |
| SL | -.11 | .59 | -.08 | 1.00 | | | | | | |
| AX | -.14 | .24 | -.18 | .38 | 1.00 | | | | | |
| SC | .29 | .33 | .06 | .21 | .31 | 1.00 | | | | |
| PT | .46 | -.07 | .48 | .02 | .05 | .30 | 1.00 | | | |
| CL | .35 | .17 | .45 | .32 | .35 | .30 | .41 | 1.00 | | |
| AG | -.23 | .60 | -.11 | .28 | .39 | .35 | .03 | .21 | 1.00 | |
| OP | .29 | -.16 | .57 | -.14 | -.25 | -.24 | .28 | .26 | -.23 | 1.00 |

Table E32. Pearson product-moment coefficients of correlation between scales on the second administration of the HMACL4 (after the learning phase of the experiment).

| | CN | DP | CO | SL | AX | SC | PT | CL | AG | OP |
|---|---|---|---|---|---|---|---|---|---|---|
| CN | 1.00 | | | | | | | | | |
| DP | -.74 | 1.00 | | | | | | | | |
| CO | .72 | -.52 | 1.00 | | | | | | | |
| SL | -.75 | .74 | -.66 | 1.00 | | | | | | |
| AX | -.19 | .37 | -.18 | .30 | 1.00 | | | | | |
| SC | -.02 | .32 | .01 | .05 | .37 | 1.00 | | | | |
| PT | .77 | -.54 | .80 | -.63 | -.15 | .03 | 1.00 | | | |
| CL | .50 | -.18 | .54 | -.36 | -.04 | .49 | .59 | 1.00 | | |
| AG | -.08 | .42 | -.24 | .07 | .25 | .64 | -.06 | .24 | 1.00 | |
| OP | .75 | -.59 | .88 | -.63 | -.08 | -.01 | .77 | .57 | -.19 | 1.00 |

Table E33. Pearson product-moment coefficients of correlation between scales on the third administration of the HMACL4 (after the recall test).

| | CN | DP | CO | SL | AX | SC | PT | CL | AG | OP |
|---|---|---|---|---|---|---|---|---|---|---|
| CN | 1.00 | | | | | | | | | |
| DP | -.61 | 1.00 | | | | | | | | |
| CO | .84 | -.65 | 1.00 | | | | | | | |
| SL | -.73 | .77 | -.66 | 1.00 | | | | | | |
| AX | -.03 | .37 | -.23 | .26 | 1.00 | | | | | |
| SC | -.21 | .52 | -.30 | .48 | .51 | 1.00 | | | | |
| PT | .82 | -.49 | .74 | -.60 | .09 | -.10 | 1.00 | | | |
| CL | .54 | -.18 | .50 | -.25 | .01 | .25 | .45 | 1.00 | | |
| AG | -.28 | .64 | -.46 | .52 | .48 | .57 | -.19 | .21 | 1.00 | |
| OP | .77 | -.53 | .77 | -.67 | -.03 | -.11 | .87 | .44 | -.28 | 1.00 |

## Experiment III

Table E34. Analysis of variance summary for corrected proportional accuracy (right minus wrong), first set of diagrams. Factor A represents the three predicted levels of interference, and factor B represents the learning mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2,412.63 | 2 | 1,206.32 | 3.21 | .048 |
| B | 43.35 | 1 | 43.35 | 0.12 | .74 |
| AxB | 772.30 | 2 | 386.15 | 1.03 | .36 |
| Error | 20,272.70 | 54 | 375.42 | | |

Table E35. Analysis of variance summary for perfect reproductions, second set of diagrams. Factor A represents the three predicted levels of interference, and factor B represents the learning mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 1.033 | 2 | 0.517 | 2.05 | .14 |
| B | 0.267 | 1 | 0.267 | 1.06 | .31 |
| AxB | 0.833 | 2 | 0.417 | 1.65 | .20 |
| Error | 13.600 | 54 | 0.252 | | |

*Table E36*. Analysis of variance summary for perfect reproductions plus those otherwise perfect but rotated, reflected, or containing an extra line. Factor A represents the predicted levels of interference, and factor B represents the learning mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 1.733 | 2 | 0.867 | 2.54 | .09 |
| B | 0.067 | 1 | 0.067 | 0.20 | .66 |
| AxB | 1.733 | 2 | 0.867 | 2.54 | .09 |
| Error | 18.400 | 54 | 0.341 | | |

*Table E37*. Analysis of variance summary, diagrams from list one reproduced perfectly or as rotations as reflections, with an extra line or in the wrong recall task. Factor A represents predicted level of interference, factor B represents mood of learning.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2.03 | 2 | 1.02 | 2.57 | .09 |
| B | 0.00 | 1 | .00 | 0.00 | 1.00 |
| AxB | 0.30 | 2 | .15 | 0.38 | .69 |
| Error | 21.40 | 54 | .40 | | |

<u>Table E38</u>. Analysis of variance summary, number of perfect reproductions, first set of diagrams. Factor A represents learning mood, and factor B represents recall mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | .03 | 1 | .03 | 0.11 | .74 |
| B | .03 | 1 | .03 | 0.11 | .74 |
| AxB | .53 | 1 | .53 | 1.83 | .18 |
| Error | 16.40 | 56 | .29 | | |

<u>Table E39</u>. Analysis of variance, number of perfect, rotated, reflected and extra-line reproductions. Factor A represents learning mood, factor B represents recall mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | .03 | 1 | .03 | 0.11 | .744 |
| B | .03 | 1 | .03 | 0.11 | .744 |
| AxB | .83 | 1 | .83 | 2.70 | .106 |
| Error | 17.30 | 56 | .31 | | |

Table E40. Analysis of variance, proportional accuracy. Factor A represents learning mood, factor B represents recall mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 2.13 | 1 | 2.13 | 0.01 | .94 |
| B | 270.00 | 1 | 270.00 | 0.79 | .38 |
| AxB | 997.63 | 1 | 997.63 | 2.93 | .09 |
| Error | 19,060.40 | 56 | 340.36 | | |

Table E41. Analysis of variance, corrected proportional accuracy (right minus wrong). Factor A represents learning mood, factor B represents recall mood.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.68 | 1 | 0.68 | 0.00 | .97 |
| B | 261.08 | 1 | 261.08 | 0.70 | .41 |
| AxB | 2,279.41 | 1 | 2279.41 | 6.10 | .02 |
| Error | 20,917.15 | 54 | 373.52 | | |

Table E42. Analysis of variance, recognition scores for the second set of designs. Factor A represents learning mood, factor B represents recall mood. The interaction shows the SDL effect.

| Source | SS | df | MS | F | p |
|---|---|---|---|---|---|
| A | 0.00 | 1 | 0.00 | 0.00 | 1.00 |
| B | 0.53 | 1 | 0.53 | 0.23 | .63 |
| AxB | 12.03 | 1 | 12.03 | 5.17 | .03 |
| Error | 130.30 | 56 | 2.33 | | |

## Appendix F

### Test Materials

#### 1. Word Recognition Tests

THIS IS A 16-ITEM MULTIPLE-CHOICE WORD-RECOGNITION TEST FOR THE FIRST LIST OF WORDS THAT YOU LEARNED HERE TODAY. PLEASE GO THROUGH THE LIST, AND CIRCLE THE WORD IN EACH SET OF FOUR WHICH YOU RECALL LEARNING IN THE FIRST LIST. YOU HAVE THREE MINUTES.

| | | | | |
|---|---|---|---|---|
| 1. | PLEDGE | FOLLY | FUN | GENIUS |
| 2. | ECCENTRICITY | TROUBLE | ECONOMY | HARDSHIP |
| 3. | DEVIL | MISCHIEF | TRAGEDY | PREDICAMENT |
| 4. | PROSPERITY | CAPACITY | JOVIALITY | POWER |
| 5. | DUTY | VICTORY | DEVELOPMENT | DEMON |
| 6. | HOSTILITY | AFFECTION | ABILITY | DELIRIUM |
| 7. | PHANTOM | RECOGNITION | LIFE | CHARM |
| 8. | COMPARISON | GAIETY | DEATH | AMAZEMENT |
| 9. | SATIRE | HEAVEN | ADVERSITY | GRAVITY |
| 10. | ADVANTAGE | MISERY | PERJURY | SADNESS |
| 11. | CHAOS | PERCEPTION | ATROCITY | DISCIPLINE |
| 12. | HEROISM | MOMENT | PEP | HUMOR |
| 13. | BLASPHEMY | PLEASURE | PANIC | METHOD |
| 14. | VIGILANCE | CRISIS | AGREEMENT | INTIMATE |
| 15. | OPPORTUNITY | DISTRACTION | DISTINCTION | FAULT |
| 16. | INTEREST | SAFETY | QUALITY | MIRACLE |

THIS IS A 16-ITEM MULTIPLE-CHOICE WORD-RECOGNITION TEST FOR THE SECOND LIST OF WORDS THAT YOU LEARNED HERE TODAY. PLEASE GO THROUGH THE LIST, AND CIRCLE THE WORD IN EACH SET OF FOUR WHICH YOU RECALL LEARNING IN THE SECOND LIST. YOU HAVE THREE MINUTES.

| | | | | |
|---|---|---|---|---|
| 1. | EXERTION | OPINION | HARDSHIP | POWER |
| 2. | EQUITY | PANIC | CHARM | TIME |
| 3. | INCIDENT | DISCIPLINE | DEVIL | EFFORT |
| 4. | GAIETY | GHOST | FOLLY | DISPARITY |
| 5. | JEOPARDY | FACILITY | DEMON | TROUBLE |
| 6. | MIRACLE | COMRADESHIP | CUSTOM | HEROISM |
| 7. | ATTRIBUTE | VIGOR | FAULT | PROSPERITY |
| 8. | TRAGEDY | MIND | CHAOS | BEREAVEMENT |
| 9. | MADNESS | ILLUSION | SADNESS | CRISIS |
| 10. | MISERY | VIOLATION | FUN | INSTANCE |
| 11. | OUTCOME | AFFECTION | LIFE | MASTERY |
| 12. | JUSTICE | HOSTILITY | QUEST | PLEASURE |
| 13. | HINDRANCE | ADVERSITY | EXPRESSION | DEATH |
| 14. | VICTORY | HEAVEN | STRENGTH | ADVICE |
| 15. | IMPULSE | AGREEMENT | DISTINCTION | FANTASY |
| 16. | EMANCIPATION | WELFARE | HUMOR | SAFETY |

2. Answer sheet for experiments II and III.

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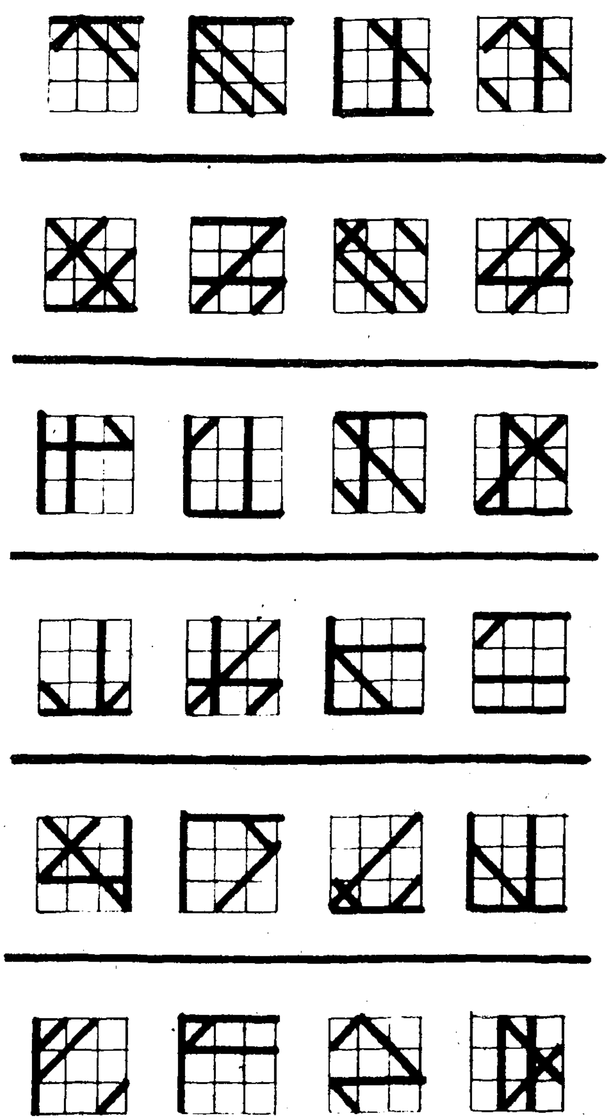
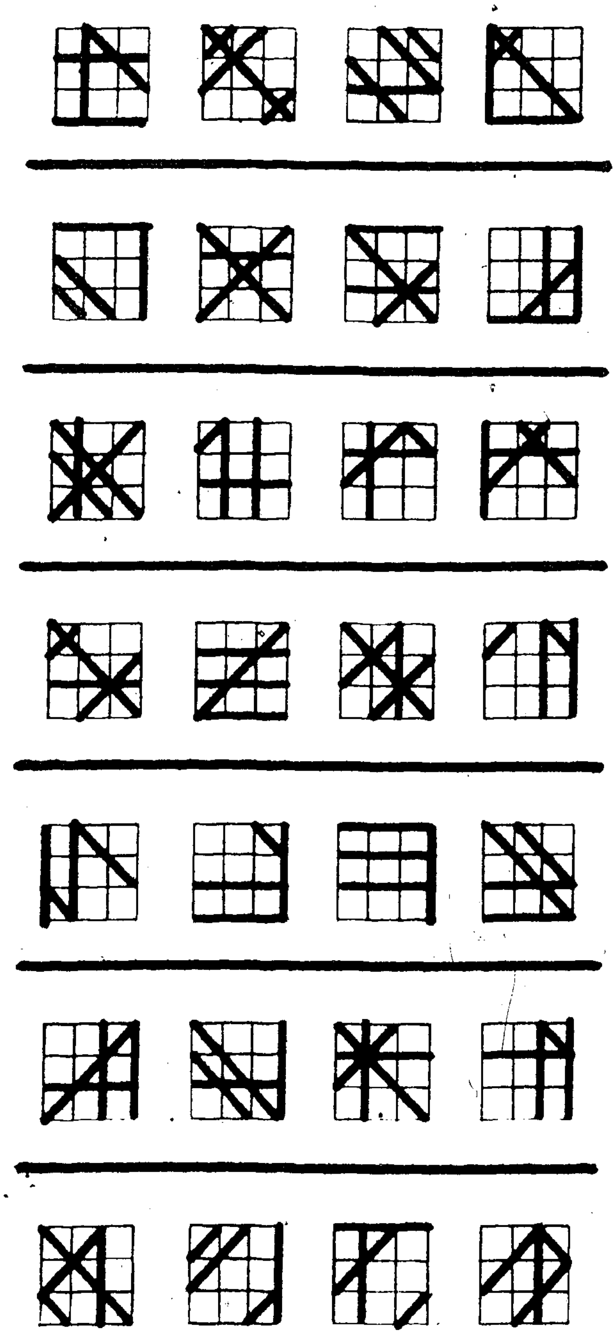
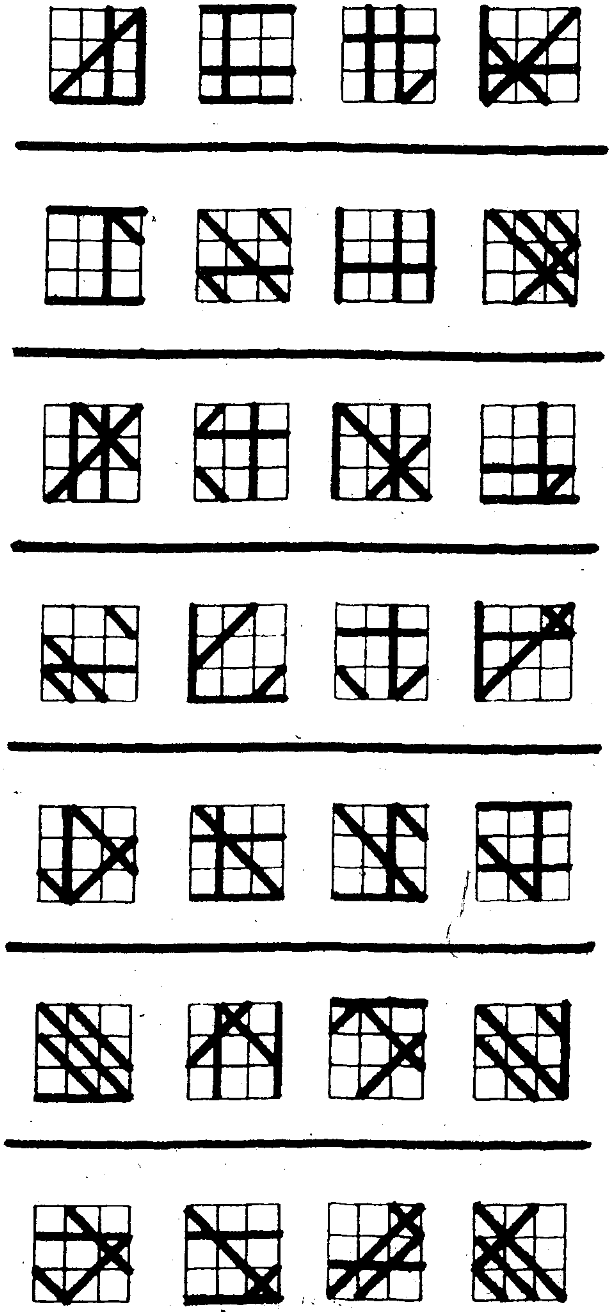
3. Multiple-choice design recognition tests.

a. Experiment II-- three pages.

Please select from each group of four designs the one which you previously saw projected on the screen. Please indicate your choice by circling it.

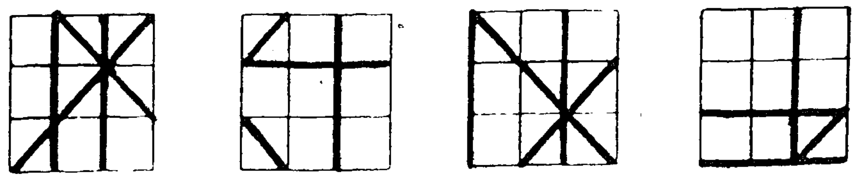


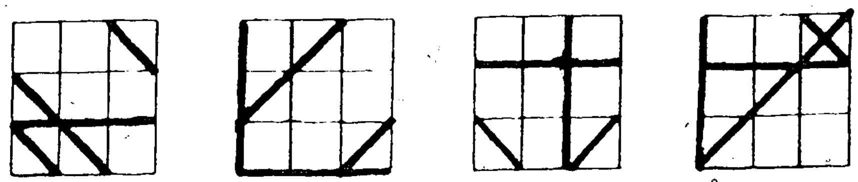


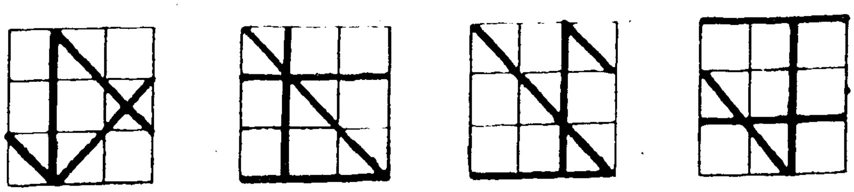


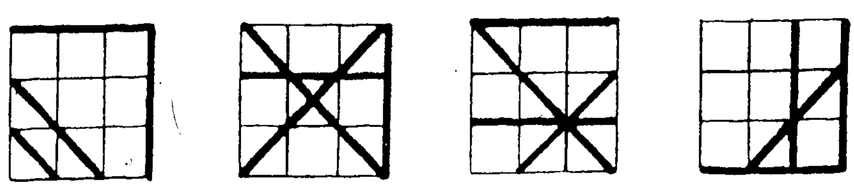
b. Experiment III-- four pages.

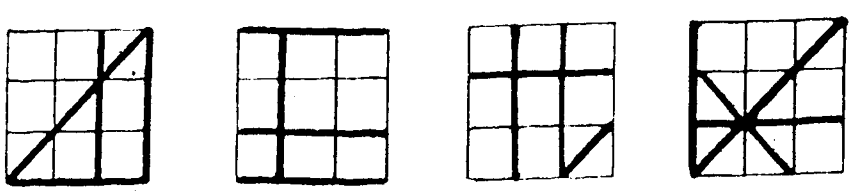
Please select from each group of four designs the one which you previously saw in the <u>first</u> group of designs you learned. Please indicate your choice by circling it.

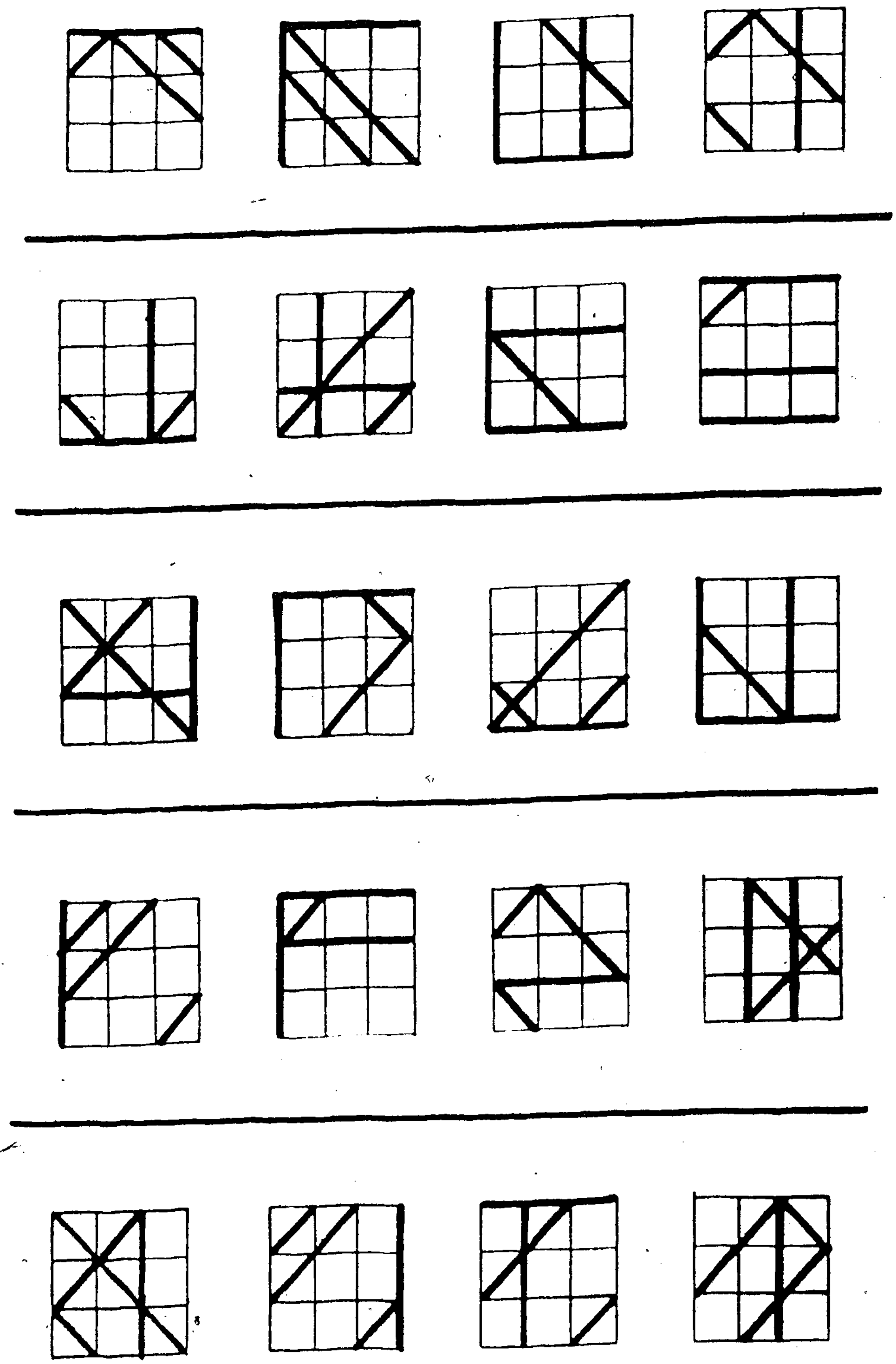




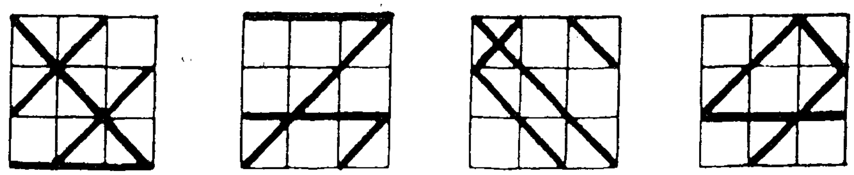


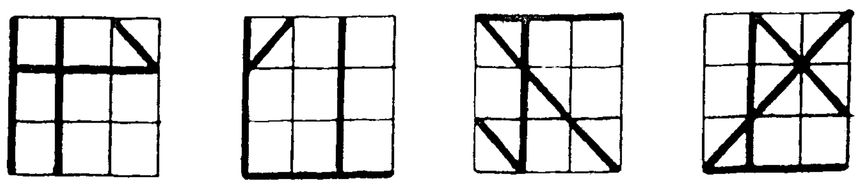


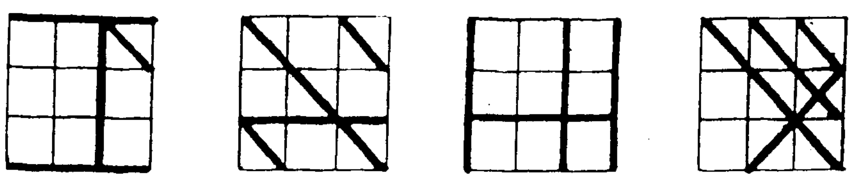


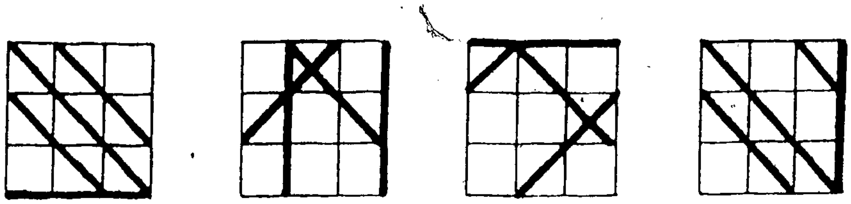


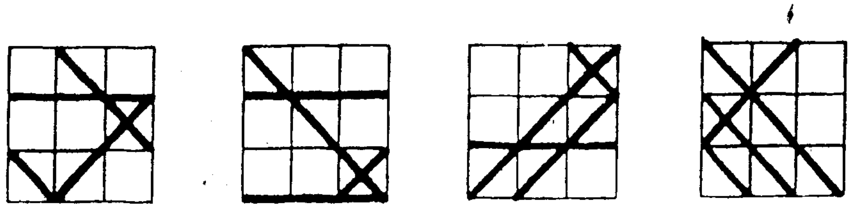
Please select from each group of four designs the one which you previously saw in the second group of designs you learned. Please indicate your choice by circling it.

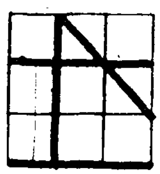
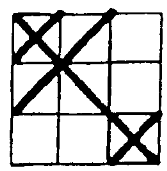
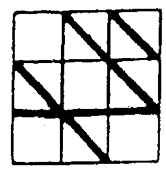
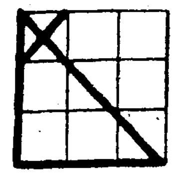


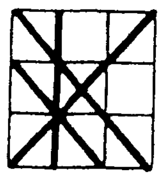
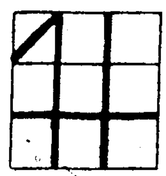
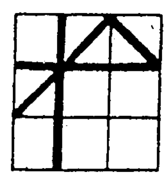
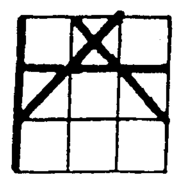


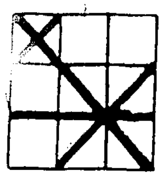
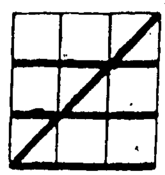
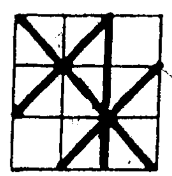
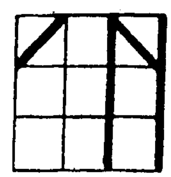


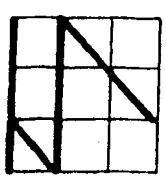
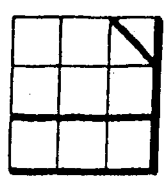
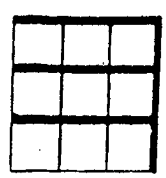
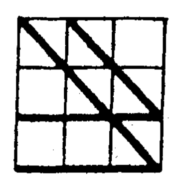


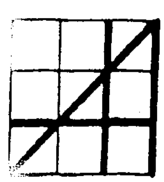
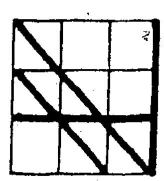
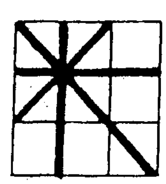
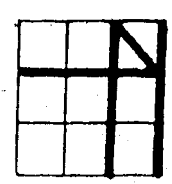


## Appendix G

With the repeated use of the same instructions suggested by Velten, during the three phases of study I, considerable resistance to reading the same instructions was observed. Participants would sigh, take the cards slowly, and even verbally complain about the repetition. This did not seem to be a problem for the mood-statements.

In addition, many subjects took an inordinate amount of time reading the instructions, contributing to a long experimental session. This even meant that some of the subjects did not complete the experiment, and had to be replaced.

Consequently, in experiment III, a shortened and simplified set of instructions was developed by removing some of the redundancy and paternalism from the Velten instructions. For the first mood induction procedure, the instructions were almost as long as the original Velten instructions, but for the second and third inductions, the instructions were dramatically shortened, and relied on reminding the subjects of the earlier, more complete instructions.

The instructions are listed below.

First set

Card 1.

I AM GOING TO SHOW YOU A SET OF CARDS WITH STATEMENTS TYPED ON THEM. THESE FIRST CARDS CONTAIN INFORMATION ABOUT HOW TO USE THE CARDS TO PUT YOURSELF INTO A CERTAIN MOOD FOR THE EXPERIMENT. TO HELP YOU GET USED TO THE TASK REQUIREMENTS, PLEASE READ EACH OF THE FOLLOWING INSTRUCTION CARDS TO YOURSELF, AND THEN READ IT OUT LOUD.

CARD 2.

I WILL READ EACH OF THE FOLLOWING CARDS TO MYSELF. THEN I WILL READ EACH OF THE CARDS OUT LOUD, AND I WON'T WOORY ABOUT THE READING ERRORS WHICH OFTEN OCCUR IN UNFAMILIAR SITUATIONS.

CARD 3.

THE CARDS CARRY STATEMENTS REPRESENTING A CERTAIN MOOD. MY TASK IS TO ATTEMPT TO ENTER THAT MOOD BY BEING RECEPTIVE AND RESPONSIVE TO THE IDEA IN EACH STATEMENT. THESE IDEAS ARE CALLED SUGGESTIONS.

CARD 4.

AFTER I READ THE CARD TO MYSELF, I WILL CONCENTRATE

ON <u>EXPERIENCING</u> THE IDEA. I WILL READ IT ONCE OUT LOUD IN A MANNER APPROPRIATE TO ITS INTENDED SERIOUSNESS, AND I WILL GO OVER EACH IDEA IN MY HEAD WITH THE DETERMINATION AND WILLINGNESS TO REALLY GO INTO THAT MOOD.

<u>CARD</u> <u>5</u>.

DIFFERENT PEOPLE MOVE INTO MOODS IN DIFFERENT WAYS. WHATEVER INDUCES THE MOOD IN ME FASTEST AND MOST DEEPLY IS THE BEST WAY FOR ME. SOME PEOPLE SIMPLY REPEAT THE STATEMENTS WITH THE INTENTION OF EXPERIENCING THEM. OTHERS REPEAT THE STATEMENTS AND IMAGINE SCENES WHEN THEY HAVE BEEN IN THAT MOOD.

<u>CARD</u> <u>6</u>.

THE KEY TO SUCCESS IN THIS PART OF THE EXPERIMENT IS TO CONCENTRATE ON EXPERIENCING THE MOOD SUGGESTED BY THE STATEMENTS. THE ACTUAL STATEMENTS MAY NOT BE TRUE FOR ME, BUT I WILL STILL TRY TO EXPERIENCE THE MOOD.

<u>CARD</u> <u>7</u>.

ONE VALUE OF THIS EXERCISE IS THAT IF I FIND THAT I CAN TALK MYSELF <u>INTO</u> A MOOD, THEN I HAVE LEARNED THAT I CAN CONTROL MY MOODS TO AN EXTENT.

CARD 8.

I WILL TRY TO TAKE THIS TASK SERIOUSLY, EVEN THOUGH SOME OF THE STATEMENTS MAY MAKE ME WANT TO LAUGH. I WILL CONCENTRATE ON EXPERIENCING THE MOOD SUGGESTED BY THE STATEMENTS, REMEMBERING THAT I CAN LEARN TO HELP MYSELF OUT OF UNDESIRABLE MOODS THAT OCCUR IN EVERYDAY LIFE. IF FOR ANY REASON I FEEL I CANNOT CONTINUE, I WILL SO INDICATE.

CARD 9.

THE NEXT CARD WILL BEGIN THE SERIES OF STATEMENTS. I WILL READ EACH TO MYSELF, THEN I WILL READ IT OUT LOUD. THEN I WILL TRY TO EXPERIENCE THE MOOD AS WELL AS I CAN, AND CONTINUE TO DO SO AS I READ EACH CARD AND MOVE FURTHER INTO THE MOOD.

<u>SECOND SET</u>.

<u>CARD 1</u>.

PLEASE READ THE FOLLOWING INSTRUCTION CARDS TO YOURSELF, AND THEN OUT LOUD.

<u>CARD 2</u>.

I WILL READ THESE MOOD STATEMENTS FOLLOWING THE INSTRUCTIONS I READ EARLIER. I WILL READ EACH CARD TO MYSELF, THEN I WILL READ IT OUT LOUD. I WILL CONCENTRATE ON TRYING TO <u>EXPERIENCE</u> THE MOOD SUGGESTED BY EACH STATEMENT, AND I WON'T WORRY ABOUT WHETHER THE STATEMENT IS LITERALLY TRUE FOR ME.

<u>CARD 3</u>.

I WILL TRY MY BEST TO GO INTO THE MOOD SUGGESTED BY THE STATEMENTS. I WILL REMEMBER THE POTENTIAL VALUE OF THIS, IN TEACHING ME HOW I CAN CONTROL MY MOODS IN EVERYDAY LIFE. <u>IF FOR ANY REASON I FEEL I CANNOT CONTINUE, I WILL SO INDICATE</u>.

<u>CARD 4</u>.

THE NEXT CARD WILL BEGIN THE SERIES OF STATEMENTS. I WILL READ EACH TO MYSELF, THEN I WILL READ IT OUT LOUD.

THEN I WILL TRY TO EXPERIENCE THE MOOD AS WELL AS I CAN, AND CONTINUE TO DO SO AS I READ EACH CARD AND MOVE FURTHER INTO THE MOOD.

# Appendix H

The line drawings used in experiments II and III were constructed by randomly selecting, without replacement, sets of four lines from a grid of 18 defined lines. The grid was defined as a 4 x 4 matrix, three units square, with four vertical and four horizontal lines one unit apart. The horizontal and vertical lines intersect at 12 points on the perimeter of the matrix, and these points served as the endpoints for ten diagonal lines: five with a slope of 1, and five with a slope of -1. The 18 lines thus defined, taken four at a time, made possible a total of 3,060 different figures. Figures which had high verbal encodability due to resembling letters, numerals, or common geometric figures were eliminated.

Once selected, the designs were drawn on a finely lined square grid background. The design lines were heavy and black.

A panel of three judges, drawn from the same population as the experimental subjects, was asked to rate the designs for any remaining mood-association value. Two designs were consequently eliminated.

The diagrams used are presented in appendix D.

Here is the scoring procedure for diagram reproductions.

1. The designs which met the criterion of having exactly four of the lines defined by the grid were identified. If a line covered more than one-half of the distance through a block of the grid, it was deemed to be complete.

2. Designs which correctly reproduced presented designs were identified, counted, and scored as the number of grid-block lines correctly drawn. Each block correctly traversed received a score of 1. Thus, an 11 block design correctly reproduced was given a score of 11/11.

3. Designs which were correctly drawn but rotated, reflected, or included an extra line were marked as such and were counted separately.

4. The incorrect designs were then scored for partial correctness. If a drawing had fewer than two (2) correct design lines reproduced, it was scored zero and removed from further consideration. If a design had two or three lines drawn correctly, it was identified and the proportion of correct blocks traversed was determined. The sum of these, reduced to a proportion, was the proportional accuracy score.

5. The number of design lines incorrectly reproduced

was then subtracted from the number correctly reproduced for each drawing, yielding a right minus wrong score. Here, a negative score was possible. The sum of these corrected scores, reduced to a proportion, was the corrected proportional accuracy score.

6. In 4 and 5, if a reproduction could be compared to two or more designs, the one yielding the higher score was used in each case, provided that a particular design could be reproduced only once.

7. The total number of drawings attempted and scored was tallied.