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Mood effects on implicit and explicit memory

Tobias, Betsy Ann, Ph.D.

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U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

MOOD EFFECTS ON IMPLICIT AND EXPLICIT MEMORY

by

Betsy Ann Tobias

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As members of the Final Examination Committee, we certify that we have read the dissertation prepared by Betsy Ann Tobias

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and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy

John F. Kihlstrom — Date 6/11/92

Richard Bootzin — Date 6/11/92

Alfred Kaszniak — Date 6/11/92

Elizabeth Glisky — Date 6/11/92

Date

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Dissertation Director John F. Kihlstrom — Date 6/11/92

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SIGNED: Betsy Ann Tobias

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DEDICATION

I would like to dedicate this dissertation to my parents Richard and Joan Tobias who were beginning to despair of my ever getting out of school, but, who nevertheless supported me every step of the way, and to my soon-to-be-husband Drew McGill who gave me great emotional support through the final stages of completing this project and who I know will continue to provide me with loving encouragement for the rest of my life. Thank you.

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ABSTRACT

Three major effects of mood on memory have been identified including mood-dependent memory (MDM), mood congruent memory (MCM) and resource allocation (RA) effects. The results of studies examining these effects have been inconsistent. The majority of these studies have employed explicit memory tests; however, explicit tests provide the opportunity for subjects to self-generate cues for retrieval that might overpower mood as a cue. It was hypothesized that use of an implicit memory test would highlight mood by reducing the opportunity for subjects to generate relatively stronger cues for retrieval, resulting in intensified MDM and MCM effects, provided that the implicit memory test was conceptually-driven and, therefore, could be impacted by mood, and the nominal cues provided at test were reduced to a minimum. An implicit analogue of free recall was developed which met these conditions. It was also hypothesized that MDM would be most likely to be found if stimulus items were related to mood semantically as well as temporally.

Subjects studied positive, neutral and negative words following either a happy (H) or sad (S) uninstructed musical mood induction. Half of the stimulus items were encoded elaboratively and half shallowly. Prior to test, subjects received either a happy or sad musical mood induction. Subjects were placed into one of four mood groups based on subjective reports of mood prior to encoding and retrieval (HH, HS, SH, SS). Each subject received an implicit memory test (free recall analogue) followed by an explicit memory test (free recall) for the studied words. No MDM effects were observed; however, when only items that were semantically related to encoding mood (mood congruent) were examined, there was a strong trend towards mood congruency in the implicit but not explicit condition. Mood congruent retrieval was found in the implicit but not explicit condition. No mood congruent encoding or resource allocation effects were observed. It was concluded that mood had a greater opportunity to affect retrieval from episodes when implicit memory tests were employed. Some caveats to this conclusion are discussed as well as potential methodological pitfalls in conducting this type of research.

CHAPTER 1

INTRODUCTION

A topic of major theoretical interest within cognitive and clinical psychology is the bidirectional relation between cognitive and emotional processes. For example, Schachter and Singer (1962) proposed that attributions regarding internal events are important determinants of emotional experience, a point which has recently been debated by Zajonc (1980, 1984) and Lazarus (1984). Beck (1967) and Abramson, Seligman, and Alloy (1980) argued that distorted cognitions or attributions regarding the causes and consequences of negative life events may lead to depression. Conversely, a number of theorists have argued that cognitive processes such as perception, memory, and judgment are themselves shaped by a person's emotional state (e.g., Bower and Cohen, 1982; Isen, 1984). Among investigations concerned with the impact of mood on cognition, most attention has been focused on memory effects of various sorts (Blaney, 1986; Bower, 1981; Ellis & Ashbrook, 1987, 1988; Johnson & Magaro, 1987; Leventhal & Tomarken, 1986).

Mood Effects on Memory

Within this domain, three phenomena have been of particular interest: mood-dependent memory (MDM), mood-congruent memory (MCE) and mood effects on encoding and retrieval (resource allocation effects). These phenomena and their inter-relations are the topic of this study.

Mood-Dependent Memory

Mood-dependent memory (MDM) occurs when retrieval of material is enhanced by reinstating the mood that the individual was in when the material was initially encoded (Bower, 1981). The notion of mood-dependent memory is based on an analogy with state-dependent memory (SDM), whereby internal physiological states induced by centrally acting pharmacological substances serve as cues for retrieval (Overton, 1968, 1974; for reviews see Eich, 1977, 1980, 1987; Swanson & Kinsbourne, 1978, 1979). Conceptually similar environment-dependent memory (EDM) effects have been observed in experiments where the study and test phases take place under water or on land (Godden & Baddeley, 1975, 1980), in differently furnished rooms (Eich, 1985; Smith, 1979; Smith, Glenberg, & Bjork, 1978) or at different times of day (Folkard, 1979; Holloway, 1978). In fact, it has recently been suggested (Eich & Birnbaum, 1987; Eich, 1985) that the context-dependent memory effects produced by psychoactive drug states and environmental setting may be mediated by their affective properties. Like SDM and EDM, MDM appears to be an instance of a broader class of context-dependent effects in memory. Unfortunately, as currently understood, all of these context-dependent effects seem to be rather weak and unreliable in humans (Eich, 1980, 1987; Fernandez & Glenberg, 1985).

The primary theoretical underpinnings of context-dependent memory are Anderson and Bower's (1973) network theory of human memory and Tulving and Thomson's (1973) encoding specificity theory. In network theory, human memory is conceptualized as an associative network of nodes representing concepts or propositions. An event is represented in memory through the activation of concepts used in describing the event and the establishment of associative connections among the concepts and event. When the activation level of a concept exceeds some threshold, it reaches consciousness. Activation spreads from one node to another through associative linkages so that activation of any associated concept will aid in retrieving the information, including mood state at the time of retrieval (Bower, 1981). Both the network and encoding specificity theories (Tulving & Thomson, 1973) state that the accessibility of a memory is determined by the degree of similarity between the features of the event encoded at the time it occurred and the information supplied by the cues presented at the time of retrieval. Therefore, the internal and external environment may affect the accessibility of associated concepts to the extent it is encoded with the event and subsequently serves as a distinctive cue for retrieval.

Some early evidence of MDM came from studies of patients with bipolar affective disorder (Weingartner, Miller, & Murphy, 1977) and normal subjects threatened with electric shock (Macht, Spear, & Levis, 1977). However, since that time, MDM has assumed a "now you see it, now you don't" quality. MDM has rarely been observed in straightforward designs in which subjects study a single list in one mood, and are tested in the same or a different mood (Bartlett & Santrock, 1979; Bower, Monteiro, & Gilligan, 1978, Experiments 1-2; Isen, Shalker, Clark, and Karp, 1978; Mecklenbrauker & Hager, 1984). Bower et al. (1978) were able to produce the effect using an interference design employing two word lists, but subsequent conceptual replications have yielded mixed results (Bartlett, Burleson, & Santrock, 1982; Bower & Mayer, 1985, 1986, 1989; Share, Lisman, and Spear, 1984; Wetzler, 1985; Johnson & Klinger, 1988). Many have concluded that MDM is an unpredictable "evanescent will-'o-the-wisp" (Bower & Mayer, 1985, pp.42) rather than a robust, generalizable phenomenon, and that earlier positive results might have been spurious outcomes (Bower, 1986; Bower & Mayer, 1986, 1989; Mayer & Bower, 1987; Blaney, 1986; Leventhal & Tomarken, 1986; Wetzler, 1985; Haaga, 1989). Attempts to find MDM with anxious mood have also failed (Foa, McNally, & Murdock, 1989); however, one experiment did find evidence of MDM with induced pain (Pearce, Isherwood, Hrouda, Richardson, Erskine, & Skinner, 1990).

A number of theorists (e.g., Baddeley, 1982; Fernandez & Glenberg, 1985; Bower & Mayer, 1986) have suggested that context is an effective retrieval cue only when it is explicitly attended to and/or is perceived as relevant to the subject's activities at the time of encoding or retrieval. Manipulations of attention and "relevance" may serve to change the status of contextual cues from implicit to explicit (Eich, 1980; Kihlstrom, Brenneman, Pistole, Shor, 1985). Alternatively, these manipulations, may be seen as transforming mood from a purely contextual, temporally-related cue to a more descriptive, meaning-related cue that is interactively encoded with the stimuli. This may serve to strengthen the links between mood and the items in the associative network during encoding and thereby strengthen mood's cue value at time of retrieval, making MDM effects, which depend on these links, more probable.

Along these lines, Bower and Mayer (1989) demonstrated MDM under conditions where a sense of "causal belongingness" was created between the stimuli and mood. In this experiment, the materials used to induce mood, also served as targets for later retrieval. They have been unable to replicate this result (Bower & Mayer, 1989), but suggest that further inquiry along these lines may represent the future of MDM research. Use of affectively-valenced material which is congruent to encoding mood would presumably have this same effect due to the semantic and prior episodic relationship between the mood and stimuli which may lead to increased attention to mood, or interactive encoding.

Eich & Metcalfe (1989) suggested that the link between mood and memory might be strengthened by having subjects generate the to-be-remembered stimuli while in a particular mood state. It was hypothesized that stimuli generated through internal processes might become more strongly imbued with the mood of the rememberer than externally generated material and a change in mood would have a greater impact on retrieval of these items. Using procedures developed by Slamecka and Graf (1978) to explore the generation effect in memory, they were able to demonstrate a mood-dependency effect for items that were generated but not for those that were simply read, even when level of recall of read and generated items was equated by having subjects read items three times. However, a replication showed equal mood-dependency in both generate and thrice read conditions.

To explore this idea further, Eich & Ryan (1989) had subjects generate autobiographical memories in response to neutral probes, while in a happy or sad mood, and then later recall these memories and the eliciting cue while in the same or different mood. Memories were classified as positive or negative according to subject's ratings of how positive or negative the event was at the time it originally occurred. A significant mood-dependency effect was seen for both positive and negative memories.

These positive demonstrations of MDM suggest that using valent material or imbuing the stimuli with affect strengthens the associative link between mood state and stimuli and increases the likelihood of finding MDM. Teasdale and colleagues tested memory for valent autobiographical events or word lists while subjects were in different naturally occurring or manipulated mood states. Their findings that subjects more readily accessed stimuli that were congruent with retrieval mood have generally been construed as evidence of mood congruent memory rather than MDM. However, in the case of autobiographical memories, the preferentially accessed memories were most likely previously encoded in moods that matched retrieval mood and thus their results could be construed similarly to those of Bower & Mayer (1989) and Eich & Metcalfe as instances of MDM (e.g., Teasdale & Fogarty, 1987; Teasdale & Russell, 1983; Teasdale & Taylor, 1981; Teasdale, Taylor & Fogarty, 1980; Clark & Teasdale, 1987; Teasdale & Dent, 1987). In these cases, MDM appears to have more in common with MCM, where valence of the material provides the link between mood and stimuli, than other context effects where temporal contiguity is the only presumed link between context and to-be-remembered stimuli.

Mood-Congruent Memory

Mood congruent memory (MCM) occurs when mood state facilitates the processing of material with a similar emotional valence. In contrast to MDM, MCM effects have been well documented in experiments on both verbal learning and autobiographical memory, using both normal subjects and patients with affective disorders (for reviews, see Blaney, 1986; Johnson & Magaro, 1987; Leventhal & Tomarken, 1986). Conceptually, MCM effects can be separated into those that operate at the encoding stage (MCE; e.g., facilitating the encoding of information that is congruent with the perceiver's mood) and those that operate at the retrieval stage (MCR; e.g., facilitating the retrieval of information that is congruent with the rememberer's mood).

These phenomena are also predicted by the network theory of memory (Bower, 1981). MCE may occur due to a selective reminding effect, whereby, when a person is in a particular mood, memories of similar moods and related events will be activated. Ongoing mood-related events will be elaboratively encoded with respect to these activated concepts, thereby facilitating later retrieval. In addition, selective reminding may enhance memory for the new event because input is elaborated or infused with greater emotion, or because the event may enhance the ongoing mood, thus increasing the distinctiveness and/or saliency of the event. Since people are more likely to remember distinctive or salient events, memory for mood congruent material is enhanced (Bower, 1981). Others have suggested that attentional resources are differentially devoted to processing of affectively congruent stimuli as an adaptive response which promotes vigilance to dangerous stimuli and enhances the ability of the organism to acquire relevant information in affectively laden situations (Mathews, Mogg, Mays & Eysenck, 1989). There is evidence that, in some cases, MCE may be the result of valent material attracting attention because it is personally relevant or unusual, which then leads to a mood, rather than mood promoting the processing of the congruent information.

Mood-congruent retrieval (MCR) occurs because of the proposed link between mood state and affective valence of material in the network. This explanation could be reinterpreted as an intensified MDM effect, since material often acquires its affective valence by virtue of being encoded in a particular mood state. This is particularly true of autobiographical material. In effect, mood at time of initial encoding and retrieval is matched and the associated valence given to the material simply makes the mood state cue more distinct. Despite this possible theoretical link, evidence of MCR has rarely been seen as constituting evidence for MDM, except by Teasdale and colleagues. In fact, researchers rarely discuss MCR in theoretical terms. Instead, they use the term descriptively to indicate the increased accessibility of material which is congruent to retrieval mood when only retrieval mood is manipulated and encoding mood is either not controlled or neutral.

Five verbal-learning experiments reported by Bower, Gilligan, and Monteiro (1981) showed good evidence for MCE, but little or no evidence for MCR (one of their experiments also tested for MDM in a standard free-recall paradigm, and yielded no evidence of the effect). On the other hand, Nasby and Yando (1980, 1982) obtained clear evidence of both MCE and MCR in children, although MCR was definitely weaker than MCE (no evidence of MDM was apparent in their one-list, non-interference design). Studies that compare memory in depressed and non-depressed subjects for affectively valenced word lists have generally found that depressed subjects access relatively more negative material than non-depressed subjects in self-referenced encoding conditions. While these studies do provide evidence for MCM, they confound MCE and MCR (as well as MDM) effects so that it is uncertain whether one or both of theses effects are operating and to what degree (Bradley & Mathews, 1983; Derry & Kuiper, 1981; Kuiper & Derry, 1982; Mathews & Bradley, 1983; Zuroff, 1980; Hammen, Marks, deMayo, & Mayol, 1985). Hasher, Rose, Zacks, Sanft, and Doren (1985) failed to find any evidence of mood-congruent recall in normal subjects with naturally fluctuating moods (for critiques see Ellis, 1985; Isen, 1985; Mayer & Bower, 1985; for a response see Hasher, Zacks, Rose, & Doren, 1985). Foa, McNally & Murdock (1989) found no evidence of MCM with anxious mood. Pearce, Isherwood, Hroudi, Richardson, Erskine, & Skinner (1990) found evidence of mood congruity with chronic pain patients; however, Eich, Rachman, & Lopatka (1990) found that mood congruent retrieval of autobiographical memories with pain patients was mediated by unpleasant affect.

Bower and Mayer (1989) also failed to find evidence for MCR in a study where subjects were expressly instructed to maintain a neutral mood during encoding of a number of increasingly positive and negative vignettes and then asked to recall the vignettes in either a positive or negative mood. However, as noted above, when subjects were requested to experience a congruent mood during encoding, MCR, interpreted as MDM, was shown. An attempt to replicate this result has failed (Bower & Mayer, 1989). This result highlights the controversy over whether instances of MCM may in fact be disguised instances of MDM since MCR was only seen when encoding and retrieval moods matched.

Prima facie evidence for MCR comes from studies of autobiographical memory where both clinical and non-clinical subjects have been found to access personal memories that are affectively congruent to mood state at time of retrieval more readily than incongruent ones (e.g., Clark & Teasdale, 1982; Diener, Larson, and Emmons, 1984; Fogarty & Helmsley, 1983; Teasdale, Taylor & Fogarty, 1980; Teasdale & Taylor, 1981; Teasdale & Fogarty, 1979). One difficulty with autobiographical memory designs, alluded to above, is the lack of control over encoding conditions. In addition, there is often a failure to assess or take into account encoding mood in the data interpretation when, in fact, valent memories are generally encoded in moods congruent to the valence of the memories for one of two reason; (1) the autobiographical memory may have induced a mood at time of encoding or (2) the event may have taken on a valence because of the mood the subject was in at the time it occurred.

Whether MDM and MCR are theoretically distinct is an unresolved controversy with little empirical evidence on either side (Blaney, 1986). As noted above, rather than MCR constituting a separate phenomenon, it may be that mood-congruence merely affects the strength of the MDM effect by strengthening the associative link between the mood and stimulus item at the time of encoding (during the study or during prior experiences with the stimuli) through the mechanisms which create MCE effects (i.e., by elaboration of the trace or intensification of the associated mood), thereby making mood a more distinctive retrieval cue.

Congruence may also strengthen the link in two related but somewhat distinct ways; (1) by drawing attention to mood during encoding, increasing the probability that mood context will be processed and that mood will be maintained or strengthened; and (2) by converting mood from a merely temporally-related contextual cue, which is independently processed, to a contextual cue with descriptive, meaning-related associations which is interactively processed with the stimuli. Eich (1985) has demonstrated that interactive processing (in this case having subjects imagine the stimuli-to-be-encoded in connection with an aspect of the environment, e.g., kite on the table, as opposed to imagining the stimuli independent of the environment, e.g., kite in the sky) does affect the strength of environmental-context effects.

The possibility that MCR is a subset of MDM or that mood congruence is a variable influencing MDM, increases the importance of obtaining clear evidence concerning the reliability and generalizability of MDM using both neutral items that have no past encoding history related to mood, as well as items with varying degrees of "relatedness" to mood.

Recently, a number of researchers have obtained evidence of mood <u>in</u>congruency effects, using autobiographical memories (Parrott, 1989; Sabini) or word lists (Singer & Salovey, 1989). Incongruency was more likely to be found if naturalistic mood inductions were used (e.g., the subjects were responding to their natural environment or were experiencing clinical mood states such as anxiety or depression). It has been hypothesized that when subjects are not trying to maintain a mood state for experimental purposes, they will exert controlled processes to elevate negative moods or stabilize extreme mood states, including focusing on incongruent stimuli (Blaney, 1986). Mood congruency still represents the predominant finding in this type of experiment but it is important to consider the contribution of both controlled and automatic processes.

Resource Allocation Effects

One feature of both MDM and MCM is an asymmetry in effects as a function of mood state. In MCM, mild negative mood states appear to decrease access to positive stimuli, relative to happy moods, but do not affect access to negative or neutral stimuli, whereas positive mood states both increase access to positive stimuli and decrease access to negative stimuli. In part, this may reflect the unanticipated consequences of self-regulation strategies employed by subjects, independent of the experimenter's formal instructions, in order to dispel or contain negative feelings that they consider unpleasant and undesirable. It may also represent a natural tendency towards happy or neutral mood states (Blaney, 1986) or the fact that positive items occur at a higher frequency, in general, than negative ones (the Pollyanna Principle) which has been shown to influence retrieval (Nasby & Yando, 1982; Matlin & Stang, 1978).

In addition, this asymmetry may reflect the differential information-processing consequences of positive and negative mood states. It has been proposed that emotional mood state produces **resource allocation effects** on ongoing information-processing tasks (Ellis & Ashbrook, 1987, 1988). In particular, depressed mood appears to increase a person's information-processing load. This internal cognitive activity drains attentional resources that would otherwise be devoted to other tasks, resulting in poor encoding of material presented during a depressed mood and performance deficits on subsequent retention tests (Ellis, Thomas, McFarland, Lane, 1985; Leight & Ellis, 1981; Ellis, Thomas & Rodriguez, 1984). The greater the processing demands, the more pronounced the deficits will be. For example, processing that requires great concentration or skill and is unrelated to mood will be affected to a greater extent than processing of mood-related information, e.g., memories of personal mood-congruent experiences.

Alternatively, when negative mood is mild, resources may be allocated to the processing tasks and taken away from focusing on the mood state which would lead to a dissipation of or inattention to the negative mood and hence, diminution of MDM or MCR effects, without any processing deficits. This effect will also be more pronounced when the task requires great skill or concentration and is unrelated to mood and may also account for the asymmetry in effects. This possibility has never been directly examined. Motivation to perform the tasks can also influence these effects. Strength of mood, level of processing demands and motivation to perform may interact to determine whether resource allocation will favor mood or the information processing task (Miller, 1975; Ellis & Ashbrook, 1987, 1988).

The resource allocation theory is not explicit about positive rather than negative mood states, and the outcomes of such comparisons are of considerable theoretical importance in determining whether effects are mediated by the distracting effect of the person's mood-relevant thoughts. If so, we should expect happy and sad moods to have the same effects on information processing, increasing as the mood becomes more intense. Alternatively, depressed moods may have a more specific effect on attentional allocation policy, e.g., by reducing people's interest in their surroundings and consequently their motivation to pay attention to them and other ongoing activities. In this case, happiness and sadness should have opposite effects: the sad person's disinterest should impair cognitive processing, while the happy person's motivation should facilitate it.

Significance

If mood effects were merely curiosities of mental life, their apparent unreliability would have few consequences. However, they are not isolated phenomena, but have broad practical and theoretical implications. For example, all of these effects have been implicated in the perseveration and treatment of clinical episodes of depression in affective disorder patients (e.g., Beck, Rusk, Shaw, & Emory, 1979; Johnson & Magaro, 1987; Ingram, 1984; Kihlstrom & Nasby, 1981; Nasby & Kihlstrom, 1986). MDM and MCM theories suggest that once a person is in a negative mood, for whatever reason (e.g., life stress, biological factors, aversive situations, etc.) they will tend to automatically access just those cognitions that will serve to maintain and increase the negativity of their mood. This sets the stage for a vicious cycle leading to a downward spiral into depression. These theories also imply that prevention and treatment of depression might involve breaking this cycle either at the affective or cognitive level (e.g., by medication, pleasant life events, distraction, controlled thought precesses, etc.). Those most vulnerable to depression may have more frequent or intense mood states initially or may be unable to recruit positive cognitions to repair negative mood states for a variety of reasons.

These effects also have implications for a variety of theories of memory that assume that the context in which an event occurs is encoded as part of the trace of that episode in memory, and can serve as an effective cue for the retrieval of that trace (e.g., Anderson & Bower, 1983; Baddeley, 1982; Bower, 1981; Davies & Thomson, 1987; Kihlstrom, Brenneman, Pistole, & Shor 1985; Tulving & Thomson, 1973). Thus, the empirical status of these effects, especially given the weakness of analogous SDM and EDM effects in humans and the inconsistency in MCM effects, is a matter of considerable theoretical importance. An understanding of the conditions necessary for demonstrating these effects will shed light on the more general problem of context and its representation in memory (Baddeley, 1982; Davies & Thomson, 1987). The primary focus of the proposed study is to clarify these conditions.

Methodological Considerations

In view of the inconsistency in the results of studies examining the MDM and MCM effects, it is essential to determine the optimal conditions under which they and other instances of context-dependent memory can be demonstrated (Baddeley, 1982; Bower & Mayer, 1986; Eich, 1980; Fernandez & Glenberg, 1985; Kihlstrom, Brenneman, Pistole, & Shor, 1985; Overton, 1974; Swanson & Kinsbourne, 1978, 1979). Overton (1974) and Swanson and Kinsbourne (1978, 1979) have argued that drug-induced SDM may be obscured by main effects of psychoactive drugs on encoding and/or retrieval, leading to a failure to obtain the perfect crossover interaction predicted by the SDM hypothesis. This point takes on added importance given the arguments of Ellis and Ashbrook (1987, 1988) concerning the effects of depressed moods on the allocation of attentional resources. It is important to evaluate whether resource allocation effects may be obscuring or accentuating other mood effects.

More importantly, Eich (1980) has argued that SDM, of which MDM is an analog, is a cue-dependent phenomenon which critically depends on the nature of the cue information available at the time of encoding and retrieval. In general, MDM will be most readily demonstrated when mood is a strong cue, learning is poor, or material is otherwise relatively inaccessible (thereby increasing the importance of any available retrieval cues), and when mood adds an additional cue that can be used to sort out similar material - i.e., when mood is a helpful feature in distinguishing the target material from interfering material (Bower, 1981). MDM should not be expected to the extent that mood at time of encoding or retrieval is weak or unattended to, or when other, relatively stronger, cues are available to aid retrieval, thereby making mood a redundant cue. This central theoretical premise has been widely ignored in previous studies and could explain the majority of negative findings.

The most prevalent example of more powerful cues overshadowing the mood cue occurs in experiments using differentially affectively-laden stimuli (e.g., positive, negative and neutral stimuli in a single word list) within a single mood condition (e.g. Bower, Gilligan & Montiero, 1978; Bower & Mayer, 1985; Nasby & Yando, 1982). As discussed above, the findings of MCR in these studies may actually be interpreted as MDM effects when prior encoding conditions are taken into account. Whether or not this is the case, there is clearly a stronger, meaning-related (semantic) relationship between moods and affectively-congruent stimuli, in addition to the contextual (temporal) relationship. This relationship is likely to result in mood at time of retrieval being a relatively stronger cue, which will override the effects of mood context at time of encoding, for accessing congruent stimuli, as opposed to neutral or incongruent stimuli where mood is only contextually (temporally) related. In recognition of this difficulty, related (affectively congruent) and unrelated (neutral or opposite affect) stimuli should be examined and analyzed separately when looking at MDM.

Another important feature has to do with the status of context (whether physiological, emotional, or environmental) with respect to other potential retrieval cues. Context cues of all sorts are usually implicit rather than explicit (Eich, 1980), so there is likely to be great variability in the degree to which they are processed at the time of encoding and retrieval (Bower, 1972; Estes, 1959). If context is not actively processed at the time of encoding, it cannot serve as an effective cue at the time of retrieval (Tulving & Thomson, 1973).

The most unambiguous way of demonstrating MDM is to use only neutral stimuli that do not have a prior episodic or semantic relationship to mood. Unfortunately, the use of neutral stimuli is problematical because of the weakness of the resulting association between the mood cue and stimuli and consequent likelihood of stronger retrieval cues being inadvertently supplied. The mood itself may also be weak in these studies since mood must be manipulated and there are problems with all mood induction procedures. Most relevant to the question of strength of mood cue is that induced moods tend to be relatively mild and transient, the moods are not always discrete (Polivy, 1981), there are individual differences in responses to MIPs, and some subjects report a response when they have none, due to demand characteristics (Buchwald, Strack, & Coyne, 1980). Obviously, no MDM effects would be predicted if subjects are not actually experiencing distinctive moods. Use of strong criteria for determining whether the subject is in the appropriate mood, which has frequently been neglected, can eliminate some of these concerns. In addition, attempts to minimize demand characteristics should be employed, such as using instructions which emphasize the necessity of accurate reporting of mood. Use of an MIP to which most people respond is also essential, to reduce the impact of individual differences and increase the generalizability of experimental findings.

Most experiments using neutral stimuli fail because of the presence of relatively stronger cues for retrieval. As discussed above, the mood cue is likely to be weak, unless interactive encoding or affectively-valenced stimuli are utilized, then this same weak cue is paired with all of the stimuli, thereby weakening its distinctiveness even further. This has been referred to as the cue-specificity hypothesis (Smith, Glenberg, & Bjork, 1978). The fewer items in which a cue is encoded, the more specific and, therefore, more effective it is since it is less overloaded with associated items (Watkins & Watkins, 1975). General cues, such as contextual cues, will be more effective when the use of more specific and more powerful but equally general cues is restricted, i.e., when degraded encoding and retrieval conditions are used. This can be done in a number of ways.

It has been found in environmental context studies (Eich, 1985) that cue overload can be reduced by having subjects associate stimulus-items to contextual features on a one-to-one basis, i.e., by asking them specifically to associate each word to a different piece of furniture in the room. Eich (1985) did not obtain positive EDM results with interactive encoding of stimuli and environment until he solved the cue overload problem in this manner. Use of two-list interference designs, in which mood is a helpful feature in distinguishing the two lists, has proven more successful than single list designs. It may also be possible to reduce cue overload in MDM studies by asking subjects to associate, or by temporally associating, single stimulus-items to different aspects of their mood, e.g., energy level, motivational level, attentional level, feelings of sadness, worthlessness, anger. This affects not only the specificity of the mood cue but also its power relative to equally general contextual/background cues by drawing attention to it and strengthening its link with the stimuli.

In general, MDM is more likely to be shown when incidental learning and shallow processing is used (Smith, 1986) because learning is generally poorer and mood becomes a relatively powerful cue. By contrast, with intentional learning or elaborative encoding, the subjects often generate more relevant or powerful cues, such as mnemonic devices, which make mood cues redundant.

The retrieval task can also supply superseding cues. Cued recall tasks, including recognition, will generally provide such strong cues for retrieval that weak mood cues are redundant and MDM will not be found (Schare et al., 1984), although at least one study did find MDM in a recognition task when the time between learning and retrieval was substantial (Leight & Ellis, 1981). With free recall, only the self-generated and/or temporal and spatial cues generated by explicit referral to the list are available. Eich and Metcalfe (1989) further suggest that free recall represents a more internally generated process that might be more influenced by the subject's emotional state.

Preliminary Study:

Interactive Encoding and Deliberate Attention

In an initial attempt to address these methodological concerns, an experiment was conducted that manipulated interactive vs. independent encoding of stimuli and mood and deliberate vs. incidental attention to mood during encoding (Tobias, 1990). A two-list interference design was utilized where subjects incidentally encoded two lists of words, one in a sad mood and one in a happy mood (Bower, Monteiro, & Gilligan, 1979). Free recall was performed in either a happy or sad mood state.

In the independent/incidental condition, subjects formed sentences relating the stimuli to "something about the state of Arizona" and rated faces for attractiveness periodically during retrieval. In the independent/deliberate condition, subjects related words to Arizona but were asked to rate their mood throughout encoding in an attempt to draw attention to mood to facilitate explicit encoding of mood. In the interactive/ deliberate condition, subjects formed sentences relating the words to some aspect of their current mood state and rated mood throughout encoding.

A musical mood induction technique was chosen because it had previously been shown to reliably induce relatively strong moods in most subjects (Clark, 1983; Sutherland, Newman, & Rachman, 1982; Clark &

Teasdale, 1985; Bower & Mayer, 1986; Eich & Metcalfe, 1989). Objective mood measures (letter cancellation) were employed in addition to subjective mood ratings; however, while subjects in happy and sad mood conditions differed significantly on all of these measures, the objective measures were determined to be unreliable. Only subjects who actually reported being in the appropriate moods for encoding and retrieval were included in the analyses. Out of 284 subjects, 74 subjects met a conservative criterion for inclusion and 186 met a liberal criterion for inclusion.

No effects of mood on memory were obtained; however, memory appeared to have a significant effect on mood in that mood dissipated significantly during encoding and retrieval tasks. A number of possible problems may have contributed to the failure to find MDM in this experiment including the failure of the mood induction to produce strong moods or the possibility that subjects reported being in moods that they were not actually experiencing. Although an attempt was made to reduce demand characteristics related to mood induction by telling subjects that we were examining whether or not the induction was effective as part of the experiment and needed an accurate report, subjects were asked to try to "get into" the appropriate mood by using whatever strategies they could recruit to aid them while listening to the music. This created an implicit demand to get into the mood state required (for a more detailed discussion see Tobias, 1990).

More importantly, encoding was relatively elaborate in all conditions. A free recall test was used which allowed subjects to consciously think back to the encoding episodes and utilize whatever cues for retrieval may have been generated during encoding. Under these circumstances, it is likely that subjects were able to generate relatively strong cues for retrieval that made the mood cue redundant.

Mood and Implicit Memory

Almost without exception, research on emotion and memory has focused on "conscious" or explicit memory: the person's conscious, intentional recollection of some previous episode, most commonly reflected in standard tests of recall and recognition. However, there is more to memory than what the individual can bring to awareness in an act of conscious, intentional, recall or recognition. Memory may be expressed implicitly by a change in behavior, often facilitation in task performance, under circumstances where the subject is not aware of the relationship between this behavior and the learning episode. This has been termed implicit memory, or memory without awareness (Eich, 1984; Jacoby & Witherspoon, 1981; Graf & Schacter, 1985; Schacter, 1987).

There are a number of reasons to believe that mood may affect implicit memory somewhat differently from explicit memory. Use of implicit tasks may address some of the concerns regarding the relative weakness of mood as a retrieval cue in most experimental paradigms. In addition, use of implicit tasks may also provide greater ecological validity given theoretical notions regarding the automaticity and "unconscious" nature of mood effects in vivo. It has been postulated that, outside of the laboratory, mood-congruent or dependent material may simply "pop" into mind, as opposed to being the consequence of effortful retrieval. This notion has clinical ramifications in that the automaticity may preclude the opportunity to exert controlled processes to alter this pattern at the outset, which may set the stage for the vicious cycle into depression postulated by Bower and by Teasdale. It may also speak to the evolutionary value of having two memory systems, one to alert the organism to danger, relatively effortlessly, and the other to exert control over memory to enable organisms to effectively respond.

Interestingly, many of the prominent theories of mood disorders postulate the operation of what could be construed as automatic or unconscious memory processes, e.g., Freudian theories of psychopathology, conditioning theories of fear, cognitive theories of depression. Given this theoretical emphasis, an examination of implicit memory effect would appear to be imperative in any theory of emotion. In addition, emotional material and state constitute important and relatively unexplored variables that may help to delineate the parameters of implicit memory as well as the practical implications of such a system. The examination of mood effects on implicit memory is the focus of the current study.

Defined most broadly, implicit memory is demonstrated by any change in behavior that is attributable to some prior episode of experience, but that cannot be accounted for by explicit memory for that event. Typically, implicit memory is revealed by tasks that do not require conscious or intentional recollection of those experiences

(Schacter, 1987, p. 501). For example, in an experiment by Kihlstrom (1980), hypnotized subjects memorized a list of words, followed by suggestions of posthypnotic amnesia for the learning experience. As expected, these subjects showed a dense amnesia for the word list, as measured by free recall. Nevertheless, they were more likely to produce list items as responses on a word-association task. Similar results were obtained in a second experiment involving category instance generation. In an experiment by Graf and Schacter (1985), amnesic patients and normal controls studied a list of paired associates. Later, they were presented with the first word of the pair. For some test items, the subjects were asked to recall the associated word from the previously studied list; not surprisingly, the amnesic patients performed quite poorly. For other items, the subjects were provided with the first three letters of the second item, and give the first word that came to mind: on this task, amnesics and controls were equally likely to give an item from the previous list.

In both experiments, subjects showed a facilitation in task performance that was attributable to a prior experience. Nevertheless, these same subjects were unable to remember the experiences themselves. Thus, these experiments illustrate the dissociation between explicit and implicit memory (for more complete reviews, see Richardson-Klavehn & Bjork, 1988; Schacter, 1987, 1989, 1990, 1992). This dissociation is manifested in one of two ways. (1) Explicit memory is impaired while implicit memory is (at least relatively) spared. This situation is illustrated in the specimen experiments described above, as well as in aging (Schacter, Kaszniak, & Kihlstrom, 1990) and surgical anesthesia (Kihlstrom & Schacter, 1990). (2) Different variables affect performance on explicit and implicit memory tasks. For example, some experiments find that level of processing affects explicit but not implicit memory (Graf & Mandler, 1984), while others find that modality shifts between study and test affect implicit but not explicit memory (Schacter & Graf, 1989).

It is possible that explicit and implicit memory effects reflect the operations of several different memory systems in the brain concerned with the perceptual representation of experience, procedural memory for skill knowledge, semantic memory for conceptual relations, and episodic memory for experiences (Tulving & Schacter, 1990). Processing and activation accounts of priming phenomena have also been postulated (for reviews see Schacter, 1987; Richardson-Klavehn & Bjork, 1988; Roediger, 1990; Jacoby & Dallas, 1981). Although theoretical interpretation of relevant phenomena remains somewhat controversial, what is clear is that explicit and implicit memory are two different modes by which memory for some prior event can be expressed. Thus, two fundamental questions, derived from the bidirectional relations between memory and emotion present themselves: "does implicit memory affect emotion?" and "does emotion affect implicit memory?".

While little data exits on the effects of mood on implicit memory, there is a small body of anecdotal and empirical literature on the effects of implicit memory on emotion which has been reviewed elsewhere (Tobias, Kihlstrom, & Schacter, 1992). The current study addresses the second of these questions, "does emotion affect implicit memory?". However, the two questions are intimately related, given that the effects of mood on implicit memory may have implications for the development and maintenance of mood states which in turn may affect memory, thus creating a cycle of mood and memory effects.

Theoretical Predictions

Mood-dependent and Mood-Congruent Memory

Can mood or emotional state affect implicit memory, as expressed on nominally non-emotional tasks? From one point of view, it might be expected that emotional state would have relatively little effect on implicit memory. Consider the phenomenon of mood-dependent retrieval. A shift in mood state between encoding and retrieval, can be considered analogous to a change in the subject's internal physiological environment, as in the classic phenomenon of drug-state-dependent memory, or in the external ecology, as in the phenomenon of environment-dependent memory. In all three cases, the shift in context (internal or external, physiological or mental) appears to induce a type of amnesia. In many forms of amnesia, memory loss often is greatest in the explicit domain, with implicit memory being relatively preserved. From this point of view, one might expect that implicit memory would be preserved for material which is rendered inaccessible to explicit memory because of mood shifts. That is to say, implicit memory may transfer over various mood-states, even when explicit memory does not.

This hypothesis is supported by further consideration of the functional dissociations observed between explicit and implicit memory. Although explicit memory is affected by a wide variety of encoding factors, the variables that most consistently have been found to affect implicit memory are changes in the surface features of the events (e.g., Roediger & Blaxton, 1987; Roediger, Weldon, & Challis, 1989; Schacter, 1990) -- at least when the implicit measure is data-driven or perceptually-based. Since affect changes the connotative meanings of events, but not their perceptual features, mood may constitute another variable that affects explicit but not implicit memory.

One might also argue that if mood-dependent and congruent memory depend on the elaboration of stimuli with respect to mood state so that mood can later serve as a cue for retrieval, no effects should be found on tests of implicit memory where elaboration and conscious retrieval do not typically play a role (Macaulay, Ryan & Eich, 1991).

On the other hand, there may be reasons to suggest that context effects, including mood effects, will be observed to a <u>greater</u> extent in implicit memory than explicit memory. For example, the psychoactive drugs that induce state-dependent memory in humans (e.g., alcohol, marijuana, barbiturates) can alter sensory-perceptual processes. In fact, Graf (1988) suggested that environmental contexts directly alter the processing of perceptual or surface features of events, producing effects analogous to modality shifts. Accordingly, Graf has found that shifts in environmental context affect implicit memory even when they do not affect explicit memory. The same argument could be made for the effects of mood-contexts: perhaps the world does look darker to sad people, and brighter to those who are happy. Macaulay, Ryan and Eich (1991) and others have suggested that mood may be incorporated with other information about the stimuli into a unitary representation such that re-presentation of part of this information (mood state) would promote redintegration of the entire memory representation and facilitate activation of the trace (Graf & Ryan, 1990, c.f. Macaulay, Ryan and Eich, 1991).

Moreover, it is important to recognize that mood is not just a state, like sleep or hypnosis, that alters perception or induces a kind of amnesia. Mood is also a cue that is processed when memories are encoded, and guides the course of retrieval. As discussed above, it has been argued that mood-dependent memory and is a cue dependent phenomenon that critically depend on the nature of the cues available at retrieval (see also Kihlstrom, 1989; Kihlstrom, Brenneman, Pistole, & Shor, 1985). From this point of view, a primary reason for inconsistency in the results of studies on context-dependent memory findings is the tendency for other, stronger cues to overshadow the usually weak context cue. These potentially stronger cues may include experimenter presented or subject generated cues.

The foregoing analysis suggests two conditions under which the chances of finding mood-dependency would be increased: (a) if the link between the subject's mood and the list items were strengthened; and (b) if other potentially superseding cues were eliminated, thereby highlighting the mood cue. While incidental learning and free recall would seem to substantially reduce competing cues, they cannot eliminate them completely. Free-recall tests still specify the spatiotemporal context in which learning occurred, and subjects are highly likely to generate cues for themselves over the course of intentional retrieval, even if they did not generate them during incidental encoding. In fact, Smith (1979, 1984) found that subjects were able to recreate environmental contexts through imaginative processes which nullified the effects of context changes and resulted in EDM when the imagined environments were congruent. It is unclear whether individuals spontaneously recreate contexts, but explicit memory tests provide the opportunity to do so. This potentially variability in what subjects do during retrieval may partially account for the inconsistency in results when explicit memory tests are utilized.

It is proposed that use of implicit memory tests can further reduce both experimenter-supplied and subject-generated cues. By definition, implicit memory tasks eliminate all explicit references to any prior learning episode: they do not require retrieval of autobiographical memories. Thus, no cues pertaining to spatiotemporal context are supplied by the experimenter; and subjects have no incentive to deliberately generate episodic cues that might aid their performance. Therefore, the combination of incidental learning and implicit memory will reduce the salience of potentially competing cues, and isolate and highlight cues pertaining to mood and other aspects of context. To the extent that the relatively strong link between mood and congruent stimuli can also be overpowered by stronger cues, these arguments apply equally to mood congruent memory effects.

Resource Allocation Effects

It is not clear whether resource allocation effects should be expected on implicit processes that typically require far less cognitive effort, at least from a memory point of view, than explicit tasks. Findings of affects of attention on implicit memory have been mixed. Obviously, the subject must devote some minimal amount of attention to the material at encoding, e.g., they must look at it and perceive it; however, implicit memory can be seen when encoding is done under conditions of impaired attention such as divided attention (Jacoby, Woloshyn, & Kelly, 1989) and when stimuli is below perceptual thresholds (Kunst-Wilson & Zajonc, 1980). Other studies have found that extra attention can improve implicit memory, e.g., additional exposures to the material is sometimes necessary when using patients with memory disorders due to dementia (Richardson-Klavehn & Bjork, 1988).

While reduced cognitive effort might not be expected to effect implicit memory in general, it might result in failure to forge links between mood-state and unrelated stimuli, such that mood will not serve as a cue for unrelated stimuli that require relatively greater effort to associate with mood. To the extent that elaboration is required to establish new associative links between mood and stimuli (Graf & Schacter, 1985; Schacter & Graf, 1986), reduction of cognitive resources necessary for such elaboration could potentially impair implicit and explicit memory alike.

Whether or not mood generally impairs unconscious as well as conscious cognitive processes has a number of implications. If strong moods can result in the organism failing to attend to its environment to the extent that implicit processes are compromised, the organism may be in peril of not responding adequately to cues necessary for survival or of responding inappropriately or in a systematically maladaptive manner which perpetuates their mood state. On the other hand, if unconscious cognitive processing continue with little compromise, even in the face of disrupted conscious processing, the organism may be able to function in the world in a relatively automatic, adaptive manner. The point at which the line is crossed between impairment of unconscious and conscious processes may be an important one to understand when considering the development, maintenance and treatment of intense pathological mood states.

Literature Review

Implicit memory has only recently emerged as a topic for formal research, and so it is perhaps not surprising that few experiments have assessed mood effects (or, indeed, any sort of context effect) on implicit memory. Weingartner, Miller, and Murphy (1977) found evidence for state-dependency in the generation of word associations: subjects were more likely to generate the same associates when they were in the same mood as on a previous trial. However, this study was not clearly designed as a test of implicit memory, and did not include a comparable explicit memory task. More recently, Hertel and Hardin (1990) found that implicit memory (homophone spelling) transferred between depressed and neutral mood), whereas recognition did not. Similarly Danion, Willard-Schroeder, Zimmermann, Grange, Schlienger and Singer (1991) found that depression did not impair stem completion performance, whereas it did impair recognition performance. Danion et al. (1991) suggested that stem completion performance might help distinguish depressed individuals from those with Alzheimer's disease, since AD patients are relatively impaired on stem completion tasks. Williams and Markar (1991) observed that a manic-depressive patient was able to find money that he had hid during a previous manic phase when in another manic phase, despite his inability to explicitly recall where it was hidden at any time. The authors interpreted this finding in terms of procedural knowledge or "mood-congruent action-reinstatement."

Another recent study by Mathews, Mogg, May, and Eysenck (1989), examined attentional biases in anxious subjects as reflected in mood-congruent encoding using threat-related words and stem completion. They suggested that anxious individuals would deliberately fail to elaborate on threat-related words, thereby impairing later explicit memory for these words, which depends on elaboration. Implicit memory, on the other hand, does not depend on elaboration, thus, implicit memory for these words would be intact and appear relatively greater. Mathews et al. hypothesized that threat-related words would be accessed more readily on implicit memory tests than explicit memory tests by clinically anxious subjects. The results indicated a bias in clinically anxious subjects towards retrieving threat-related words in both the implicit and explicit conditions; however, this differential tendency was significant only in the implicit memory condition. Thus, as predicted, the effects of mood were stronger on implicit than on explicit memory. Retrieval of non-threatening words appeared to be somewhat depressed rather than retrieval of threatening words enhanced relative to nonanxious controls, suggesting that processing of irrelevant words may have been impaired due to allocation of diminished attentional resources to relevant words. The hypothesis that the differential is a result of anxious subjects not elaborating threat-related words was not born out.

Mathews et al. (1989), suggested that the relation between emotional state and memory for mood-congruent items is not straightforward, but they interpreted their data as demonstrating attentional bias. Unfortunately, the operation of mood effects at encoding or retrieval and the contribution of explicit effects cannot be ruled out because mood was not manipulated in this experiment; nor was a clear functional dissociation shown between implicit and explicit memory.

Some evidence of the effects of context on implicit memory can be found in studies examining other types of contexts. Graf & Schacter (1985) found that implicit memory for new associations requires some degree of elaboration (see also Schacter & Graf, 1986). In this experiment, subjects studied unrelated word pairs (window-reason) and were later presented with the first three letters of the target word (reason) preceded either by the same-context word (window) or a different context word (officer) and asked to write down the first word beginning with those three letters that came to mind. They were told that the context word might help them think of a completion. Presentation of the same context word facilitated stem completion only when subjects elaboratively encoded the context and target word together (e.g., formed a sentence linking the two). Mood can be seen as a new association relative to unrelated words; thus this experiment supports the notions presented above that additional linkages between context and targets above temporal contiguity are important (e.g., mood congruency) and suggests that attentional resources must be devoted to encoding the context and targets interactively when they are unrelated.

Graf (1988) examined analogous environmental context effects on explicit and implicit memory. In Graf's study, subjects studied a list of verbal items in one of two distinctively different environmental settings, and then received a memory test in either the same or the different setting. It appears that subjects must consciously process context for its effects to emerge; therefore, Graf explicitly drew the subjects' attention to their environment. It has also been demonstrated that when context has no prior associative link to the list items, some degree of item-to-context elaboration is necessary for implicit memory effects to emerge (Graf & Schacter, 1985; Schacter & Graf, 1986). Therefore, Graf asked his subjects to rate how easy it would be to relate the items to the environment in which they were presented. Comparing same- versus different-context testing conditions, Graf found context-dependent memory effects on implicit but not explicit memory in his Experiment 1; but his Experiment 2, in which the items were not elaborated with respect to contextual cues, found no context dependency for either form of memory.

SUMMARY

Few studies have examined the effects of any type of context, whether it be mood, environment or internal physiological state, on implicit memory. Initial attempts exploring environmental context (Graf, 1988) or word context (Graf & Schacter, 1985) indicate that matched contexts can increase priming under certain conditions (e.g., elaborative encoding), although these researchers also reported failures to find effects of new associations on priming. An attempt to explore mood congruency with anxious individuals also yielded mixed results (Mathews et al., 1989), but suggested that mood congruency can be observed when implicit tests are used. Two studies that examined the effect of depression on priming found that depressed mood did not impair performance on homophone biasing and stem completion tasks. These studies did not specifically examine MDM or MCM but imply that with certain tasks, implicit memory transfers completely over mood and that resource allocation effects are not operating to impair priming. None of these studies have specifically addressed the issue of MDM or MCM with an experimentally manipulated mood. All of these effects need to be replicated.

CHAPTER 2

PRELIMINARY STUDIES

Mood Effects on Cued Recall and Stem Completion

A first attempt to investigate the question of mood effects on explicit and implicit memory, was made using stem completion as the implicit test and cued recall as the explicit test, a procedure that clearly distinguishes between the two forms of memory expression (Tobias, Kihlstrom, & Schacter, 1989).

Method

In this study, 86 subjects recruited from an introductory psychology class studied a list of 36 words in anticipation of a memory test. For a variety of reasons, the study phase incorporated a levels-of-processing manipulation. (1) A finding that the explicit, but not the implicit, memory task was affected by elaborative activity would insure that the tasks were in fact measuring two different forms of memory. (2) Mood-dependency effects are more likely to be found when the mood-item link is strong (as when subjects explicitly relate items to mood), or when few other cues are available to support retrieval (as in shallow processing tasks), and least likely to be found in elaborative conditions that supply relatively high levels of cue information, but do not involve mood. (3) Resource allocation effects are more likely to be seen for items processed under conditions that demand relatively high amounts of attentional activity (e.g., encoding of difficult associations or retrieval of poorly encoded items).

Therefore, items were studied under one of three processing conditions: (1) in the **mood-relating** condition, the subjects were asked to judge (on a 1-10 scale) how well the item could be related to their current mood; (2) in the **non-mood-relating** condition, they were asked to judge how well the item related to the State of Arizona; (3) in the **structural** condition, they were asked to judge (without actually counting) whether the word contained more straight than curved lines. Items were randomly assigned to processing conditions, and presented in one of 12 random orders. An additional 12 items were held in reserve to provide baseline measures of stem-completion. The study was designed so that, by counterbalancing across subjects, each of the 48 items appeared equally often in each of the processing conditions or as a baseline item. Occasionally, item presentations were interrupted by mood ratings (on a single bipolar adjective scale) intended to check the manipulation of mood, and also to draw subjects' attention to their mood states. Unfortunately, as described below, counterbalancing was not complete due to the failure of a large number of subjects to respond to the mood induction; thus the results of this experiment must be considered to be tentative.

Baseline mood assessments were collected by means of five bipolar adjective rating scales, each anchored by three positive and three negative adjectives. The subjects then heard a series of musical selections intended to induce a happy or sad mood, and were instructed to actively place themselves in the appropriate mood state and deliberately maintain it until instructed otherwise. In addition, the subjects were asked to write down any thoughts that occurred to them during the mood-induction procedure. After approximately 20 minutes, the subjects completed another set of mood ratings and then studied the list. The items were presented on cards at a rate of 6 seconds per item, paced by a signal presented on the audiotape and accompanied by a visual cue instructing subjects how they were to encode each item.

Immediately after the encoding phase, subjects completed another set of baseline mood ratings and then received a second mood-induction procedure involving music plus instructions. Half the subjects were assigned to the same mood, happy or sad, as the encoding phase, while the remainder were assigned to the opposite mood.

Following a second mood-rating procedure and a filler task (stem completion of person and city names) which served to orient subjects to the main task, the subjects were administered the memory task. All subjects were presented with 94 three-letter stems, including 36 derived from words in the study list, 12 baseline items, an additional 22 stems derived from the words marking the poles of the mood rating scales, and 24 distractors. Subjects in the cued recall condition were asked to complete as many stems as possible with a word from the study list, and to make confidence ratings on a 3-point scale. Subjects in the stem completion condition were asked to complete each stem with the first word that came to mind, without reference to the prior study phase. All subjects then completed a post-retrieval mood rating, and were asked for free recall of both list and rating-scale items. After a final mood-rating, the subjects received a post-experimental questionnaire, and then were debriefed and dismissed.

Results

The data yielded by the experiment was analyzed by a 2x2x2x4 mixed-design analysis of variance with encoding mood (happy vs. sad), retrieval mood (happy vs. sad), and test (explicit vs. implicit) as between-groups factors, and processing condition (mood, nonmood, surface, and baseline) as a within-subjects factor.

In order to examine priming effects, a repeated-measures ANOVA with four levels of processing (mood, nonmood, structural, and baseline) was applied to stem-completion scores for the stem-completion subjects only, collapsing across the remaining between-groups factors. There was a significant effect of processing condition, with more stems completed from list items than from baseline items. The baserate for stem completion was 4%, which is somewhat lower than the level observed in other experiments on stem completion. There were no differences in the amount of priming observed in the three experimental conditions, which together averaged 19%.

In order to establish the status of stem-completion as an implicit memory task, a 2x2x2x3 mixed-design ANOVA was applied to the scores for all subjects. For present purposes main effects and interactions involving the mood conditions are ignored. There was the expected main effect for the task variable, with cued recall significantly higher than stem completion. A significant effect of levels of processing was seen on cued recall but not on stem-completion confirming that subjects approached the two tasks differently.

Random assignment to mood groups was successful as indicated by the lack of significant differences in baseline mood between groups, although subjects generally reported being somewhat happy at the outset. Subjects were classified by their actual mood as measured immediately prior to encoding and retrieval since many reported that they were not experiencing the required mood and it makes no sense to analyze the effects of mood in people who are not really in the mood. As it happens, there were group differences in mood even at baseline using this method of classification (and, in fact, there were no effects of mood when we analyzed our data by experimental manipulation rather than actual mood state). There is no way around this fact, but it does mean that any differences that are attribute to mood state might also be attributable to individual differences associated with pre-experimental mood. The reclassification also left one of the eight cells (happy at study, sad at test) rather sparsely filled. It should be noted that even with this criterion, the "sad" subjects were, generally, not as sad as the "happy" subjects were happy; and subjects classified as being in different moods at encoding and retrieval were not always in <u>very</u> different moods.

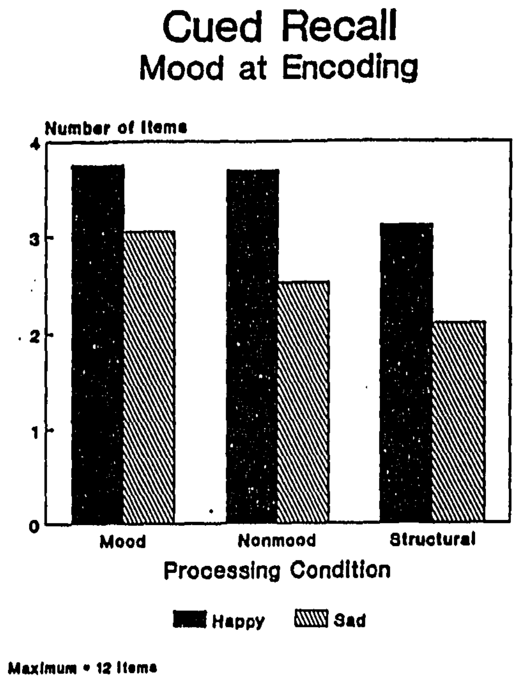
The results of primary interest are derived from the stem-completion test, and are presented separately for the explicit and implicit memory conditions. In the analyses that follow, only those words that precisely match study list items are counted as correct.

The 2x2x2x3 mixed-design ANOVA showed a significant effect of mood at the time of encoding, but no main effect of mood at the time of retrieval. Subjects who were happy at encoding produced more list items than those who were sad. There was no interaction of encoding mood with experimental task, indicating that encoding mood had parallel effects on explicit and implicit memory. However, planned comparisons did indicate that the effects of encoding mood were somewhat weaker on stem completion than on cued recall in the nonmood condition, but somewhat stronger in the mood and structural conditions (see Figure 1).

Another perspective on the results is given by combining encoding and retrieval conditions to compare subjects who were in the same mood (whether happy or sad) at both encoding and retrieval to those who were in different moods. A 2x2x3 mixed-design ANOVA showed no main effect of mood-state dependency: those who were in the same mood at encoding and retrieval retrieved no more items than those who were in different moods (see Figure 2).

Although they do not bear directly on the distinction between explicit and implicit memory, mood effects on the final free recall test were also of interest. A 2x2x3 mixed-design ANOVA, collapsing across the implicit and explicit conditions,

Figure 1.
Resource Allocation Effects at Encoding



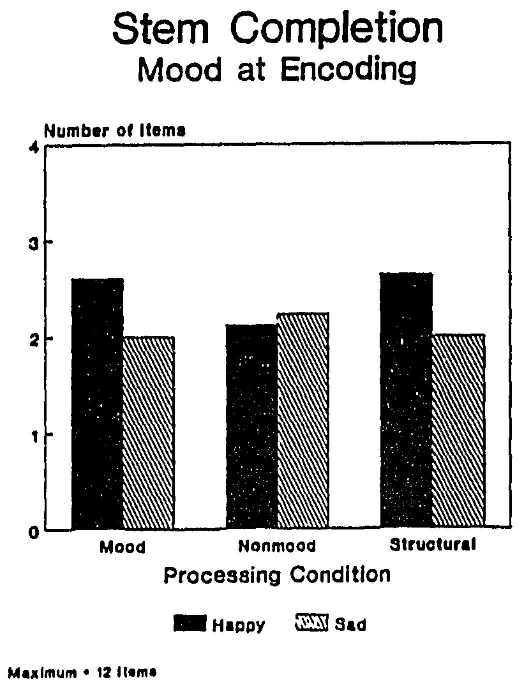
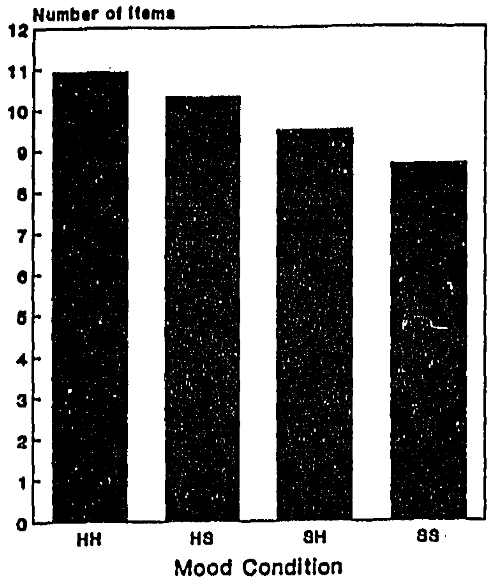
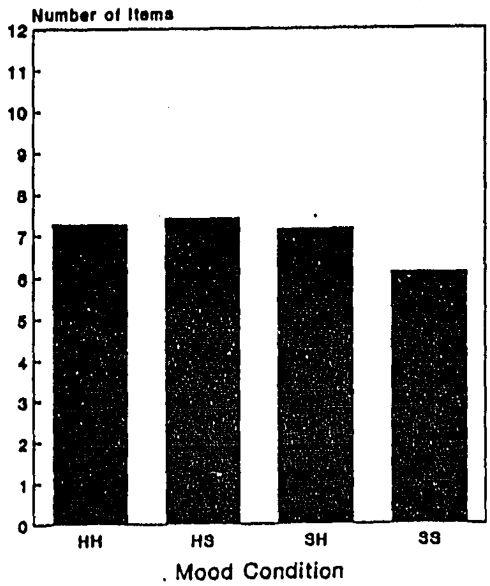


Figure 2. Mood-Dependent Memory

Cued Recall



Stem Completion



showed, as expected, a significant main effect of processing condition. There was also a significant effect of retrieval mood, but no effect of encoding mood; and there was a significant interaction between processing condition and retrieval mood (see Figure 3). Again, sadness depressed performance relative to happiness; but this effect was only observed in the mood and nonmood elaborative tasks, however, the lack of an effect in the structural item may be an artifact of floor effects. When free-recall data was examined for evidence of a dependency effect, again there was none.

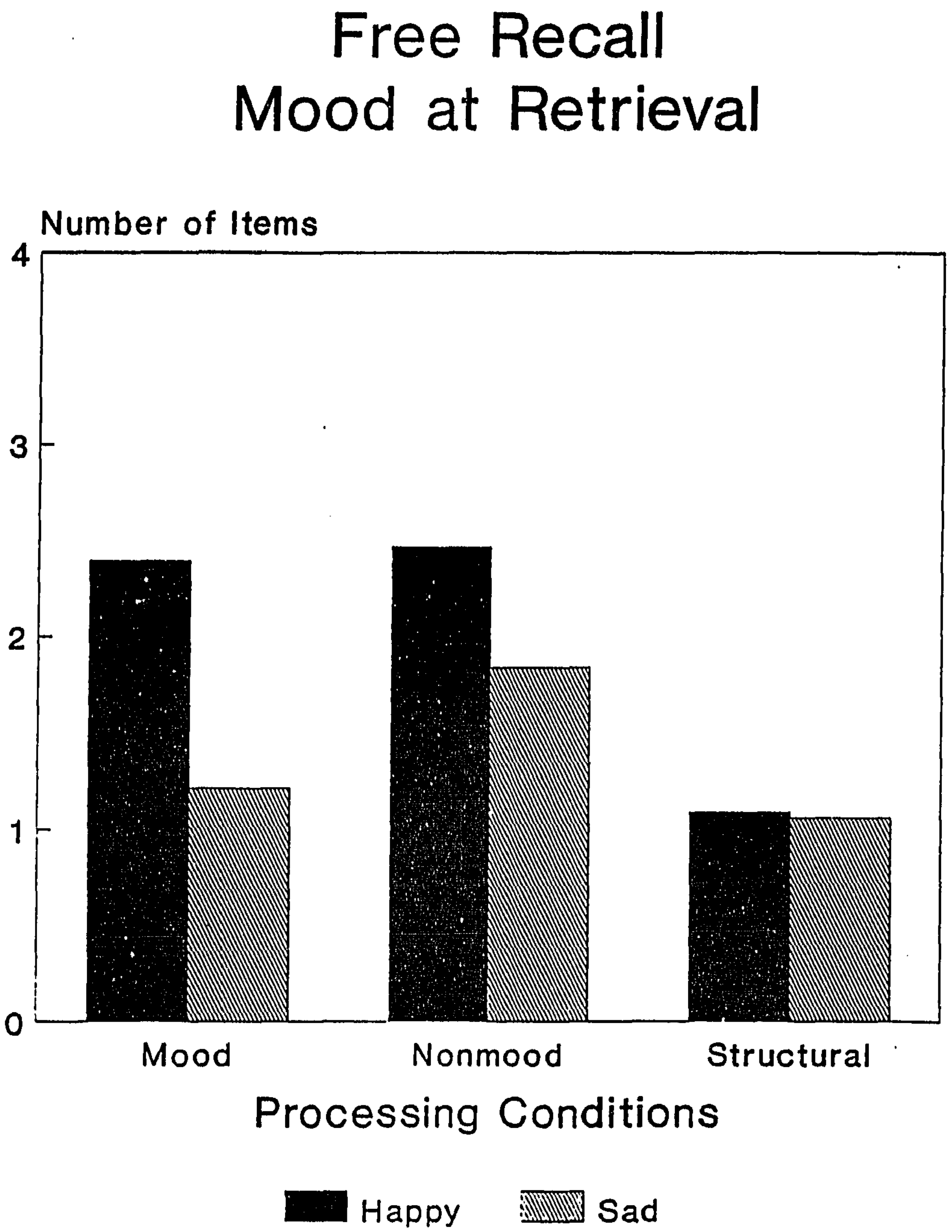
Discussion

With respect to the mood effects on memory described at the outset, the present experiment speaks most directly to matters of resource allocation and mood-dependency. Our list items were selected without regard to their emotional connotations, so we cannot determine without further analysis whether memory is affected by the congruence between mood state and item valence. Such an analysis might reveal that what appear to be resource allocation effects are in fact asymmetrical mood-congruence effects, if the "sad" subjects were not very sad, and thus did not associate items to mood as readily as "happy" subjects. This argument would not apply to items in the structural condition, where there is no opportunity to elaborate items with respect to mood.

Consideration of resource allocation effects yields two competing predictions concerning the effect of mood on explicit and implicit

Figure 3.

Resource Allocation Effects at Retrieval



Maximum = 12 Items

memory. Even though sadness may consume attentional resources, and thus diminish elaboration at the time of encoding, impairing explicit memory, there would still be no mood effect on implicit memory -- provided, of course, that the implicit memory task were one that is known to be unaffected by elaborative processing. Stem-completion, which we used in this experiment, is one such task.

On the other hand, it is conceivable that sadness could impair resource allocation to such an extent that items do not receive even the minimal amount of elaborative processing necessary for successful performance on a stem-completion task. By this argument, resource allocation effects might be expected to be seen on implicit as well as explicit memory, although the effects of mood on implicit memory would not necessarily be different than those on explicit memory. It is this latter hypothesis that is most strongly supported by the current data: there was no interaction between mood state (happy or sad) and experimental task (explicit or implicit). Sadness at the time of encoding tended to impair performance on both cued recall and stem completion. That is, sad subjects may devote less processing capacity (or cognitive effort) to the experimental tasks than happy subjects do. There was no effect of sadness at the time of retrieval on either test. The results for free recall show an effect of mood at the time of retrieval, again probably best interpreted in terms of resource allocation.

Why were encoding effects observed on cued recall and retrieval effects observed on free recall? Cued recall and stem completion both provide a relatively rich retrieval environment that allows items to be accessed with relatively little effort. Thus, sadness will have minimal effects on retrieval, provided that the words were adequately encoded to begin with -- which is just what does not happen when people are sad at the time of encoding. Free recall, by contrast, provides weak and fragmentary retrieval cues, and requires correspondingly more effort for successful access (and, in fact, free recall was considerably worse than cued recall) -- application of resources that sad subjects do not have. This means that performance should be especially poor for subjects who are sad at both encoding and retrieval, and best for those who are happy on both occasions, which is in fact the case.

No evidence was found for mood-dependency on either cued recall or stem completion or free recall. This would seem to support the positive transfer hypothesis, and negate the hypotheses that implicit tasks might eliminate potentially stronger cues that might outshine mood as a cue or be affected by shifts in the sensory aspects of the stimuli occasioned by mood, akin to modality shifts. This lack of a dependency effect is different from what would be expected given Graf's results, which showed significant effects of environmental congruency, Graf and Schacter's (1987) results on weak associations, and the evidence of positive mood effects on free recall. It is not inconsistent with the evidence concerning mood effects on cued recall, because transfer is complete under those retrieval conditions.

In retrospect, however, it seems the analogy between mood context on the one hand, and environmental context or weak paired-associates on the other, is imperfect in at least one critical aspect. Moods have resource allocation effects that environments and other words do not. Happiness enhances encoding compared to sadness, presumably because sadness consumes attentional resources. So when happy-happy subjects are combined with sad-sad subjects into a single group, what results is an intermediate level of performance that is hard to distinguish from that of happy-sad or sad-happy subjects. In fact, just the sorts of resource allocation effects that would yield this situation were found. A similar argument applies to environmental context effects: If one of the two environments were highly distracting, and thus consumes attentional resources that otherwise would be devoted to encoding or retrieval, the main effect of environment might also mask the congruency effect; this is a problem for further research.

There is yet another way in which mood-induced resource allocation effects may prevent testing the hypothesis that moods have cue value. As indicated at the outset, before contextual features can serve as effective retrieval cues, they must be associated with items at the time of encoding -- a process that requires some degree of elaborative activity. These associations are difficult to make, precisely because the items themselves lack any pre-existing links to mood. But if sadness impairs the allocation of attentional resources, then the mood-item link will never be made in the first place, and mood cannot serve as an effective retrieval cue. This will result in an asymmetry between happy moods, where mood-item associations can be encoded, and sad moods, where they cannot -- an asymmetry that will effectively obscure any effects of moods as cues.

Third and perhaps most important is that, while stem-completion is the paradigm of choice for many studies of implicit memory, it may not be ideal for experiments on mood and other context effects. In the first place, three-letter stems are relatively powerful cues; thus, this experimenter-supplied information may well overshadow mood cues. Another possible difficulty with stem-completion is that it is primarily data-driven (Roediger, & Blaxton, 1987; Roediger et al., 1989): it taps into memory for the perceptual qualities of the list items (e.g., how they appear on the page, or how they sound when spoken). Although it may be argued, following Graf, that mood "colors" our perception of events, it is also clear that mood changes how they are interpreted. If emotional effects are primarily conceptual in nature, considerations of transfer-appropriate processing (Roediger et al., 1989) lead us to expect that mood would have no effect on a data-driven tasks such as stem-completion.

The results of our preliminary study have a number of implications for future research intended to compare mood effects on explicit and implicit memory, or to explore the cue properties of mood states. The first of these is that it is a nontrivial matter to insure that subjects are in the appropriate mood state, and that the mood states of those who are in ostensibly different moods are highly distinctive. The second is that the resource allocation effects of moods may well obscure any cue functions that moods may have for unrelated material. The third is that the implicit test used may not provide a fair test of the mood-as-cue hypothesis. Future tests of the mood-as-cue hypothesis will have to employ implicit memory tests paralleling free recall which minimize nominal cues and are conceptually-driven.

Development of an Implicit Free Recall Analogue

A second study was conducted to develop just this sort of free recall analogue, i.e., an implicit task that both minimized experimenter-supplied nominal cues, and was classifiable as conceptually-driven, in the hope that it would prove more sensitive to context cues (Tobias, Wunderlich, & Kihlstrom, 1990).

Method

Subjects first studied one of two lists of positive, negative, and neutral words, about which they made either structural or semantic judgments. The design was completely counterbalanced so that an equal number of subjects studied each list and rated each item structurally or semantically an equal number of times. Following this encoding activity, subjects listened to 15 minutes of tape-recorded mood music. Subjects in the implicit memory condition were then falsely informed that the tape was of the "subliminal perception" variety, in which a list of words had been masked by the music. In order to determine whether the words had been subliminally perceived, they were asked to perform one of four tasks: (*a*) One group was given a sheet with blank spaces on it, setting up the conditions for a free-recall test. (*b*) A second group was provided with the first letters of target words, thus creating a cued-recall test with minimal cues. (c) A third group was provided with cues representing broad conceptual categories, in the form of phrase completions: "The person felt _____" or "The person bought the _____". (d) A fourth group was prompted with standard three-letter stems. In all conditions, subjects were asked simply to list the first words that came to mind. A comparable set of cued recall memory tasks was also administered, in which subjects were specifically instructed to list items from the word list they had studied.

Results and Discussion

Data analysis revealed significant priming effects on each of the implicit memory tasks: that is, significantly more target than baseline words appeared in the subjects' lists (see Figure 4). While the strength of the experimenter-supplied cue affected the sheer number of target and baseline words generated, it had no effect on the magnitude of priming (target/baseline) observed. Moreover, cued recall was affected by the level of processing at the time of encoding, but priming was not (see Figure 5). This failure to find a levels of processing effect was not necessarily anticipated since the tasks were specifically designed to be conceptually-driven. Research has shown the levels of processing dissociation is primarily found in data driven tasks which rely on the structural features of the stimuli to drive retrieval and do not depend on processing of the semantic/conceptual features of the

Figure 4.

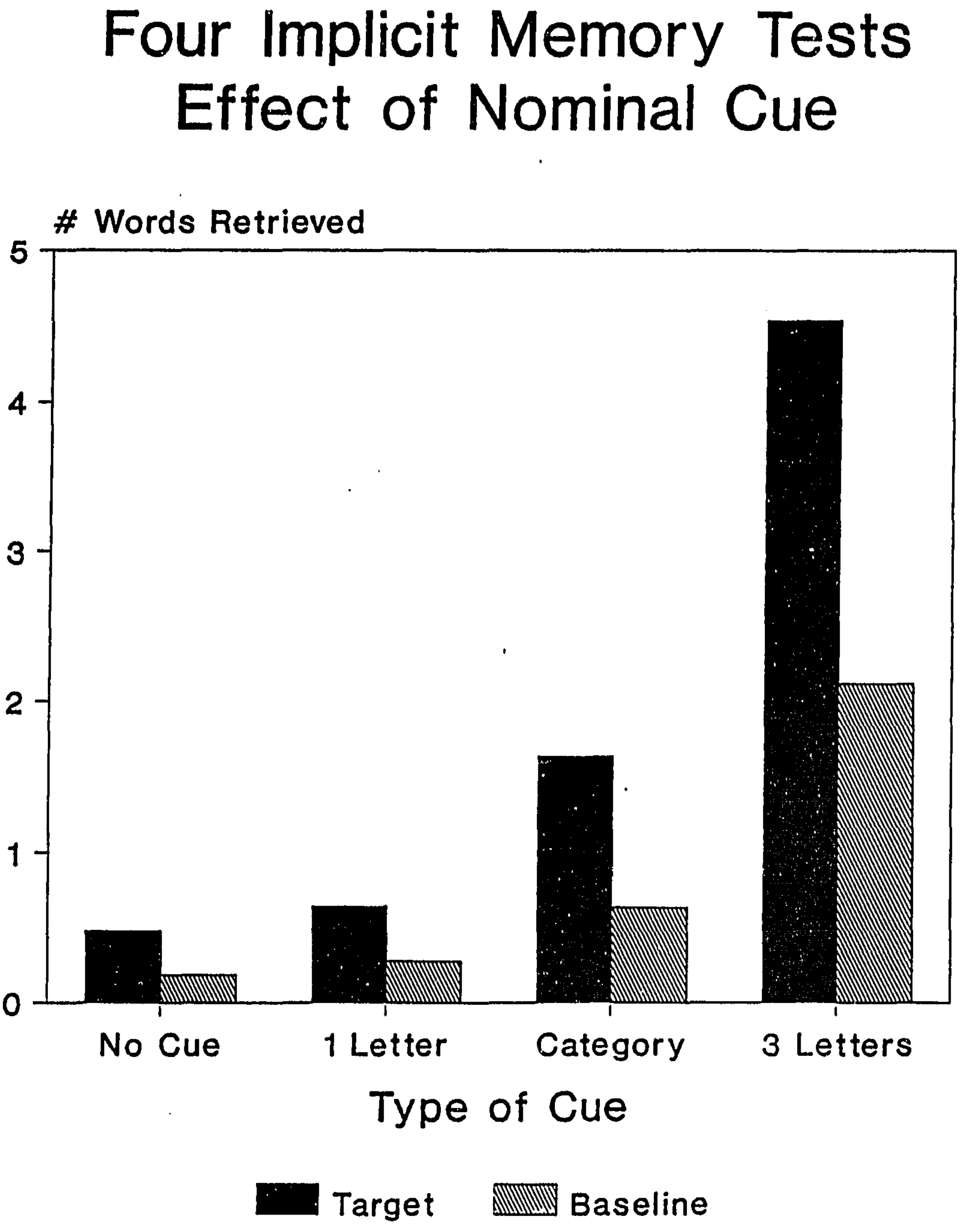
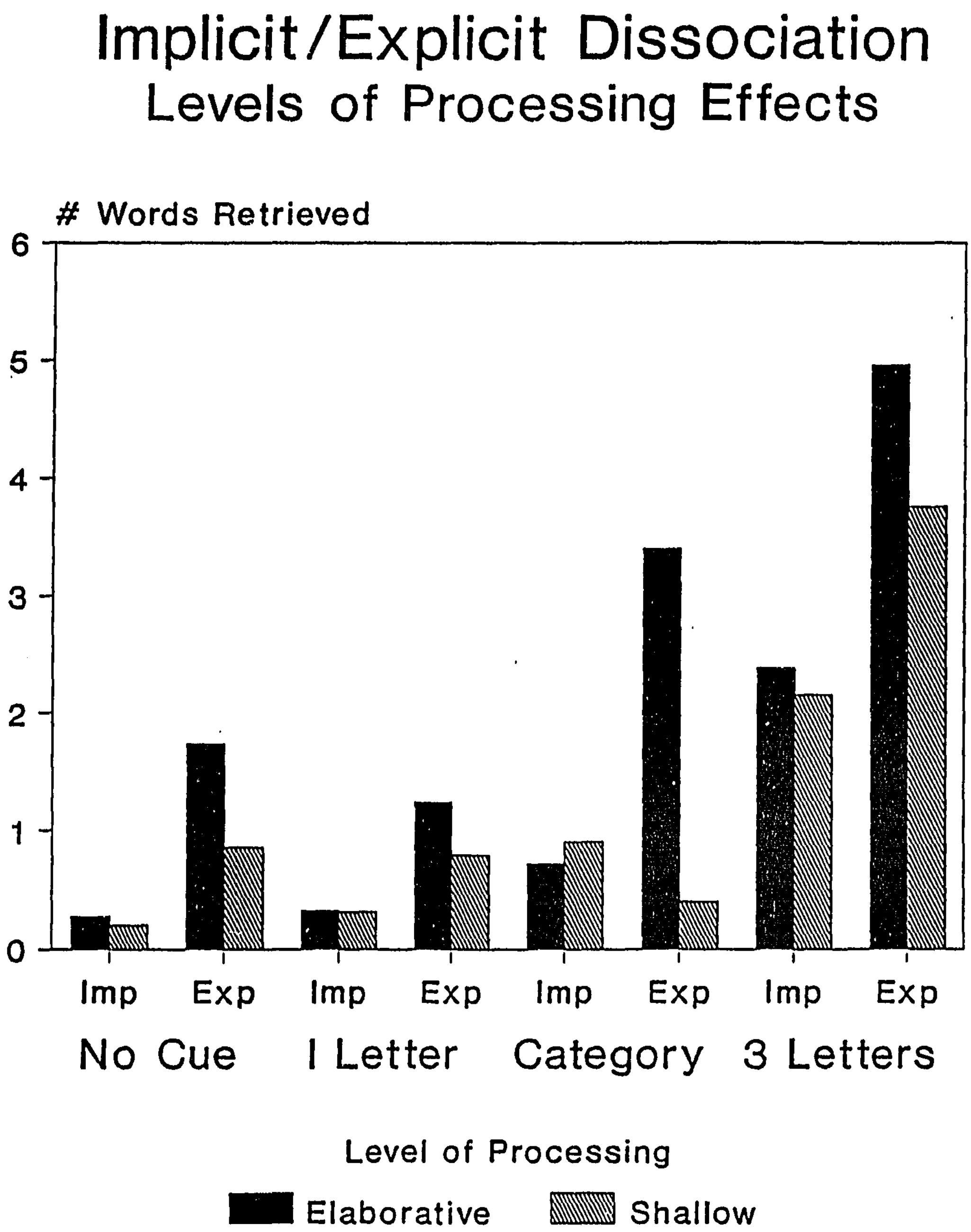

Four Implicit Memory Tests
Effect of Nominal Cue
Words Retrieved
5
4
3
2
1
0
No Cue
1 Letter
Category
3 Letters
Type of Cue
Target
Baseline

Figure 5.



Implicit/Explicit Dissociation
Levels of Processing Effects
Words Retrieved
6
5
4
3
2
1
0
Imp
Exp
Imp
Exp
Imp
Exp
Imp
Exp
No Cue
I Letter
Category
3 Letters
Level of Processing
Elaborative
Shallow

stimuli. It is not clear whether conceptually-driven tasks are affected by elaborative encoding. There is some evidence that certain variables that affect explicit memory tests also affect conceptually-driven implicit tests, e.g., organization (Rappold & Hashtroudi, 1991). In some cases, even if a variable affects implicit and explicit memory similarly, the effect might be proportionately greater in one or the other task which can then serve to dissociate the two tasks (Schacter, Bowers, & Booker, 1990).

The dissociation found here confirmed that we had, indeed, developed implicit-memory analogues of free and minimally cued recall. In the "no cue" condition, subjects are simply presented with a blank sheet of paper and asked to write down the first words that come to mind, without any reference to the study phase. In fact, our minor deception may have actually directed subjects' attention <u>away</u> from the study phase. Obviously, this condition reduces to an absolute minimum the influence of potentially competing experimenter-supplied and subject-generated cues. The current study seeks to examine the effects of mood on implicit and explicit memory using free recall and this implicit analogue.

Choosing a Mood Induction Technique

One potentially important difference in studies finding different MCR results and inconsistent MDM effects is the type of mood induction procedure (MIP) used. It may make a difference whether it is instructed or uninstructed and thus more or less susceptible to demand characteristics or attentional biases, whether it is more or less cognitively based and thus leads to greater or lesser degrees of priming of certain types of congruent material, and how effective it is as to both strength and duration. Clearly, it is difficult to draw conclusions regarding mood congruency effects if the subject is not actually experiencing the intended mood or is intentionally biasing their cognitions to maintain a mood. When mood congruence is measured may also be crucial. MCR may be strong early on, but then dissipate when counter thought processes or events occur (Singer & Salovey, 1988). What type of cognitive material is being examined may also be important, e.g. generation of thoughts and explicit memory for words or autobiographical information may all produce different MCR effects. This mood induction comparison study attempts to address these issues.

Method

Subjects. A total of 424 college students were recruited for an experiment involving personality and cognition. In return for their participation, the subjects received credit toward the experimental participation requirement of their introductory psychology course. The subjects were randomly assigned to one of the 20 experimental conditions, with an average of 21 subjects per cell. Approximately half the subjects in each condition were male, the remainder female.

Mood-Induction Techniques. In this experiment, four mood-induction techniques and a control group were compared for two moods, happy (positive) and sad (negative), with half of each group being instructed explicitly to try to "get into" the mood and half simply told to concentrate during the procedure yielding a 5x2x2 between subjects design. All instructions to subjects were presented by means of a personal stereo tape recorder.

Velten technique. The Velten procedure (Velten, 1968) is historically the most popular procedure for inducing happy and sad moods in the laboratory (for reviews, see Clark, 1983; Larsen, Sinnett, & Kasimatis, 1988). It involves reading 60 increasingly positive or negative self-statements. This experiment employed Velten's original set of self-statements and instructions, with only minor changes (e.g., a reference to Vietnam was changed to the Middle East). The subjects in the instructed condition were told to read each card out loud, to be receptive and responsive to the ideas in each statement, and to talk themselves into the appropriate mood. The subjects in the uninstructed condition were told merely to read each card out loud, and to concentrate on the statements presented. Subjects were paced through the set at the rate of one item every 20 seconds.

Musical mood induction. Despite its popularity, the Velten technique has been criticized as being susceptible to demand characteristic effects (e.g., Buchwald, Strack, & Coyne, 1981; Polivy & Doyle, 1980). Furthermore, the instruction to think about the self-statements raises the possibility that any effects of the procedure might be mediated by cognitive priming, rather than emotion per se (Albsersnagel, 1988; Pignatiello, Camp, & Rasar, 1986). For these and other reasons, nonverbal procedures involving music have been gaining in popularity (Clark, 1983; Larsen, Sinnett, & Kasimatis). We used the technique developed by Pignatiello et al. (1986), consisting of approximately 20 minutes of increasingly happy or sad musical selections. Subjects in the instructed group were told to try to get into either a happy or sad mood while listening to the music. Those in the uninstructed group were simply told to listen to the music.

Music + Velten. In view of the finding by Larsen et al. (1988) that combined techniques seemed to be especially effective, a third group of subjects received a combination of the musical and Velten procedures. Subjects read the Velten statements while they listened to appropriate music, under instructed and uninstructed conditions as described earlier.

Autobiographical memory. The third condition was an autobiographical memory procedure of our own devising. The subjects were presented with a series of 18 positive or negative cue phrases (e.g., "A time when things seemed to be going against you"; "A time you..."), and were asked to recall two personal experiences associated with each cue. Subjects in the instructed condition were asked to get into a positive or negative mood; subjects in the uninstructed condition were asked to visualize the episode as vividly as possible.

Controls. The control groups received no mood-induction technique, but were instructed to sit silently for 20 minutes. Subjects in the instructed condition were told to get into a happy or sad mood; those in the uninstructed condition were given no instructions regarding mood.

Mood-rating. Periodically during the experiment, the subjects supplied mood ratings using six 1-10 bipolar scales anchored with adjectives representing different aspects of positive and negative mood. For purposes of economy in presentation, these analyses are confined to the first of these, a scale anchored by the adjectives, sad, depressed, and negative on the one hand, and happy, elated, and positive on the other.

Thought-monitoring. In addition, the subjects were periodically asked to record their thoughts and feelings as accurately and completely as possible, by writing words or short phrases at a rate of at least one per minute on the appropriate pages of the response booklet. Later, the subjects rated their own productions on a 1-5 scale anchored by the terms "extremely positive" and "extremely negative".

Procedure. At the beginning of the experimental session the subjects were introduced to the tape recorders and forms for recording their responses during the experiment. Then they completed a set of baseline mood ratings (Mood Rating 1), a five-minute thought-monitoring task (Thought-Monitoring 1), and a second baseline mood rating (Mood Rating 2). During the 20-minute mood-induction procedure (or comparable period for the controls), all subjects completed a continuous thought-monitoring task (Thought Monitoring 2). Then they were asked to recall the adjective that anchored their mood-rating scales, completed Mood Rating 3, a two-minute thought-monitoring period (Thought-Monitoring 3), and Mood Rating 4.

During the next phase of the experiment, about 5-1/2 minutes following the mood-induction period, the subjects were asked to recall the first three memories from their high-school years, and the first three memories of success or failure experiences, that came to mind. Later, they rated each memory on the same five-point scale used in thought-monitoring. After an administration of Tellegen's Absorption Scale (Tellegen & Atkinson, 1974), the subjects completed another two-minute thought-monitoring task (Thought-Monitoring 4), and Mood Rating 5. This cycle was repeated after completing Buss' (1980) Self-consciousness Scale (Thought Monitoring 5, Mood Rating 6). After completing Beck's (1967) Depression Inventory, the subjects filled out Mood Rating 7.

Finally, after making the retrospective ratings of the affective valence of their thoughts and memories, the subjects completed a postexperimental questionnaire which provided a retrospective measure of the effectiveness of the MIPs, assessed the perceived accuracy and reactivity of subjects' thought-monitoring, and evaluated demand characteristics.

Results and Discussion

Figures 6-10 show the results of the seven mood ratings, with subjects classified by MIP, instructions, and target mood.

Baseline Mood Ratings. A 5x2x2 factorial analysis of variance (ANOVA), varying mood induction, the presence of instructions, and target mood was applied to Mood Ratings 1 and 2. For Mood Rating 1, no main effects or interactions approached statistical significance. These analyses indicated that the groups were not significantly different as to mood before the MIP as seen by the baseline mood ratings 1 and 2. The average mood was somewhat positive at the outset (6.38, with 5.5. being neutral) and became somewhat less positive, but still above neutral at 5.95 after five minutes of baseline monitoring. This drop in mood represents the largest decrement in mood ratings in our study (with one exception, discussed below), indicating that the baseline monitoring was somewhat aversive initially, and is perhaps a relatively good negative or neutral mood induction in and of itself.

Effects of Mood Induction. Mood rating 3, taken immediately after the MIP, reveals highly significant differences between happy and sad mood inductions with happy subjects reporting an average mood rating of 6.69 and sad subjects an average rating of 5.68, representing a 1.01 difference in mood ratings between the two groups. <u>However</u>, note that the mean scores in the sad conditions generally remain above the midpoint of 5.5. The sad inductions did not really make people sad, just less happy. This result serves as a cautionary note that

Figure 6.

Course of Mood Change
Music

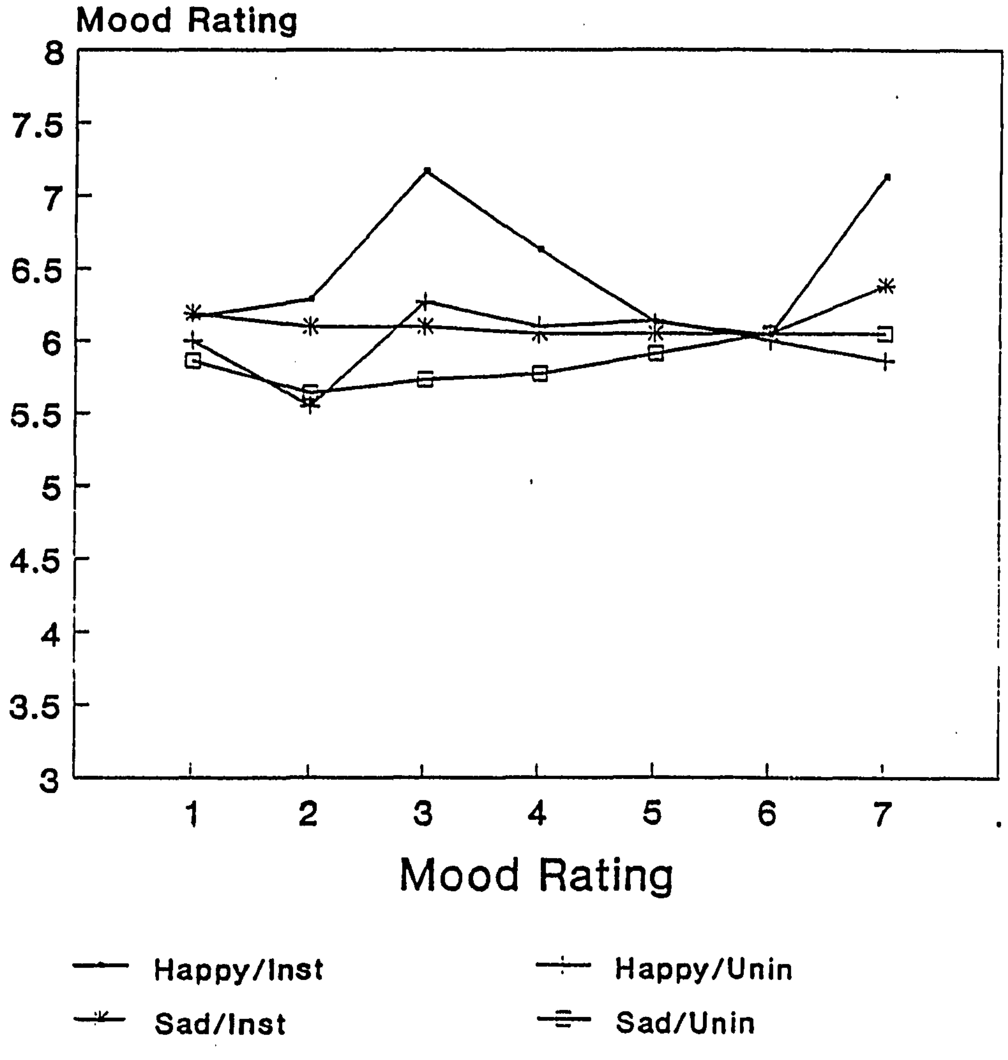


Figure 7.

Course of Mood Change
Velten

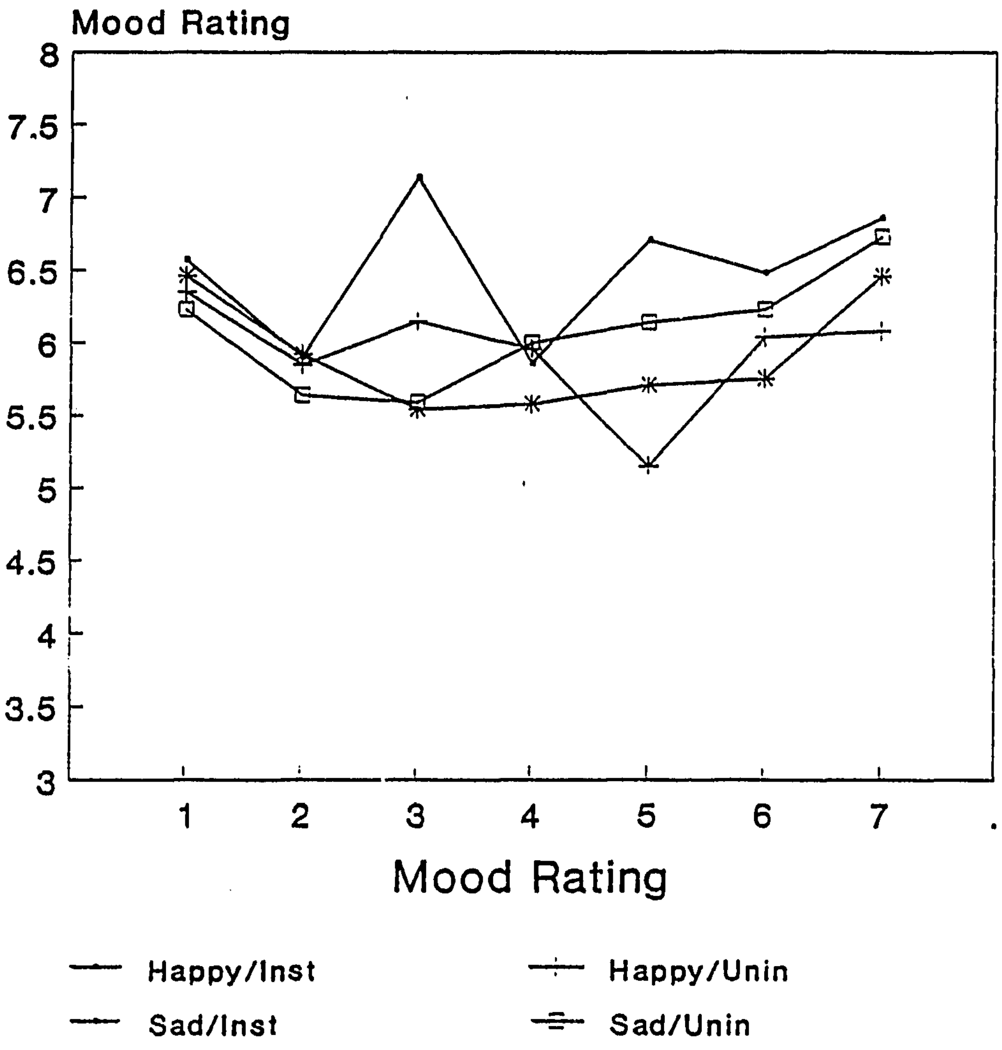


Figure 8.

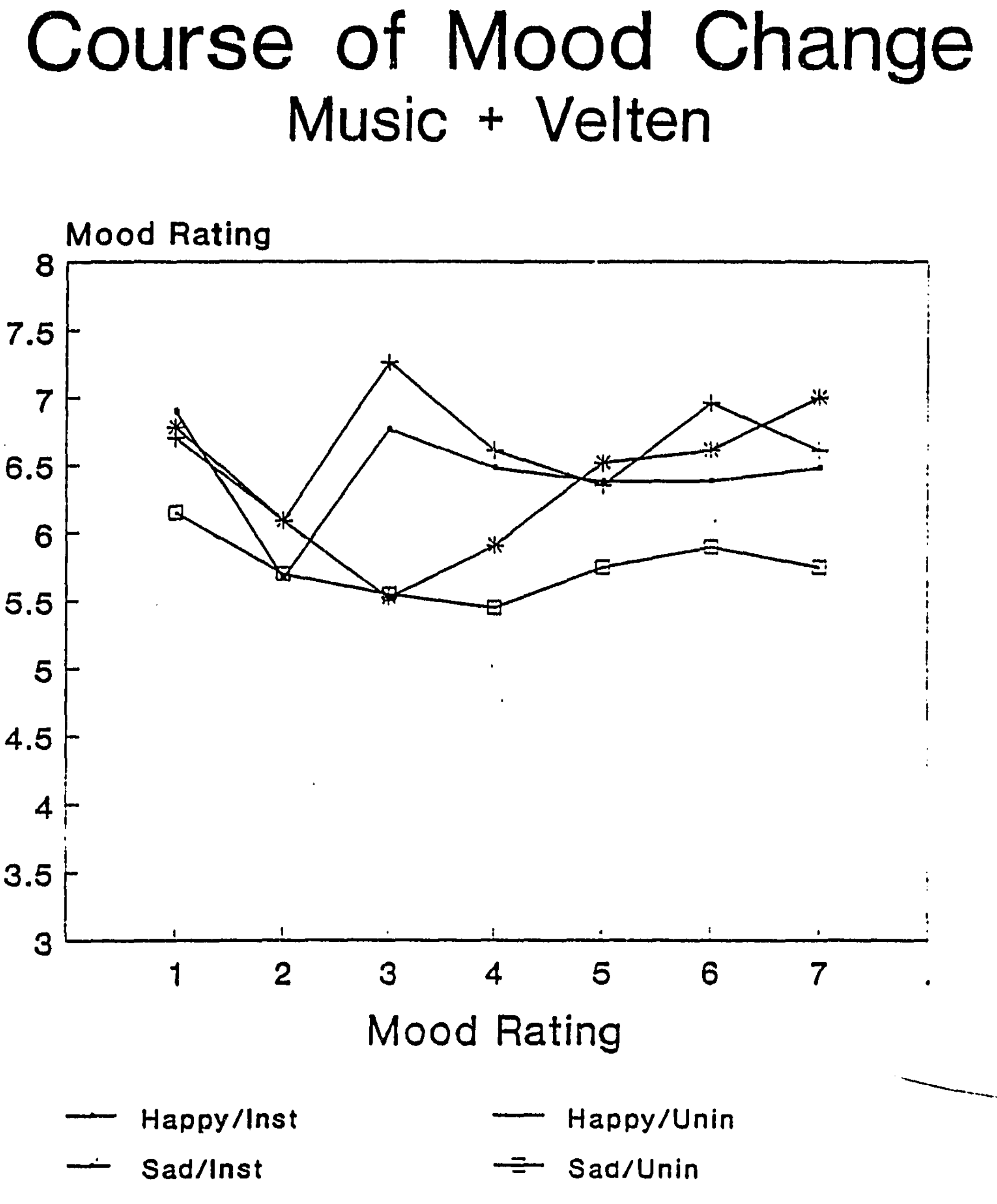

Course of Mood Change
Music + Velten
Mood Rating
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
1
2
3
4
5
6
7
Mood Rating
Happy/Inst
Happy/Unin
Sad/Inst
Sad/Unin

Figure 9.

Course of Mood Change
Memories

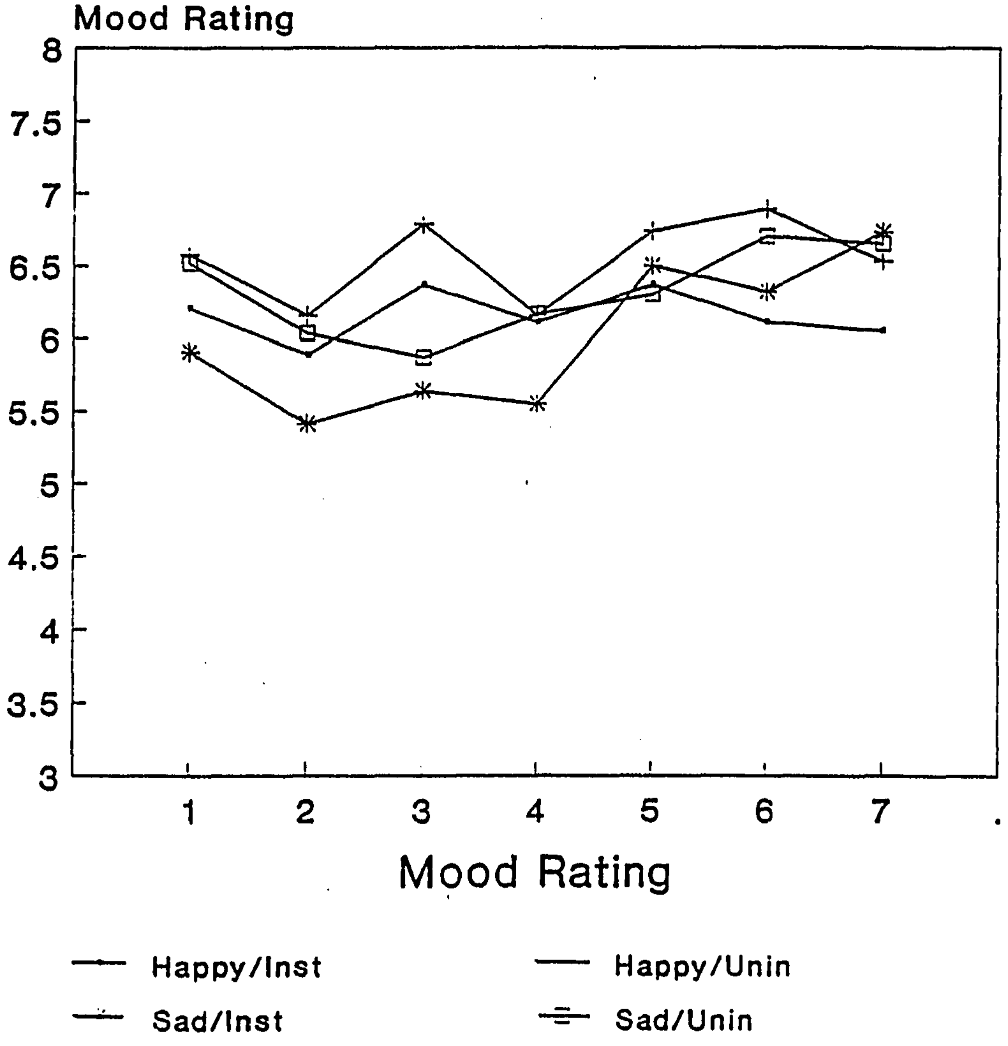
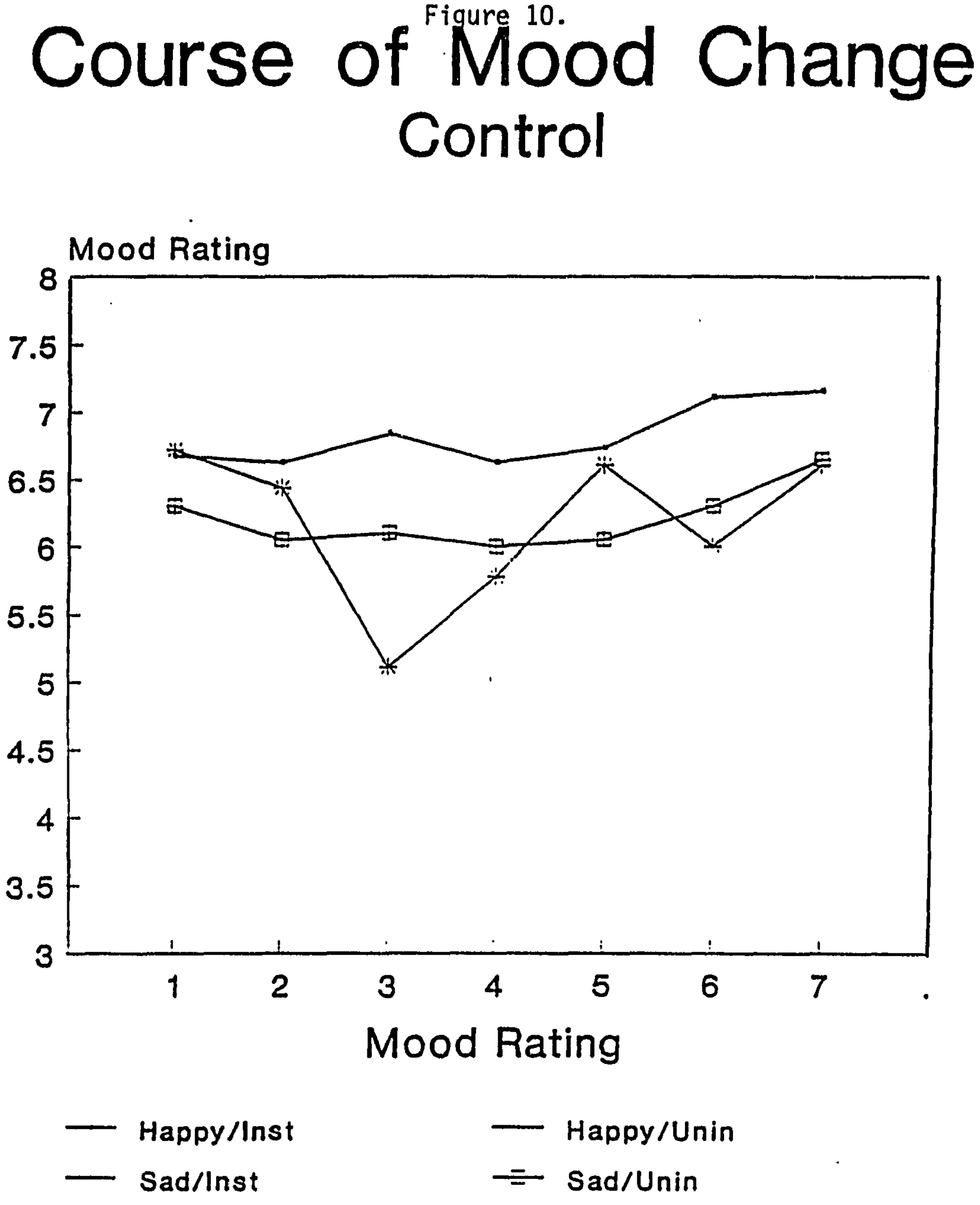


Figure 10.


Course of Mood Change
Control
Mood Rating
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
1
2
3
4
5
6
7
Mood Rating
Happy/Inst
Happy/Unin
Sad/Inst
Sad/Unin

experiments which rely simply on statistical differences between happy and sad groups may be misleading.

The differences between happy and sad inductions diminished on mood rating 4, taken after five minutes of post-induction monitoring, with happy subjects getting less happy (6.69 to 6.25) and sad subjects more happy (5.68 to 5.83) resulting in a significantly, but not very meaningful, difference of .45 between the groups. Note that the convergence was largely due to happy people getting less happy, once again attesting to the somewhat aversive nature of thought-monitoring alone. At mood ratings 5, 6, and 7 there were no significant differences between happy and sad groups and mood generally elevated until it had returned to baseline, or, in some cases, above, perhaps signaling the subjects' relief that the experiment was over.

To compare the differential effectiveness of the various MIPs and instructions we constructed a table indicating the proportion of subjects in each experimental condition who reported the mood we attempted to induce immediately after the MIP (see Table 1). In this table, ratings >= 6 are classified as happy, while ratings <= 5 are classified as sad. It can be seen looking at Table 1 that 81% of the subjects instructed to become happy with the Velten procedure did in fact rate themselves as happy, whereas, only 41% of subjects in the uninstructed, Velten, sad condition actually rated themselves as sad. Overall, 76% of those who were supposed to get happy reported doing so, but only 48% of those who were supposed to get sad reported that they did. Sixty-seven percent of the instructed subjects got into their

Table 1.

Percentage of Subjects Reporting Appropriate Mood

	Happy		Sad		
	Instruc	Uninstr	Instruc	Uninstr	Total
Velten	81	65	54	41	60
Memories	79	74	59	30	59
Music	88	68	52	50	65
Mus + Vel	89	95	61	35	75
Control	71	56	61	35	53
Total	82	71	54	43	
	76		48		

Instructed	Uninstructed
67	57

intended moods, but only 57% of the uninstructed ones did. Overall the combined MusVel and Music alone were most effective at 75% and 65% respectively. However, which procedure was best and whether or not instructions helped, depended on the mood being induced. Table 2 shows a rank ordering of the effectiveness of the ten procedures according to their effectiveness in inducing their intended moods. For happiness, MusVel uninstructed was best (good news for those concerned about demand characteristics). For sad mood, the instructed control procedure was tied for first place with MusVel instructed, indicating that simply telling subjects to get into a sad mood is as effective as any sad MIP. However, none of the procedures were very effective in inducing sadness and the last three on the sad list (MusVel U, Control U, and Memories U), actually produced more happy subjects than sad (65%, 65%, and 70% respectively) and more happy subjects than some of the happy inductions.

Summary. The course of mood fluctuations for the 4 MIPs and control group basically show the same pattern. Subjects start out somewhat happy and drop after the baseline monitoring (mood rating 2). Happy and sad groups then diverge immediately after the MIP, with instructed groups, in some cases, showing more extreme divergence. Happy and sad groups converge at mood rating 4 with a greater drop in happy groups than rise in sad groups, but they remain significantly different until mood rating five where the differences disappear. Subjects' mood continues to rise to or above baseline mood from mood rating 5 to 6 to 7. The graph for the memory groups, shows the paradox of subjects instructed to get sad actually getting happier. In the

Table 2.

Relative Effectiveness of Mood-Induction Procedures

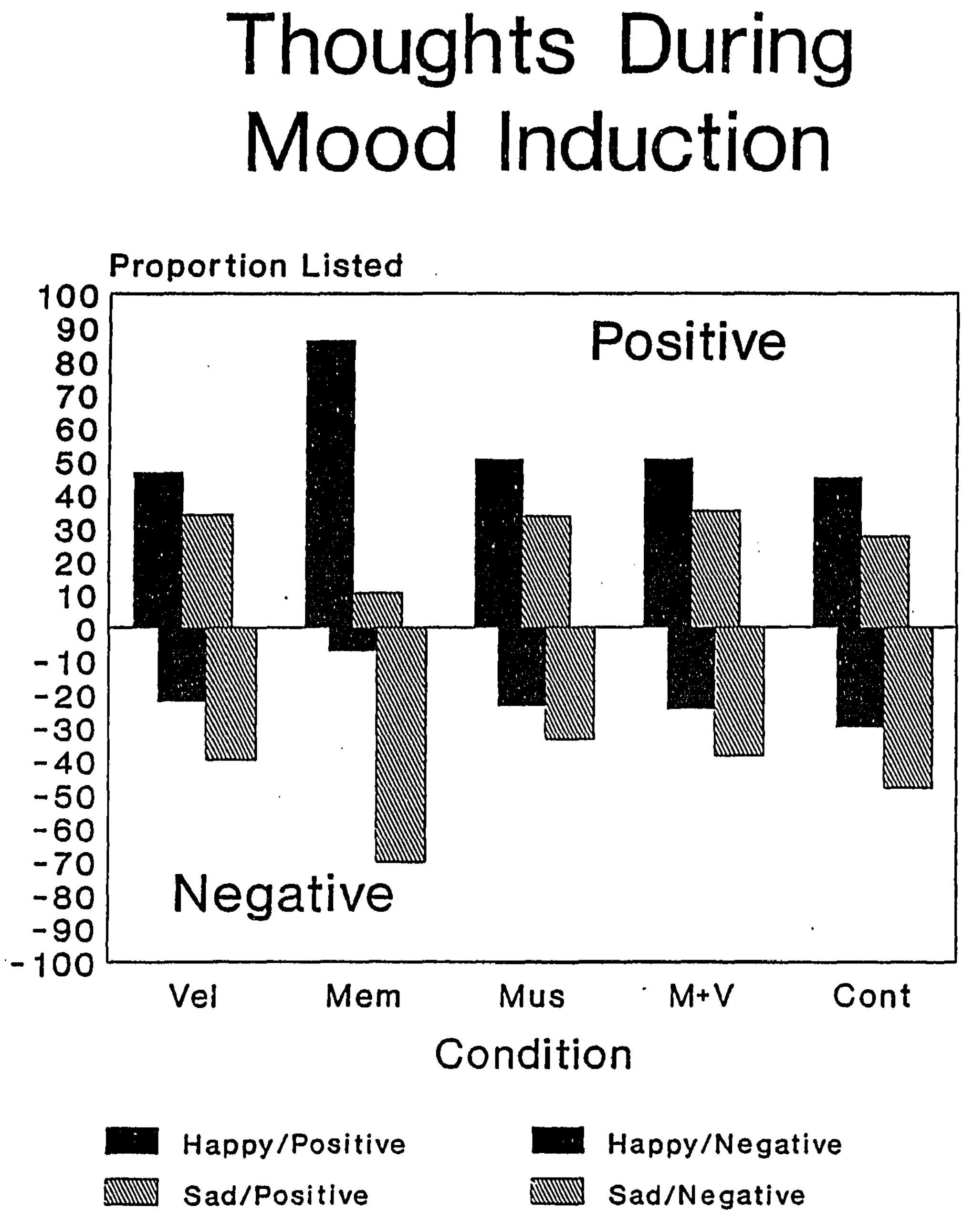
Happiness	Sadness
Music + Velten (U)	{Control (I)
Music + Velten (I)	{Music + Velten (I)
Music (I)	Memories (I)
Velten (I)	Velten (I)
Memories (I)	Music (I)
Memories (U)	Music (U)
Control (I)	Velten (U)
Music (U)	{Music + Velten (U)
Velten (U)	{Control (U)
Control (U)	Memories (U)

I = Instructed U = Uninstructed

control condition, we were relieved to find little mood change in our uninstructed subjects. However, explicit instruction to these subjects worked for both happy and sad conditions and actually proved to be the most effective means of producing sadness, supporting the theory that people are able to alter their moods in a controlled fashion. Demand characteristics can never be ruled out as a contributing factor; however, carefully worded instructions telling subjects that the purpose of the experiment was to find out whether or not these inductions were, in fact, effective, along with post-experimental information, increase our confidence that the results were not solely attributable to demand characteristics.

Strategic Activity. What are people doing during the MIPs? The proportion of positive and negative thoughts during each procedure are shown in Figure 11. It should be noted that the memory condition is constrained in that subjects were specifically asked to recall happy or sad personal memories, although they were encouraged to write down any thoughts that occurred to them, whether or not the thoughts related to those memories. Even when disregarding the memory groups, overall, happy subjects reported a higher percentage of happy thoughts than sad subjects and more happy thoughts than sad thoughts, with the opposite being true for the sad groups. Uninstructed groups also showed this effect, but to a lesser degree. This may indicate that uninstructed groups were countering congruent thoughts either automatically or in a controlled fashion or that the instructed groups were really trying to do as they were told and generated congruent cognitions to do so.

Figure 11.



Condition/Thought Valence

One surprising finding, which is not reflected in these figures, is the amount of thinking observed in the uninstructed music condition, particularly the number of autobiographical memories retrieved. This suggests that musical mood inductions are not as non-cognitive as some have argued and may in fact prime autobiographical memories and adjective recall to a greater extent than other procedures. Further analyses are necessary to determine the precise nature of these subjects' cognitions. Clearly the experimental design which required subjects to write down thoughts may have contributed to this effect by altering the amount and nature of cognitive activity, however, the content of the thought-monitoring reveals that music does provoke cognitive associations that could mediate affective response. Upon post-experimental questioning, subjects generally denied that they had altered their normal cognitive processes in response to experimental demands.

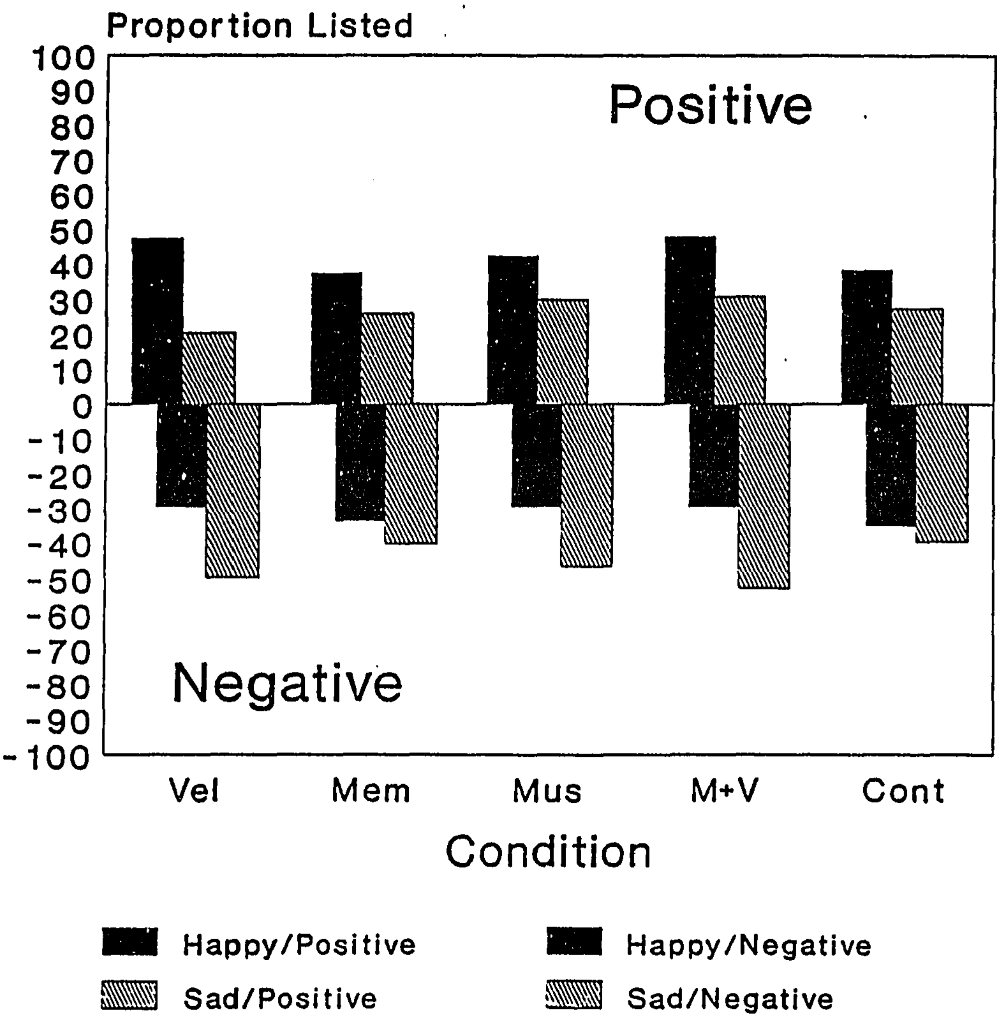
What about congruency effects after the MIPs? For these analyses we grouped those who reported being in a positive mood and those who reported being in a negative mood immediately after the MIP, regardless of the procedure they went through, since it would not make sense to analyze congruency effects using subjects that were not in the particular mood that the material was supposed to be congruent to. Unfortunately, using this categorization method, we cannot rule out stable individual differences or extra-experimental experiences, rather than our mood manipulation, accounting for these MCR results, but, as will be seen, our findings suggest that these individuals were <u>not</u> stable in their mood or retrieval of congruent thoughts or materials.

<u>Immediately</u> after the MIP the effects of mood on thought and memory can still be seen (see Figure 12). During the post-induction thought-listing task, subjects in happy moods continued to think more positive thoughts than negative thoughts and more positive thoughts than those in negative moods, while those in sad moods had more negative than positive thoughts and more negative thoughts than those in happy moods. There were <u>no</u> significant effects of instruction, thus these effects cannot be accounted for by subjects effortfully striving to maintain their instructed mood state. The same results occur with recall of adjectives on the mood rating scales, with happy subjects recalling more happy adjectives than sad adjectives or than the sad group and sad subjects recalling more sad adjectives than happy adjective or than the happy group.

These effects of mood on thought and memory set the stage for a vicious cycle leading to more intense mood states, but, as noted before, our study did not yield evidence of such a cycle in our sad conditions. Even in our happy conditions, subjects' mood tended to go down before it started to go up again. Significant differences between happy and sad groups (as opposed to happy and sad conditions) in proportion of happy and sad thoughts disappeared after the autobiographical memory test and the filling out of the absorption scale (the second post-MIP thought monitoring) and the overall proportion of happy to sad thoughts rose.

Figure 12.

Thoughts Following Mood Induction



Subject Mood/Thought Valence

Dissipation. When, how and where did the cycle break? One clue is in the results of the autobiographical memory test, immediately following the 5 minute post-induction thought monitoring. These memories were overwhelmingly positive with no differences between groups, even though the groups were still significantly different as to happy and sad ratings just prior to the test. Such an effect in and of itself could serve to break the negative cycle and perpetuate a positive one. Whether the incongruency effect for sad groups is due to automatic or deliberate cognitive strategies is unknown. Clearly our study demonstrates that subjects <u>can</u> use strategies to put themselves into certain moods and may do so automatically to get out of aversive moods. It may also reflect a difference between retrieval of autobiographical memories versus thought or memory for words. On the other hand, it may simply reflect the fact that whatever negative moods were present were rapidly dissipating due to the discontinuation of the aversive MIP along with distraction and possibly controlled thought processes. There is strong evidence that people in neutral mood states are biased towards recall of positive material and thinking of positive thoughts (Pollyanna Principle) and this effect may simply reflect that phenomenon.

The autobiographical memory effect does somewhat counter the argument that autobiographical memories are simply primed by the intentional marshalling of congruent memories during MIPs. The subjects <u>did</u> marshall congruent thoughts during the MIP, but recalled predominately happy memories approximately five minutes later.

Although it is difficult to draw conclusions about the relative effects of cognition on mood, as opposed to mood on cognition, without further analyses, these results do suggest several factors that may underlie the observed asymmetry between positive and negative mood inductions in MCR effects. First, sad inductions do not necessarily make people sad, as opposed to less happy. Second, even truly sad subjects are not very sad, and sad subjects are not sad <u>people</u>. Normal subjects, even if they have been temporarily saddened by an experimental procedure or end up being happy or sad, for whatever reason, post-induction, nevertheless retain a fund a happy memories and an ability to think happy thoughts that can help them get out of their bad moods, as seen by their ability to retrieve happy autobiographical memories, and their ability to get "into" happy or sad moods using their own resources, regardless of their pre-experimental mood. Truly depressed individuals may not have these resources to the same degree.

This brings us back to the question of individual differences in response to MIPs and how important various mood and memory effects are to the onset and maintenance of depression. It may be that these mood effects contribute to depression only in those individuals who possess an unusually large or accessible fund of negative cognitions, and/or who lack positive cognitions or ability to recruit those that are potentially available to counter negative thoughts and memories. Very few of our subjects were clinically depressed, as indicated by their responses to the BDI. A more detailed analysis of the relationship between individual differences and MIP effectiveness and MCR effects may shed light on some of these issues.

Summary and Overview of Proposed Study

A review of the literature indicated that no study has looked at the effects of an experimentally induced mood on memory. One study suggested that mood congruency effects could be observed on a test of implicit memory when anxious subjects were utilized; however, most of the experimental literature on mood and memory effects has looked at sad vs. happy moods, presumably because they are the most distinctive moods (Russell, 1980). It was decided that the clearest contrast between explicit and implicit memory and greatest continuity with prior research could be obtained by exploring MDM, MCM and RA effects with induced sad and happy moods.

An initial attempt to find MDM using stem completion failed. In retrospect, it seemed that stem completion was not the best task for exploring the effects of mood on implicit memory for two reasons. One, stem completion is a perceptually-driven and it is unlikely that mood would affect retrieval based on perceptual features, given the conceptual nature of mood as a cue. Two, three-letter stems provide a relatively strong nominal cue for the retrieval of list items that might overpower mood as a cue. An implicit analogue of free recall was developed which was thought to be conceptually-driven and eliminates all cues at test except mood. This task was used in the current experiment.

The resource allocation effects at encoding found with stem completion suggested that subjects might not be devoting sufficient cognitive resources toward encoding to forge a link between unrelated material and mood. Therefore, it was decided that valent material that has an additional semantic relationship to mood would be used in addition to neutral material in the hopes that this would facilitate the establishment of a link between the stimuli and mood. By including affectively valent stimuli, mood congruency effects can also be examined.

The failure to find MDM might also have been attributable to the relatively weak moods present at encoding and retrieval. Mood cannot serve as a retrieval cue unless it is relatively strong. A study was conducted to identify the mood induction technique that would produce the strongest moods, most reliably. In order to diminish demand characteristics and the accompanying problem of subjects reporting moods that they are not actually experiencing, it was decided to that an uninstructed MIP should be utilized. The musical mood induction proved to be the best technique for inducing sad moods. Although several other techniques were better at producing happy moods, happy mood is relatively easier to induce; thus, it was decided that a musical mood induction would maximize the number of subjects meeting mood criteria overall. In addition, a musical induction does not utilize any verbal material such as negative or positive words that might interfere with interpretation of results of memory for valent stimuli.

CHAPTER 3

HYPOTHESES

Resource Allocation Effects

I. Fewer words will be retrieved by subjects who are in sad moods at time of encoding. This effect will be most pronounced in the implicit condition, with affectively unrelated words and with shallowly encoded items.

II. Fewer words will be retrieved by subjects who are in sad moods at time of retrieval in the explicit condition, but not the implicit condition which requires relatively fewer cognitive resources from a memory point of view. This effect will be most pronounced with affectively unrelated and shallowly encoded items.

Mood-dependent Memory Hypotheses

III. A greater number of target words will be retrieved in the HH and SS conditions where encoding and retrieval moods match than in the HS and SH conditions. This effect is most likely to appear in the implicit condition since subjects are precluded from self-generating relatively stronger cues, whereas, in the explicit condition, they might or might not generate such cues.

IV. This effect will be greater for items that are affectively congruent to encoding mood because congruency provides an additional link to encoding mood. It will be least likely to be seen with items that are congruent to retrieval mood, but not encoding mood because of the possibility of countervailing congruency effects overpowering temporally-based mood-stimuli links.

V. To the extent that mood-dependency is evident in explicit memory, it will be more evident for items that were shallowly encoded.

Mood-Congruent Memory Hypotheses

VI. A greater number of target words will be retrieved that are congruent to retrieval mood than that are incongruent in both implicit and explicit conditions; however, the effect will be stronger in the implicit condition.

VII. A greater number of target words will be retrieved that are congruent to encoding mood than that are incongruent in both implicit and explicit conditions; however, the effect will be stronger in the implicit condition.

VIII. To the extent that MCM effects are observed in explicit memory, they will be stronger for shallowly encoded words.

CHAPTER 4

METHOD

Design

Happy (H) and sad (S) moods were manipulated at encoding and retrieval by means of a musical mood induction. This 2x2 of encoding by retrieval mood resulted in four between-subjects mood conditions HH, HS, SH, SS. In order to strengthen the link between items and mood, each subject studied words with positive and negative affective valence, as well as emotionally neutral items (Pos, Neg, Neut). Each subject was given an implicit memory test (Imp) followed by an explicit memory test (Exp). This yielded a basic 4x3x2 mixed design, mood x item valence x test. As secondary independent variables, a levels of processing manipulation was included to help experimentally dissociate implicit and explicit memory and examine the effects of encoding on mood and memory effects.

Additional independent variables included scores on the Beck Depression Inventory (BDI) and Tellegen's Absorption Scale (TAS). The dependent variable was number of target items retrieved. Two counterbalancing variables were employed as well; list and encoding condition. Targets were divided into three lists, each including 2/3 of the total number of targets. Each subject was presented with one of these lists during the study phase and encoded half of the items elaboratively and half shallowly. Lists were balanced so that each item was encoded each way by the same number of subjects.

Subjects

Psychology 101 students were recruited until each of 4 cells representing mood condition (HH,HS,SH, SS) was filled with a minimum of 12 subjects, counterbalanced by list (L1,L2,L3) and encoding (enc1,enc2) who met mood criteria prior to encoding and both implicit and explicit tasks. Subjects received experimental credits in partial fulfillment of class requirements. Each subject was randomly assigned to a particular mood condition, however, subjects were ultimately classified based on their subjective mood ratings, using the mood criteria outlined below, without consideration of experimental group membership to insure that subjects were experiencing the mood being analyzed. This resulted in a total of 72 subjects, since more than 12 subjects were obtained in some cells. A total of 266 subjects had to be tested to meet this criterion.

Classification of mood was based on subjective ratings on a single bipolar 11-point scale (0-10), anchored with the words sad/negative and happy /positive, immediately following the first mood induction and immediately preceding each retrieval task. A subject was considered to be happy if they rated their mood higher than the midpoint of 5, and sad if they rated their mood as less than 5. (Footnote 1)

Procedure

Subjects were given instructions in writing (See Appendix B) and orally. They were not told that they would be given a memory test following presentation of the target words. Incidental learning was chosen to maximize the possibility of obtaining MDM and MCM effects since self-generated cues which could potentially overpower the mood cue are not likely to be generated if subjects are not told that they will have to retrieve the words.

Subjects completed an initial mood rating and were given the first mood induction as described above. Then a second mood rating was taken. Next, the target words were presented for six seconds each and subjects alternately rated words for vividness of the image that they were able to generate involving themselves and the word or proportion of straight to curved line segments in the word. The encoding of the 30 target words plus two primacy and three recency words took approximately 3-1/2 minutes. Subjects rated their mood halfway through the encoding task and again at the end of encoding. They then underwent the second mood induction, rated their mood, and performed the implicit task. They then listened to five minutes of music to boost their mood, rated their mood again and performed the explicit free recall task. Subjects then filled out the BDI and TAS and answered a short post-experimental questionnaire, including questions on retrieval intentionality. Questions were answered and the subjects were carefully debriefed in writing and orally.

Materials and Equipment

The music used for the mood inductions was from Pignatiello et al. (1986) and Eich and Metcalfe (1989). The music consisted of several short pieces of instrumental music that were arranged in order of increasing mood intensity. Some of the selections were familiar to subjects (e.g., patriotic songs and theme from Rocky). Different music was used for encoding and retrieval. The music was played on a high-quality Sony cassette player. Each subject received a response booklet, containing experimental materials described below (See Appendix A). Stimulus words were presented by the experimenter on an overhead projector. A post-experimental questionnaire was given at the conclusion of the experiment. The room was divided so that small groups of subjects could be tested without impairing the privacy of the subjects. It was hoped that this would result in subjects being less self-conscious, and perhaps more honest in their mood ratings (i.e., less susceptible to demand) and less likely to be disrupted by other subjects. Each subject was given a box of crayons to draw with during the mood induction.

Stimulus items. Three lists of 15 stimulus words were constructed, with one list consisting of positive mood-related adjectives, one of negative mood-related adjectives and one of neutral concrete nouns. While it would have been preferable to use only mood-related adjectives, rather than mixing types of words which might be differentially accessible during recall or priming tasks, few, if any, unambiguously neutral mood-related or non-mood-related adjectives exist. In addition, the pool of possible neutral trait adjectives is considerably smaller than positive or negative trait adjectives, which might have created a bias at the outset against generating neutral trait adjectives on the free-recall analogue implicit task. On the other hand, the pool of concrete nouns is much larger than that of trait adjectives, creating an opposing bias, again depending on the cue and context. However, data obtained during the development of the implicit free recall analogue indicated that following a mood induction, subjects tend to favor retrieval of adjectives in the implicit conditions which somewhat compensates for this bias. Since a straightforward interpretation of mood-dependency context effects requires the use of words that have no prior semantic relationship with mood (although a prior personal association related to mood may exist), it was deemed necessary to use concrete nouns as the neutral stimuli. All concrete nouns were preceded by the word "a" or "an" to induce encoding of ambiguous words as nouns, e.g., carpet could be a verb or a noun, but "a carpet" can only be a noun. Frequency data was based on the noun version of ambiguous words. Preliminary studies showed that subjects demonstrated normal recall of target words preceded by "a" or "an" and at least some priming of these words, although given that the implicit free recall analogue is a new measure, it is difficult to ascertain whether the priming was normal.

The negative and positive words were specifically chosen to reflect the type of cognition which might serve to create, maintain or increase depression, e.g., stupid, inept, lousy, or, on the positive side, decrease depression or elevate mood, e.g., intelligent, exciting, peaceful. This is an important methodological point in that some studies have selected abstractly negative stimuli which would not necessarily be expected to generate depressive feelings, even if they are accessed more readily (e.g. _war_, _rude_), and thus lack ecological validity for studies hypothesizing a relationship between increased accessibility of certain types of cognitions and depression. In fact, studies using negative nouns have been less successful in demonstrating mood congruency effects, perhaps because they cannot easily be encoded in relation to a personal experience and may not really be _mood_ congruent, even though they are semantically affectively valenced. It has been shown that self-referencing is necessary to produce mood congruency effects. This can be promoted by use of trait adjectives or manipulations which specifically relate the word to the self. The congruent stimulus words proposed for this study are all mood-related adjectives and can all be easily related to personal experiences (the elaborative encoding task in this experiment).

The three lists of words that were generated were matched for frequency according to Kucera and Francis (1970) norms, across the three affective-valence conditions (see Appendix C).

Each word was normed by having 200 subjects in a preliminary study rate the pleasantness of the word on an 11 (0-10) point scale to insure that the words were actually positive, negative or neutral (see Appendix C). Several potential items had to be eliminated because they were ambiguous, (_silly_, _ridiculous_) or were rated as positive when they were supposed to be neutral (_painting_). Words were chosen that were semantically unrelated, when possible, to avoid one target word cuing retrieval or generation of another target word. With the trait adjectives this was impossible and needs to be considered in analyzing retrieval since, as noted above, subjects could spontaneously categorize words and use those categories, independent of mood-state cues, for retrieval. Words were eliminated that appeared with a high frequency on baseline due to their relationship to the experiment or environmental cues (e.g., painting (because subjects colored pictures during the study), tired, silly, watch, shirt, pencil). The result is three lists consisting of 15 positive, 15 neutral and 15 negative words matched for frequency, length, emotional intensity (positive and negative).

Encoding conditions. In order to control the encoding of list items subjects encoded half of the items using a shallow structural task and encoded the other half using an elaborative vividness task. For the structural task, they were asked to rate on a scale of 0-10 the relative proportion of straight as opposed to curved line segments in the word, e.g., kill would get a 10 because it has all straight lines, whereas, ouch would get a 2 or 3 because it has relatively few straight lines. For the elaborative task, subjects were asked to rate on the same scale (used throughout for all ratings) the vividness of the image that they could generate of an autobiographical memory related to the stimulus word. Subjects had 6 seconds to perform each rating and alternated between segment and vividness ratings in a regular fashion (every other item) to enhance their ability to correctly encode the words by letting them anticipate how each word is to be processed. The preliminary study demonstrated that subjects could shift between these two types of encoding in six seconds.

Memory tests. Each subject was given an implicit memory test, followed by an explicit memory test. For the implicit task, subjects were given a piece of paper with 50 blanks, (30 for target words, 5 for primacy and recency words and 15 for baseline words) and told to write down the very first words that came to mind. They were required to fill in all 50 spaces. For the explicit tasks, subjects received a piece of paper with 35 blanks, (30 for target words, 5 for primacy and recency words) and were told to write down all of the words they could recall from the study phase. Preliminary data seemed to indicate that subjects become confused when they are required to guess extensively during explicit retrieval and overall levels of explicit retrieval are depressed, thus it was decided not to include blanks for baseline items on the explicit sheet. The two forms were different only in this regard. Subjects were asked to guess if they could not recall the appropriate list word and were asked to fill in all 35 blanks. They rated their confidence in whether or not the word was on the study list on a three point scale, with 1 indicating they are sure it was on the list, 2 indicating they are not sure whether or not it was on the list and 3 indicating they are sure it was not on the list.

Subjects always performed the implicit task first, since explicit retrieval is likely to contaminate implicit retrieval. It was not believed that the implicit task would significantly affect explicit retrieval due to the low level of target generation (less than one word/subject) found in the preliminary study using this task.

Subjects were told just prior to the implicit test that the generation task was meant to test perception of words that were subliminally presented during the musical mood induction. The primary purpose of this minor deception was to give subjects some plausible explanation for the task. It was found, during pilot studies, that subjects become confused and occasionally irritable without such instructions because the task seems meaningless or silly. Giving them a reason for engaging in the task seemed to reduce this response. Moreover, it was hypothesized that subjects would be less likely to intentionally think back to list items as a strategy for generating words if they were explicitly referred to another episode. To prevent subjects from consciously refraining from generating list words, it was emphasized that the subliminally presented words were chosen randomly but that it was important to write down the very first words that came to mind in order to accurately measure subliminal perception.

Within subject baselines were gathered by recording how many stems are completed and words generated in response to cues from the list of words that the subjects did not study. Subjects studied two thirds of the words, leaving one third of the words for baseline measurement. Lists were counter-balanced so that an equal number of subjects in each condition encoded each word in each way (structure/vividness). A third of the subjects in each mood condition saw the first two thirds, a third saw last two thirds and a third saw the first and last third with the remaining third always serving as the baseline words.

Mood Induction. Subjects underwent a musical mood induction procedure chosen on the basis of the preliminary study. Subjects listened to approximately 15 minutes of increasingly happy or sad or neutral pieces of music. They were not told that the music was meant to alter their mood, or otherwise instructed to try to achieve a particular mood. An uninstructed technique was chosen to prevent subjects from intentionally focusing on congruent material to aid the induction and allow natural mood repair processes to occur. It was also hoped that demand characteristics, including reporting of nonexistent affect, would be reduced with an uninstructed technique. Subjects were asked to draw abstract pictures, with crayons, that reflected their emotional reaction to the music. It was suggested that they "turn off their minds for a few minutes and just react to the music on an emotional level." The drawing was intended to serve several purposes: (1) Preliminary studies showed that subjects get bored and restless unless they do something during the 20 minute induction; (2) The pilot data showed that it actually helped some people experience the moods; (3) attention paid to drawing may prevent some cognitive activity that could prime list-words. One danger is that some subjects reported that drawing made them feel happier, in general. Since subjects are already somewhat happy coming into the experiment and sadness is the most difficult mood to induce, this effect may have made it more difficult to achieve sad moods.

Although, it was determined that a musical induction would provide the most powerful and reliable effects, musical inductions are not very powerful, especially in producing negative moods. Subjects in the neutral condition tend to end up slightly happy (subjects also tend to come in slightly happy, so this may in fact represent "neutral" mood). Some studies have continued playing the music during encoding and retrieval in an effort to maintain mood, however, given the implicit tasks being proposed, it was likely that the music, apart from mood, would greatly influence the generation of words if it was playing during implicit retrieval.

Some concern regarding mood dissipation was noted above, particularly when subjects are elaboratively encoding words that are affectively incongruent with mood. Prior studies have also shown that mood dissipates rapidly over time and that allocation of resources to cognitive tasks results in more rapid dissipation. Given the difficulty that subjects have with the implicit tasks, it seemed likely that mood would dissipate between the implicit and explicit task. A booster period of music (5 minutes) was utilized between tasks in an attempt to forestall this problem. This difficulty resulted in a greater number of subjects having to be run in order to get enough subjects who met mood criteria for the explicit test.

CHAPTER 5

RESULTS

In the presentation that follows, the 2 x 2 interaction of encoding by retrieval moods will be represented as a single 4-level variable, mood condition, HH, HS, SH, SS. This strategy eliminates the necessity of disentangling this interaction from more complex interactions. Analysis of variance was performed to determine whether or not the groups differed significantly on the variables of interest, except where otherwise noted.

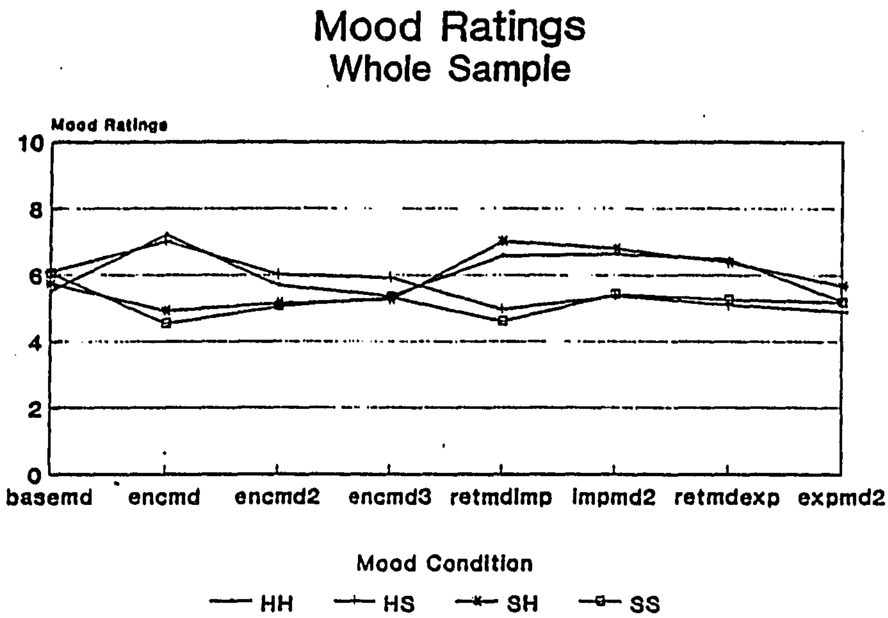
Confirmation of Random Assignment

Subjects were randomly assigned to one of four mood condition: HH, HS, SH, SS. Random assignment was successful in that there were no significant differences between mood ratings of subjects in the four conditions prior to the first mood induction (baseline mood, $F(1,3) = 1.02$, $p < .3825$) (see Figure 13). In addition, Beck Depression Inventory and Absorption scale scores did not significantly differ between groups ($F\text{s} < 1$). 266 subjects (HH = 19, HS = 102, SH = 72, SS = 73) were tested in order to obtain a minimum of 12 subjects who met mood criteria for that condition. In order to be included in one of the experimental groups, the subject had to report being in either a happy or sad mood at encoding and retrieval and had to be in the same retrieval mood for both implicit and explicit tests. These totals suggest that sad moods were much more difficult than happy moods to induce, particularly following a happy mood induction. One reason for this discrepancy is that subjects started out in relatively happy moods. The average baseline mood rating was 5.94. In addition, subjects were asked to draw with crayons during the mood induction in an effort to engage their attention and hopefully, intensify mood state. Unfortunately this turned out to be an enjoyable task for many subjects and may have made induction of negative moods more difficult. Because many subjects reported happy moods at encoding and retrieval without actually receiving happy mood inductions, proportionately fewer subjects were required to complete the HH mood condition.

Confirmation of Mood Induction

Mood induction was generally successful in that subjects who received happy inductions rated their moods following the encoding, retrieval and booster induction (which took place just prior to the explicit test) as significantly (all ps $< .0001$) more happy (MRs = 7.11, 6.79, 6.43 for first, second and booster inductions respectively) than subjects who received sad mood inductions (MRs = 4.74, 4.79, 5.18 for first, second and booster inductions) (see Figure 13). In addition, mood ratings (MR) following these inductions changed significantly from baseline (all ps $< .0001$). These differences remained significant throughout encoding (MR halfway through encoding, $p < .0007$; MR at end of encoding, $p < .03$) and retrieval tasks (MR following implicit test, $p < .0001$; MR following explicit test, $p < .028$). However, mood did dissipate significantly ($p < .0001$) during these tasks. Figure 13

Figure 13.


Mood Ratings
Whole Sample
Mood Ratings
10
8
6
4
2
0
basemd
encmd
encmd2
encmd3
retmdimp
impmd2
retmdexp
expmd2
Mood Condition
HH
HS
SH
SS

graphically displays the average mood ratings for the four groups over time.

Although subjects responded to the mood induction on average, only subjects who actually reported being in the appropriate mood, irrespective of the induction they received, were included in the analyses since one would not expect mood effects to occur in subjects who were not experiencing the mood of interest. Table 3 shows the number of subjects actually reporting happy, sad, and neutral moods at encoding, implicit retrieval, and explicit retrieval in each condition. Table 4 shows the percentage of subjects reporting the desired moods in each condition.

All subjects who reported neutral moods at any of these three points were eliminated from data analyses. Collapsing across conditions, Table 5 indicates that 114 subjects met mood criteria for inclusion in one of the mood conditions (i.e., they were in the appropriate mood at encoding, implicit retrieval and explicit retrieval). This will be labeled the WITHIN sample. After counterbalancing by means of random elimination for list and encoding condition, 72 subjects remained. The number in parentheses indicates how many subjects received mood inductions matching their actual moods. [note: few HH inductions were performed since many subjects reported HH moods without receiving HH inductions. This is why so few subjects actually reporting HH moods received HH inductions]:

Table 3.
Number of Subjects Reporting H,S,N Moods
In Each Mood Condition

		encoding	implicit retrieval	explicit retrieval
HH -	H	17*	13*	12*
	S	1	4	1
	N	1	2	6
HS -	H	87*	33	33
	S	11	41*	33*
	N	4	28	34
SH -	H	25	63*	48*
	S	34*	3	3
	N	13	4	18
SS -	H	25	20	27
	S	35*	35*	22*
	N	13	18	23

The stars (*) indicates which mood matches the induction

Table 4
Percentage of Subjects Reporting Moods Congruent to Mood Condition*

	encoding	implicit retrieval	explicit retrieval
HH	89	68	63
HS	85	40	32
SH	47	87	67
SS	47	47	30

*Note that the subjects reporting appropriate moods during one phase are not necessarily the same subjects that are reporting the appropriate mood during another phase

Table 5
Within Subjects Sample

Total	Counterbalanced
HH = 55	30 (1)
HS = 16	12 (10)
SH = 21	12 (11)
SS = 22	18 (11)
114	72

A large number of subjects had to be eliminated who changed moods between implicit and explicit retrieval tasks. This created a power problem for some of the analyses; therefore, a larger sample was also examined. These subjects reported H or S encoding moods and H or S mood <u>either</u> prior to the implicit <u>or</u> the explicit task. These samples will be labeled between subjects implicit (BTNIMP) and between explicit (BTNEXP). Table 6 summarizes the subjects that met these criteria before and after counterbalancing. Again, the numbers in parentheses indicate how many subjects received mood inductions matching the actual moods they reported.

Given that so many subjects had to be eliminated who did not meet mood criteria, a check was made to see if the subjects who did meet criteria differed at baseline. Each of the three counterbalanced samples listed above was examined (WITHIN, BTNIMP, BTNEXP), although it should be noted that group membership overlaps substantially. In each sample, subjects in different mood groups did differ significantly on baseline mood measures ($p < .0001$). In the WITHIN sample, average baseline moods were: HH = 7.4, HS = 5.42, SH = 5.64, = 4.53. In the BTNIMP sample baseline moods were: HH = 7.24, HS = 5.52, SH = 5.13, SS = 4.83. In the BTNEXP baseline moods were: HH = 7.26, HS = 5.42, SH = 5.35, SS = 4.59. However, subjects in HS, SH and SS groups all altered mood significantly following the mood inductions (for within sample, 1st induction, $F(1,3) = 18.23$, $p < .0001$); 2nd induction, $F(1,3) = 28.91$, $p < .0001$), while subjects in the HH group were able to maintain their happy moods.

Table 6

BETWEEN-SUBJECTS SAMPLES

	Imp Total	Counterbal	Exp Total	Counterbal
HH	75 (12)	42 (1)	75 (11)	48 (2)
HS	43 (32)	30 (24)	28 (23)	12 (10)
SH	36 (29)	24 (21)	29 (19)	24 (16)
SS	36 (25)	24 (19)	28 (17)	18 (12)
	190	120	160	102

Thus, despite baseline differences, mood was successfully manipulated by the musical induction procedure.

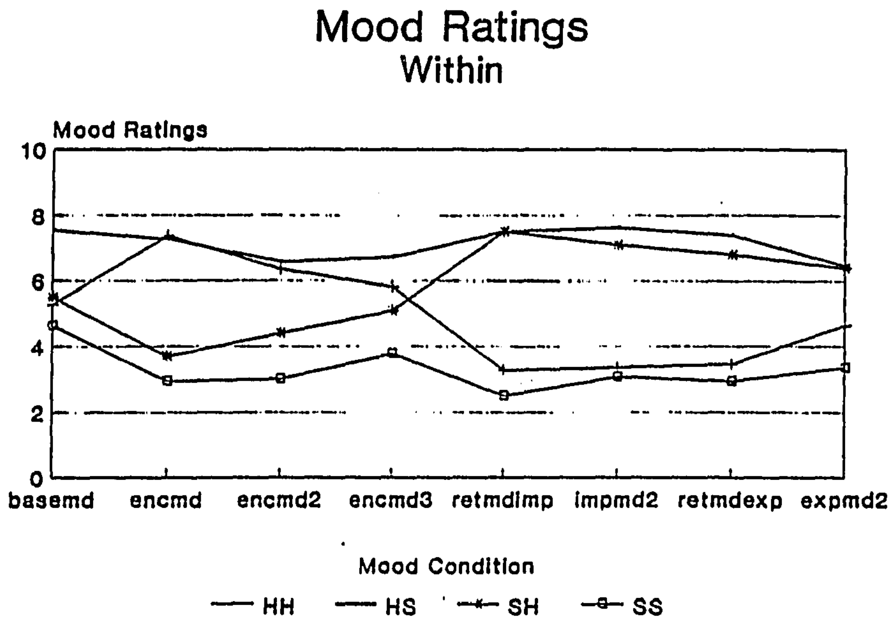
Figures 14 and 15 graphically display changes in mood ratings of subjects in the WITHIN, BTNIMP and BTNEXP samples over time. Significant dissipation of mood occurred during the encoding and retrieval tasks, except in the WITHIN sample. In that sample mood did not dissipate significantly during the implicit test.

Memory Measure Check

A new test of implicit memory was developed for this experiment. Pilot data, described earlier, indicated that memory could be expressed implicitly, as measured by target over baseline differences, using a free recall analogue. Pilot data also indicated that subjects approached this task differently from a comparable explicit free recall task in that no levels of processing effect was seen in the implicit task but was in the explicit task, that is, elaborative encoding facilitated explicit recall but had no effect on implicit generation of items. It is important to examine whether these effects were replicated in the current study.

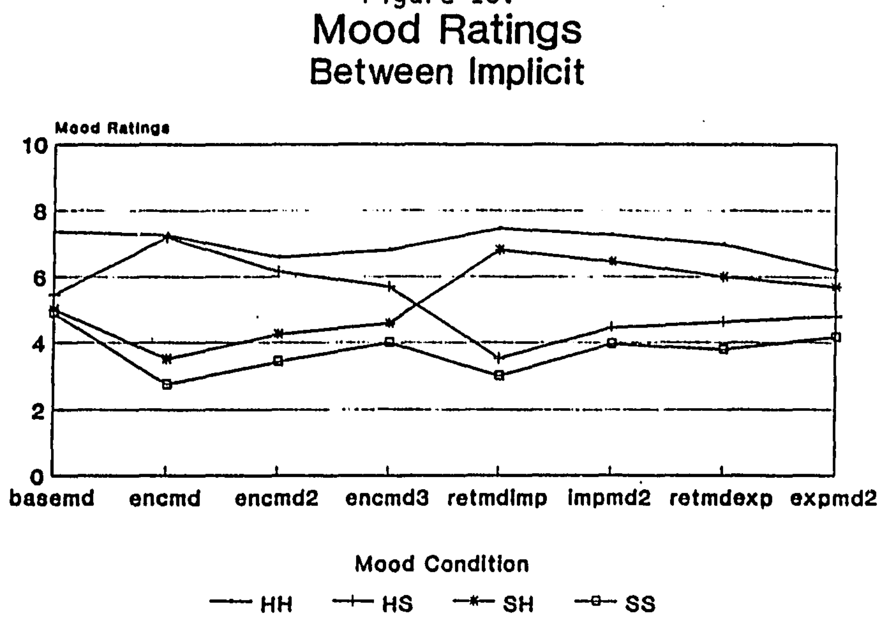
In the WITHIN subjects sample, the number of targets retrieved relative to baseline items was not significant ($F(1,71) = 1.84$, $p = .1797$, although there is a trend towards significance (see Figure 16). As noted above, the elimination of a large number of subjects created a power problem. In the larger between-subjects sample, the difference

Figure 14.



Mood Ratings
Within
Mood Ratings
10
8
6
4
2
0
basemd
encmd
encmd2
encmd3
retmdimp
impmd2
retmdexp
expmd2
Mood Condition
HH
HS
SH
SS

Figure 15.


Mood Ratings
Between Implicit
Mood Ratings
10
8
6
4
2
0
basemd
encmd
encmd2
encmd3
retmdimp
impmd2
retmdexp
expmd2
Mood Condition
HH
HS
SH
SS

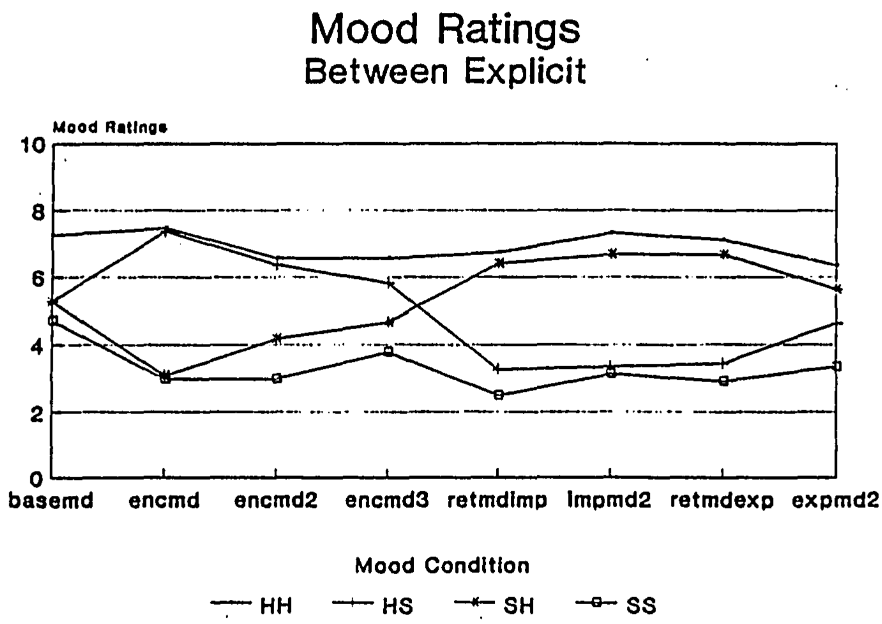
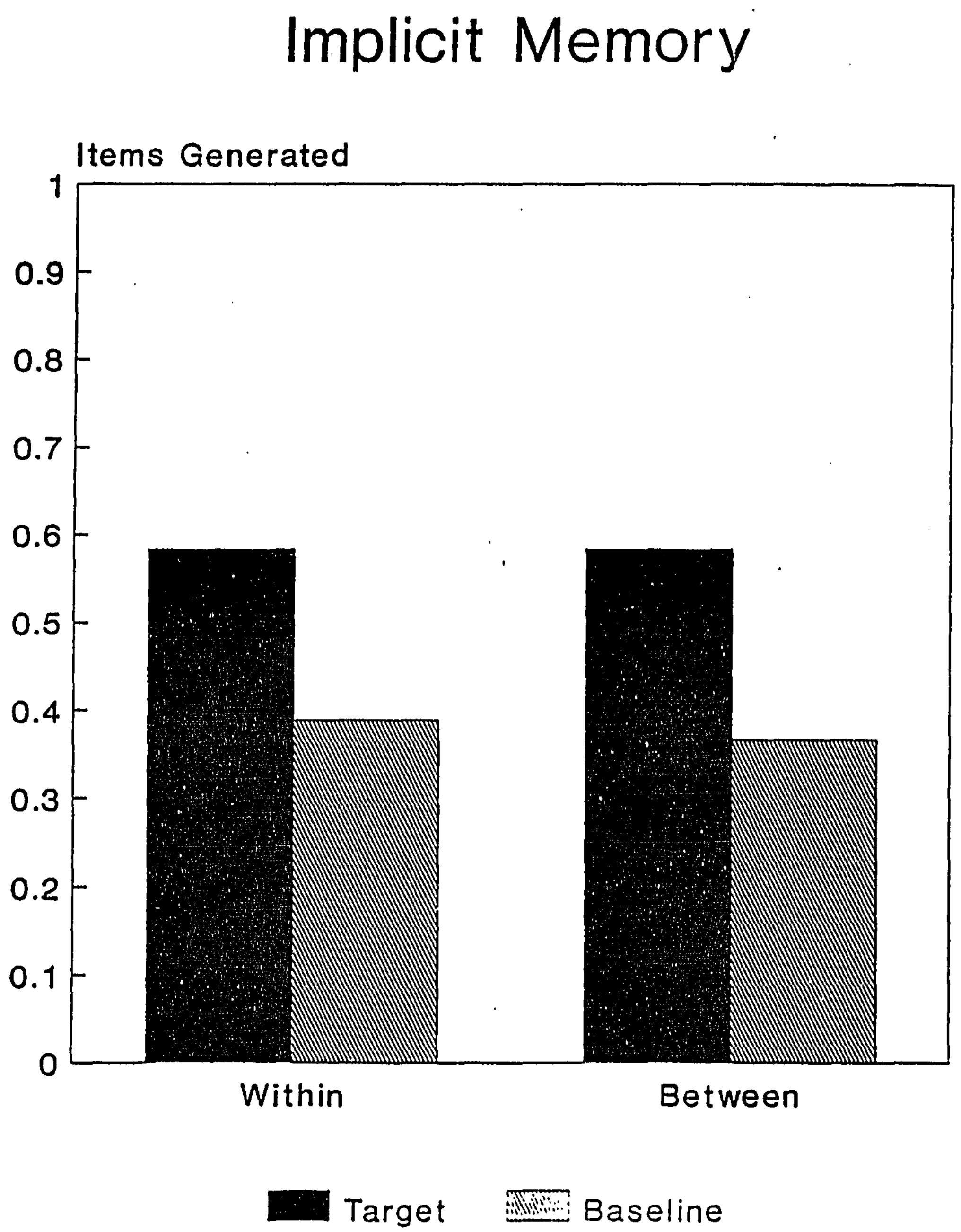

Mood Ratings
Between Explicit
Mood Ratings
10
8
6
4
2
0
basemd
encmd
encmd2
encmd3
retmdimp
impmd2
retmdexp
expmd2
Mood Condition
HH
HS
SH
SS

Figure 16.



within p = .1797, between p = .0381

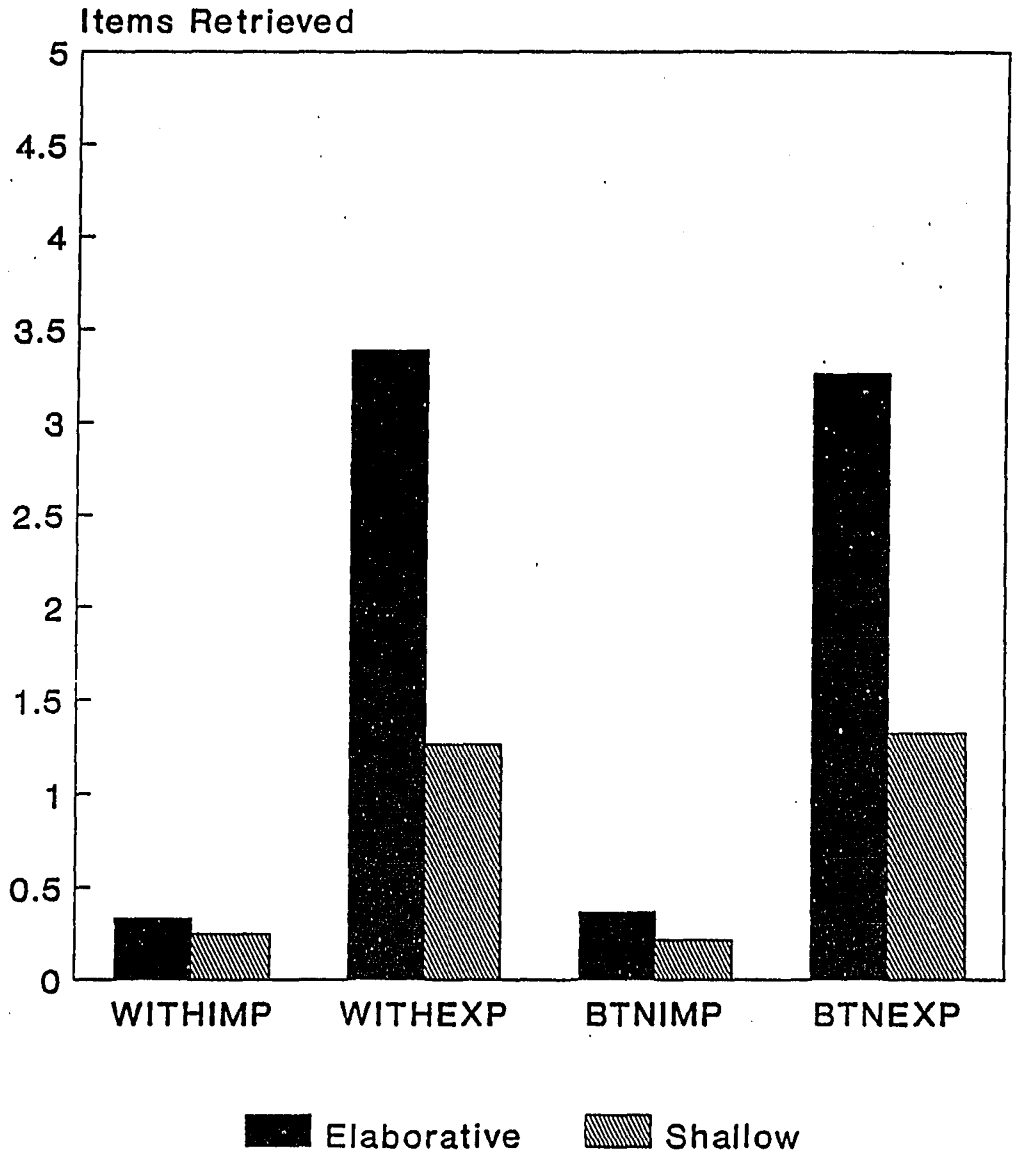
between target and baseline items was significant ($F(1,119) = 4.40$, $p = .0381$). The average number of target and baseline items retrieved was almost equivalent in the two samples (WITHIN, Tar = .583, Base = .389, BTNIMP, Tar = .583, Base = .367), suggesting that the WITHIN sample would have been significant given more subjects (see Figure 16). Thus, it can be concluded that the free recall analogue task used to assess implicit memory, does indeed reveal memory as indicated by a change in performance attributable to the prior study episode. But is it implicit memory?

Subjects in the WITHIN sample did not retrieve a significantly greater number of elaboratively encoded targets relative to shallowly encoded targets during the implicit test (.33/.25, $F(1,71) = 1.13$, $p = .292$), but did during the explicit test (3.39/1.26, $F(1,71) = 63.79$, $p = .0000$) (see Figure 17). In addition, the interaction between levels of processing and implicit and explicit tests is highly significant ($F = 58.08$, $p < .0001$). However, this failure to find significance might be attributable to lack of power in the smaller WITHIN sample.

Examination of performance on the implicit test in the BTNIMP sample does reveal a significant levels effect (.37/.22, $F(1,119) = 5.42$, $p = .0216$, although again, it is significantly less of an effect ($F(1,119) = 68.64$, $p = .001$), than that seen on the explicit test in the BTNEXP sample (3.26/1.32, $F(1,119) = 76.47$, $p < .001$) (see Figure 17). In this case, the average number of items retrieved during the implicit test in the WITHIN and BTN samples is somewhat different, suggesting that there is a real difference in the two samples on this variable.

Figure 17.

Levels of Processing



However, the difference in degree to which elaboratively encoded items are preferentially retrieved on the implicit and explicit tests suggests that the tasks were approached somewhat differently and provides some evidence that explicit strategies were not utilized on the implicit task. As mood and memory findings are presented, additional evidence will be provided that the pattern of item retrieval is markedly different on the implicit and explicit tests.

Alternatively, it is possible that a portion of subjects used explicit strategies to facilitate performance on the implicit test, which resulted in a comparatively less pronounced levels effect. An examination of responses to the post-experimental questionnaire suggests that some subjects did indeed think back to the encoding episode during the implicit test and that some subjects deliberately tried to generate words from the study phase. This will be discussed further below.

Mood Effects on Memory

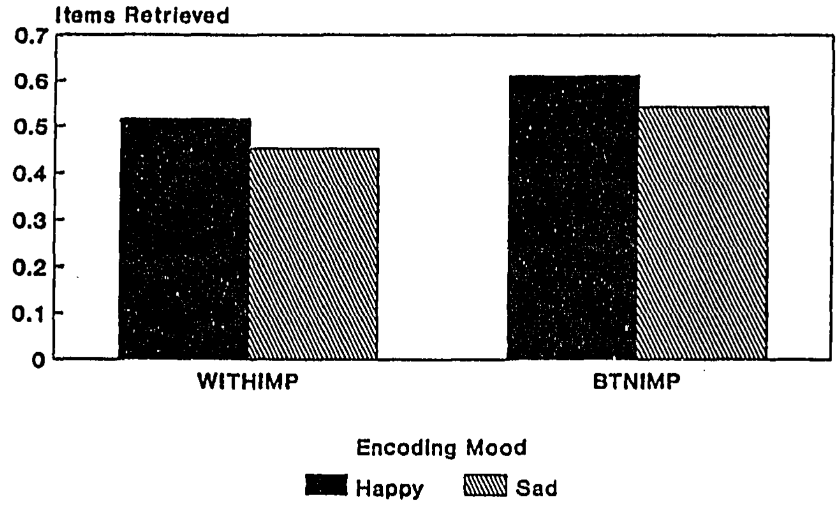
An initial analysis revealed no difference in average number of baseline items generated across mood conditions (for WITHIN/BTN samples; HH = .4/.429, HS = .5/.467, SH = .5/.25, SS = .22/.25; $F(1,3) = .3$, $p < .8248$/$F(1,3) = .5$, $p < .6853$ or in type (valence) of baseline items generated across conditions $F(2,6) = .37$, $p < .8947$/$F(2,6) = .55$, $p < .7679$. Therefore, the remaining analyses of implicit test performance were done using the mean of the absolute values of items retrieved rather than comparing targets to baseline.

While this study was designed to permit direct statistical comparisons of implicit and explicit tests, the variances of target recall within the two samples were so discrepant, primarily because of extremely low levels of item retrieval in the implicit sample, that appropriate analyses of these interactions could not be obtained by statistically comparing performances on the two tests. Therefore, implicit and explicit samples were analyzed separately for mood and memory effects.

Resource Allocation Effects. These analyses were conducted first, because of earlier findings that sad mood at encoding can impair implicit memory performance and sad mood at retrieval can impair explicit memory performance. Findings such as these could potentially obscure other mood and memory effects. There were no significant differences in the total number of target items retrieved by subjects reporting sad as opposed to happy moods at encoding (see Figure 18) or retrieval (see Figure 19) (all ps > .5); thus, the idea that sad mood might impair encoding or retrieval processes due to allocation of cognitive resources to mood was not supported. The hypotheses that intense moods, whether happy or sad, might result in reduced recall due to allocation of cognitive resources to mood could not be examined because there was no neutral mood condition in this experiment.

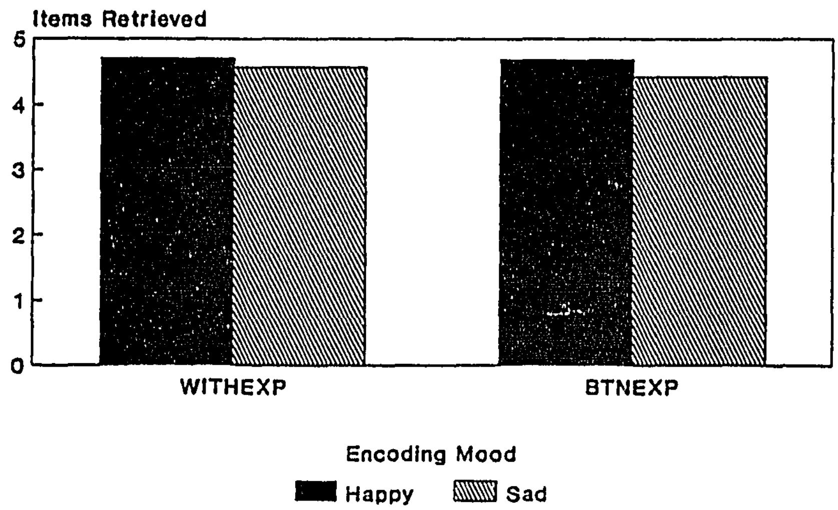
Figure 18.

Resource Allocation Effects
Encoding Mood



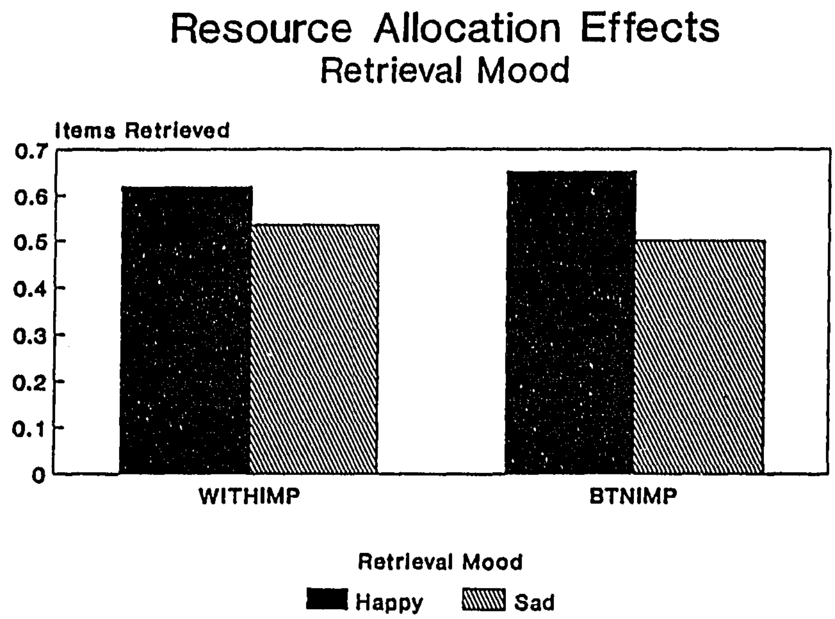
$p > .6$

Resource Allocation Effects
Encoding Mood

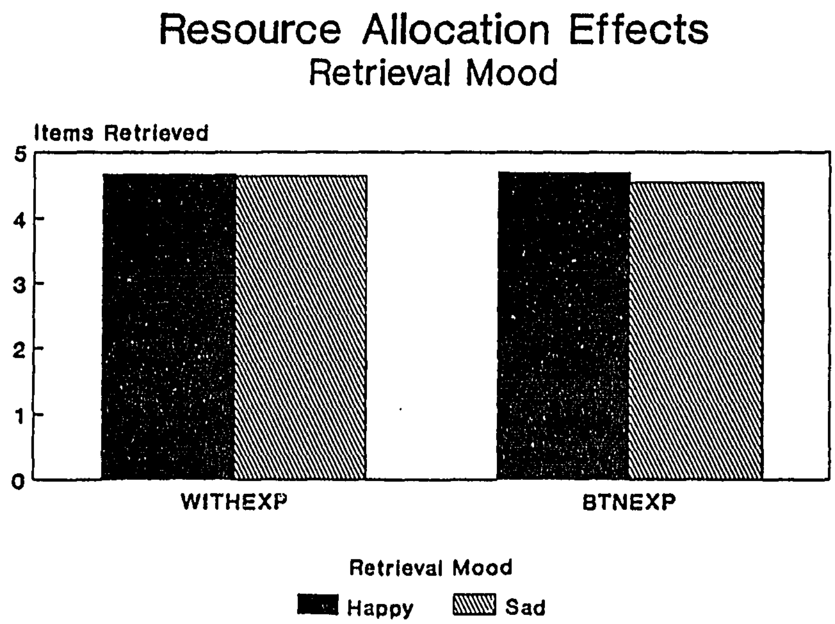


$p > .5$

Figure 19.



p › .3



p › .7

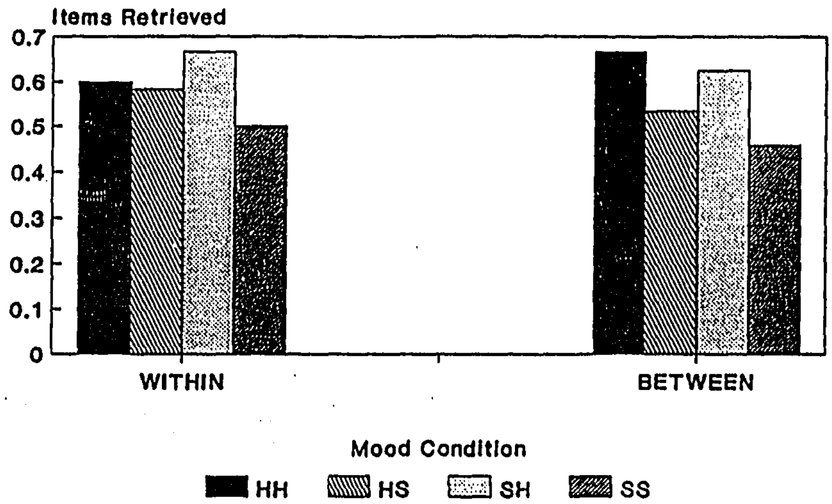
Mood-Dependent Memory. Mood-dependent memory was first examined by comparing the total number of target items retrieved in conditions where encoding and retrieval moods matched (same) to items retrieved in conditions where study-test moods did not match (different). There were no significant differences in either implicit (WITHIN or BTN) or explicit (WITHIN or BTN) samples (all ps $> .5$). Neutral items and shallowly encoded items were examined separately, since theoretically mood-dependency is most clearly revealed with neutral items and shallow encoding may result in degradation of potential competing cues. Again no significant effect of study-test mood match were seen in any of the samples (all ps $> .5$).

Since mood-dependency has sometimes been found to be asymmetrical, same and different moods were separated into four conditions; HH, HS, SH, SS. No mood-dependency effects were revealed when all items (see Figure 20), neutral items and shallowly encoded items were examined (all ps $> .5$).

Theoretically, mood-dependency is most likely to be revealed when the to-be-remembered stimuli are related to encoding mood in ways beyond mere temporal contiguity. In fact, an examination of affectively valent stimuli that were congruent to encoding mood revealed a strong trend toward mood-dependency in the implicit conditions (WITHIMP, $F(1,3) = 1.57$, $p < .2039$; BTNIMP, $F(1,3) = 2.00$, $p < .1175$, but not the explicit conditions (WITHEXP, $F(1,3) = .1$, $p < .9620$; BTNEXP, $F(1,3) = .11$, $p < .9525$ (see Figures 21 and 22). When the matched mood conditions (HH, SS) and compared to the unmatched conditions (HS, SH), MDM with related

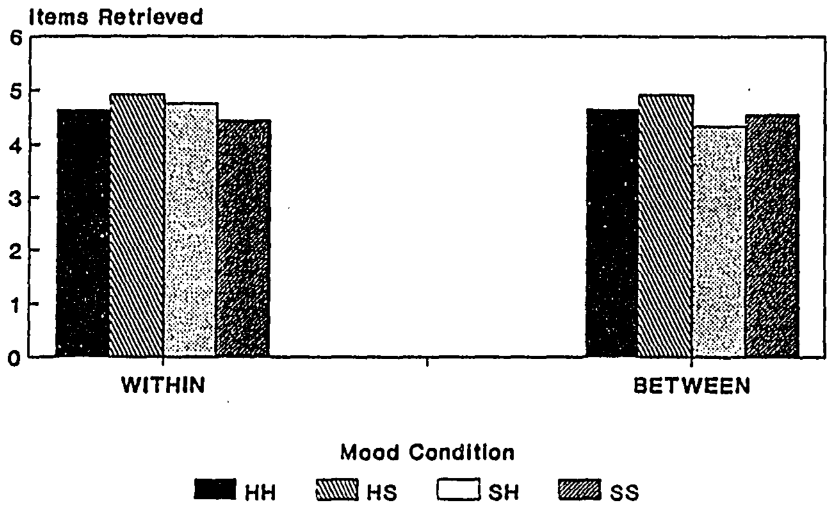
Figure 20.

Mood Dependent Memory
Implicit



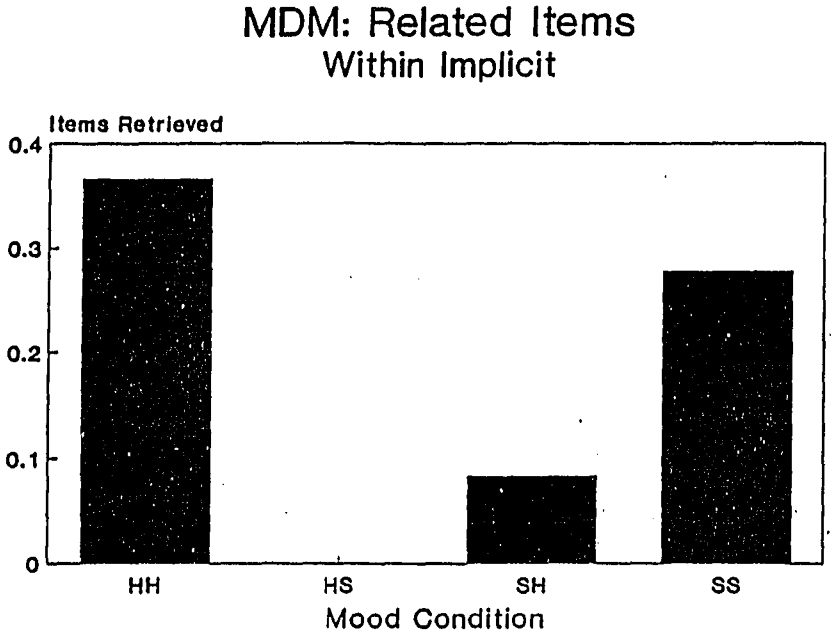
p › .9

Mood Dependent Memory
Explicit

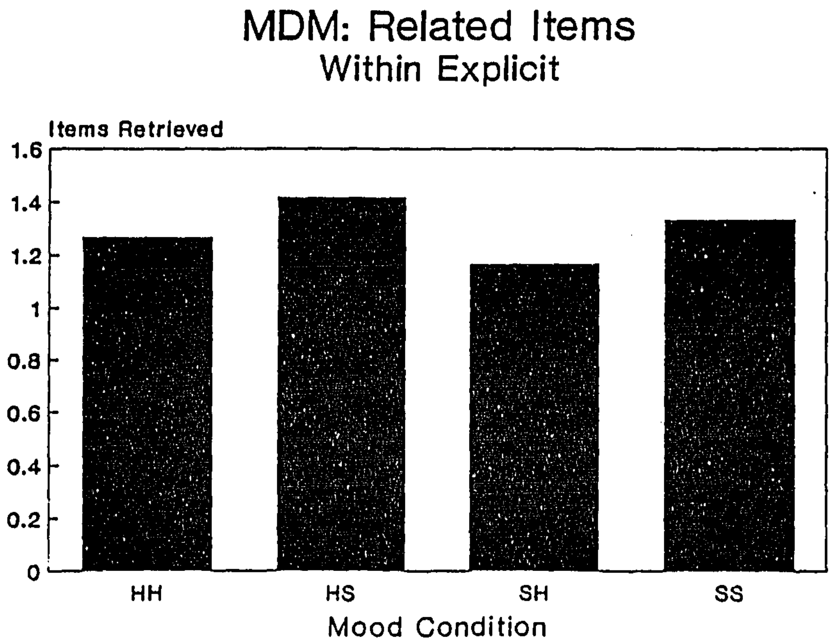


p › .9

Figure 21.



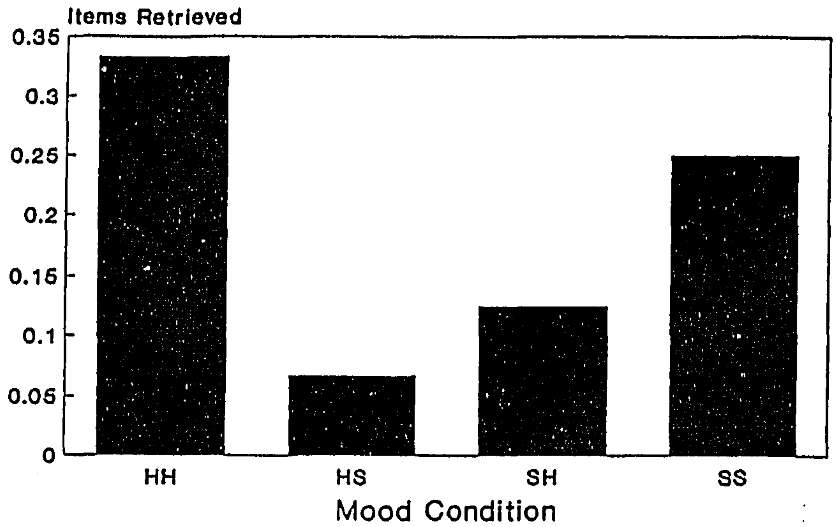
n.s.



n.s.

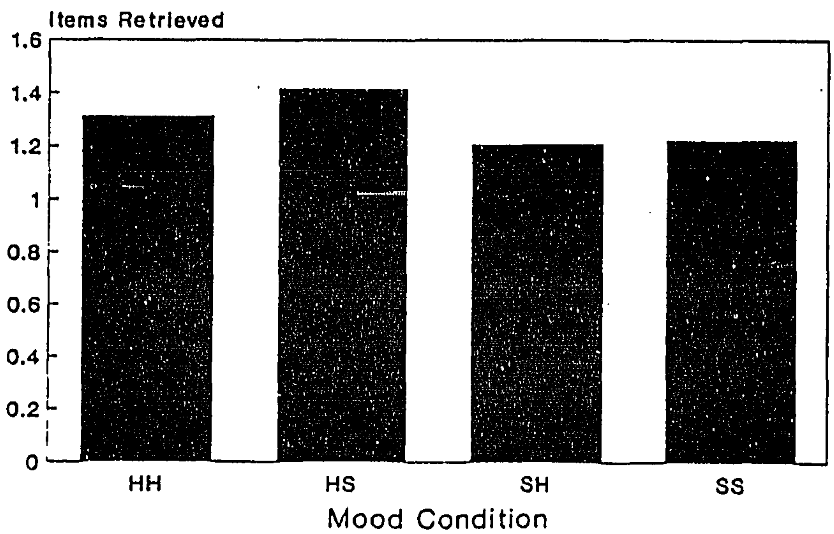
Figure 22.

MDM: Related Items
Between Implicit



n.s.

MDM: Related Items
Between Explicit



n.s.

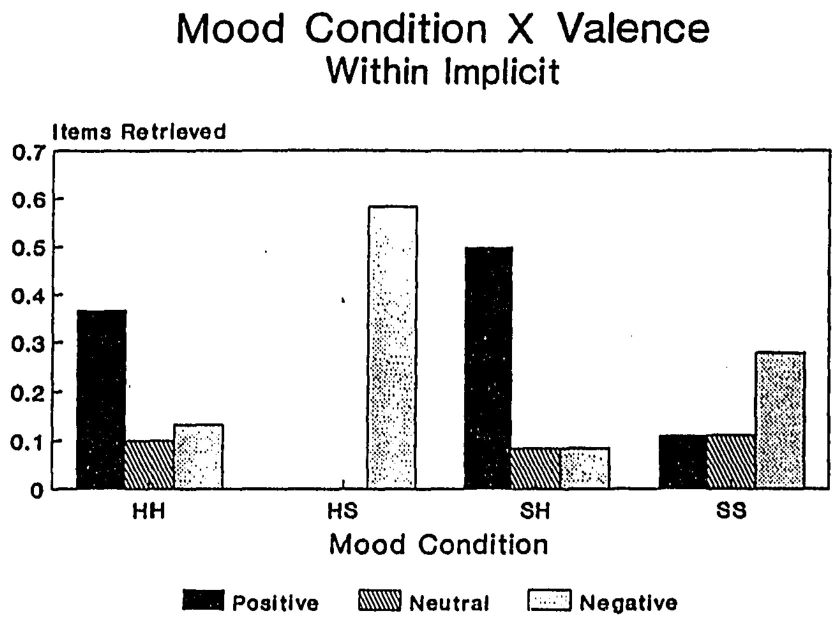
stimuli is significant in both implicit conditions (WITHIMP, $F(1,70) = 4.41$, $p < .0394$; BTNIMP, $F(1,118) = 5.45$, p , .0213).

Overall, the interaction between valence (positive, neutral and negative items) and mood condition (HH, HS, SH, SS) was highly significant in the implicit conditions (WITHIMP, $F(2,6) = 2.98$, $p < .0118$; BTNIMP, $F(2,6) = 2.58$, $p < .0192$, but not in the explicit conditions (WITHEXP, $F(2,6) = .25$, $p < .9538$; BTNEXP, $F(2,6) = .25$, $p < .9570$ (see Figures 23 and 24). Neutral items tended to be preferentially accessed in the explicit conditions; however, this was constant across the four mood conditions, as was recall of happy and sad items. However, in the implicit condition, an examination of the valence by mood interaction revealed what appeared to be mood congruent retrieval effects. In the HH and SH conditions, happy items were preferentially accessed, whereas, in the HS and SS conditions, sad items were preferentially accessed.

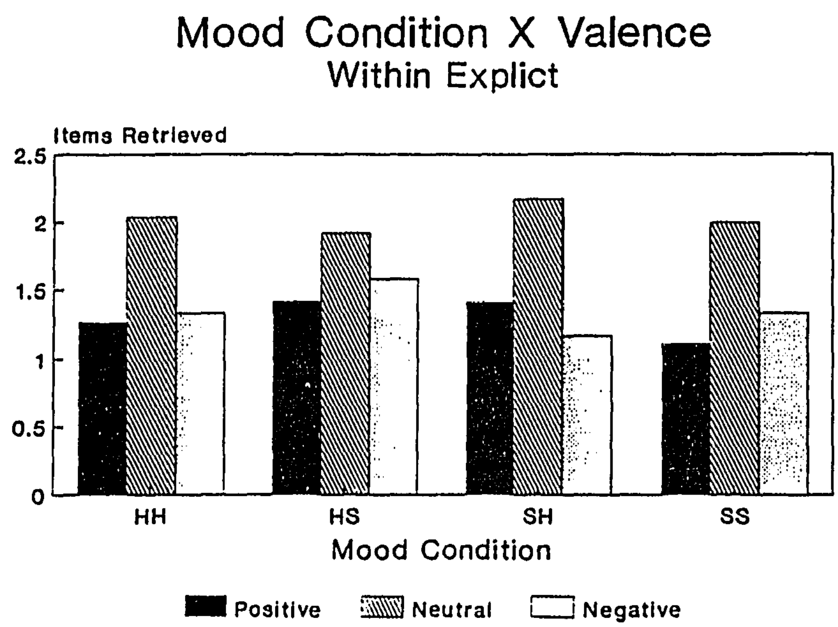
It is unclear whether these effects might be attributable to resource allocation effects whereby mood selectively impairs the encoding or retrieval of <u>un</u>related items or the formation of mood-stimulus links between unrelated items and mood which theoretically require more cognitive effort than congruent items their links with mood.

Mood-Congruent Memory. Subjects in happy retrieval moods generated significantly more happy items relative to neutral and negative items, and relative to subjects in sad retrieval moods in the

Figure 23.

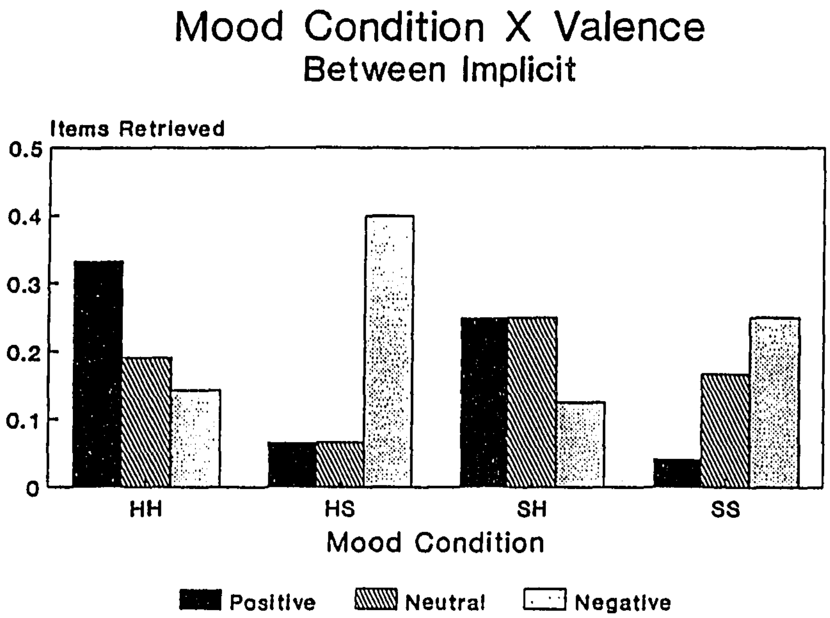


M X V p • .0118

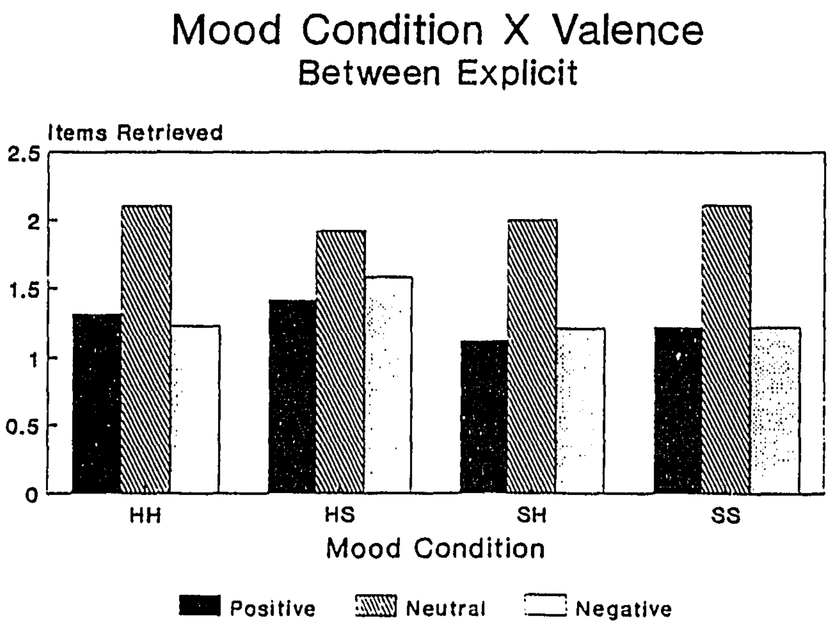


M X V n.s.

Figure 24.



M X V p • .0192

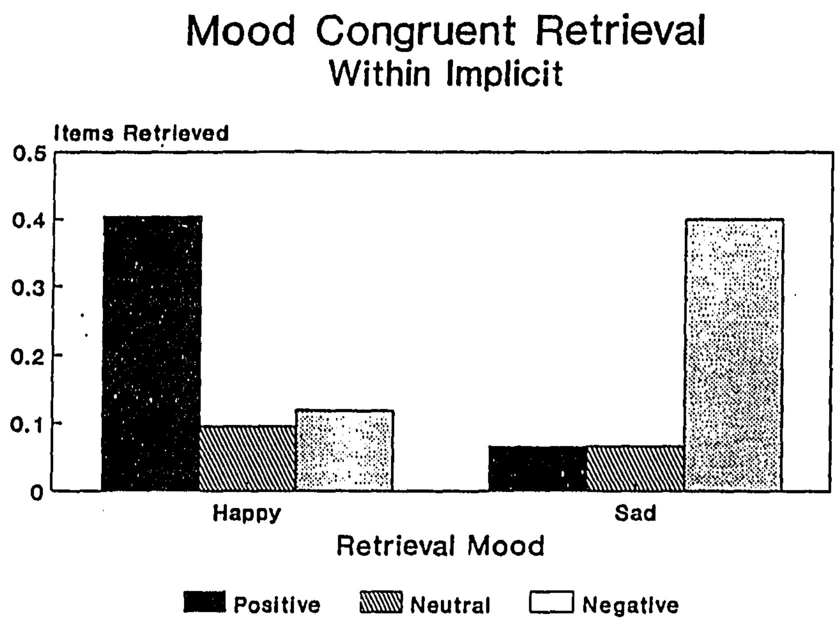


M X V n.s.

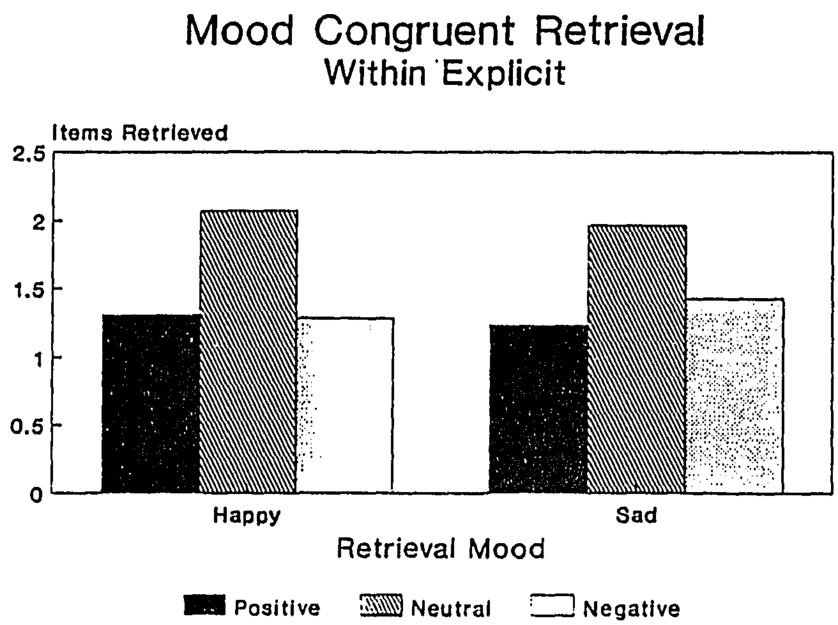
implicit conditions (WITHIMP, $F(2,2) = 6.78$, $p < .0021$; BTNIMP, $F(2,2) = 6.57$, $p < .0017$, but not in the explicit conditions (WITHEXP, $F(2,2) = .28$, $p < .7555$; BTNEXP, $F(2,2) = .15$, $p < .8504$ (See Figures 25 and 26).

No mood congruent encoding effects were seen as demonstrated by the failure of encoding mood to significantly interact with item valence in all conditions (all ps > .5) (see figure 27).

Figure 25.

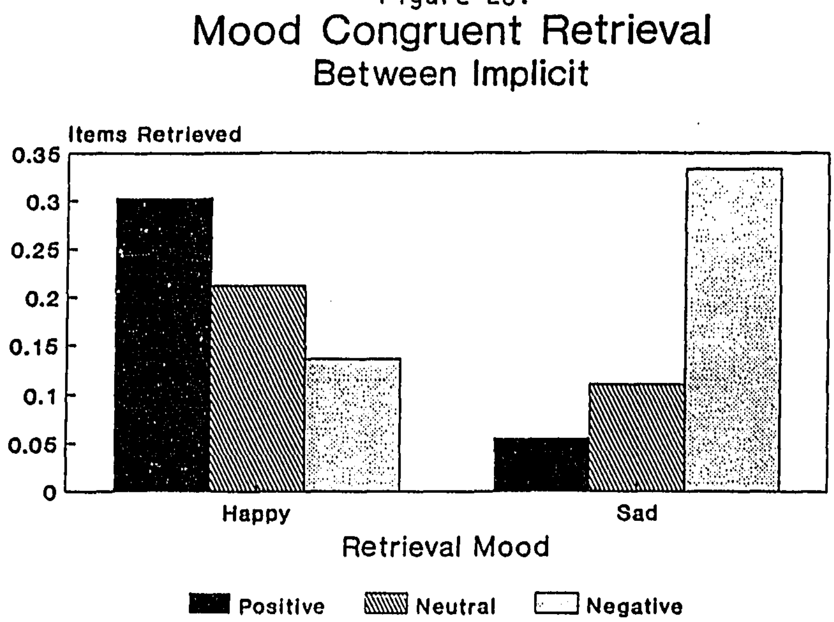


retmd x val, p = .0021

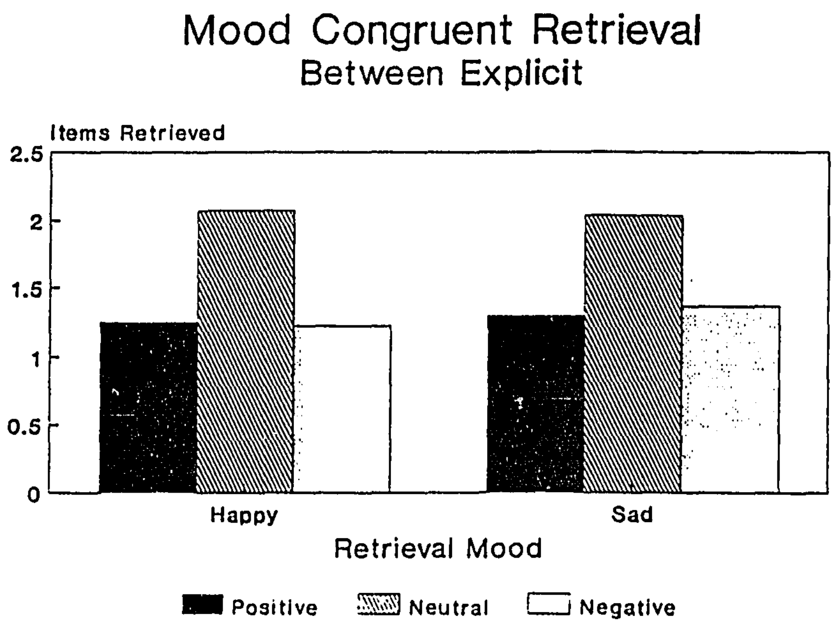


retmd x val, n.s.

Figure 26.



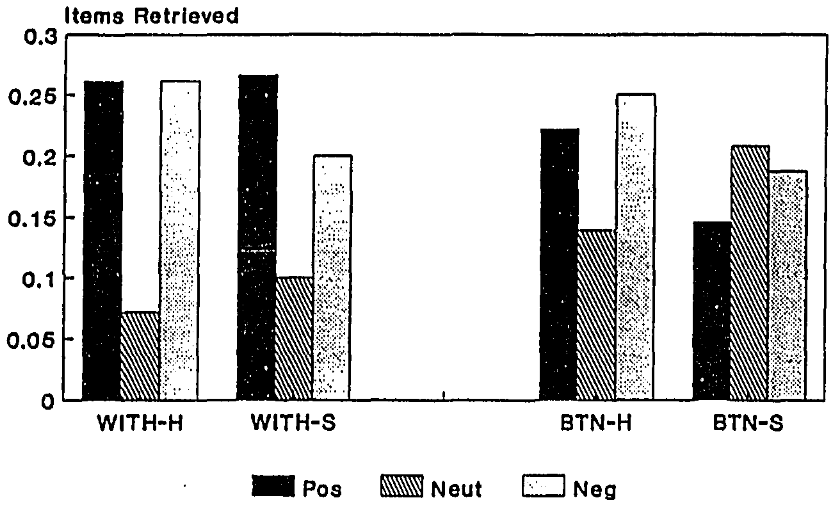
retmd x val, p = .0017



retmd x val, n.s.

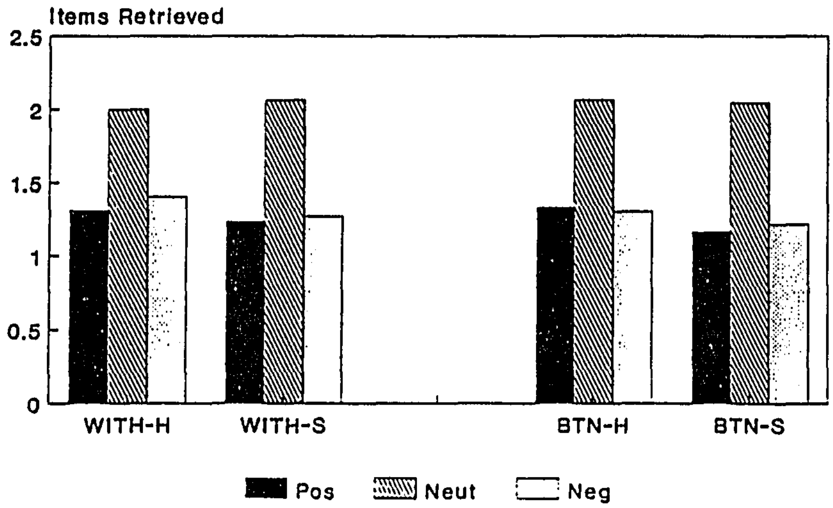
Figure 27.

Mood Congruent Encoding
Implicit



p › .5

Mood Congruent Encoding
Explicit



p › .8

CHAPTER 6

DISCUSSION

Summary of Findings

Subjects did not retrieve significantly more targets when study and test moods matched than when study and test moods did not match in either implicit or explicit memory conditions. Thus, MDM, as commonly measured was not observed. However, as noted earlier, MCM effects may obscure MDM effects because the link between mood and mood congruent stimuli is stronger than purely temporal links between mood and stimuli. Examination of neutral stimuli separately (particularly shallowly encoded neutral stimuli) or stimuli that has an additional link to encoding mood (e.g., mood congruent stimuli) provides a more unambiguous test of MDM.

No MDM was found when only neutral stimuli were analyzed and there was no interaction between shallowly and elaboratively encoded neutral stimuli. There was however, a trend towards MDM in the implicit conditions when stimuli congruent to encoding mood were examined separately which reached significance when matched and unmatched mood conditions were contrasted. This finding supports the notion that MDM is most likely to be seen when the stimuli has an additional semantic or episodic link to mood, over and above temporal contiguity, which enables mood to serve as a relatively strong cue for retrieval. MDM with related stimuli was not seen in the explicit condition. This suggests that potential competing cues can be generated in explicit conditions which will overpower even relatively strong mood-stimuli links when a particular spatiotemporal context for recall is specified.

Further examination of the data reveals that the apparent MDM effect with related stimuli does not in fact depend on the stimuli being congruent to encoding and retrieval moods. Rather, recall of related stimuli appears to depend on stimuli being related to retrieval mood, independent of encoding mood. No mood congruent encoding effects were seen.

Main effects of mood at encoding and retrieval for overall retrieval of target items were not significant (RA effects) in either implicit or explicit conditions; however, it is possible that resource allocation effects played a role in the congruency effects seen. Forging a link between mood and unrelated items might require relatively more cognitive resources than forging the link between mood and congruent material; thus, any diminution in resources available for encoding would have a greater impact on retrieval of incongruent items. If this is so, the effect was equal in sad and happy moods, supporting the idea that mood in general, as opposed to sad mood, consumes cognitive resources that would otherwise be devoted to encoding and retrieval processes. It is unclear whether a more general effect of both happy and sad mood might have resulted in diminished retrieval overall since this experiment did not include a neutral mood condition. Clearly retrieval levels in both implicit and explicit conditions were lower than those usually observed; however, it is unclear what would be "usual" for the implicit free recall analogue task.

These results are consistent with previous findings in some respects. Macaulay, Ryan and Eich (1991) recently reported on a series of experiments exploring mood-dependent memory using implicit memory tests. In the first two studies, they utilized stem completion and picture identification as the implicit test following encoding of neutral words or pictures. As in our preliminary study using stem completion, no mood-dependency effects were found. Some mood congruent retrieval effects have recently been observed using stem completion when pathologically anxious subjects were examined, e.g., Mathews et al. (1989) found that anxious subjects tend to retrieve a proportionately greater number of threat-related words on a stem completion task and Zeitlan and McNally (1991) recently reported that subjects suffering from combat-related PTSD exhibit a bias for combat related words on a stem completion task; however, other studies exploring context-dependent or resource allocation effects on stem completion demonstrate no such effects, e.g., Danion et al. (1991), found that depressed individuals were unimpaired on stem completion tasks, Graf (1988) had difficulty replicating environment-dependent effects on stem completion, particularly when a new association task was utilized, and Bowers & Schacter (1990) found no effects of new associations on stem completion in some of their conditions, particularly when subjects were "unaware."

Macaulay et al. (1991) suggested that neither the encoding or retrieval task utilized in their initial experiments facilitated the kind of internal processes that are needed to imbue the stimuli with mood and thus facilitate findings of mood-dependency. So, in a third experiment, subjects generated autobiographical experiences in response to neutral probes (e.g., trumpet). Memory for half of the neutral probes was tested with an implicit category generation task (e.g., write down the first six instruments you can think of) and memory for the remaining items was tested with a comparable explicit cued recall test where subjects were asked to recall neutral probes in response to a category cue. Mood-dependency effects were seen on both the implicit and explicit tests. It was suggested that mood effects are most likely to appear on tests that provide little constraint on the range of responses and do not depend on matches between the perceptual features of the nominal cue and response. This analysis is compatible with our notion that nominal cues must be minimized and the task must be conceptual in nature before mood effects will be seen. However, unlike our study, it appears that the valence of the memories did not effect overall retrieval. The crucial element was the match between encoding and retrieval mood and the fact that the memories tended to be emotional in nature.

Why did Macaulay et al. find mood-dependency when we did not? One possibility is that the levels of priming in our study were too low to detect MDM effects. Macaulay et al. (1991) employed a standard conceptual priming measure that shows relatively robust priming. In fact, we did find MDM in the current study when only related items, the stimuli most closely parallelling their stimuli, were examined. In addition, Macaulay et al. (1991) utilized a two-day delay which may have served to further degrade memory for the stimuli and enhance the power of mood as a cue, particularly in the explicit condition.

Their success with a standard conceptually-driven task suggests that it may be that it is the conceptual nature of the measure, rather than the strength of the nominal cue that is the crucial element in demonstrating MDM effects. In support of this notion, a recent study by Smith, Heath and Vela (199), demonstrated environment-dependent memory using a homophone biasing technique. This too can be thought of as a conceptually-driven task which could potentially be affected by context. Mathews, Richards & Eysenck (1989) found that anxious subjects tend to bias homophones towards threatening spellings (e.g., guilt vs. gilt, die vs. dye). Although this was not a memory test, except in so far as it taps semantic memory, it supports the idea that homophones can be affected by mood state. Clearly these effects need to be replicated and extended to the exploration of MDM, MCM and RA effects.

There are a number of methodological difficulties which may have contributed to negative findings of MDM, RA and MCE effects in both implicit and explicit conditions and no finding of MCR in the explicit condition, apart from the theoretical notions proposed as the basis of this investigation. In addition, a number of alternative explanations for the effects observed in the implicit condition can be offered.

Mood Manipulation

Great care was taken to include only those subjects who were actually experiencing happy or sad moods during encoding and retrieval tasks. Extensive pilot testing was done to evaluate mood induction procedures. An uninstructed mood induction was utilized to diminish demands to make false reports of being in a particular mood. Subjects were asked to engage in a task that was thought to encourage attention to mood (drawing). Only subjects actually reporting the appropriate moods were included in the analyses. Nevertheless, the moods induced were relatively mild and tended to dissipate during the experimental procedures. Sad mood was particular difficult to induce, particularly following a happy induction. As discussed previously, this may be attributable to the fact that subjects tended to be in positive moods prior to experimental procedures as indicated by an average baseline mood rating of 5.94. In addition, the coloring task, which was meant to engage subjects' attention and motivation was seen as fun by many subjects and may have made induction of sad moods more difficult.

As discussed earlier, MDM and MCM will only be seen to the extent that mood provides a relatively strong cue for retrieval of information that was either encoded in the same mood (temporally related) or is otherwise linked to mood state (congruent valence). If mood is weak and dissipates, it may not be a sufficiently potent cue for retrieval of material, particularly material that is only weakly linked to mood as in MDM with neutral or unrelated material, even if all other potentially overshadowing cues are eliminated, as in the implicit condition. This may contribute to the failure to find MDM despite findings of MCR and a trend towards MDM with related material in the implicit condition. The weakness of mood as a cue is even more problematical in explicit conditions where other, perhaps more powerful cues, can be intentionally generated and utilized to aid retrieval. This may account for the failure to find mood effects in explicit memory, even when the stimuli was strongly related to mood as in MCR and MDM with related stimuli. In addition, resource allocation effects are not likely to appear unless mood is strong enough to pull cognitive resources away from encoding and retrieval processes to mood. RA effects have generally been postulated to occur in sad moods which were particularly weak in the present study and dissipated quickly.

Another potential difficulty with laboratory induction of moods is that subjects may report moods they are not actually experiencing. An uninstructed mood induction was chosen to reduce the motivation of subjects wishing to comply with experimental demands to report moods they were not actually experiencing. However, an implicit demand remained in that subjects were asked to try to attend to the emotional tone of the music and were asked to rate their mood throughout the experiment. A great number of subjects did not report appropriate moods, suggesting that the demand characteristics were successfully minimized; however, this also suggests that the inductions were not very powerful. It is possible that a difference between those reporting appropriate moods and those not reporting appropriate moods was susceptibility to implicit demands to "get into" a particular mood state. To the extent that these reports did not actually reflect current mood state, one would not expect mood effects on memory.

One possible way to disentangle these effects would be to compare the results of subjects who reported happy or sad moods following the opposite mood induction as opposed to congruent mood inductions. The former subjects could certainly not be said to be reporting moods in response to demands to do so since the demand would be operating in the opposite direction. Unfortunately, with counterbalancing concerns and the fact that most subjects in sad moods actually received sad inductions, this analysis is not possible. The fact that some mood effects in implicit memory were observed suggests that subjects were genuinely experiencing reported moods, unfortunately, there are several possible alternative explanations for findings of MCR which will be discussed below. Objective measures of mood and or stronger induction techniques would alleviate some of these difficulties; unfortunately most objective measures are very unreliable. Eich and is colleagues measure affect on two dimensions, pleasantness and arousal. They have found that MDM effects tend to be stronger when subjects differ significantly on both dimensions and; therefore, require that they do so. This relatively stronger criteria for a successful mood induction may have contributed to their successful demonstrations of MDM.

Despite these potential difficulties, the fact that mood effects were found in implicit memory, particularly under conditions of mild mood states and under conditions where comparable effects were not observed in explicit memory, is of great interest. It may be somewhat fortuitous that conditions were such that no congruency effects were found in explicit memory, despite previous findings of MCR by other researchers, in that this provides support for our notion that implicit memory is more sensitive to mood effects. If MCR had been found in both implicit and explicit memory, no conclusions could be made regarding the relative sensitivity of implicit and explicit free recall in detecting mood effects.

It is possible, however, that the effects of mood and memory might be attributable to premorbid mood or stable individual differences as opposed to mood per se. Findings of significant differences in baseline mood ratings between groups of subjects who ended up in the mood conditions based on reports of actual moods, suggest that these subjects were in different moods prior to the mood induction. An analysis of differences in BDI scores between actual mood groups lends support to the idea that subjects who responded to the sad mood inductions were, as a group, somewhat more depressed than subjects who reported being in happy moods at encoding and retrieval (WITHIN: HH=6.15, HS=8.55, SH=6.78, SS=9.61 ($F(1,3)=1.43$, $p=.2414$)/ BTNIMP: HH=5.39, HS=8.54, SH=9.19, SS=8.79 ($F(1,3)=3.23$, $p=.0255$)/ BTNEXP: HH=6.09, HS=8.55, SH=8.1, SS=8.78 ($F(1,3)=1.45$, $p=.2335$). Unfortunately, interpretation of this is confounded by the fact that the BDI was given following experimental procedures so as not to effect the outcome of the experiment or interfere with mood inductions; thus, these findings may reflect the effect of exposure to mood induction or current mood state or mood effects on cognition (accessing of negative material) on BDI scores, as opposed to the effect of pre-experimental depression level on current mood state or susceptibility to induction. Arguing against current mood state as the source of this effect is the lack of differences in post-experimental mood ratings, since the BDI was given after mood had dissipated and the fact that subjects in the SS, SH and HS conditions are equally depressed relative to HH individuals in the BTN samples.

If mood effects are attributable to premorbid mood or stable individual differences or an interaction between mood induction and premorbid differences, the importance of the MCR findings is not diminished, the interpretation is merely changed. A finding that depressed individuals tend to preferentially access negative material implicitly, but not explicitly, relative to happy individuals conforms to theoretical notions confirmed in positive findings of MCR with autobiographical memories and depressed populations or cycling manic depressives. An interaction between premorbid depression and mood induction would support a vulnerability hypothesis. These findings suggest that depressed individuals, who are in depressed moods, do tend to access just those kinds of cognitions that would serve to maintain and increase their depression. In fact, this increased access to negative cognitions may be what was responsible for their response to mood inductions in the first place. On the positive side, the failure to find effects in explicit memory, indicates that, at least when depression or negative mood is mild, as in this case, individuals are able to intentionally access positive material that could counteract these moods and neutral material so that they can continue to function effectively in everyday situations that depend on ability to remember information.

It would be interesting to tease apart the effects of more stable depression/happiness versus induced mood state by comparing mood effects in four groups of subjects: those who reported being depressed but not in negative moods, those who were depressed and in negative moods, those who were happy but in negative moods and those who were happy and in happy moods. It is possible that the MCR effect observed is the result of biased cognitions in depressed individuals irrespective of mood state or combined depressed and in mood, but not, happy people in negative moods or depressed in happy moods and vice versa.

It is also possible that exposure to the mood induction procedures, irrespective of effect on mood, may have been responsible for the effect. Although the deception that our implicit test was testing subliminal perception of words presented during the induction seemed to effectively serve the purpose of making the implicit task appear reasonable and direct subjects away from the encoding episode, it also may have made subjects think that the "subliminal" words were related in some way to the tone of the music. They may also have believed that the mood ratings were tests of subliminal effects, and that the subliminal words were mood relevant. This hypothesis could be tested by examining the differences in mood effects between groups who received the mood induction and reported being in the mood and those who received the induction but did not report actually being in the mood.

If significant differences could be found in groups exposed to certain mood inductions, independent of mood, this hypothesis would be confirmed. Unfortunately, given counterbalancing demands, this cannot be easily analyzed.

Along these lines, it has been found that a great deal of verbal cognitive activity may occur during musical inductions. The pictures drawn by subjects, despite instructions to make abstract designs, tended to contain identifiable people and objects, suggesting what the subjects were thinking about during the induction. Even if the induction was unsuccessful in creating positive or negative moods, it may have primed positive or negative thoughts in subjects such that this verbal activity, rather than mood per se led to the mood congruent memory effect later seen in the implicit condition. Again, this would not necessarily diminish the importance of the finding but would alter the interpretation. The increase in negative or positive memories may be the result of the influence of prior cognitive rather than emotional activity or other context effects such as immediately preceding music or pictures.

An interesting recent study by Boltz, Schulkind and Kantra (1991) examined the effects of background music on the remembering of filmed events. They found that subjects recalled film scenes better when they were accompanied by congruent music, suggesting that mood congruent music might facilitate recall of congruent stimuli. No such music congruent encoding effects were observed in this experiment; however, they also found that, affectively congruent music later served as an effective cue for remembering the content of the scenes. This supports the idea that retrieval music, independent of mood, cued memory for congruent material. Perhaps most interesting was their finding that scenes were remembered best if affectively incongruent music foreshadowed the scene, i.e., incongruent music was played just prior to the scene. This most closely reflects the encoding situation in this experiment. This latter finding was construed in terms of schematic processing.

It has frequently been observed that information that violates a pre-existing schema will be remembered better, presumably because of the attentional activity devoted to such "surprising" or salient events (Loftus, 1972; Picek, Sherman & Shiffrin, 1975). A schematic processing theory might predict that subjects would recall information incongruent to encoding mood more readily than congruent information. Although there was no clear finding of mood-incongruent encoding effects, it is possible that schematic processing contributed to what appeared to be pronounced retrieval mood congruency effects in the HS and SH conditions.

Free Recall Analogue as Implicit Memory

One would like to conclude that the theory that mood effects would be seen more strongly in implicit memory was confirmed by the finding of MCR in the implicit but not explicit condition. However, it must be shown that the implicit free analogue actually measured implicit memory. Our findings of a significant target over baseline difference in the larger sample indicates that episodic memory was being tapped. The free recall analogue was chosen precisely because the level of retrieval was extremely low, due to the elimination of nominal cues for retrieval and, thus, unconstrained response format, in an effort to increase the relative power of mood as a cue and hopefully provide a more sensitive test of context effects. However, the fact that this target over baseline difference was somewhat smaller than in our initial study was puzzling and the unusually low level of priming (2.07% Targets/1% Baseline) may have precluded detection of mood effects on implicit memory.

One potential explanation for this reduced level of priming relative to pilot studies is that mood or context shifts reduced priming. The low level of explicit recall supports the idea that mood generally impaired memory. Although there were no significant differences between baselines in the various mood and valence conditions, they did fluctuate somewhat. For example, the baseline in the SS conditions was almost half as great as the baseline in the HS condition, thus an equal number of targets represents more memory in the SS condition, as would be predicted by MDM theories. Although a significantly greater number of targets were retrieved than baseline items, the target over baseline differences are not statistically significant in individual conditions because of the small number of subjects in each condition. Because of this, the data was analyzed comparing average number of targets retrieved as opposed to target/baseline differences. This assumes that fluctuations in target retrieval indicate greater or lesser degrees of priming. However, in some cases, it appears that there is <u>no</u> priming in certain mood conditions or for certain valences of stimuli in certain mood conditions, as opposed to relatively <u>less</u> priming. Unfortunately it would have been almost impossible for analyses of shallow vs. elaboratively encoded items, or neutral items alone, which in some cases represent the best tests of MDM and MCM to reach significance given the low level of priming and small sample size. This may have been a problem in the explicit condition as well where recall levels were quite low, particularly when targets were divided into valence and level of processing. Unfortunately because of the power problem, it is unclear whether these baseline fluctuations are meaningful or not. Clearly they were not statistically significant and no meaningful pattern emerges when the raw data is examined that might account for this fluctuation. On the other hand, the obstacles to finding significant results magnifies the meaningfulness of the MCR effect that was observed in the implicit condition.

Interestingly, a series of studies by Bowers and Schacter (1990) examining awareness and associative priming also found an absence of priming in both same and different context conditions among unaware subjects and an absence of priming in different context conditions in aware subjects using a standard stem completion paradigm. It appears that the level of priming is somewhat lower in our different-context conditions as well (although not statistically significant). Unfortunately, they were unable to account for this lack of priming but it is possible that changes in context depress even relatively robust priming.

It is possible that slightly different forms of the target words were generated and that a comparison of the total of similar words over baseline might have been greater than exact words over baseline, e.g., marry appeared when subjects studied merry, fortunate may have become unfortunate, particularly in negative moods, excited often appeared when exciting was the target. Unfortunately this was true of baseline words as well and since different forms were not taken into account when developing items as stimuli, this analysis can not be done post hoc, i.e, exciting would have been excluded as a stimulus if excited appeared a large number of times on baseline.

A closer examination of subjects' responses on the implicit task reveals what appears to be the effects of memory for a variety of episodes within the experiment itself and outside of the experiment, in addition to episodic memory for the study list. For example, subjects wrote down the sample items quite frequently. Words such as subliminal and rate also appeared with high frequency. Words reflecting the tone of the music or associations to the music were also common, i.e., the theme from Rocky was one of the selections and subjects often wrote down words related to the movie. It is likely that subjects would be able to identify the source of many of these words and; thus, they might represent explicit memory or involuntary implicit memory; however, it can be reasonably hypothesized that a large number of words reflected memories for a large variety of prior experiences or thoughts and; thus, that episodic memory was represented by subjects' responses to a far greater extent than reflected by target over baseline measures.

Despite the low levels of priming, it is clear that this free recall analogue measures episodic memory to some degree, but does it measure implicit memory? Implicit memory can at times be functionally dissociated from explicit memory. Certain variables that effect explicit memory, such as levels of processing, do not affect implicit memory, whereas, variables such as modality shifts affect implicit but not explicit memory. Unfortunately, these dissociations have most commonly been found on data-driven or perceptually-driven tests of implicit memory which rely on structural features of the stimuli to guide retrieval and do not depend on the meaning of the stimuli. It was hypothesized that mood effects would only be seen on conceptually-driven tasks since mood would appear to be related in a semantic connotative way to stimuli as opposed to affecting the physical characteristics of that stimuli. Thus we set out to develop a minimally cued conceptually-driven task. Unfortunately it is not clear from the literature that the same variables that dissociate data-driven tasks should functionally dissociate these types of tasks from comparable explicit memory tests. A number of researchers have demonstrated that variables that affect explicit memory tests affect conceptually-driven implicit tests in similar ways. For example, Rappold and Hashtroudi (1991) found that organization facilitates both explicit and implicit conceptually-driven tests. Blaxton (1984) found parallel effects between implicit and explicit conceptually-driven tests as well.

Although levels of processing did not appear to effect retrieval in the smaller, WITHIN sample, there was a significant effect of levels on the implicit test in the larger BTN sample. It was significantly smaller than the levels effect seen on the explicit test, which suggests that subjects were not simply using explicit strategies. In addition, the findings that mood affected the implicit but not explicit retrieval and that the patterns of retrieval were quite different between implicit and explicit tests lends support to the notion that subjects approached the two tests in different ways (e.g., total number of targets and valence main effects such as neutral items preferentially accessed in explicit but other items preferentially accessed, depending on mood, in implicit). However, it is possible that a portion of subjects did in fact use explicit strategies to some degree.

Subjects appeared to find the implicit test very difficult since there was no structure or guidance for what to write down. It took some subjects quite a long time to generate 50 items. Although they were told that they were being tested for subliminal perception of items presented during the music, they may have thought that the words rated earlier were somehow related. Even if they were not cognizant of how the task related to the study episode, they may have consciously thought back to it while trying to think of words and may have been conscious that they were writing down words that they saw previously.

Given the difficulty of the implicit test, explicit retrieval of words could have been perceived as an aid to performance. In subjects with intact explicit memory, this is often a complicating factor in dissociating implicit and explicit memory. If the implicit task can be performed more readily using explicit memory, performance in normals will be better relative to amnesic subjects who cannot use explicit memory (examples include studies exploring preferences (Johnson, Kim & Risse, 1985, mirror reading, PI of novel words (Haist, Musen and Squire, 1992). This is why small levels effects are often seen in subjects with some awareness regarding the connection between encoding and implicit retrieval (Bowers & Schacter, 1990). When unaware subjects are examined this effect often disappears.

A post-experimental questionnaire (See Appendix A) was given to try to get at the issue of awareness. A series of questions were presented modeled after Bowers and Schacter's (1990) awareness criteria. In fact, a substantial portion of subjects indicated that they did think back to the encoding episode during retrieval (51/118 in BTN group) and a large number also reported that they specifically tried to generate items from the encoding episode (33/118 in BTN group). Unfortunately, the results of this questionnaire are somewhat ambiguous in that a number of subjects indicated that their "yes" responses related to the explicit condition (e.g., they thought back and deliberately generated when asked to). An attempt was made to clarify this ambiguity but it is unclear how successful we were. In addition, a large number of subjects who said they purposefully generated items from the study list also said they never consciously thought back to that episode (11/33), which poses a logical dilemma. Regardless of "yes" responses to these two questions, a vast majority claimed that they had in fact written down the first words that came to mind. Unfortunately, due to counterbalancing problems, it is not possible to statistically compare total targets/baseline and vivid/structure of aware and unaware subjects. An analysis performed without counterbalancing indicated less priming among unaware subjects, but oddly, in the WITHIN sample, the subjects who said they deliberately tried to generate items from the study list wrote down more shallowly than elaboratively encoded items, whereas the subjects who did not try to generate study items wrote down more elaboratively encoded items. None of these interactions reached significance. It must be concluded that at least some subjects used explicit strategies to generate some items on the implicit tasks which may have resulted in the observed levels of processing effect.

Another approach to the question of whether the free recall analogue measured implicit memory is to see whether performances on the implicit and explicit test are independent. In the WITHIN sample, 44.44% of the words retrieved in the implicit condition were also retrieved in the explicit condition. This represents the joint probability of an item being retrieved on both tests. The simple probability of an item being retrieved in the implicit condition is 2.07%. In the explicit condition it is 32.1%; thus, the product of the simple probabilities (32.1%) is lower than the joint probability, indicating that the two tasks are not completely independent. Another way of evaluating independence is to examine whether the probability of an implicitly retrieved item being recalled is different from the probability of an item that was not implicitly retrieved being recalled.

In this case the former probability is 44.44% while the latter probability is 14%, clearly a significant difference. Of course, this does not mean that the performance on the implicit test was affected by explicit memory. It may have been that the explicit performance was affected by the prior implicit memory performance, e.g., subjects may have been reminded of study items by their implicit performance.

Interestingly, subjects tended to write down items during the explicit test that they had written down during the implicit test when filling in the blanks remaining after they could think of no more items from the study list. They may have unknowingly written down study items in some cases; thus, implicit retrieval on the explicit test may have occurred, creating dependence. It is also possible that some of the same factors directing implicit retrieval also affected explicit retrieval (e.g., mood), but that additional strategies were available during explicit retrieval as well, resulting in the higher level of recall.

It remains a possibility that the memory effect seen on the implicit test was largely attributable to explicit memory, even if it was not explicit in the sense that subjects purposefully tried to generate items from the study list. They may have written down items that they consciously knew had been on the study list when trying to generate words. Nevertheless, it is clear that different variables guided explicit retrieval in the two conditions given the very different patterns of retrieval. It is possible that traditional intentional strategies focussing on retrieval from a specific spatiotemporal context guided retrieval in the explicit condition, whereas, there was no concerted effort to generate items from a specific episode on the implicit tasks, but rather, subjects picked and choose from a number of episodes, one of which just happened to be the study episode. As discussed above, a perusal of subjects' responses suggests that many items reflected various types of episodes.

This type of explicit memory may actually be akin to the memory seen in autobiographical memory paradigms. In these studies, subjects are not constrained to a particular episode in their recall, rather they are asked to generate the first memories that come to mind from a lifetime of episodes. In this case, mood can exert more of an influence because there is no motivation to remember a particular episode and; thus, no reason to believe subjects will generate cues to retrieve particular episodes. The autobiographical paradigms have provided the strongest evidence of mood congruent retrieval (and MDM if one considers that the events were most likely encoded in matching moods). In these studies, there is no evidence that subjects can not recall mood incongruent episodes if asked to, rather, they the studies show that they tend to recall congruent episodes when no constraints are provided, presumably because their mood activates these episodes or makes them more readily available. The current study may simply represent a less constrained version of autobiographical memory tests in that subjects can write down material from personal memories, semantic memory, thoughts, etc., with the added advantage of experimental control over one learning episode. Macaulay et al. (1991) also capitalized on the potential for mood to guide retrieval of autobiographical memory by using personally generated memories as stimuli in their studies that demonstrated MDM.

Significance of Findings

Clinical. Given the low level of retrieval in the implicit condition one might ask whether a statistically significant finding is in fact meaningful. The idea of mood effects on memory arose from anecdotal observations that people in negative moods tend to preferentially access negative cognitions. To the extent that these cognitions represent episodic memories, they tend to be encoded in like moods. In everyday life, individuals are unconstrained in the spatiotemporal context of the episodes from which they retrieve material. There are hundreds of thousands of potential episodes from which they can choose in generating ongoing thought, which might include events, conversations and even previous thoughts. As noted above, a perusal of subjects' responses on the implicit test suggests that they drew on a number of previous episodes in generating their responses. The fact that the very small experimental episode was reflected in their retrieval would be quite astonishing given the lack of constraint imposed on subjects' generation of items were it not for the temporal contiguity of the episode and apparent links to retrieval in the minds of some subjects, i.e., it is natural to look to recent events when attempting to generate strategies for performance (Tversky and Kahneman, 1973). Again, whether these effects are implicit or explicit is not clear, but the implicit condition seems to parallel everyday experience to a greater extent than the explicit condition. If one could multiply these very small effects over numerous encoding and retrieval episodes that make up cognition and experience the impact of a tendency towards generating material congruent to current mood could indeed be significant. The fact that retrieval of congruent items from a single brief episode reached statistically significance would appear to be very significant given the obstacles to finding such an effect.

Cognitive. What does this experiment tell us about memory? There are a number of theoretical accounts of implicit and explicit memory dissociations. Most prominent are multiple memory system and processing accounts. Both of these accounts rely on findings that implicit and explicit memory can be functionally dissociated. Multiple memory system proponents account for these dissociations by postulating separate memory systems that may have separate anatomical substrates, whereas, processing theory proponents argue that these dissociations can be explained by differences in processing generally required by the two forms of memory. Explicit memory tends to be conceptually driven and implicit memory tends to be perceptually driven. When the conceptual or perceptual nature of the task is held constant the dissociations between implicit and explicit memory tend to disappear. However, multiple memory system accounts also rely on findings that amnesics show intact implicit memory on both perceptually-driven and data-driven tasks which processing accounts cannot adequately address at this time.

This study provides another way that implicit and explicit memory can be functionally dissociated. Mood effects were seen using conceptually driven implicit tasks but not perceptually driven implicit tasks or conceptually driven explicit tasks. Multiple memory system theories suggest that implicit memory can be subdivided into at least two systems, one of which handles perceptual material and the other conceptual material. The fact that conceptually driven implicit and explicit tests are dissociated provides argues against a straightforward processing account; however, it has been argued that this difference is based on the cue environment present at time of retrieval and the extent to which study and test cues overlap. This is a processing account, albeit somewhat different than that which is traditionally proposed. In fact, mood effects have been found from time to time with explicit memory tests and stem completion (e.g., with pathologically anxious subjects), suggesting that the relative strength of the mood state and associative link with the stimuli as well as the surrounding cue environment are the critical elements, not whether the task is implicit or explicit. Implicit tasks simply promote the utilization of context cues, whereas, explicit tests promote the generation of other potentially overpowering cues including those related to the spatiotemporal context of the study episode. Data on amnesic subjects would be useful in elucidating whether utilization of spatiotemporal cues in explicit memory which override mood effects is possible in amnesia and whether amnesics can form the associations between mood state and stimuli that are necessary for these mood effects to occur.

Proponents of some multiple memory system accounts (episodic vs. semantic) suggest that priming can be accounted for by activation of pre-existing concepts stored in semantic memory, whereas, processing theories require the postulation that implicit memory reflects new memory traces. Positive findings of MDM with neutral stimuli would suggest that new associations can be made in implicit memory (i.e., the temporal association between mood and unrelated stimuli). We did not find MDM with neutral material and no study to date exploring MDM with implicit measures has found it with unrelated material. It appears that a pre-existing relationship between mood and stimuli is necessary. On the other hand, it may be that the mood-stimuli relationship can be forged given stronger mood states and active elaboration of mood with respect to the unrelated material. This link may not occur automatically as has been previously suggested. Along these lines, Graf & Schacter (1985) and Schacter & Graf (1986) did find that normal and amnesic subjects can demonstrate memory for new associations on implicit memory tests. Positive findings of environment-dependent memory using stimuli unrelated to the environment also suggest that these links can be made with elaboration (Graf, 1988), and in some cases, may be made automatically (Smith, Heath & Vela, 1990). It is possible that failures to find the effects of weak associations in implicit memory may be the result of the specific task being employed. Since these links are quite weak, it is important that the implicit task not provide strong cues for retrieval of competing information in order for these effects to be seen. Johnson, Kim & Risse (1985) and Tranel & Damasio (1989) demonstrated that amnesics can form new associations between faces and valent biographical information or actions which persist over long periods of time. While somewhat different than traditional mood and memory effects, these studies demonstrate that a mood context can be associated with previously unrelated material in amnesics and that implicit memory is based on the lying down of new traces.

Future Directions

Inducing mood is a very precarious enterprise and despite having strong theoretical reasons for employing a free recall analogue of implicit memory, this procedure is very risky given the possibility of basement effects and lack of power. Therefore, use of the current experimental paradigm in exploring mood and memory issues is cautioned against. However, the interrelations between emotion and cognition remain theoretically and practically important topics of research. Fortunately, there are a number of other possible ways to explore the effects of emotion on memory. This study addressed the issue of whether mood affects implicit memory; however, an equally important and unexplored issue is whether implicit memory affects mood. These two questions are clearly related in that the primary interest (from a clinical perspective) in mood affects on memory for valent material or material encoded and retrieved in matching mood states (which is usually valent) is that biases in recall can increase or decrease ongoing mood state. There is a small body of anecdotal and experimental literature on the effects of implicit memory for emotional material on mood state

(Tobias, Kihlstrom, & Schacter, 1992). This literature suggests that individuals experience implicit memory for emotional material (sometimes provoked by current mood state) which can lead to anxiety, depression and dissociative phenomena. These emotional state can, in turn, be considered the measure of implicit memory for that material. Very little empirical work has been done exploring questions such as; is emotional material retrieved more readily than neutral material in implicit memory? Is emotional material retrieved more readily in implicit than explicit memory? Given that amnesics have greatly impaired explicit, but preserved implicit memory, how would implicit memory for emotional material impact their emotional functioning, particularly if they are unable to explicitly recruit countervailing memories? Are preferences and previously acquired emotional reactions preserved following onset of amnesia? To what extent can new ones be acquired? How will they differ from nonamnesics acquired emotional responses? Given the dearth of information on emotional functioning in amnesics and other memory disordered patients, this line of research could be critical in truly understanding emotional functioning in these patients and might in turn shed light on normal/pathological emotional functioning.

APPENDIX A

FOOTNOTE

Footnote 1. More complex, multi-dimensional mood rating scales have been developed and used (MACL, DACL, PANAS) for various reasons, e.g., positive and negative moods may have different aspects (e.g, anger vs. depression, excitement vs. peacefulness). For the purposes of MDM, qualitative features of a particular mood are irrelevant, to the extent that a purely temporal link is postulated, as long as the same positive or negative mood is reinstated in the congruent condition. Instead of determining the exact nature of the mood, this experiment relies on uniform administration of mood inductions that are meant to induce sadness and happiness and a range of mood-related stimuli to allow for findings of mood congruency along a range of mood. A fundamental problem with going to more complex mood ratings is the possibility that the words anchoring the scales will intrude on the memory tasks, where 2/3 of the stimuli consist of similar mood-related adjectives. Simple bipolar scales have been successfully utilized in a number of mood and memory experiments and there is no good evidence to support the use of more complex measures. Unfortunately, no clear objective measure exists, and even if it did, it has been argued that physiological, cognitive and behavioral dimensions of mood are independent. This experiment is primarily interested in how subjectively reported mood impacts on cognition and it is unclear how a multi-dimensional scale would enhance the analyses.

APPENDIX B

WORD LISTS

Happy:	Pleasantness Ratings	Frequency	Word Length
ENTHUSIASTIC	8.03	24	12
EAGER	7.27	27	05
LIVELY	8.04	22	06
ELATED	7.16	03	06
TRIUMPHANT	8.12	05	10
CLEVER	6.84	17	06
INTELLIGENT	8.36	26	11
OPTIMISTIC	7.50	15	10
FORTUNATE	8.18	22	09
PEACEFUL	8.64	26	08
MERRY	7.64	08	05
CONFIDENT	8.07	17	09
ENTERTAINING	8.18	04	12
EXCITING	8.61	27	08
HEALTHY	8.85	33	07
Sad:			
MISERABLE	2.00	13	09
FOOLISH	3.77	16	07
PATHETIC	3.20	08	08
IMMATURE	2.76	07	08
USELESS	2.24	17	07
LONELY	2.12	25	06
INEPT	2.76	02	05
GLOOMY	2.44	03	06
STUPID	1.76	24	06
LOUSY	1.30	13	05
HELPLESS	1.95	21	08
INFERIOR	2.32	07	08
UNEASY	2.11	22	06
DISGUSTING	2.11	04	10
WEAK	2.36	32	04
Neutral:			
A CLOCK	5.08	20	05
A BATTERY	4.89	19	07
A COUCH	5.96	13	05
A SANDWICH	6.20	13	08
A BLANKET	5.96	19	07
A CANDLE	6.20	18	06
A BASKET	5.92	17	06
A CARPET	5.52	13	06
A REFRIGERATOR	6.36	23	12

A LAMP	5.93	18	04
AN ANTENNA	4.71	13	07
A MAGAZINE	5.96	39	08
A STOVE	5.32	15	05
A BANANA	6.71	05	06
A COOLER	6.18	05	06

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