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ABSTRACT

This study examined the influence of experimentally induced mood change on the learning and recall of a list of pleasant and unpleasant daily events in young (18-35 years) and old (58-75 years) women. Mild mood changes were induced by having 166 subjects read emotionally descriptive accounts of tragic or uplifting life experiences. For half the subjects, the mood induction was presented before they learned a list describing 15 pleasant and 15 unpleasant daily events. For the remaining subjects, the mood induction occurred before they recalled the list. Baseline memory performance was assessed by having all subjects learn and recall one list in a neutral mood. Two dependent variables were used to look at mood induced changes in level (Total recall) and content (Affective Bias = Pleasant Events - Unpleasant events) of memory recall. Only the 128 subjects who met prespecified criteria for mood change were used in these analyses.

Compared to performance in the neutral mood condition, significant mood content effects were observed only for negative moods induced at time of recall. Equivalent changes in affective bias were found across age groups, however, were due to increased recall of mood congruent memory items for the young, and decreased recall of mood incongruent memory items for the old. This mood content effect contributed to an overall decrease in total recall for old participants that was not found for young subjects. Because significant group differences in baseline memory performance were found between and within age groups, analysis of covariance was employed, using baseline memory performance as a covariate. No differences in the pattern of significant effects were found. Similarly, the use of pre-experimental mood, verbal ability, and affective response to the memory stimuli as covariates did not change the results, suggesting observed age differences in mood-induced memory change could not be attributed to these factors.

These findings suggest that the locus of mood congruent memory selectivity occurs at time of retrieval. Mood-related memory cuing appears to be equally effective for young and old. The observed qualitative age differences in mood congruent memory were the reverse of the predicted pattern, however, it was

suggested that more effective use of mood control strategies by the older women could have produced these effects. Results also suggest that the elderly may be more sensitive to the disruptive effects of negative mood on memory processing.

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Table of Contents

Table of Contents (cont.)

List of Tables

List of Figures

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Chapter One

Introduction

Over the past decade, a growing body of research has examined the nature of the relationship between affective mood states and memory performance. Results of this research suggest that mood variability may be an important contributor to state-like fluctuations in memory performance, influencing both the overall efficiency of memory processing and the content of what is recalled. For the most part, this research has been conducted with young adult age groups and has been non-developmental in focus. Although there have been some attempts to examine the contribution of mood states such as depression and anxiety, to age-related differences in memory performance, progress in understanding the interaction of mood and memory across the adult years has been limited.

Most empirical research in the cognitive aging literature has focused on the extent to which negative mood states predict inter-and intra-age group variability in overall memory performance. This research strategy is based on an assumption that the influence of (negative) mood on memory performance is to disrupt overall performance. This assumption forms the basis of several related models of the relationship between mood and memory, in which mood functions to reduce overall information processing efficiency (e.g., Leight & Ellis, 1981; Johnson & Magaro, 1987; Weingartner & Silberman, 1982). Based on this theoretical framework, the corollary development prediction has been that negative mood states may be a factor contributing to impaired memory performance in older age groups, because negative mood states either are more disruptive or more prevalent in this age group.

Comparisons of mood and memory relationships across young and old age groups have not found consistent evidence of age differences in the effect of mood on memory (e.g, Cavanaugh & Murphy, 1986; Raskin, Friedman, & DiMascio, 1985). Within older age groups, relationships have generally been small and most often nonsignificant (e.g., Kahn, Zarit, Hilbert, & Niederehe, 1975; Williams, Little, Scates, & Blockman, 1987). This pattern of results suggests that mood does not account for much of the variance in memory performance across or within adult age groups, and has led some researchers to conclude that the influence of mood on the memory performance of older adults is at best indirect and mediated through other factors

(Cavanaugh & Murphy, 1986; Lachman, Steinberg, & Trotter, 1987). However, by examining only global memory deficits associated with negative mood states, cogniuve aging researchers have adopted a restricted conceptualization of the influence of mood on memory. In particular, they have ignored content specific affective processing, which has been found to be associated with positive and negative mood states in young age groups (e.g., Bower, 1981).

Content specific affective processing, or the mood congruity effect, refers to the finding of selective learning or recall of information emotionally congruent with the individual's mood at time of learning or recall. Demonstrations of mood congruent memory suggest that the influence of mood may be evident in the organization and type of stimulus attributes attended to and remembered as well as in overall performance scores. Furthermore, the influence of mood may also be memory enhancing rather than primarily disruptive as predicted by processing efficiency models.

In contrast to aging research based on processing efficiency models of mood and memory interaction, there has been almost no empirical work examining content specific affective processing beyond early adulthood. The objective of most of the available research, because it is based on a processing efficiency model, has been to explain quantitative differences in memory performance. Examination of content specific affective processing across adulthood, on the other hand, may provide a useful paradigm for studying selective aspects of memory behavior and qualitative changes in memory performance in later adulthood. A more complete examination of mood and memory interactions across adulthood may lead to a more complete understanding of age-related change in memory performance.

Chapter Two

Review of the Literature

This chapter reviews recent theoretical and empirical work examining the influence of mood on memory performance. Current interest in the influence of mood on memory is part of a broader exploration of the relationship between cognition and personality. The major concepts and guiding theoretical framework for studying this relationship are reviewed in the first section of this chapter as they apply to the study of mood and memory interaction. Recent research findings defining the nature of the influence of mood on memory and the mechanisms by which these effects occur are reviewed in the second and third sections. Finally, the fourth section reviews the literature on mood and memory interaction in later adulthood.

Theoretical Underpinnings

Although cognition and personality have always been viewed as interrelated elements in a holistic psychology of human experience and behaviour, actual research practise has traditionally focused on the study of isolated component processes by separate subdisciplines of psychology. Lacking common concepts, theoretical frameworks, and empirical methods that would allow analysis of interrelationships, acknowledgement of the importance of other components was most often a prelude to assiduous attempts to control or exclude their influence. The recent flourishing of empirical work examining the interaction of personality and cognition has been made possible because both subdisciplines have accepted a common world view and theoretical framework for conceptualizing psychological phenomena (Isen & Hastorf, 1982; Kihlstrom, 1981; Lazarus, Coyne, & Folkman, 1984; Mischel, 1981)

Theories of personality and cognition, as other scientific theories, are based on and influenced by world views. World views are metaphorical representations of the nature of phenomena that establish an overarching framework within which theories are constructed. Componential approaches to the study of personality and cognition were, for the most part, founded on a mechanistic world view in which it was assumed that psychological reality could be understood by breaking it into

mutually exclusive constituent parts. In recent years, attempts to reintegrate human behaviour and subdisciplines of psychology have underscored the limitations of this approach and provided momentum for increased prominence of psychological theories implicitly or explicitly based on contextual world views.

In contrast to the mechanistic metamodel with its emphasis on reductionism and linear causality, the basic assumption of contextualism is that of dynamic change arising from the interrelationship of multiple levels and multiple systems of influence. Therefore, in contextual models, psychological phenomena are defined in terms of relationships between components and systems. Interrelationships are conceptualized as transactional or bidirectional, and, thus, both define and change the nature of the phenomena (e.g., Lerner, Hultsch, & Dixon, 1983; Sarbin, 1977).

The contextual metamodel promotes a perspective in which interrelationships form the central focus of psychological description and explanation, thus providing the metatheoretical paradigm for reintegrating cognition and personality. The acceptance of the information processing framework in both cognitive and personality psychology has also been a critical component of the current zeitgeist by providing a level of analysis for defining processes in one domain that makes them translatable and interactive with processes in another domain (Kuhl, 1986). The dominant conceptual framework in cognitive psychology since the 1960s, and adopted by personality psychologists in the 1980s, the information processing approach describes mental activity as a sequence of mental processes that operate to transform environmental input into behavioral output. Within this framework, memory is conceptualized as the encoding, storage, and retrieval of information, regulated by executive metamemorial processes. The contextual emphasis is evident in the emphasis on memory as a multidimensional process, influenced by many individual and situational variables.

One important line of research that has emanated from this perspective has been examination of individual differences in learner characteristics as mediators of individual differences in memory performance. Many potentially influential learner characteristics have been examined, including factors associated with relatively stable and enduring characteristics of the individual (e.g., personality trends, intellectual

ability), as well as dimensions associated with short term change or variability (e.g., health status, emotional states). Although research on the effect of state variables on memory performance has, for the most part, been pursued from an individual difference perspective, evidence for their influence implies that memory may also have state-like properties. This is consistent with the contextual principle of dynamic change, but challenges the traditional view of memory as a relatively stable and enduring quality of the individual.

In everyday life, mood variability is likely to be one important antecedent of intraindividual change in memory performance. Clark and Isen (1982) have argued that,

> ...feelings have important effects in cognition and behaviour, and we would argue that, because these states occur so frequently, understanding of their effects is extremely important to our understanding of behaviour. ..[T]he subtle, pervasive and almost irresistible effects of low-level affective states are so often with us that their potential influence may be very great. (p. 79)"

Empirically, two lines of research have addressed the influence of mood on memory performance. The first has examined overall performance on traditional psychometric and experimental memory tasks during states of clinical or subclinical depression. The second has contrasted the effects of positive and negative mood states on the content of recalled memories, using emotionally salient memory stimuli. Differences in these two separate lines of research in the nature of the independent variable (the dimension of mood variability assessed) and dependent variable (the type of memory response targeted) reflect fundamental differences in the underlying assumptions about the nature of mood states and their influence on memory performance.

Common to both approaches, however, is a conceptualization of mood as a resource characteristic that either enhances or constrains the memory processing system. Resource characteristics, in contemporary information processing theory, include any factor that impose limits on cognitive performance. Two types of resources have been described, dynamic and structural. Dynamic resources have

been conceptualized as a type of mental energy, which allocated as cognitive effort or attentional capacity, fuel memory and other forms of mental processing. It is further assumed that the amount of mental energy is limited, and, therefore, sets the upper limit on processing capacity or efficiency. Structural resources include the capacity and content of long-term memory. The influence of structural resources on memory processing has only begun to be explored. However, it appears that the amount and organization of information contained within the individual's knowledge base can effect both component and executive memorial processing (Salthouse, 1985).

The distinction between dynamic and structural resources is useful in contrasting approaches that conceptualize mood as a structural resource (e.g., Bower, 1981) and those that conceptualize mood as a dynamic resource (e.g., Ellis, Thomas, & Rodriguez, 1984). In the former approach, mood states are seen as a form of knowledge, represented in memory as an attribute of people, objects, and experiences (Isen, 1984). Dynamic resource models, on the other hand, focus on the contribution of mood to memory processing efficiency through its effect on mental energy. In the next two sections, research examining the effect of mood on memory processing efficiency and memory content will be reviewed.

Dynamic Resource Models of Mood and Memory Interaction

Interest in the effect of depression on memory performance has a long history in clinical and experimental psychology. Depressed individuals often complain that they have difficulty remembering, and early research was directed at providing empirical verification of this subjective complaint. For the most part, this research confirmed that depression is associated with impaired performance on a wide spectrum of memory and intellectual tests. For example, depressed patients have been shown to do more poorly than normal control subjects on tasks assessing memory (Breslow, Kocsis, & Belkin, 1980; Coughlan & Hollows, 1984), psychomotor speed (Friedman, 1964), abstract reasoning (Savard, Rey, & Post, 1980; Silberman, Weingartner, Laraira, Bynes, & Post, 1983), and spatial processing (Flor-Henry, 1979). Moreover, the level of intellectual impairment was found to be functionally related to the severity of the clinical depression with more severe depression

associated with more severe intellectual impairments (Sternberg & Jarvik, 1976).

This early research was based on a psychometric approach to the assessment of cognitive functioning, and although providing evidence of memory impairment in depression, could provide little insight into the nature of the impaired functioning. More recent research, based on an information processing approach, has sought to move beyond description of memory impairment in depression to explanatory research that identifies the processes and mechanisms underlying such deficits.

One example of the use of an information processing approach to delineate the nature of the memory deficit in depression is research conducted by Weingartner and colleagues (Weingartner, Cohen, Murphy, Martello, & Gerdt, 1981; Weingartner & Silberman, 1982), comparing the performance of clinically depressed patients and normal individuals on a series of memory tasks. Through manipulations of stimulus properties and task instructions, they investigated the effect of depression on the encoding stage of information processing. In particular, they focused on two processing strategies that have been found to enhance memory performance in normal subjects, viz, organization and elaboration. Organization, which refers to the encoding of relationships among to-be-remembered items, was studied by having the subjects sort categorized or random lists of words and later recalling them. The performance of depressed subjects was equivalent to that of controls for the categorized lists but was much poorer on the uncategorized lists. This suggested that the depressed subjects were able to utilize the experimenter-imposed organizational scheme, but were unable to benefit from their own subjective organization of the items into categories. In a second study examining organizational deficits in depression, memory performance deficits shown by depressed patients with randomized word lists were eliminated when the organizational structure of the lists was made more explicit by categorizing the words and presenting them as clustered word categories.

The use of elaborative encoding strategies was investigated by Weingartner et al. (1981). Elaboration refers to the richness or extensiveness of encoding of an individual item, and like organization, has been found to enhance the memory performance of normal subjects. Elaboration is usually studied by varying the

orienting tasks used by subjects during presentation so that some items receive more semantic elaboration than others. For example, Weingartner et al. had subjects rate whether the to-be-remembered words were pleasant (semantic processing) or rhymed with another word (acoustic processing). As predicted, semantically processed items were recalled better than acoustically processed items by the normal subjects. Depressed subjects, in contrast, showed no such memory enhancement for semantically processed items and, thus, recalled significantly fewer of these items than the nondepressed subjects. Weingartner et al. concluded that decreased memory recall in depressed individuals is the result of ineffective use of memory enhancing encoding strategies, including both organization and elaboration.

Ellis and colleagues (Ellis, Thomas, & Rodriguez, 1984; Leight & Ellis, 1981) also examined encoding operations in depression, although they relied on mood induction techniques to induce depressed mood states in normal college students. The validity of experimentally induced mood states as analogues of naturally occurring mood states will be discussed in a later section. However, for the most part, results from Ellis and colleagues' work have corroborated the results found with clinically depressed patients. Like Weingartner, Ellis et al have focused on elaborative encoding and organizational strategies as the locus of depression-related deficits. In one study, for example (Leight & Ellis, 1981), they examined the use of chunking as an organizational strategy through use of a perceptual grouping task. Nondepressed subjects were found to reorganize meaningless letter sequences into meaningful chunks. Subjects in the induced depression group did not adopt this efficient organizational strategy and showed reduced chunking in recall, and reduced overall recall performance. In a second study focusing on elaborative encoding, Ellis, Thomas, & Rodriguez (1984) had subjects rate the comprehensibility of sentences that varied in the extent to which the context of the sentence elaborated on the meaning of the to-be-remembered target word. On a subsequent cued recall task, neutral mood subjects showed enhanced recall of target words from the elaborated sentences, whereas depressed subjects showed no difference in their recall of elaborated and non-elaborated words. This contributed to a significant performance difference between mood groups in the elaborated high context condition.

Thus, like Weingartner et al (1981), Ellis et al. concluded that organizational and elaborative mnemonic processing are not carried out by depressed individuals.

Both Weingartner and Ellis have attributed the failure of depressed individuals to utilize these memory optimizing strategies to a reduction in the level of cognitive effort. This explanation is based on the assumption that cognitive processes differ in the extent to which they require mental effort for their operation. Memory encoding processes such as those involved in organization and elaborative encoding are presumed to be effortful cognitive operations requiring mental energy for their efficient employment.

To provide support for the hypothesis that cognitive effort is reduced in depression, Ellis et al. (1984) presented depressed and nondepressed subjects with high and low context sentences and asked them to select the target word that completed the sentence. They hypothesized that generating target words for low context sentences would require more cognitive effort. Since overall memory performance is assumed to be a function of the amount of cognitive energy expended, it was predicted that low context/high effort targets would be more memorable than high context/low effort items. Results confirmed this prediction, but only for subjects in neutral moods. Depressed subjects did not benefit from the effortful encoding task and recalled significantly fewer words in this condition than did the neutral mood subjects. Ellis has proposed a resource allocation model to account for these findings and, more generally, to explain memory deficits in depression. According to this model, depressed individuals allocate some of their cognitive resources to task-irrelevant processing of cognitions associated with the depressed mood and, therefore, have less available for task-related processing.

Cohen, Weingartner, Smallberg, Pickar, and Murphy (1982) also focused on cognitive effort as the source of depression-related deficits in memory performance. These investigators, however, argued that depression reduces the availability of cognitive energy rather than just its allocation. Perhaps because of their work with clinically depressed samples, they have argued for a biological origin related to pathological neurochemical changes in the central activating system during episodes of clinical depression. To provide empirical confirmation of this hypothesis, they

examined the relationship between severity of depression, motor behaviour, and memory performance in a group of depressed inpatients and normal controls. Results indicated that as depression severity increased, the ability to sustain effort on the motor task declined, as did overall memory performance. As predicted, memory and motor performance were positively correlated, with better memory performance associated with longer periods of sustained effort on the motor task. Cohen et al. suggested that clinical depression produces changes in the central activating system which results in a decline in the availability of mental energy for both cognitive operations and behavioral output.

Most research on memory and depression has focused on the encoding stage of memory processing and the retrieval stage has received little attention. Ellis et al (1984) have speculated that the effect of depression on retrieval processes is minimal, although they acknowledge that available evidence is limited. Weingartner et al. (1981) also emphasize encoding processes as the locus of depression-related deficits, although they have shown that manipulation of the amount of retrieval information provided at time of recall also influences the size of group differences found between depressed and normal individuals. For example, they showed that depression-related deficits found in free recall were attenuated when category names were provided as retrieval cues. Since cued recall is presumably less effortful than free recall, this finding suggests that deficits in retrieval processes will be found in depressed patients to the extent they depend on effortful cognitive operations.

The effect of positive mood states on memory performance has also received little attention. Johnson and Magaro (1987) reviewed the results of a handful of studies that had looked at memory performance during manic states. Based on this limited evidence they suggested that mania produces impaired memory performance with the amount of impairment related to the severity of the manic disorder. They proposed that deficits in overall memory efficiency are related to the severity or intensity of mood states, regardless of affective valence.

In sum, research based on a conceptualization of mood states as a dynamic resource support a number of conclusions about memory performance in depression. Depressed individuals perform more poorly on memory tasks with the extent of the

memory impairment related to both the severity of the depression and the extent to which the memory task requires encoding operations that are mentally demanding. Depressed mood states associated with clinical depression and temporarily induced dysphoria both have been found to produce similar patterns of memory deficits. It has been hypothesized that depressed individuals do more poorly on memory tasks because they allocate less mental energy to mnemonic processing, either because they have less available or because they allocate it inefficiently. As with other resource based explanations of intergroup differences in memory performance, supportive evidence for this hypothesis is indirect. Mental energy is a hypothetical construct that is only vaguely defined and inferred from indirect measures. Two unresolved and/or unexamined issues concern the effect of depression on mnemonic processes other than encoding and the effect of other mood states.

Structural Resource Models of Mood and Memory Interaction

Current interest in the effect of mood on memory content can be attributed in large part to the efforts of Gordon Bower. In the late 1970s and early 80s he published a series of studies describing the effects of hypnotically induced mood states on memory for pleasant and unpleasant stimuli (for review, see Bower, 1981). Important for the present discussion was the phenomenon of mood selective learning, referring to enhanced learning of material that was emotionally congruent with the learner's mood. In Bower's original demonstration of mood selectivity (Bower, Gilligan, & Monteiro, 1981), he had individuals read a story which described the interaction of two friends playing tennis. One character had mostly positive thoughts and experiences, the other mostly negative. Learners in hypnotically induced happy moods recalled more facts about the happy character, regardless of their mood at recall whereas depressed learners recalled more facts about the sad character. Thus, although total recall did not differ, the nature of what subjects remembered varied as a function of mood state. In addition to describing mood content effects. Bower proposed a model based on associative memory theory to account for the mood content effect. This model, and other models proposed subsequently, will be described in more detail later.

Historically, research by Bower and others on the effect of mood on recall

memory was predated by a large body of research produced in the earlier part of this century examining emotions and their effect on memory for pleasant and unpleasant experiences. This work, conceptually based on the Freudian theory of repression, also demonstrated mood congruency effects in learning and recall (for review, see Rapaport, 1942). More recently, cognitive theories of depression (e.g., Beck, 1967) have been based on the assumption that depressed individuals selectively attend to (and, therefore, learn and remember) negative information about themselves and their environment. Thus, Bower's contribution has not been to discover the mood congruency effect, but to reinterpret the effect within the framework of information processing theory and to develop a research paradigm for studying the phenomena within the laboratory.

Over the past decade, there have been numerous demonstrations of mood congruent memory phenomena, using a variety of stimulus materials, including words (e.g., Isen, Shalker, Clark & Karp, 1978), sentences (Laird, Wagener, Halal, & Szegda, 1982), stories (e.g., Bower, Gilligan, & Monteiro, 1981), autobiographical memories (e.g., Teasdale & Fogarty, 1979), and pictures (Fiedler & Stroehm, 1986). Most of this research has contrasted the effects of happy and depressed mood states, although mood congruency effects have been also demonstrated with angry and fearful moods (e.g, Laird et al., 1982). Similar effects have been reported with naturally occurring mood states of clinical (e.g, Breslow, Kocsis, & Belkin, 1981) and non-clinical severity (e.g, Ingram, Smith, & Brehm, 1983), and with laboratory induced mood states (e.g, Bower, 1981). Although a few studies have failed to find evidence of mood congruent memory (e.g., Mecklenbrauker & Hager, 1984; Hasher, Rose, Zacks, Sanft, & Doren, 1985) the preponderance of evidence points to the robustness of the phenomena. However, consistent with contextual principles, it is apparent that the nature and size of the observed effect is dependent on the nature of the mood state, the nature of the stimulus materials, and the nature of the memory task.

Although mood congruent memory effects have been shown across several mood states, Isen (1984, 1985) has drawn attention to the fact that positive and negative moods do not appear to have symmetrical effects on memory recall. Happy

subjects demonstrate higher recall of positive stimuli, relative to their own recall of negative or neutral stimuli and relative to subjects in negative or neutral moods. Depressed subjects, on the other hand, demonstrate superior recall of negative stimuli, but only relative to their own recall of positive or neutral stimuli. Thus, it appears that in contrast to happy moods, which enhance memory for mood congruent information, negative moods tend to impair memory for mood incongruent material.

A number of researchers have also looked at the effects of mood intensity on the strength of the mood selectivity effect. Bower and Cohen (1982) described the results of an unpublished study comparing the effects of high and low intensity mood states on recall of happy and sad vignettes. The intensity of the induced moods was related to overall recall (as would be expected from the processing efficiency model of mood and memory interaction), but not to the strength of the mood congruent memory bias. Fiedler and Stroehm (1986) reported a similar outcome using amphetamines to simulate central arousal in the presence or absence of induced positive moods. Mood congruent memory effects were found for participants in positive moods, although the strength of the mood bias was unaffected by the drug manipulation. These results suggest that mood congruent memory effects are functionally related to mood tone but are independent of mood intensity.

A somewhat more complicated pattern of findings was reported by Rholes, Riskind, and Lane (1987) using mood change as the independent variable and recall latency as the dependent variable. When moods were induced by having subjects read statements describing the somatic correlates of positive and negative mood states, there was a low but statistically significant correlation between amount of mood change and mood congruent recall latency (pooled $r = .33$). However, when mood change was induced through exposure to self-evaluative statements, mood change was uncorrelated with the size of the mood congruent memory bias. One difficulty in interpreting this finding is that although mood change can be assumed to be related to mood intensity, the two are not isomorphic because the relationship is affected by the amount of variability in initial mood levels. The relationship also would be attenuated in Rholes et al.'s study if some of the subjects in the low change

group were more properly classified as no change. If more subjects were responsive to the self-evaluative induction process than to the somatic induction, this could explain the difference between the two conditions, particularly if mood congruent memory recall is a threshold effect requiring a certain level of mood intensity to be activated.

As noted previously, a number of stimulus materials have been used to demonstrate mood congruent memory. By definition, the stimulus material must be emotionally salient in order to produce mood congruent memory effects, although affective tone appears to be more important than intensity. For example, mood congruency effects have been demonstrated using nonsense trigrams that subjects had pre-rated as liked or disliked (Slife, Micura, Thompson, Shapiro, & Gallagher, 1984).

Although affective intensity may not be a critical factor, the structure of the memory materials does appear to play an influential role in the demonstration of mood congruency. It is somewhat ironic that story materials, although used to provide one of the first demonstrations of mood selectivity, have proven in subsequent research to be resistant to mood congruent processing. For example, two studies using the same story materials developed by Bower, failed to demonstrate mood congruent memory effects (Hasher et al., 1985; Mecklenbrauker et al., 1984). Ellis (1984) suggested that the narrative structure provided an organizational framework more salient than the cues provided by mood tone, thus, explaining the difficulty demonstrating mood congruency effects with story materials.

A recent study examined the effect of organizational structure directly by comparing mood congruency effects for positive and negative pictures that were either organized categorically or were uncategorized (Fiedler & Stroehm, 1986). Categorized pictures were recalled better by all subjects, but mood congruent memory effects were found only for the uncategorized series. This finding suggests that highly structured materials, including stories and organized lists, may be less effective for the demonstration of mood congruency.

The locus of mood congruent memory effects has not been clearly resolved. Much of the available research was not designed to untangle encoding or retrieval effects and have confounded participants' mood at time of learning with mood at

time of recall. This is unavoidable in research using naturalistic mood variability to attain group differences in mood and in mood induction research using autobiographical memory as the to-be-remembered events. In the latter case, there is no way to determine or control exposure mood. Only a handful of studies have independently manipulated learning mood and recall mood and these have provided contradictory evidence concerning the locus of memory effects. In some studies, mood congruent effects have been found only for mood states induced at time of learning (Bower et al., 1981; Bower & Mayer, 1985; Nasby & Yando, 1982). Other researchers have found effects only for recall mood (Isen et al., 1978).

A number of theoretical frameworks for explaining mood congruency effects have appeared in the literature (Bower, 1981; Gilligan & Bower, 1984; Fiske, 1981; Isen, 1984; Johnson & Magaro, 1987). A common feature of these models is the assumption that mood congruent memory effects are mediated through the cognitive representation of mood in memory. Mood tone is assumed to be encoded without effort or conscious intent as a descriptive attribute of people, events, and objects, as are other automatically encoded attributes such as spatial location (Hasher & Zacks, 1979). One difference between models concerns the assumptions made concerning the organization of information in memory. Theories based on the associative network conceptualizations of memory organization assume than mood is represented in memory as a specific node linked to other propositional nodes representing experience and semantic knowledge (e.g., Bower, 1981). Models based on schema theory posit that mood is represented as an aspect of the organization or meaning of a memory schema, rather than as a discrete node (Isen, 1984). In either case, the experiencing of a particular mood primes or activates other mood congruent information, increasing its accessibility.

A further difference between models concerns the locus of the effect at either the encoding or retrieval stage of memory processing. Bower's associative memory model of mood selectivity effects appears to favour the encoding stage because it assumes that mood congruency effects observed in memory recall are due to differences in the quality of information originally encoded. Increased accessibility of mood congruent thoughts and memories bias selective attention mechanisms

leading to greater elaboration of environmental information that is emotionally compatible with the prevailing mood. Alternatively, Isen's interpretation of the mood congruency phenomena emphasizes the retrieval stage as the locus of mood selectivity. According to a retrieval-based explanation of mood congruent memory, mood acts as a retrieval cue, increasing the accessibility of mood congruent memory just as providing a category name at time of recall enhances recall of exemplars of that category. This difference may reflect a difference of emphasis more than of substance. It will be recognized that whether the mood congruency effect is localized at encoding or retrieval, the proposed underlying mechanism in both cases is the automatic activation of mood congruent memories.

Although the primary effects of mood are posited to occur automatically though cognitive priming, some authors have suggested that controlled mental processes also can play an important role in regulating the cognitive consequences of mood states, particularly in the case of depression (Blaney, 1986; Clark & Isen, 1982; Isen, 1984). The use of control processes in the service of "mood repair" was first hypothesized to account for the observed asymmetries in the effects of positive and negative moods on memory recall. As was described earlier, it appears that happy moods enhance recall for mood congruent information, but negative moods tend to impair memory for mood incongruent information. According to the mood repair hypothesis, this asymmetry occurs because subjects in negative moods use (unspecified) control processes to override automatically activated negative thoughts and memories. Thus, there is no recall advantage for mood congruent information in negative moods. Recall of positive information is also reduced, because of the lack of priming advantage. At first glance, this hypothesis appears inconsistent with the conclusion that effortful memory processing is impaired during depression. As discussed earlier, this conclusion was based on research looking at overall memory processing efficiency in depression. It may be recalled that Ellis' resource allocation model (Ellis et al., 1984) proposed that less effort is directed towards the processing of neutral memory stimuli because more effort is being used for task-irrelevant processing of negative thoughts activated by the depressed mood. Presumably some of the effort not available for memory processing was being utilized in the service

of mood repair. To date, research examining controlled memory processing in depression does not appear to have been extended to include emotionally salient stimuli, research that would be necessary to support the mood repair hypothesis.

In conclusion, mood control effects have been demonstrated with a variety of mood states and stimulus materials. These effects do not appear to be related to the intensity of the mood state but rather are determined by the feeling tone of the mood. Stimulus material that is emotionally compatible with the feeling tone of the experienced mood is recalled better than neutral or incongruent information, although it is unclear at present whether this effect occurs at time of encoding or retrieval (or both). Theoretical models have focused on automatic priming and increased accessibility as the underlying mechanism of mood congruent memory.

Adult Age Differences in Mood and Memory Interaction

Empirical and theoretical efforts towards understanding specific linkages within the cognition/personality interface, such as that between mood and memory, have been made possible by the acceptance within both cognitive and personality psychology of an information processing approach based on a contextual world view. This has promoted an integrated view of mental processes and provided a level of analysis for defining interactive processes. For the most part, this work has been non-developmental, and has focused on the interaction of cognition and personality at one point in time, usually young adulthood. The principles and processes of intraindividual change in the cognition/personality interface over the adult life span have received relatively less interest and are only poorly understood (Cavanaugh, Kramer, Sinnot, Camp, & Markley, 1985).

Although little is known about the interaction of personality and cognition in adult development, personality factors have long been acknowledged to contribute to average differences in cognitive performance between young and old. As early as 1933, Jones and Conrad suggested that personality variables, among other factors, might contribute to the generally poor performance of older adults on many intelligence tests. Although Jones and Conrad ultimately rejected this hypothesis, this was the beginning of a long standing debate in the cognitive aging literature concerning whether performance deficits commonly observed in older age groups

represent a decline in basic intellectual capacity or represent performance limited by noncognitive factors such as increased anxiety or decreased motivation. Implicit in the performance/competency controversy is the belief that performance factors might modify rather than determine age-related cognitive change. Thus, although it is accepted that performance factors such as mood, may contribute to performance variability within and between age groups, it is assumed that this variability can be separated from variance associated with "true" age differences in basic cognitive ability. An alternative view of the role of performance factors is suggested by the life span model of human development.

The life span perspective, based on a contextual world view, embodies a number of principles that are congruent with prevailing approaches within personality and cognitive psychology. According to this perspective, developmental change occurs throughout the life span and is a multidimensional process, operating within a multidimensional context. Reciprocal interaction both between intraindividual subsystems and between the individual and his/her environment are recognized as the antecedent of developmental change (Baltes, 1987). Thus, understanding the interaction between personality and cognition in adult development is essential from a life span perspective as part of the description and explanation of behaviour change in adulthood. Moreover, according to this view, performance factors are not just sources of error variance. Rather, they represent important theoretical and process variables that relate systematically to individual patterns of cognitive aging.

One corollary of this reconceptualization of performance factors has been increased attention to differential patterns of cognitive change throughout adulthood and aging rather than an exclusive focus on universal or normative patterns of cognitive development. An important component of the study of differential patterns of cognitive aging is research examining the contribution of personality factors to individual differences in cognitive performance within and between age groups. However, as Willis and Baltes have noted,

> "A differential aging perspective, however, is not restricted to interindividual variability in development.... In addition, focusing on

> differential aging also suggests concern with intraindividual variability. The range of intraindividual variability (plasticity), both long-term and short-term, appears not to have received as much attention as interindividual variability and requires further exploration (p. 263, 1980)."

Within the cognitive aging domain, most of the interest in intraindividual variability has focused on the potential for enhanced cognitive performance in the elderly (e.g., Baltes & Willis, 1982). This research has established that the performance of the elderly can be improved dramatically, with ability-specific training and practise. Research on plasticity of performance in the elderly has utilized experimental interventions to enhance performance. It is necessary, therefore, to explore the range and antecedents (e.g., performance factors) of intra-individual variability in cognitive performance under real world conditions. Mood variability may be one important antecedent of state-like fluctuations of memory performance in everyday life and may be important to understanding of age differences in memory performance.

In sum, information on age-related differences in the effect of mood on memory may provide a more profound understanding of intraindividual variability in cognitive aging. The next section will review the empirical literature on mood and memory interactions in adulthood and aging. Most of this research has focused on memory performance in the depressed elderly.

Depression and Memory Aging

Most empirical research in the cognitive aging literature has implicitly assumed a cognitive efficiency model of mood and memory interaction. The conceptual basis of this type of model is that mood functions to reduce overall processing efficiency through reduced availability or allocation of processing resources. These hypothesized relationships are observable as a decline in overall performance level that is directly proportional to the severity of the depressed mood state. Based on this theoretical framework, the corollary developmental prediction has been that negative mood states may be a factor contributing to impaired memory performance in older age groups, because negative mood states either are more

disruptive or more prevalent in this age group.

The first study on the effect of depression on cognitive performance in the elderly was conducted by Kendrick and Post (1967). Using a psychometric approach, they contrasted the performance of depressed, brain-damaged and normal elderly at three six-week intervals on tests assessing verbal intelligence, speed of performance and short-term memory. Repeated measures were used because as Kendrick and Post stated,

> "... the literature contains little work on the stability or instability of cognitive status over short periods of time in elderly subjects, and this information is necessary if the psychometric assessment of the elderly psychiatric patient is going to be used in a manner that is not primarily concerned with diagnosis but with change in functioning (italics in original)(p. 75, 1976)".

Both mean level and rank order stability were compared across the three patient groups. The depressed patients did not differ from the normal controls in mean levels of performance or in measures of test-retest reliability. However, both groups differed significantly from the brain-damaged elderly. Despite the absence of group differences in mean level of psychometric performance between the depressed and normal groups, the authors did note that there appeared to be a subsample of depressed patients who showed severe memory impairments. They used the term "pseudo-dementia" to describe this group of patients.

This early study on depression and memory aging is important for several reasons. First, it was the first of a series of studies conducted over the past twenty years that has failed to show an effect of depression on the memory performance of the elderly. Second, although the study produced non-significant effects, the authors recognized the importance of intra-individual change and inter-individual differences in explaining the effect of depression on memory performance. Unfortunately, these issues were largely ignored by subsequent researchers. Instead, research on depression and memory aging over the past 15 years has focused almost exclusively on interrelationships between depression, memory complaints, and memory performance.

Interest in subjective complaints and objective performance in depressed elderly originated in an influential study reported by Kahn, Zarit, Hilbert, and Niederehe (1975). Participants in the study were all over the age of 50 and included psychiatric outpatients and their relatives. The presence and severity of memory complaints and symptoms of clinical depression was assessed using a standardized interview format. Participants were also administered a battery of memory tests, designed to tap immediate, recent and remote memory recall. To examine relationships between depression, memory complaints, and memory performance, correlations between the different measures were calculated. Results indicated that depression and memory complaints were significantly correlated, however, neither was related to memory performance.

Since this study was published, there has been consistent replication of the finding of a significant association between depression and memory complaints in the elderly (Cavanaugh & Murphy, 1986; Lachman et al., 1987; Neiderehe & Camp, 1985; O'Hara, Hinrichs, Kohout, Wallace, & Lemke, 1987; Popkin, Gallagher, Thompson, & Moore, 1982; Scogin, Storandt, & Lott, 1985; West, Boatwright, & Schleser, 1984; Williams, Little, Scates, & Blockman, 1987; Zarit, Cole, & Guider, 1981; Zarit, Gallagher, & Kramer, 1981). This has lent support to the conclusion that depression in the elderly is associated with a negative assessment of memory ability whether or not this is objectively demonstrated in real- life or laboratory performance.

Results have been less consistent regarding whether depression has any significant impact on the memory performance of the elderly at all. In some studies, depressed subjects have not differed from non-depressed subjects in memory performance (Lachman et al, 1985; O'Hara, et al, 1987; Scogin et al., 1986; West et al, 1984; Zarit, Cole, et al, 1981; Zarit, Gallagher, et al, 1981). Other researchers have reported statistically significant effects of depression on memory performance in the elderly (Cavanaugh & Murphy, 1986; Gibson, 1981; Hart, Kwentus, Hamer, & Taylor, 1987; Raskin, Friedman, & DiMascio, 1985; Reisberg, Ferris, Georgotas, DeLeon, & Schneck, 1982; Williams et al, 1987). Careful examination of the relevant studies suggest that measurement factors may be largely responsible for the

inconsistent findings.

One problem is in the measurement of depression in older age groups. Most of the available scales for assessing mood were designed and standardized with young adult age groups, and their construct validity in the elderly is not known (Nesselroade, in press). It cannot be assumed that scales designed to assess depression in young subjects measure the same thing in the elderly. For example, Nesselroade, Mitteness, & Thompson (1984) examined the factorial structure of the 8-State battery in a sample of older adults. Results replicated two of the hypothesized mood states, but it appeared that effort stress, regression, and depression had merged to form a single factor. This suggests a structural difference in the dimensions of mood state for this age group.

Operationally, three forms of assessment have been used in the study of mood and memory relationships, (a) clinician assessments of depressive symptoms, (b) self-reports of depressive symptoms, and (c) self-ratings of depressed mood. Self-ratings of depressed mood assess negative affect directly, whereas self- or clinician-rated depression inventories tap a range of symptoms associated with clinical depression, including sleep and appetite disturbance, suicidal ideation, and so forth. One study has examined the measurement issue directly by contrasting clinician assessments of depression, self-ratings of depression and self-ratings of depressed mood (Reisberg et al., 1982). In this study, which included only depressed individuals over the age of 60, significant correlations with memory and cognitive performance measures were found only for the self-ratings of mood (range of significant correlations .43 to .68), and not for the psychiatric or self-ratings of depressive symptoms. The Reisberg et al. (1982) study also illustrates the importance of the nature and type of performance tasks used in the detection of depression and memory relationships. In this study, a wide range of memory and cognitive performance tasks were utilized. Depressed mood was found to be significantly related only to some of the performance measures, most notably the perceptual motor tasks and nonverbal memory measures. This suggests that depressed mood may influence only specific aspects or dimensions of memory and cognitive performance and that failure to assess the relevant aspects of performance may yield nonsignificant findings. This

conclusion is consistent with findings from research with young adults and suggests that developmental psychology might well follow the lead of general psychology. This literature with its information processing based models of mood and memory relationships can provide a rich source of hypotheses concerning those dimensions of mood and memory relationships that may be sensitive to adult developmental change.

One issue that has received surprisingly little attention concerns the stability or instability of depression performance relationships across adult age groups. Research with young depressives suggests that cognitive impairments associated with depression increase in relation to the severity of the disorder, but perhaps because it has been so difficult to confirm the existence of a functional relationship between depression and memory in the elderly, there has been little effort made to find out whether the relationship changes or stays the same with age.

Only two studies were found which compared depression-performance relationships across adult age groups.

The first study by Raskin et al (1985) included 277 psychiatric patients and 112 normal controls ranging in age from 16 to 70. Participants were classified as depressed or nondepressed on the basis of clinical ratings by psychiatrists. For the purposes of statistical analyses, subjects were divided into two age groups, younger (under 40), and older (over 40). Multivariate statistics were used to assess the effects of age, sex, and mood on psychometric test performance. Main effects were found for all three subject characteristics with depressed, old, or female subjects performing more poorly in general than nondepressed, young, or male subjects. There was also a significant two way interaction of depression and age, as well as between depression and gender. Differences between depressed and nondepressed groups were greater for old than for young subjects and for males compared to females. Raskin et al. suggested that depression has a more negative impact on individuals whose cognitive skills are beginning to decline or who have the greatest premorbid strength in these areas.

A second study by Cavanaugh and Murphy (1985) suggests a different conclusion about stability in depression performance relationships with age. This

study compared young (M = 19 years) and old (M = 69 years) community volunteers on list and prose memory recall. State and trait mood depression were assessed using the Multiple Affect Adjective Checklist. Both state and trait depression were found to have a small but significant relationship with memory performance measures. Although actual age-specific correlations were not reported, the authors did report that these were computed and were not significantly different. This suggests that the effects of depression on memory performance remain stable across adulthood.

Results of these two studies are difficult to reconcile since a number of methodological factors could have contributed to the inconsistent findings. Subjects in the two studies differed in age range and depression severity. The studies also differed in their conceptual and operational measures of both mood and memory performance. Any or all of these factors may have contributed to differences in findings. It is also worth keeping in mind Kendrick and Post's (1967) observation that there are individual differences among the elderly themselves in susceptibility to the negative effects of depression on memory performance. Thus, the important issue may not be whether there is age-related change in the relationship between depression and memory, but to identify factors that are associated with increased vulnerability to depression-related deficits.

To summarize, it is apparent that few definitive conclusions can be drawn at the present time about depression and memory performance in the elderly. Within older age groups, relationships between depression and memory have generally been small and most often nonsignificant. This pattern of findings has led some researchers to conclude that depression does not account for much of the variance in memory performance within or across age groups (Cavanaugh et al, 1986; Lachman et al., 1987). However, this conclusion may be premature because many basic issues concerning the nature of the relationship between aspects of depression and memory performance, including the extent to which these relationships change with age remain unresolved. It has been suggested here that many of the gaps in the literature can be attributed to methodological shortcomings in the assessment of mood and memory. It is also apparent that by focusing on global memory deficits

associated with negative mood states, cognitive aging researchers have adopted a restricted conceptualization of the influence of mood on memory. In particular, they have ignored content specific affective processing which, as reviewed earlier, has been found to be an important and reliable phenomenon in younger age groups.

The exclusive focus on mood variability as an antecedent of quantitative differences in memory performance reflects the underlying processing efficiency model of mood and memory interaction that has been implicitly adopted by cognitive aging researchers. It also reflects the bias towards conceptualizing memory change in old age as a process of quantitative decline. Some researchers, most notably Labouvie-Vief (1985), have argued that qualitative changes in memory performance may also occur with increased age but may not be evident in total performance scores. Instead, understanding of age-related changes in processing style may require attention to selective aspects of memory behaviour, in particular, the organization and type of stimulus attributes attended to and remembered.

Very little is known about selective aspects of memory behaviour in general, or in the elderly in particular. Research on mood congruent memory processing suggests that mood states are one important influence on selective attention mechanisms. Theoretical speculation regarding qualitative aspects of memory change in old age suggest that content specific affective processing may be particularly salient during this life stage. According to Adams, Labouvie-Vief, Hobart, and Doray (in press), one characteristic of the processing style of older adults is an increased sensitivity to affective dimensions of stimuli and a tendency to process affective information more deeply. Since memory is a function of stimuli attended to during learning and the depth of processing of stimuli, this hypothesis implies that the elderly should show enhanced recall for affective information. Moreover, according to the encoding specificity principle, effective retrieval cues are those that match the attributes of the stimulus that were attended to and encoded at time of learning (Tulving & Thompson, 1973). If the elderly have a stronger tendency to encode information along affective dimensions, then mood-activated retrieval cues should be most effective in this age group, producing enhanced mood congruent recall.

Aging research on mood congruent recall may have broader implications beyond explaining age differences in memory performance. Speculation concerning the importance of mood congruent memory effects in the etiology and maintenance of depressive disorders implies a more bidirectional exchange of influence and suggests that mood and memory research may provide an explanation of observed age differences in vulnerability to depression.

Many authors have speculated that mood congruent memory effects may play an important role in the propagation and maintenance of depressive mood disorders (e.g., Blaney, 1986; Goodwin & Williams, 1982). Ingram (1984) developed a formal model to describe this relationship. Based on the principle of reciprocal interactionalism, he proposed a negative feedback model in which negative thoughts and memories automatically primed by negative mood states intensified the negative feeling and spiralled into more severe and persisting forms of depression. To explain why all individuals don't become severely depressed after experiencing a negative mood, Ingram posited that there is a natural decay of mood activated priming that in most individuals allows for the dissipation of cognitive aftereffects of negative moods before they develop into more severe depressed states. Individual differences in the rate of decay, thus, accounts for individual differences in vulnerability to depression.

An alternative hypothesis has been proposed by Clark and Isen (1982; Isen, 1984) based on their suggestion that people may also utilize more active cognitive strategies to regulate mood change. According to this hypothesis, individual differences in the use of effective cognitive control strategies to attenuate the negative spiral of depression account for individual differences in vulnerability to depression.

At present, there is no direct evidence to support either the passive decay or effortful mood repair explanations of resistance to depression. Although proposed to account for individual differences in vulnerability to depression, these hypotheses may also have implications for understanding age group differences in vulnerability to depression. For example, the elderly are both more vulnerable to depression (Blazer & Williams, 1980; Gurland, 1976) and to impairments in effortful memory

processing (Hasher & Zacks, 1979). Clark and Isen (1982) have alluded to the possibility that these two phenomena may be related. In other words, age-related decline in controlled memory processes may affect the proposed mechanism of mood repair in older adults, reducing their ability to attenuate the cognitive and behavioral consequences of depressed mood. Alternatively, stimulus persistence theory, a general explanation of age changes in performance, is based on the principle that the aftermath of stimuli lasts longer in the nervous system of old people than of young people (Botwinick, 1973). This suggests that there may be slower decay of mood-activated cognitive priming in the elderly, which according to Ingram's (1984) model may increase vulnerability to depression.

Although intriguing, hypotheses concerning age differences in mood repair or mood decay are highly speculative since they are based on a line of reasoning that is itself speculative and only indirectly supported by empirical evidence. Perhaps the only conclusion that can be drawn from this discussion is recognition of the relevance of studying mood congruent memory in the elderly, and the potential contribution of such an endeavour to understanding age differences in memory performance and in vulnerability to depression.

Only one study has been found that was specifically designed to examine mood congruent memory across different age groups (Slife et al., 1984). In this study, clinically depressed elderly patients were compared to young and old community volunteers. Memory stimuli consisted of a list of 16 nonsense trigrams, selected from a longer list that subjects had previously rated as liked or disliked. Memory was tested in an immediate free recall task. Total memory recall was lowest in the depressed elderly group, supporting the view that severe depression reduces overall memory performance, independently of the affective tone of the material. Age also affected overall memory recall, with the nondepressed elderly recalling fewer trigrams in total than the nondepressed young. Mood congruent memory was assessed by comparing memory for liked and disliked trigrams within groups. For both young and old nondepressed subjects, recall of liked trigrams was superior to recall of disliked trigrams. In contrast, the depressed elderly showed superior recall of disliked trigrams. This was due to their decreased recall of

positive trigrams relative to the nondepressed elderly. This result is consistent with mood congruent memory effects demonstrated with young depressives and suggests that depression in the elderly decreases overall recall and recall of mood-incongruent information.

Slife and colleagues also examined age differences in mood congruent memory, although because a depressed young group was not included, this comparison was made by comparing the two normal control groups. Mood congruent recall was defined for these groups as enhanced recall of liked trigrams relative to recall of disliked trigrams. Results indicated that there was a significantly stronger memory enhancement effect for young subjects than there was for older subjects. Although suggestive of age differences in mood congruency effects, two potential confounds in the methodology weaken support for this conclusion. First, the possibility of age group differences in overall mood exists for the two nondepressed groups. Subjects were selected into mood groups on the basis of scores on the Beck Depression Inventory, but no other ratings of current mood were administered. As has been discussed previously, depressed mood states can occur independently of clinical depression, and the Beck Depression Inventory may not be sensitive to these normal fluctuations in mood. Therefore, it is possible that the normal elderly group, although not clinically depressed, may have contained more individuals who were temporarily experiencing depressed mood, and this may have contributed to the mean group differences between the young and old in recall of positive trigrams.

A second problem was the use of nonsense trigrams as emotionally salient stimuli. Although positive and negative trigrams were selected on the basis of subjective preferences, it is questionable how well liked or disliked a trigram can be. Although emotional salience has not been found to affect mood congruency effects in young subjects, it cannot be assumed that this true across age groups. In general, the elderly have been found to be more sensitive to stimulus meaningfulness, with age differences in memory performance being reduced when meaningful memory stimuli are used (Botwinick, 1973).

A recent study by Hyland and Ackerman (1988) provides some support for

the possibility that age differences in mood congruency effects in the Slife et al. study were artifacts of age differences in affective response to the memory stimuli. The focus of this study was age differences in reminiscence and, thus, the memory stimuli were autobiographical memories elicited in response to cue words describing objects, actions, and feelings. In the total sample, more pleasant than unpleasant memories were recalled. Age group differences in the recall superiority of pleasant memories were also examined, comparing the young, middle aged and old age groups. No differences were found, suggesting that with meaningful memory stimuli, mood congruency effects are equivalent across age groups. Unfortunately, this study was not designed to examine mood congruent memory and no measures of participants mood were included. Thus, as in the Slife et al. study, the possibility of group differences in mood presents a confound to the interpretation.

It is evident that there are many gaps in current knowledge of mood and memory relationships in later adulthood. Most of the existing research has examined the contribution of negative mood states to quantitative decline in memory performance with increased age. This focus, although important, has precluded investigation of the contribution of mood to short-term fluctuations in memory performance or to qualitative effects of mood on memory content.

Chapter Three

Objectives and Hypotheses

Objectives

The purpose of the present study was to examine the influence of positive and negative mood states on intraindividual memory change within two adult age groups. Based on theoretical models of mood and memory interaction, two types of memory effects were examined, (1) global effects on memory processing efficiency as measured by total recall scores, and (2) content specific effects measured as the congruence between participant's mood and emotional tone of the memory stimuli. In addition to examining age differences in the effect of mood on memory, the study was designed to reveal whether mood level or content effects, if evidenced, occurred during the encoding or retrieval stage of information processing.

Experimental Hypotheses

Quantitative age differences in mood congruent recall were predicted based on Labouvie-Vief's (1985) theory of a qualitative shift in processing style in middle and late adulthood. If the elderly are more inclined to deeply process emotionally salient information, then mood congruent memory effects should be stronger in this age group.

It will be recognized that this predicted direction of effects is inconsistent with the findings of the Slife et al. (1984) study where weaker mood congruent memory effects were observed in the elderly and the Hyland et al. (1988) study where there were no age differences in the emotional bias of autobiographical memory recall. However, age comparisons in the Slife et al. study were made only for the neutral mood group since no positive mood groups or depressed young groups were included. Thus, the opportunity for mood induced cuing at retrieval was minimal. No information about the mood state of participants in the Hyland et al. study is available.

In addition to including both positive and negative mood groups, the present study also used more ecologically valid and affectively salient memory stimuli than the nonsense trigrams used by Slife et al. (1984). The stimuli consisted of a list of pleasant and unpleasant daily events that were selected from a list established in

previous research to be representative of the daily activities of older adults (Gallagher & Thompson, 1984). Since there is some evidence that the elderly are more sensitive to task meaningfulness, the use of a meaningful everyday memory stimuli in the present study was expected to support the use of affective processing styles by the elderly participants.

Predictions concerning qualitative age differences in mood congruent memory were derived from speculations concerning the breakdown of controlled memory processes in old age (Hasher & Zacks, 1979) and Clark and Isen's (1982) model of the use of controlled memory processes in the service of mood repair. The use of mood control strategies has been proposed to account for observed asymmetries in the effect of negative mood on memory performance. If the elderly are less efficient in the use of controlled memory processes, then one would expect greater symmetry in the effects of positive and negative mood for this age group.

No specific hypotheses were developed concerning age differences in memory efficiency effects. As will be discussed later, the mood states compared in the present study were of mild intensity, and it was not clear whether significant level effects would be detected. Nonetheless, it was considered worthwhile to examine age differences, since if the elderly are more sensitive to negative effects of depressed mood, they may show these effects with more mild mood states than the young. Thus, it was predicted that young subjects would not show differences in mean levels of memory performance in response to positive or negative mood change in the present study. Evidence of significant mean level changes in the elderly would suggest greater sensitivity to the negative effects of mood on memory processing efficiency. The absence of effects would be neutral evidence, neither confirming or disconfirming hypothesized age differences.

Mood Manipulation.

In studying the effect of mood on memory, cognitive aging researchers have most commonly adopted an individual differences approach, capitalizing on the natural mood variability present in cross-sectional samples. In some cases, researchers have examined the association between mood and memory in unselected samples drawn from one or more age groups (e.g., Cavanaugh et al., 1985; West et

al., 1984). However, this approach when used with community volunteers can result in a restricted range of mood variability. Other researchers have, therefore, used extreme group comparisons, manipulating group differences in mood by selecting subjects according to pre-established mood criteria (e.g., Raskin et al., 1985; Williams et al., 1987). However, unlike many individual difference variables that reflect stable and enduring characteristics of the individual, mood state is a dimension of intraindividual change that can be directly manipulated in experimental studies. The development of techniques for the experimental induction of affective states has been an important methodological advance which has undoubtedly contributed to the burgeoning interest in the study of mood and memory. As yet there do not appear to have been any attempts to apply affect induction techniques to the study of mood and memory relationships in older age groups. However, experimental manipulation of mood is necessary to unconfound encoding and retrieval effects of mood induced memory effects and make easier the investigation of intraindividual memory changes.

A number of diverse methods have been developed for the induction of mood in the laboratory. Most commonly used is the Velten Induction technique (Velten, 1968) which requires participants to read a series of positive or negative self-referent statements with instructions to try and get in the mood. Other techniques include listening to affect-inducing music (Sutherland, Newman, & Rachman, 1982), watching humorous or depressing movies (Isen & Gorgolione, 1983), manipulation of facial expressions (Laird et al., 1982), hypnosis (Bower, 1981), and autobiographical recall (Brewer, Doughtie, & Lubin, 1980).

Although experimentally induced mood states have been shown to produce most of the same behavioral and cognitive changes as naturally occurring mood states (Clark, 1983; Hale & Strickland, 1976; Velten, 1968), a number of concerns have been raised about their reliability and validity. For example, Clark (1983) has estimated that only about 50 to 75% of participants show mood change using the Velten technique. In another study by Isen & Gorgolione (1983), mood changes induced by the Velten technique had completed dissipated after four minutes. Equally problematic have been concerns about whether observed effects are due to

the induced mood, experimental demand (Polivy & Doyle, 1980), or cognitive priming of personal memories (Rholes et al., 1987). Supporters of mood induction techniques have attempted to refute these concerns, but there is yet no consensus about the relative reliability or validity of the various mood induction procedures.

There also are a number of ethical issues raised by mood induction techniques, particularly in regard to the intensity, duration, and ease of removal of induced mood states. Research with young subjects has shown that induced negative moods can be relatively intense, depending on the induction technique, but are brief in duration and easy to remove with debriefing or positive mood induction (Frost & Green, 1982). It is not known, however, whether these results are generalizable to an elderly age group.

With these considerations in mind, mood changes were induced in the present study by having subjects read emotionally descriptive accounts of tragic or uplifting life experiences. Stories were written in a style to encourage the readers' identification with the protagonist and to emphasize the affective impact of the experience. Thus, the procedure was similar to the experience of reading human interest stories in a newspaper or magazine, and was expected to produce shifts in mood which, although mild, would be typical of the range of normal mood variability people experience in the course of day-to-day living. The type of affective response expected could be categorized as a "feeling state" , which as defined by Clark and Isen (1982) are,

> ...general and pervasive, having no inherent targets, and they usually do not interrupt ongoing behaviour. They are relatively transitory, they occur frequently, often in the normal course of everyday life, and they consist in thinking about positive or negative material and in having easy access to a substantial amount of additional compatible material in memory (pp. 77-78)".

Of course, the latter characteristic of increased accessibility of mood congruent memories was the focus of the present study.

The use of affectively salient stories to induce mood change has been successful in a number of previous studies (Johnson & Tversky, 1983; Kaplan, 1981;

Veitch & Griffitt, 1976). The technique used in the present study was closely modelled after that reported by Johnson and Tversky. They had young subjects read stories about a young man's tragic death. Compared to a control group who read a neutral story, the group reading the negative story reported significantly higher levels of depressed mood and demonstrated mood congruent effects on a perceptual judgement task.

In addition to its demonstrated effectiveness, this task had a number of benefits which recommended it for use in the present study. First, it required a minimum of effort or imaginal ability on the part of subjects to try to get in the mood. As in the Johnson and Tversky study, participants were not informed that the purpose of reading the story was to induce mood change. Instead they were asked to read the story and rate it on a number of dimensions, including its effect on their mood. This question was used as the manipulation check. By reducing the need for subjects to try and actively change their mood, the problem of experimental demand was reduced. Finally, since the induced mood change was likely to be of mild intensity and comparable to naturalistic mood change occurring in everyday life, ethical concern about the consequences of negative mood induction were reduced.

Chapter Four
Methods

Design

The study employed a 2 by 2 by 2 factorial design with two dependent variables. Age (Young, Old), mood (positive, negative), and locus of mood effect (encoding, retrieval) were manipulated as between subject variables. Thus, within each age group, four treatment conditions were included, (1) positive mood at encoding, neutral mood at retrieval, (2) negative mood at encoding, neutral mood at retrieval, (3) neutral mood at encoding, positive mood at retrieval, and (4) neutral mood at encoding, negative mood at retrieval. Each subject also participated in a neutral mood at encoding/neutral mood at retrieval condition. Thus, the design was comparable to the traditional pretest/posttest design, allowing calculation of changes in memory performance in response to induced mood states relative to memory performance in neutral mood states. The two dependent variables used were, (1) change in total recall, and (2) change in mood selective bias.

Subjects

Participants were 166 adult females, recruited as unpaid volunteers. Only female subjects were tested, because of previous research suggesting that mood congruent memory effects may be stronger in females (Clark & Teasdale, 1984). Subjects were recruited from two age groups, Young (age 18 - 35), and Old (age 58 - 75), and in two geographical locations (Victoria, British Columbia, and Welland, Ontario). The Victoria sample consisted of 95 individuals, including 53 young and 42 old. Young participants were drawn from the undergraduate subject pool at the University of Victoria. The older sample was recruited through newspaper ads and community appeals requesting volunteers for research in memory and aging, or through previous participation in psychological research. Table 1 shows sample characteristics by age and location. The mean number of years of education was 13.2 for the young and 13.8 for the old. Ninety-two percent of the young sample were full- or part-time students. The majority of the older sample were retirees (85%) or housewives (10%). On a five-point rating scale, 92.3% of the young and 82.2% of the old rated their health as good or very good.

The Welland sample consisted of 71 individuals, including 21 young (M = 23.4 years) and 50 old (M = 67.0 years). The participants were recruited from the membership of two area churches. As with the Victoria sample, the elderly sample was comprised of reasonably healthy community-dwelling retirees or housewives (85.4%). Subjects in the younger age groups were either attending school (52 3%) or working (47.6%). All rated their health as good or very good. The mean number of years of education in this sample was 13.7 for the young and 13.0 for the old. Further statistical analyses of age and location differences in sample characteristics are reported in the results section.

Materials

Memory Materials. The recall material consisted of two lists, each containing 30 brief descriptions of common experiences or activities (e.g., being caught in the rain, going out for dinner). Most of the items were selected from the Older Persons' Pleasant and Unpleasant Event Schedule (Gallagher & Thompson, 1984), with some additional items devised by the experimenter. Events were selected to represent experiences common to the everyday lives of both age groups and to be neither extremely pleasant nor extremely unpleasant in affective tone. Each list contained 15 pleasant and 15 unpleasant event descriptions. Pleasant and unpleasant events were randomly ordered on each list.

Event Rating Scales. After the memory tasks had been concluded, participants were asked to rate each of the 60 memory items for subjective pleasantness/unpleasantness, based on their own personal experience. A 5-point rating scale was used, with the midpoint (3) representing an affectively neutral event or experience.

Affect-inducing Stories. Three affect-inducing stories (positive, negative, and neutral) were adapted from magazine articles by the experimenter. All were approximately 500 words long (range 474 to 497 words). The affect-inducing stories were selected from a number of alternative stories on the basis of pilot testing with a small sample of young and old subjects. Stories were related in the first person to increase the reader's identification with the narrator. All described a personal experience in the life of the narrator, who was an adult of unspecified age. None

Table 1

Sample Characteristics by Age and Location (Total Sample)

	Young	Old	Total
Sample Size	74	92	166
Welland	21	50	71
Victoria	53	42	95
Age (M yrs.)	21.6	67.0	-
Welland	23.4	68.1	-
Victoria	20.9	65.9	-
Education (M years)	13.4	13.4	13.4
Welland	13.7	13.0	13.3
Victoria	13.2	13.8	13.5
Health (M)*	1.6	1.8	1.7
Welland	1.5	1.8	1.7
Victoria	1.6	1.7	1.7
Vocabulary (M)	10.4	13.6	11.3
Welland	9.9	13.6	12.0
Victoria	10.5	12.7	11.7

*Rated on a 5-Point Scale (1 = Very good)

of the events recounted in the stories matched events on the to-be-remembered memory lists.

The positive mood story, "The Gift of Understanding", reminisced about a young child's pleasure in a trip to the candy store and understanding service by the kindly proprietor. The negative mood story, "For the Love of Anne", described the tragic illness and death of the protagonist's young daughter, emphasizing the parent's sense of helplessness and grief. The neutral mood story "Beginnings" was an autobiographical account of the early life of an unidentified woman. Although a number of personal events were recounted, the story focused on non-affective details surrounding these events.

Two additional non-affective stories were also written to be used as filler stories. These stories were non-narrative, popular science essays. The "Wonder of Winds" described the effect of winds on the environment and "The Light of Day" described the proper care of houseplants.

After reading each story, participants were asked to rate the story on three dimensions - interest, difficulty, and emotional reaction. A 7-point bipolar rating scale was used to rate each dimension. The emotional reaction scale, which served as the mood manipulation check, asked subjects to rate how the story made them feel from very negative and depressed to very positive and uplifted.

Mood adjective checklist. Prior to exposure to the experimental materials, participants were asked to rate their current mood on a 7-point scale analogous to that used in the story rating task. The Profile of Mood States (POMS) questionnaire (McNair, Larr, & Droppleman, 1971) was also administered at this time. This scale contains 65 adjectives pertaining to five mood states (Anxiety, Fatigue, Depression, Vigour, and Well-being) and has been recommended for use with the elderly (McNair, 1972). Subjects were instructed to rate on a 5-point scale how well each adjective described their feelings "at the present time". This served two purposes, (1) to provide a more sensitive measure of the participant's pre-experimental mood states, and (2) to provide a validity check of the global mood scale.

Vocabulary. As a measure of verbal ability, participants were asked to complete the Advanced Vocabulary test (I-V4) of the Kit of Factor Referenced

Cognitive Tests (Ekstrom, French, Harman, & Dermen, 1976). This test contains 18 items in a multiple choice format.

Procedure

Testing took place in small groups of one to four participants and lasted approximately one hour. The Victoria sample was tested in an office or classroom on the university campus. The Welland sample was tested in the boardroom of a local church. Each age group was tested separately.

The testing protocol began with informed consent procedures. Subjects were informed that the main purpose of the study was to examine memory for daily events. They were also told that during the course of the study, they would be asked to read and evaluate a series of stories. The nature of the stories was described, but their affect-inducing properties were not disclosed at this time. (A full debriefing, including the rationale for withholding the information about the story tasks occurred after subjects had completed the study.) Following completion of the standard consent procedures, participants were asked to answer a short questionnaire requesting information about age, educational background, work history, and current health. The POMS was also administered at this time.

The experimental procedure was composed of two interlocked tasks, (1) the memory task, and (2) the story evaluation task. For the memory task, each list of 30 events was typed on a single page and participants were allowed four minutes to read and study the items. Subjects were informed that their memory for the events would be tested following a brief delay. After the delay (during which time, the story task was administered), subjects were allowed seven minutes to write down all of the events they could remember from the list in their own words and in any order.

Each subject participated in two memory trials, one involving a neutral mood induction and one involving the positive or negative mood induction. Mood induction was achieved through reading of the affect-arousing stories. For subjects in the encoding condition, an affect-arousing story was presented prior to the study phase of the memory task and a filler story was presented prior to recall. For subjects in the retrieval condition, the order of stories was reversed, so that a filler story was read prior to studying the memory list and an affect-arousing story was

presented prior to recall.

To ensure maximum effectiveness of the mood manipulation, the story evaluation task was self-paced. This meant that the time interval between learning and recall of the lists was variable, and largely dependent on subject's reading speed. Logistics made it impossible to time these intervals, however, pilot testing revealed that most subjects spent 2 to 2.5 minutes reading and rating the stories. Although the variable time interval between time of learning and time of recall may be viewed as a confound in the study design, it should be recognized that the design did equate the amount of information presented during the retention interval, and therefore, equated for retroactive interference. Interference is likely to be the primary cause of short-term forgetting over the time interval used (Waugh & Norman, 1965), and therefore, is most important to control.

During the course of the study, each participant read and evaluated five stories. A brief story, "Having a Baby" was always presented first as a practise story to familiarize subjects with the nature of the task. All subjects read "Beginnings" in the neutral mood condition and either "The Gift of Understanding" if they were assigned to the positive mood condition or "For the Love of Anne" if they were in the negative mood condition.

A Latin square design was used to counterbalance the order of the neutral and mood conditions, the filler stories, and the memory lists. Within each age group and mood condition, each order of stories and lists was presented to two individuals.

During the interval between memory tests, subjects were asked to complete the Vocabulary test. As a final task, after both memory trials were completed, the event rating scales were administered.

Scoring

Memory recall was scored using a lenient scoring criteria for number of events correctly recalled. Separate scores were calculated for number of pleasant and unpleasant events recalled based on pleasantness/unpleasantness categorization reported by Gallagher and Thompson (1984). Pleasant and unpleasant event scores were summed to produce a total score (Total) representing the number of events correctly recalled (Total = pleasant events + unpleasant events). A mood bias

(Mood Bias) score was also calculated by subtracting the number of unpleasant events recalled from the number of pleasant events recalled (Mood Bias = pleasant events - unpleasant events). Thus, a positive Mood Bias score indicates that relatively more pleasant events were recalled and a negative Mood Bias score indicates that relatively more unpleasant events were recalled.

Analysis

It was argued in the literature review that mood is a variable of intraindividual change and should be studied as such. The present study was designed to allow for the analysis of intraindividual changes in memory performance in response to the induced mood changes.

There has been considerable discussion in the developmental literature about the analysis of change scores (e.g., Bereiter, 1963; Cronbach & Furby, 1970; Labouvie, 1980; Rogosa, Brandt, & Zimowski, 1982). The use of change scores has been strongly discouraged by most authors on the basis that these scores are (1) unreliable and (2) uninterpretable.

Change scores are considered intrinsically unreliable, because the higher the correlation between pre (X) and post (Y) measures, the lower will be the reliability of the change score. However, as Labouvie (1980) has pointed out, the reliability of change scores as calculated in classical test theory is based on the assumption that errors of measurement are uncorrelated. If errors of measurement are positively correlated, the reliability of change scores can actually be higher than the reliability of either of the initial measures. Rogosa et al. (1982) have argued that reliability is a psychometric characteristic of change scores that is not isomorphic with their statistical properties. Thus, they provide the following "motto" for the measurement of individual change:

> "Reliability is not the "be all and end all" in the measurement of change. Statistical properties are important.
>
> a. Low reliability does not necessarily mean lack of precision.
>
> b. The difference between two fallible measures can be nearly as reliable as the measures themselves."

(1980, p.744)

Perhaps more serious than the problem of reliability of difference scores is the issue of validity. Change scores are considered by some authors to be inappropriate because they are frequently observed to be negatively related to initial levels. This means that individuals who start off with initially high levels will change less than individuals who start off with initially low levels. Related to this is the problem of regression towards the mean, another frequently cited drawback to the use of change scores (Furby, 1973).

An alternative to simple change scores that is frequently recommended involves the use of analysis of covariance to adjust for initial level. Using baseline measures as a covariate removes this source of variance from post-treatment scores, and thus, analyzes effects that are unrelated to initial level. Change scores which have been adjusted for pre-treatment scores are referred to as residualized change scores. The difference between the analysis of change scores and the analysis of residualized change scores through analysis of covariance lies in the assumptions made about the regression of pre-treatment on post-treatment scores. Analyzing simple gain scores assumes that the regression coefficient is equal to one. Since in reality, the regression coefficient is always less than one because of errors of measurement and different rates of individual change, the amount of true change is underestimated by an unknown amount. In the analysis of residualized change scores, this problem is avoided because the actual value of the regression coefficient is utilized in calculating treatment effects.

One drawback to the use of ANCOVA in the present study is the assumption of homogeneity of regression. In adjusting for the covariate, group membership is ignored and a pooled regression coefficient is calculated. If there is heterogeneity of regression, i.e, the relationship between pre- and post-treatment effects varies across age groups, than the use of the pooled regression coefficient will produce biased estimates of the true treatment effects. Thus, it will be necessary to establish homogeneity of regression across age groups before proceeding to analysis of residualized change scores.

Even if the assumption of homogeneity of regression can be met, the expected

differences between young and old in memory performance may reduce the power of the analysis to detect significant differences. Although ANCOVA is usually considered to be a more powerful analysis, this is not necessarily the case when nonequivalent groups are being compared. The ANCOVA procedure tests the hypothesis that treatment effects (with the treatment being the mood induction) are equal across age groups at the grand mean of the covariate (the baseline memory performance). The greater the actual mean difference between age groups in baseline performance, the lower will be the power of ANCOVA to detect significant differences. This is because if there is a difference in covariate means and with parallel regression lines (homogeneity of regression), the adjusted means will be closer together. Furthermore, the meaning of residualized change scores in non-equivalent groups has been questioned. In the present study, comparisons of mood induced memory effects at the grand mean of baseline memory performance will not be representative of the actual memory performance of either age group.

The discussion now appears to have come full-circle. Starting from the premise that mood and memory interactions should be investigated from an intra-individual change perspective, it was noted that simple change scores are considered by many to be unreliable and uninterpretable. The recommended alternative, residualized change scores, cannot be used to compare age groups if there is heterogeneity of regression across groups, and is less powerful and possibly inappropriate when comparing groups differing in baseline performance.

The solution adopted for the present study involved the analysis of both simple and residualized change scores. As Huitema (1980) has noted, these two analyses address two different issues. Analysis of unconditional change scores addresses the question, are there mean age differences in memory change after mood induction? Analysis of covariance addresses the question, are there age differences in memory change after mood induction that are conditional on baseline memory performance? If age differences in mood induced memory change are eliminated when variance due to baseline memory performance is eliminated, it can be inferred that the age effect is mediated by memory performance differences between age groups.

As a final note on the method used to analyze mood induced memory change in the present study, it may be worthwhile to point out that analysis of simple change scores in equivalent to repeated measures analysis of pre-/post-treatment memory scores, but is more straightforward and parsimonious (Huck & McLean, 1975). Similarly, the analysis of residualized change scores adjusted for neutral mood memory performance is statistically equivalent to analysis of post-treatment scores adjusted for pre-treatment of memory performance (Huitema, 1985).

Chapter Five

Results

Data analysis proceeded through a series of three stages. In the first stage, descriptive analyses of personal and demographic characteristics of the sample were conducted in order to identify age or location differences that might influence subsequent interpretation of mood and memory interactions. The second stage focused on mood variability -- both interage group differences in pre-existing mood states and intraindividual mood change in response to the mood manipulation. The purpose of the former was to identify the presence and extent of any pre-existing group differences in mood. The purpose of the latter was to establish the effectiveness of the story task as a mood inducer, and to identify individual subjects who met the pre-established criteria for mood change in response to the story task. During the third stage of the data analyses, the central experimental hypotheses concerning age-related differences in the effect of mood on memory were tested using only young and old participants who were responsive to the mood manipulation. Because of the well-known interpretive difficulties of the quasi-experimental design, a series of analyses were conducted. All of the analyses involved testing of mean age group differences in mood-induced intra-individual memory change. To clarify the interpretation of age differences, unconditional analyses of memory change scores were compared to analyses of change scores adjusted for initial differences in mood, vocabulary, memory performance and/or subjective pleasantness/unpleasantness of the to-be-remembered events. The goal of these comparisons was to determine the extent to which observed age differences in mood-induced memory change could be attributed to pre-existing age differences in mood, verbal ability, memory, or affective response to the memory stimuli.

Sample Characteristics

To examine age and location differences in descriptive characteristics of the sample, a multivariate analysis of variance (MANOVA) was conducted on six dependent variables; vocabulary, education, health, and global mood rating. Location differences in baseline memory performance were also of interest, so Mood Bias and Total scores from the neutral mood condition were also included as

dependent variables in this analysis. The entire sample of 166 subjects was included.

The multivariate test of significance for the age main effect was highly significant (F (6, 157) = 8.79, p < .01). Univariate analyses revealed that the old subjects rated their moods as more positive (F (1, 162) = 22.89, p < .01), but their health as less good than the young (F (1, 162) = 3.80, p = .05). It should be noted that the mean health rating for the older sample was still in the good category (M = 1.8 ± .8). Howeve , this was reliably lower than the good to very good rating that the average young subject reported (M = 1.6 ± .5). Vocabulary level was reliably higher in the older age group (F (1, 162) = 47.78, p < .00), however, memory performance in the neutral mood condition was significantly poorer (F (1, 162) = 12.58, p < .00). There was also a marginally significant age effect on Mood Bias scores (F (1, 162) = 3.44, p = .065). Both age groups showed a slight bias favouring the recall of pleasant events, with the older age group having a tendency towards a stronger positive bias in their recall. (More detailed analyses of age differences in mood and memory performance will be presented in a later section.) No significant age differences were found for educational attainment.

Location differences were tested as simple main effects within each age group. The MANOVA for the location effect was nonsignificant in the young age group (F (6, 157) = 1.26, p > .05) and significant for the old age group (F (6, 157) = 2.78, p < .05). Univariate comparisons in the older age group revealed that the Victoria sample scored significantly higher on the Vocabulary test than did the Welland seniors (F (1, 162) = 8.53, p < .01). No other differences approached statistical significance.

Age Differences in Mood

As noted above, there were significant age differences in self-evaluations of current mood using the global bipolar scale. The purpose of the next analysis was to examine the pattern of age differences in pre-existing mood across the five mood states represented on the POMS. Analyzing the total sample of subjects, a MANOVA indicated that there was a significant overall age effect (F (5,158) = 10.55, p < .00) on self-rated mood as measured by the POMS. Univariate comparisons revealed significant differences on all of the mood measures, with the

Table 2

Mean Scores on the Mood Scales (POMS and Bipolar) by Age (Total Sample)

Scale	Young	Old	Total
	M (S.D.)	M (S.D.)	M (S.D.)
Bipolar rating	4.7 (1.0)	5.6 (1.1)	5.2 (1.1)
Profile of Mood State Scales			
Depression	26.2 (7.8)	23.4 (5.3)	24.7 (6.7)
Fatigue	22.7 (8.8)	14.6 (5.0)	18.3 (8.0)
Well Being	26.3 (6.2)	28.8 (7.5)	27.6 (7.0)
Vigour	26.6 (7.7)	30.2 (8.3)	28.6 (8.2)
Anxiety	19.9 (5.9)	18.4 (4.6)	19.0 (5.3)

exception of the anxiety scale. As can be seen in Table 2 showing mean score on the POMS, the old subjects were generally in better moods than the younger subjects. They rated their moods as less depressed (F (1, 162) = 7.5, $p < .05$), less fatigued (F (1, 162) = 53.5, $p < .00$), more vigourous (F (1, 162) = 7.92, $p < .01$), and higher in well-being (F (1, 162) = 5.10, $p < .05$).

Participants scoring more than two standard deviations above the total sample mean on the Positive and Negative Mood Components were excluded from further data analysis. This was to ensure that subjects were in a relatively neutral mood prior to being exposed to the memory stimuli or the affect induction procedures. Five young subjects and three old subjects were excluded due to failure to meet this mood criterion.

Mood Manipulation Effects

The effectiveness of the affect-arousing stories was assessed by asking subjects about their emotional response to the stories. Although global mood rating scales are commonly used in mood induction research, the validity of the measure is unknown, particularly in an older adult age group. Therefore, as a preliminary check on the validity of this measure, the relationship between the POMS mood scale scores and the bipolar mood rating was examined. First order correlations between the POMS subscales and the global mood rating are shown in Table 3. There was a significant correlation between all of the POMS subscales and the global measure (range (young) r = -.55 to .56; (old) r = -.31 to .31). Entered as a set, utilizing standard multiple regression procedures, the five POMS scales accounted for almost half the variance in the global mood measure (R^2 = .49, F (5,67) = 12.86, $p < .00$) for the young subjects. For the old sample, the five POMS scales accounted for only 21% of the variance in the global mood measure (F (5, 84) = 4.4, $p < .01$). It can be concluded that single scale measure of mood has some validity as a global indicator of current mood. However, the attenuated R^2 in the old sample, suggest that the scale may be somewhat less sensitive for this age group.

Table 4 shows the mean scores on the story rating task by age and story type. The stories appeared to have the desired effect on self-reported mood. A 2 (age) by 4 (story) by 2 (mood condition) MANOVA with repeated measures on the story

Table 3

First Order Correlations of POMS Scales by Age (Total Sample).

	POMS Scales					Bipolar
	Dep.	Fat.	Well.	Vig.	Anx.	
Depression						
Y	1.00					
O	1.00					
Fatigue						
Y	.32**	1.00				
O	.50**	1.00				
Well-Being						
Y	-.38**	-.11	1.00			
O	-.04	-.08	1.00			
Vigour						
Y	-.30**	-.34**	.71**	1.00		
O	.01	-.12	.81**	1.00		
Anxiety						
Y	.57**	.21*	-.35**	-.02	1.00	
O	.60**	.52**	-.20*	-.00	1.00	
Bipolar Mood Rating						
Y	-.57**	-.36**	.56*	.49**	-.37**	1.00
O	-.31**	-.25**	.31**	.31**	-.17*	1.00

Table 4

Story Ratings by Age (Total Sample)

	Story Type				
Dimension	Positive M (S.D.)	Negative M (S.D)	Neutral M (S.D.)	Filler M (S.D.)	Filler M (S.D.)
MOOD EFFECT					
(7 = Positive Mood)					
Young	5.9 (0.6)	2.5 (0.8)	4.2 (0.8)	4.4 (1.5)	4.4 (1.6)
Old	6.0 (0.9)	2.9 (1.3)	4.6 (1.2)	5.0 (0.9)	4.8 (1.1)
INTEREST					
(7 = Uninteresting)					
Young	3.1 (1.7)	3.0 (1.5)	5.0 (1.4)	4.1 (1.6)	4.3 (0.7)
Old	3.2 (2.0)	3.2 (2.0)	4.0 (1.7)	3.2 (1.8)	3.6 (1.1)
DIFFICULTY					
(7 = Easy)					
Young	6.4 (1.0)	6.3 (0.7)	6.1 (1.1)	5.9 (1.1)	6.2 (0.9)
Old	6.4 (0.5)	6.5 (0.6)	6.3 (0.7)	5.9 (1.0)	6.1 (0.9)

task was conducted on the three dependent variables of story interest, difficulty and mood effect. The mood condition factor was necessary since participants read each of the three neutral stories but only one of the two mood stories. The first level of the story task represented the mood story, and interactions of this level with mood condition provided the relevant comparisons of the positive mood-inducing story and the negative mood-inducing story. Planned contrasts were conducted to compare, (1) the mood stories with the remaining three stories, (2) the neutral story with the two filler stories, and (3) the two filler stories with each other.

The main interest was, of course, the effectiveness of the mood manipulation, as indicated by story comparisons across the mood rating question. Univariate analyses on this variable revealed a significant mood by story effect (F (1, 162) = 106.9, $p < .00$). The planned contrasts indicated that this was due to significant differences between the two mood stories and between the mood stories and the remaining neutral and filler stories. Thus, as expected, the negative mood story was rated as having a significantly depressing effect on readers' mood and the positive mood story was rated as having a significantly uplifting effect on readers' mood. As can be seen in Table 4, the neutral and filler stories were rated in the mid-point of the mood rating scale and did not differ significantly from each other. There were no significant age main effects or interactions in mood effect ratings.

Although the questions on story interest and difficulty were included only to increase the plausibility of the story rating task, age and story differences were examined on these variables. As evident in Table 4, all of the stories were rated as very easy to understand by both age groups. Statistical analyses confirmed that there were no significant differences between groups on any of the five stories. There was a significant age by story effect for the interest ratings (F (1, 162) = 4.22, $p < .01$). Both young and old found the mood stories more interesting to read than the neutral and filler stories. Young and old did not differ in their ratings of the interest level of the mood stories but the old subjects found the neutral and filler stories more interesting than did the young. There were no other significant differences on this dimension.

In sum, the story task had the anticipated effect on self-reported mood,

producing a positive emotional response in the positive mood condition and a negative emotional response in the negative mood condition. The overall mood effect was equivalent across the two age groups. (However, if there is not age-equivalence on this scale as suggested by the validity analyses, this age comparison is non-interpretable.) Both young and old rated the two mood stories as equally easy to understand and interesting to read. The remaining three stories, used in the neutral mood condition and as filler stories, were all rated as having a neutral effect on readers' mood, and were equally easy to understand. The old subjects, however, did find these stories more interesting than the young.

Although the mean effect of the story task was in the anticipated direction, there was significant individual variability in response to the stories. Only subjects who responded to the mood manipulation, based on criteria established before the experiment began, were included in the experimental sample. A mood induction effect score was calculated by subtracting mood response in the neutral condition from the mood response in the mood condition. For both the positive and negative mood conditions, a change in self-reported mood of at least one unit from the neutral mood condition was required for assignment to the experimental sample. Furthermore, a positive mood response required a score of five or more on the mood rating scale. A negative mood response required a score of three or less. Table 5 shows the final sample sizes and mood effect scores for the subjects who met or failed to meet the experimental criteria.

Both age and mood type influenced the effectiveness of the mood manipulation. Positive moods were more easy to induce than negative moods, being effective in 94% of the positive subsample compared to a 70% effectiveness rate for the negative mood condition (2 (1, N = 166) = 14.47, $p < .05$). Young subjects were more responsive to the affect arousing stories (89%) than were the old (73%) (2 (1, N = 166) = 5.79, $p < .05$).

Correlations between the mood induction effect and personal characteristics of the participants are shown in Table 6. Pre-existing mood, as rated by the POMS, had the strongest relationship with mood manipulation effect. For the old subjects, the positive mood induction was more effective in subjects who rated their mood

Table 5

Mood Manipulation Effectiveness by Age and Mood Condition

	Positive Mood		Negative Mood	
	Met criteria	Didn't meet criteria	Met criteria	Didn't meet criteria
Young:				
N	34	1	32	7
Mood Effect				
M	1	0.2	-2.1	0.9
Old:				
N	33	3	33	21
Mood Effect				
M	2.1	0.0	-2.6	-0.3
Total				
N	67	4	65	28
Mood Effect				
M	1.9	0.0	-2.3	0.6

Table 6

Correlations between Mood Effect and Descriptive Variables (Total Sample)

Variable	Positive Mood		Negative Mood	
	Young	Old	Young	Old
Mood				
(Bipolar Rating)	.02	-.10	-.02	-.10
POMS -Depression	.02	.26*	.19	-.15
Anxiety	.07	.25*	.36*	-.25*
Fatigue	.05	-.10	.19	-.01
Well-Being	-.04	-.31*	-.23	.15
Vigour	.00	-.09	-.32*	.06
Health	-.06	.08	.17	-.22
Education	.04	-.14	.02	.12
Vocabulary	.07	.12	-.16	.25*

* $p < .05$

as more depressed (r = .26, p < .05), more anxious (r = .25, p < .05), and less positive (r [well-being] = -.31, p < .05). Increased anxiety was related to decreased effectiveness of the negative mood manipulation (r = -.25, p < .05) for the old subjects. In contrast, for the young, increased anxiety was associated with a stronger negative mood effect (r = .36, p < .05). As well, for the young sample, low levels of vigour were associated with increased response to the negative affect-arousing story (r = -.32, p < .05). Overall then, for young subjects, negative mood inductions were most effective for tired and/or anxious participants and tended to make their moods more negative. In contrast, old participants who came to the experiment in arelatively negative mood were most responsive to the positive mood induction which had an uplifting effect on their moods.

In addition to the mood variables, education, vocabulary, and self-rated health were also examined in relation to the effectiveness of the mood manipulation. Only vocabulary showed a significant relationship with negative mood effects for the old subjects (r = .25, p < .05). Thus, increased verbal ability in the elderly was associated with increased affective responsiveness to the negative story.

Experimental Sample

Two mood criteria were established to select subjects for the experimental sample. Participants meeting the criteria, (1) reported a mood change in the appropriate direction, after reading the affect-arousing stories, and (2) were neither extremely negative nor extremely positive in mood tone. After excluding participants who did not meet these criteria, the final experimental sample consisted of 128 subjects, with 16 subjects in each of the experimental conditions.

Age Differences in Memory Performance

Before proceeding to analysis of mood-related changes in memory performance, mean levels of memory performance in the neutral mood condition were examined across age groups and experimental conditions. Across the experimental sample, there was a mean recall of 5.55 pleasant events and 4.78 unpleasant events, for a Total recall of 10.13 events and a Mood Bias score of 0.80. Thus, in the neutral mood condition, there was a slight but statistically significant bias favouring the recall of pleasant events (t (128) = 3.58, p < 01).

A 2 (Age) by 2 (Mood) by 2 (Learning/recall) MANOVA was conducted on Mood Bias scores and Total scores received in the neutral mood condition. As was found for the total sample, there was a significant overall effect of age (F (2, 119) = 6.70, $p < .01$). Univariate tests showed that both dependent variables contributed to this significant effect (Mood Bias, F (1, 120) = 8.95, $p < .01$; Total, F (1, 120) = 3.65, $p = .058$). Old subjects recalled fewer events overall than young subjects, but showed a stronger bias toward recall of pleasant events.

Although the presence of significant age differences in level of memory recall was anticipated, there was also an unexpected significant main effect of mood (F (2,119) = 3.53, $p < .05$), and a significant interaction of mood by age by learning/recall (F (2, 119) = 4.49, $p < .05$). Univariate tests showed that in both cases the significant effect was due to differences in Mood Bias scores across conditions. Subjects assigned to the negative mood condition showed a stronger bias towards recall of pleasant events than subjects assigned to the positive mood condition (F (1, 120) = 40.50, $p < .01$). Probing the three way interaction of age by mood by learning/recall condition for happy bias scores (F (1, 120) = 22.78, $p < .05$), showed that this effect was due to the performance of the old subjects assigned to the negative mood recall condition. This group of subjects showed a very strong positive bias in their recall relative to that shown by other subjects.

Examining the actual number of pleasant and unpleasant events recalled, suggest that the Mood Bias was due to a disproportionate recall of pleasant events. For instance, old subjects assigned to the negative mood recall condition recalled on average 7.5 pleasant events compared to an average of 5.9 pleasant events recalled by the young and an average of 4.5 pleasant events recalled by the remaining older subjects.

The extreme performance of the participants in this condition also contributed disproportionately to the previously noted significant main effects of age and mood on Mood Bias scores. Post hoc comparisons, using Tukey's Least Significant Difference test, showed that no other differences in Mood Bias scores were significant in the recall or learning condition. Thus, if the performance of old participants in the negative mood recall condition were excluded, there were no age

(or mood condition) differences in Mood Bias scores. The overall Mood Bias score was reduced to 0.51, which was still significantly different from 0 (t (112) = 2.3, p < .05).

To summarize the pattern of age differences found with no mood manipulation, the old recalled fewer pleasant and fewer unpleasant events than young subjects, but both age groups showed an equivalent but slight bias towards the recall of pleasant events.

Since the bias in memory performance in the one older group presents a serious interpretive problem to the planned analyses of mood-related memory effects, a series of follow-up analyses were done in an attempt to uncover the source of the bias. These analyses focused on two potential sources of bias, (1) sampling effects, and (2) selection effects.

The potential confound due to sampling effects was investigated by examining group differences across experimental conditions in background characteristics and in neutral memory performance after adjustment for these covariates. The goal of these analyses was to identify pre-existing differences between the experimental groups that may have contributed to differences in memory performance in the neutral mood condition.

As the first step, a 2 (Age) by 2 (Mood) by 2 (Learning/Recall) MANOVA was conducted on the following dependent variables, vocabulary level, education, location, self-rated health, and POMS scores. There was a significant main effect of age (F (9, 115) = 6.77, p < .00). As has been previously reported, there were significant age differences in vocabulary level, initial mood (depression, fatigue, vigour, well-being), self-rated health, and location. The multivariate analysis also showed a significant age group by learning/recall interaction (F (9, 115) = 3.06, p < .01), which was due to a significant univariate location effect (F (1, 120) = 13.09, p < .00). There were more Welland seniors in the learning condition and more Victoria seniors in the recall condition. No other main effects or interaction were significant for the multivariate analysis of background characteristics across experimental conditions. The multivariate F for the three way interaction of age by mood by learning/recall was less than one, and none of the univariate F's for this

interaction approached statistical significance ($p > .10$). Therefore, there did not appear to be any obvious difference between older subjects in the negative mood recall condition and the other subjects.

As a further test of possible sampling bias, each of the nine background variables was entered individually and as a group into a 2 (Age) by 2 (Mood) by 2 (Learning/recall) ANCOVA with Mood Bias scores as the dependent variable. Adjusting for these covariates individually or collectively did not eliminate the significant interaction of age by mood by learning/recall condition (F (1, 107) = 8.24, $p < .00$). This suggests that none of these variables was critical in explaining the bias in scores in the negative mood retrieval condition for the older subjects. This, of course, does not eliminate sampling biases as an explanation as the critical variable may not have been identified.

The next set of analyses examined selection effects as a potential source of memory bias. As has been discussed above, participants were selected into the experimental sample on the basis of their response to the affect-arousing story. This selection process may have contributed to the differences in pleasant event recall, if subjects who responded to the negative mood induction differed from those who did not. To test this hypothesis, a 2 (learning/recall) by 2 (+/- response to mood /manipulation) ANOVA on Mood Bias scores in the neutral mood condition was conducted. Only older subjects in the negative mood condition were selected for these analyses, since this was the only mood condition that had sufficient numbers of subjects who failed to respond to the mood manipulation. Table 7 shows averaged Mood Bias scores for older subjects who responded or failed to respond to the mood manipulation in the learning and recall condition.

There was a significant interaction of learning/recall by response to mood manipulation (F (1, 46) = 12.36, $p < .05$). Post hoc comparisons revealed that subjects who responded to the negative mood induction in the recall condition showed a stronger bias towards the recall of pleasant events, relative to participants who failed to respond to the negative mood induction and relative to participants who responded to the negative mood manipulation in the learning condition. The Mood Bias score of those who responded to the negative mood manipulation in the

Table 7

Neutral Mood Memory Performance by Condition and Response to Negative Mood Manipulation. (Older Age Group)

Condition	Responded To Mood Manipulation			Failed To Respond		
	n	X	(S.D.)	n	X	(S.D.)
NEGATIVE MOOD: OLD						
Learning						
Pleasant Events	16	4.4	(2.2)	5	4.6	(2.3)
Unpleasant Events		3.4	(1.8)		3.4	(0.9)
Recall						
Pleasant Events	16	7.5	(2.0)	13	4.5	(1.8)
Unpleasant Events		4.7	(2.3)		4.5	(2.3)

learning condition did not differ from those who did not respond to the mood manipulation in the learning or recall condition.

This leads to the conclusion that selection effects contributed to the bias in memory performance in the neutral mood condition. Older subjects who responded to the negative mood induction at time of recall performed differently than subjects who did not respond to this mood induction and differently as well from subjects receiving the mood induction at time of learning. As the analyses above revealed, this bias did not appear to be related to any identifiable personal or demographic differences between this group and the other experimental groups.

Age Differences in the Influence of Mood on Memory Change

Change scores representing intraindividual changes in memory performance in response to the induced mood changes were calculated by subtracting memory performance scores in the neutral mood condition from memory performance scores in the treatment condition (positive or negative mood at time of learning or recall). Two change scores were calculated for each subject, (1) Mood Bias change scores, and (2) Total change scores. These unconditional change scores were analyzed using a 2 (age) by 2 (mood) by 2 (learning/recall) MANOVA with two dependent variables, Mood Bias change and Total change. Because of the selection effect in the one recall condition, effects were tested as simple main effects of mood and age and their interaction within the learning and recall conditions.

Unconditional Gain Scores. Mean Mood Bias and Total gain scores by age and experimental condition are shown in Table 8 and Figures 1 and 2. The first analysis examined list and order effects in a 2 (age) by 2 (mood) by 2 (learning/recall) by 2 (list) by 2 (order) MANOVA on Mood Bias change and Total change scores. There were no significant main effects or interactions of list or mood condition order so these effects were collapsed in subsequent analyses.

After removing the list and mood order factors, there were no significant mood, age, or age by mood interactions in the learning condition. In the recall condition, the combined dependent variables were significantly affected by mood (F (2, 119) = 7.42, $p < .001$), age (F (2, 119) = 9.39, $p < .01$), and the interaction of age and mood (F (2,119) = 6.20, $p < .01$.

To investigate the effects of significant multivariate main effects and interactions in the recall condition, univariate tests of each dependent variable were conducted. For the Mood Bias change scores, only the simple main effect of mood (F (1, 120) = 14.57, $p < .001$) was statistically significant. The mood effect was due to a significant decrease in Mood Bias in the negative mood condition, indicating that mood congruent effects on recall were evident only in this condition. The absence of a significant age effect or mood by age interaction confirm what is obvious from inspection of the mean scores presented in Table 8; viz, both age groups showed equivalent changes in Mood Bias in response to induced negative moods. Thus, the hypothesis that older adults would show stronger mood congruity effects was not confirmed.

Qualitative age differences in mood congruity effects had also been predicted and were tested by examination of interactions of mood by event type within age. Since Mood Bias scores were calculated by simple subtraction of unpleasant events from number of pleasant events recalled, the main effect of mood on Mood Bias change scores is identical to the interaction of mood by event type using a repeated measures design (Huck & McLean, 1975). Although both age groups demonstrated equivalent and statistically significant mood congruity effects in the negative mood condition, age differences in the pattern of mood effects across pleasant and unpleasant event recall remain a possibility. This possibility was pursued by examining the mood by event type interaction within each age group (see Figure 3). Only the negative mood recall condition was examined since this was the only condition in which significant mood congruity effects were evident.

To compare mood effects across pleasant and unpleasant events within each age group, pairwise comparisons using Tukey's Honestly Significant Difference Test were performed, using the mean square error term from a 2 (Age) by 2 (Mood) by 2 (Learning/recall) by 2 (Event type) repeated measures ANOVA on pleasant and unpleasant event gain scores. The significant change in Mood Bias scores in the negative mood recall condition was explained by a significant increase in the recall of unpleasant events for the young subjects (t (120) = 3.24, $p < .05$) and a significant decrease in the recall of pleasant events for the old subjects (t (120) =

Table 8

Memory Performance by Age and Experimental Condition (Experimental Sample)

Condition	Pleasant Events (P)		Unpleasant Events (UP)		Mood Bias (P - UP)		Total Score (P + UP)	
	X	(SD)	X	(SD)	X	(SD)	X	(SD)
LEARNING: POSITIVE MOOD								
Young (n = 16)								
Control	5.6	(2.0)	6.3	(2.0)	-0.6	(1.6)	11.9	(3.7)
Treatment	5.4	(2.3)	4.4	(1.6)	1.0	(2.7)	9.8	(2.9)
Old (n = 16)								
Control	5.1	(2.9)	4.1	(2.1)	1.0	(2.6)	9.1	(4.3)
Treatment	5.6	(1.9)	4.1	(2.6)	1.5	(2.1)	9.8	(3.9)
LEARNING: NEGATIVE MOOD								
Young (n = 16)								
Control	6.1	(2.2)	5.6	(2.2)	0.6	(2.4)	11.7	(3.8)
Treatment	6.3	(2.5)	5.0	(2.4)	1.3	(1.9)	11.3	(4.6)
Old (n = 16)								
Control	4.4	(2.2)	3.4	(1.8)	0.9	(1.6)	7.8	(3.7)
Treatment	4.7	(1.7)	3.0	(1.7)	1.7	(2.1)	7.7	(2.7)

Table 8 (cont.)

Memory Performance by Age and Experimental Condition (Experimental Sample)

Condition	Pleasant Events (P)		Unpleasant Events (UP)		Mood Bias (P - UP)		Total Score (P + UP)	
	X	(SD)	X	(SD)	X	(SD)	X	(SD)
RECALL: POSITIVE MOOD								
Young (n = 16)								
Control	6.0	(3.1)	5.5	(2.3)	0.5	(3.1)	11.5	(4.4)
Treatment	6.4	(2.1)	5.5	(1.8)	0.9	(2.3)	11.9	(3.0)
Old (n = 16)								
Control	4.1	(2.2)	4.0	(2.6)	0.1	(2.6)	8.1	(4.1)
Treatment	4.1	(2.6)	3.8	(1.8)	0.3	(3.1)	7.9	(3.3)
RECALL: NEGATIVE MOOD								
Young (n = 16)								
Control	5.7	(1.8)	4.6	(2.1)	1.1	(2.1)	10.3	(3.3)
Treatment	5.8	(2.1)	7.0	(2.8)	-1.2	(2.6)	12.8	(4.3)
Old (n = 16)								
Control	7.5	(2.0)	4.7	(2.3)	2.8	(2.8)	12.2	(3.3)
Treatment	4.3	(2.0)	4.3	(2.7)	0.0	(3.2)	8.6	(3.4)

Figure 1

Mood Bias Change Scores by Age and Mood Condition

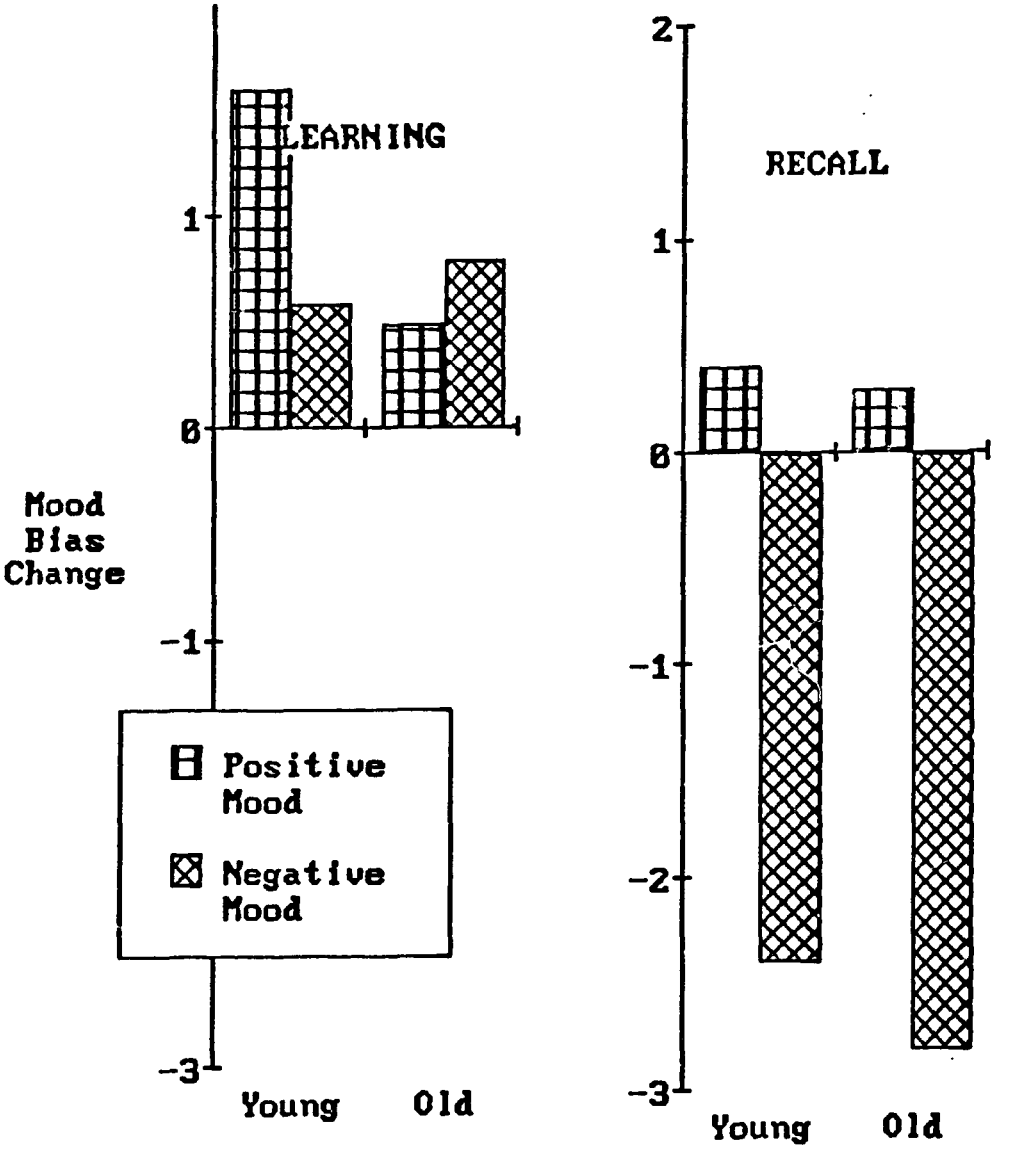


Figure 2

Total Change Scores by Age and Mood Condition

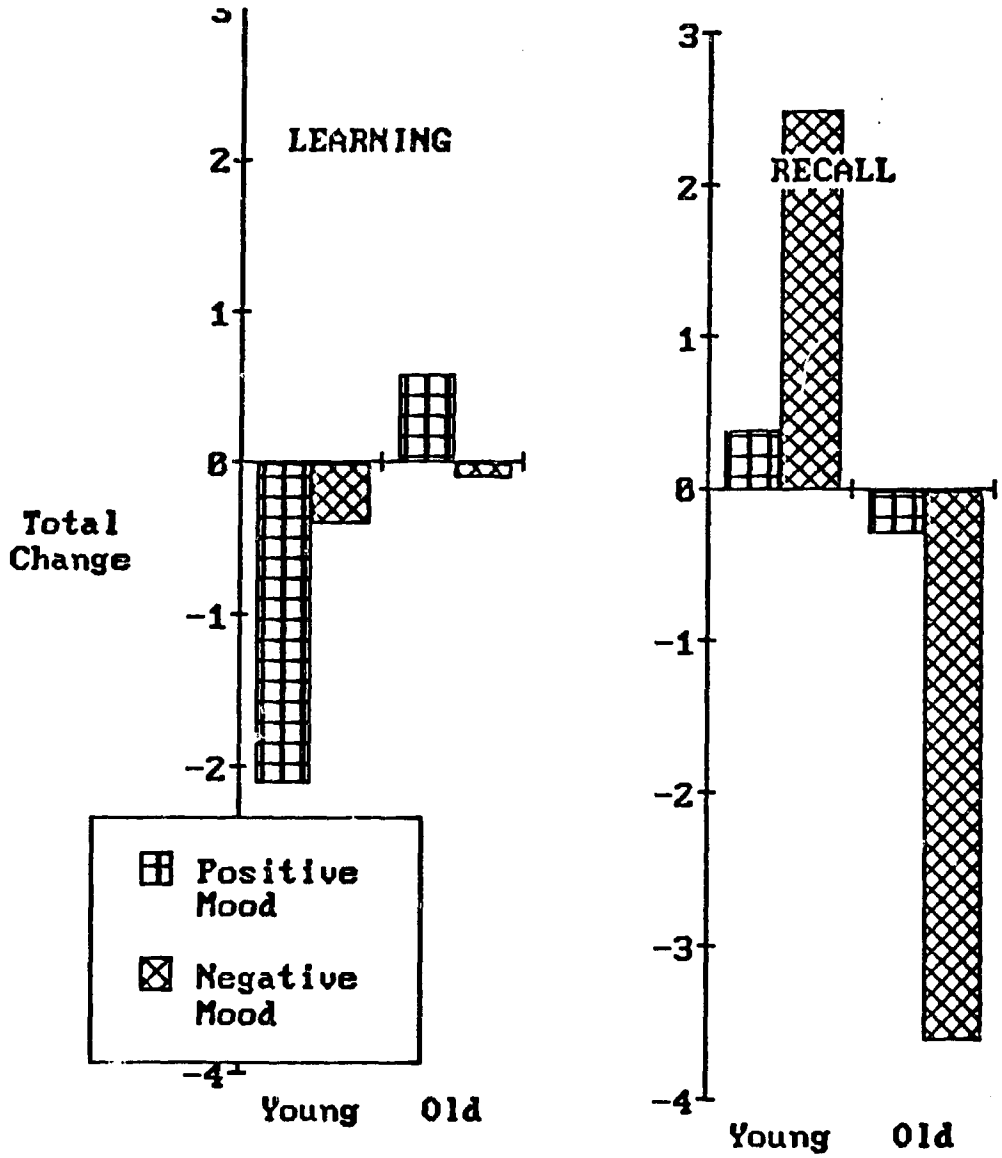
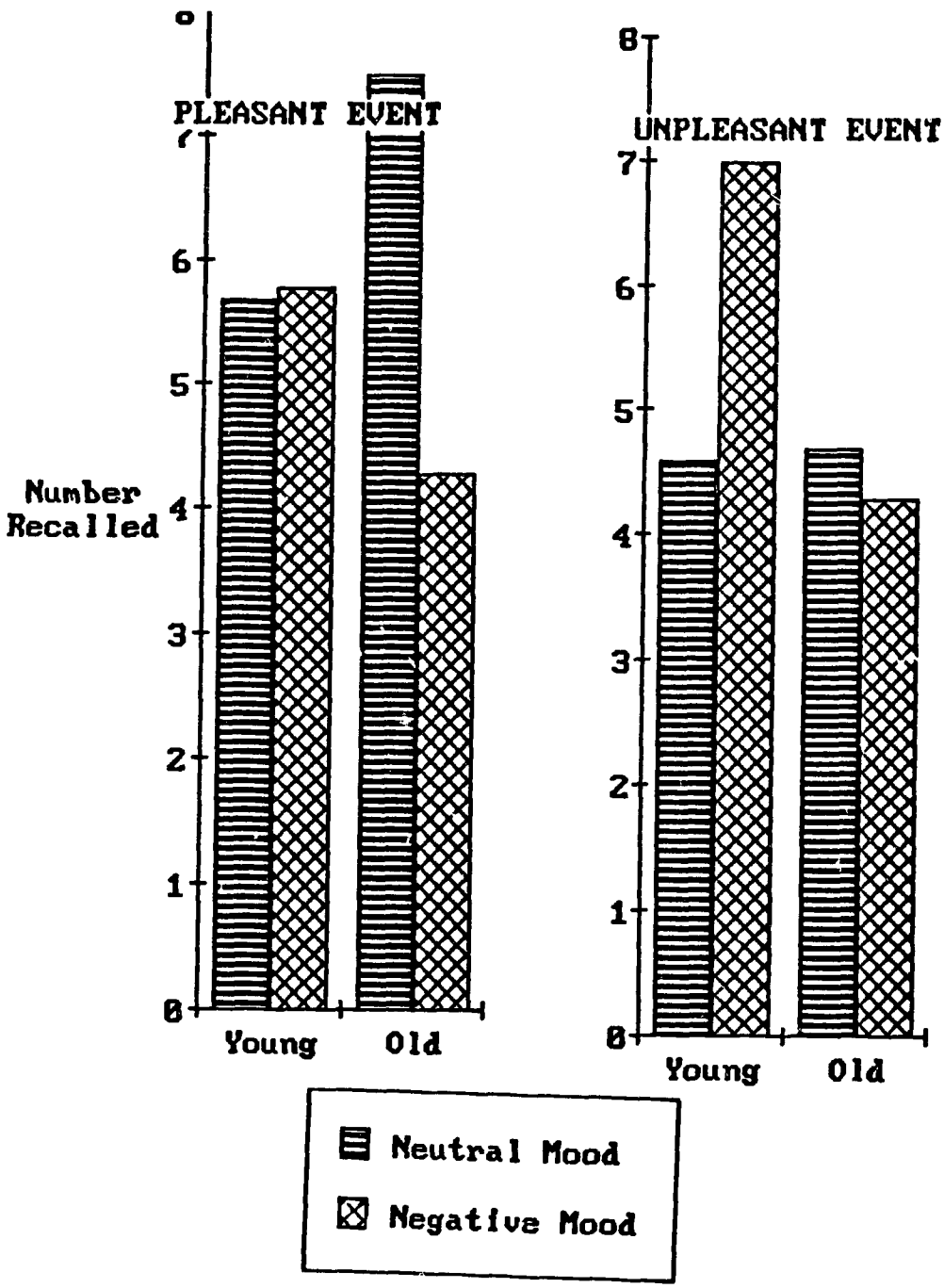


Figure 3

Pleasant and Unpleasant Event Scores (Negative Mood Recall Condition).



4.16, $p < .05$). Qualitative age differences were, therefore, evident in the pattern of mood congruity effects for young and old in the negative mood recall condition. However, it will be recognized that the observed effects were the reverse of the predicted pattern.

Turning to Total change scores, univariate analyses revealed a significant age by mood interaction ($F(1,120) = 12.49$, $p < .001$) in the recall condition. Pairwise comparisons revealed that this was due to significant age differences in total recall change scores in the negative mood condition but not in the positive mood condition. Total memory recall declined for the elderly depressed, relative to the young depressed who showed an overall increase in Total recall ($t(120) = -5.57$, $p < .01$). It is interesting to note that the change in Total recall is almost entirely accounted for by mood congruency effects. For example, young subjects showed an average increase of 2.4 unpleasant events in the negative mood recall condition. Their total score gain in the same condition was 2.5 events. Old subjects recalled, on average, 3.2 fewer pleasant events, and 3.6 events in total.

To summarize, the results of the analyses of raw change scores suggest that the experimentally induced mood states had significant effects on memory performance only in one experimental group, the negative mood recall condition. In this condition, significant mood congruent memory change and global processing effects were evident. Hypotheses concerning age differences in the effect of mood on memory were not supported. There were no age or age by mood effects on Mood Bias change scores, and thus, the prediction concerning quantitative age differences in mood congruity effects in favour of the old was not supported. Qualitative age differences in mood congruity effects were demonstrated, but in the opposite direction than had been predicted. Mood congruity effects in the young were traced to their enhanced recall of negative events in a negative mood. For old subjects, an equivalent overall mood congruity effect resulted from a decline in recall of positive events in a negative mood. Changes in Total memory recall were also statistically significant in the negative mood recall condition, but the direction of the effect differed with age. Young subjects showed an increase in total recall and old subjects showed a decline in total recall.

Conditional Gain Score Analyses. The next set of analyses examined age differences in the effect of mood on memory performance, using change scores adjusted for memory performance in the neutral mood condition. As in the previous analysis, Mood Bias change and Total change scores were used as the dependent variables in a 2 (Age) by 2 (Mood) by 2 (Learning/recall) MANCOVA with scores in the neutral mood condition acting as a covariate. Mood Bias control scores were used as the covariate for Mood Bias change scores and Total control scores were used as the covariate for the Total change scores. As noted previously, after covarying out initial levels of performance, the residualized change score represents mood-induced memory change that is uncorrelated with initial performance levels.

Tests of the homogeneity of regression assumption across each dependent variable revealed that this assumption was not violated (Mood Bias $F < 1, p > .10$; Total $F = 1.04, p > .10$). This means that, despite age differences in mean levels of memory performance, the regression of neutral memory performance on memory change scores was statistically equivalent across age and treatment groups. Therefore, it can be concluded that treatment effects were equivalent across the varying levels of memory performance and covariance analyses could proceed without violation of the assumption of homogeneity of regression.

As with the unconditional gain score analysis, effects were tested as simple main effects of age and mood and their interaction within the learning and recall condition. Results of MANCOVA did not differ from those found using MANOVA. There were no significant main effects or interactions in the learning condition. In the recall condition age (F (2, 117) = 14.01, $p < .001$, mood (F (2,117) = 3.07, $p = .05$, and the interaction of mood by age (F (2, 117) = 3..52, $p < .05$) remained statistically significant.

Univariate tests revealed that for both Mood Bias scores and Total gain scores, the covariates contributed significantly to the dependent variable as indicated by the significant regression effects (Mood Bias F (1, 119) = 63,04, $p < .00$; Total F (1, 119) = 35.30, $p < .00$). Calculating the proportion of change score variance that could be accounted for by baseline memory performance indicated that 29.66 % of the variance in Total score change was related to level of neutral mood memory

performance. Similar calculations showed that 52.97% of the variance in Mood Bias change could be accounted for by Mood Bias in the neutral mood condition. After accounting for baseline levels of memory performance, there was still a significant effect of mood on Mood Bias change scores for the recall condition. As was found with unadjusted gain scores, scores in the negative mood condition showed a significant decline relative to Mood Bias change scores in the positive mood condition. Inspection of the adjusted means (see Table 9) shows that the Mood Bias change for the old subjects was attenuated after adjustment for Mood Bias neutral mood scores. However, age differences even in adjusted Mood Bias change scores were statistically nonsignificant.

The significant mood main effect in the negative mood condition was followed up with an examination of mood by event type interactions within each age group. Pairwise comparisons were calculated using an error term corrected for differences between covariate means in the cells being compared (Huitema, 1980). For young subjects, unpleasant events were recalled significantly better in the negative mood condition, relative to the change in recall of positive events ($t = 2.84$, $p < .05$) and relative to unpleasant gain scores in the positive mood condition ($t = 2.95$, $p < .05$). For old subjects, there was still a significant decline in the recall of pleasant events, although the adjusted pleasant event gain score for the negative mood condition was significantly lower only in comparison to the change in recall of unpleasant events in this condition ($t = 2.64$, $p < .05$) and not relative to the performance of age-matched controls in a positive mood ($t = 1.19$, $p > .05$).

Because of the significant differences in pre-existing mood and vocabulary between the two age groups, POMS mood scores and vocabulary were also used as covariates in the analysis of Mood Bias change and Total change scores. Tests of homogeneity of regression across age groups were conducted with each new covariate to ensure that this assumption was not violated. Adjusting memory change scores for initial mood only or for initial mood and neutral mood memory performance had no effect on the pattern of significant mood and mood by age findings reported above. Similarly, the use of vocabulary as a covariate did not affect the pattern of significant findings.

Table 9

Adjusted Total Change Scores by Age and Experimental Condition

Condition	Change score adjusted for:		
	Unadjusted	Total Recall Neutral Mood	Initial Mood - POMS scales
LEARNING: POSITIVE MOOD			
Young	-2.1	-1.5	-2.2
Old	0.6	0.2	0.7
LEARNING: NEGATIVE MOOD			
Young	-0.4	0.0	-0.6
Old	-0.1	-1.0	0.0
RECALL: POSITIVE MOOD			
Young	0.4	0.8	0.3
Old	-0.3	-1.1	-0.2
RECALL: NEGATIVE MOOD			
Young	2.5	2.4	2.4
Old	-3.6	-2.8	-3.4

Table 10

Adjusted Mood Bias Change Scores by Age and Experimental Condition

Condition	Change score adjusted for:		
	Unadjusted	Mood Bias Neutral Mood	Initial Mood - POMS scales
LEARNING: POSITIVE MOOD			
Young	1.6	0.6	1.7
Old	0.5	0.6	0.5
LEARNING: NEGATIVE MOOD			
Young	0.6	0.8	0.8
Old	0.8	0.7	0.7
RECALL: POSITIVE MOOD			
Young	0.4	0.3	0.4
Old	0.3	-0.5	0.2
RECALL: NEGATIVE MOOD			
Young	-2.4	-2.1	-2.3
Old	-2.8	-1.5	-2.9

Proportional Gain Scores based on Subjective Event Ratings. In the preceding analyses, pleasant and unpleasant event scores were calculated based on the experimenter's a priori classification of the memory items as pleasant or unpleasant. It will be recalled that individual ratings were also made of the subjective pleasantness or unpleasantness of each item. These ratings were used in the next set of analyses to calculate proportional gain scores based on the actual number of items subjects rated as pleasant or unpleasant.

Age variability in subjective response to the items was minimal. Pairwise comparisons on an item by item basis, using an alpha level corrected for the number of comparisons made, showed reliable age differences for only three of the events. Old subjects reported that they found forgetting an appointment and lying to someone more unpleasant than did young subjects. The young rated sleeping in to be a more pleasant experience than did the old. In addition to the item by item comparisons, total pleasantness and unpleasantness scores were calculated, by summing ratings across the 30 pleasant and 30 unpleasant events respectively. There were no significant age differences in overall pleasantness or unpleasantness ratings.

Proportional pleasant event scores were calculated by dividing the number of pleasant events recalled by the number of events rated pleasant or very pleasant. A similar procedure was followed to calculate proportional unpleasant event scores. These proportional scores were then used to calculate Mood Bias scores and Total scores in the same way as described earlier. Proportional Mood Bias change and Total change scores were analyzed as previously, using a 2 (age) by 2 (mood) by 2 (learning/recall) MANOVA and testing for simple main effects of mood and age and their interaction within learning and recall. Because of the use of proportional scores, an arc sine transformation was used.

As in the previous analyses, effects of mood were evident only in the recall condition and confirmed to the pattern of mood effects and age differences in mood effects reported earlier. Thus, age differences in mood effects (or the absence of age differences) could not be attributed to age differences in the subjective pleasantness or unpleasantness in the memory stimuli used.

Table 11

Adjusted Proportional Gain Scores by Age and Experimental Condition

	Total		Mood Bias	
		Gain Score Adjusted for:		
	Un-adjusted	Memory Control	Un-adjusted	Memory Control
LEARNING: POSITIVE MOOD				
Young	-.04	-.02	.03	.00
Old	.03	.01	.02	.03
LEARNING: NEGATIVE MOOD				
Young	.00	.02	.02	.01
Old	-.02	-.05	.05	.04
RECALL: POSITIVE MOOD				
Young	.01	.03	.01	.00
Old	-.01	-.04	.02	.00
RECALL: NEGATIVE MOOD				
Young	.09	.09	-.07	-.06
Old	-.14	-.10	-.14	-.07

Chapter Six

Discussion

The present investigation studied the influence of mood on intraindividual memory change within two adult age groups. The first step was to establish the effectiveness of emotionally descriptive stories in inducing mood change in the sample of young and old women. Results indicated that the stories were effective in eliciting significant changes in self-reported mood, although the use of mood induction procedure was also found to introduce an unexpected bias in baseline memory performance in one of the experimental groups. Notwithstanding the selection bias and the interpretive ambiguities it introduced, the experimentally induced negative mood states were found to influence both the content and overall level of memory recall. Predictions concerning quantitative and qualitative age differences in mood congruent recall were not supported. The overall strength of the mood congruency effect was similar across the two age groups. Qualitative age differences were found but were the reverse of the predicted pattern. Negative mood states at time of recall increased recall of mood congruent memory items for the young but decreased recall of mood incongruent memory events for the old. This mood content effect contributed to an overall decrease in total recall for old participants that was not found for young subjects.

Mood Manipulation Effects.

Cognitive and behavioral consequences of laboratory-induced mood states have not previously been investigated beyond young adulthood. One of the objectives of the present study was to determine whether this methodologically valuable procedure could be effective in an older age group. Because of ethical concern over the induction of negative mood states in general, and uncertainty about their ease of removal in the elderly in particular, a decision was made to use a relatively mild mood inducing procedure. Previous research has demonstrated that reliable mood congruent phenomena can be demonstrated even with very mild mood manipulations including the technique used in the present study (e.g., Johnson & Tversky, 1983). This procedure required participants to read short stories describing a tragic or uplifting life experience. It was expected that this manipulation would induce

mild positive and negative feeling states as defined by Clark and Isen (1982).

As with any mood induction procedure, two critical questions concern the reliability and validity of the induced mood states. The present use of a mood induction procedure in an age-comparative design also made it necessary to establish the age equivalence of the induced mood change. There appear to be no standardized procedures for establishing the reliability or validity of a mood induction procedure (Isen & Georgoline, 1983). In the present study, demonstration of the reliability and validity of the story evaluation task as mood induction procedure focused on the following issues, (1) were there significant differences in self-reported mood after reading the positive, negative, and neutral mood stories, (2) if so, were the mood states induced by the story task genuine, and (3) what proportion of the sample were responsive to the affect induction procedure? Analyses in each case were done on each age group separately in order to identify age differences in reliability or validity. Although not strictly an issue of validity or reliability, the present study also sought to identify personal characteristics of the participants that were related to the effectiveness of the mood induction procedure.

The self-report measure assessing emotional response to the stories showed that, as anticipated, the story about a child's death made readers report feeling negative and depressed, and the candy store story made readers report feeling positive and uplifted. Statistical analyses confirmed that across both age groups, these mood effects were reliably different from each other and from the mood effects of the neutral and filler stories. To provide evidence of the genuineness of the self-reported mood change, the validity of the unidimensional mood measure, used as the manipulation check, was assessed against a longer, multidimensional mood inventory of established validity (POMS). Correlational analyses demonstrated that the single item measure showed significant overlap with all five of the mood scales making up the POMS. This suggests that the seven-point mood scale was tapping a global dimension of mood variability, and, thus, provides a rough but modestly valid indicator of participants' moods.

It did appear, however, that the global mood indicator might be less valid in the older age group. Although it was possible to demonstrate statistically significant

correlations between the POMS subscales and the bipolar scale for both age groups, the strength of the associations were weaker in the old. One interpretation of this finding is that the bipolar mood scale was less reliable for this age group. This interpretation is based on the assumption that the POMS is itself a valid and reliable indicator of mood state in the elderly. Unfortunately, there is no empirical evidence to support this assumption. Although the POMS has been found to be sensitive to mood change in the elderly (McNair, 1979), its measurement equivalence across age groups has not been established. This problem is not unique to the POMS. Most of the available scales for assessing mood were designed and standardized with young age groups, and their psychometric properties with other age groups is unknown. For the present purposes, it was assumed that the unidimensional mood measure provided a valid measure of mood state in both young and old, however, because of the difficulty in establishing it's age equivalence, no inferences were made concerning the meaning of age differences in the global mood scale across age groups.

Despite the convergent validity check, it could still be argued that reported mood changes were due to experimental demand. Unlike standard mood induction procedures in which subjects are instructed to try and get in the mood, the present study eliminated this overt form of experimental demand by presenting the mood manipulation as a story evaluation task. There was no indication that subjects saw through this cover story and, in fact, during debriefing, only two subjects (one young and one old) reported suspecting the true purpose of the story task. It was concluded, therefore, that the story task produced genuine albeit mild shifts in mood in the readers and that experimental demand effects were, at most, minor.

The reliability of mood induction procedures has also been a concern as there appears to be significant interindividual variability in emotional response to these techniques. The reliability of the story evaluation task has not previously been reported but in the present study was found to be effective in 80% of the sample. This estimate is based on pre-established but admittedly arbitrary criteria for defining a significant mood change. Nevertheless, it is consistent with reliability levels reported for musical induction procedures (Sutherland et al., 1982) and

somewhat higher than reported for the Velten technique (Clark, 1983).

Participants' pre-existent mood states were found to have a significant impact on the effectiveness of the mood induction procedure. Interestingly, the relationship between pre-existing mood states and mood change in response to the affect-arousing stories differed with age. Among the young women, those who were most responsive to the negative mood induction were those who were already in negative moods. In contrast, old subjects as a group were less responsive to negative mood inductions, and those who arrived at the test sessions in bad moods tended to be least responsive. This latter subsample was, on the other hand, particularly responsive to positive mood inductions.

Other than mood and age, additional individual difference variables investigated in the present study (i.e., vocabulary, education, health) were found to have little impact on the effectiveness of the mood manipulation technique. Only verbal ability, as assessed by vocabulary level, was significantly related to negative mood change for the old with elderly of higher verbal ability being more responsive to the negative mood inductions. This may provide a clue to the explanation of the selection bias found in baseline memory performance.

Selection Bias

In examining baseline memory performance in the sample of subjects who met the pre-established mood change criteria, it was found that older subjects in one of the experimental conditions showed particulary good recall of pleasant events, relative to their own recall of unpleasant events and relative to the recall of young and old participants in the other experimental groups. The cause of this bias appeared to be somehow related to the mood induction procedure, in that, subjects who did not respond to the mood manipulation in this experimental condition did not show the same recall bias, and in fact, did not differ from old subjects in the other experimental groups. Although traced to an effect of the mood induction procedure, the nature of the bias remained unclear. No differences could be found between the memory biased group and the other experimental groups on any of the background characteristics measured in the present study. Also puzzling was the fact that the bias was only evident when the mood manipulation was presented at time

of recall and not for when it was presented at time of learning. One possible explanation is that the effect was not due to selection effects but was simply an unhappy coincidence and represented the 5% probability that mean group differences will appear by chance. Careful consideration of the task demands in the recall condition suggest an alternative explanation. One difference between the recall and learning condition, is that in the recall condition, the subjects had to read and evaluate the story while trying not to forget the memory items, whereas in the learning condition, subjects had only to read the stories. Thus, the recall condition task had many qualities of a divided attention task, a task which is known to present special difficulties for the elderly (Craik & Rabinowitz, 1984). It is possible that only the more verbally able elderly were able to process the story deeply enough to respond to its affective connotations while trying to keep the memory items in mind. This possibility is suggested by the observed significant relationship between negative mood induction effects and verbal ability in the elderly. It will also be recalled that there were many more elderly who failed to respond to the negative mood induction in the recall condition than in the learning condition. This explanation is, of course, necessarily tentative given its post hoc nature. In general, there has been relatively little effort made towards examining individual differences in response to mood induction.

Whatever the cause, the selection bias had negative consequences for both the internal and external validity of the present study. Differences in baseline memory performance between the negative mood recall condition and the other experimental groups make ambiguous the interpretation of differences in mood-related memory performance within the older age group since these may be attributed to the differential effects of mood across the four conditions or to the pre-existing differences in memory performance. Of course, it might be argued that selection effects were already problematic in the present study in making comparisons across age groups. This is undeniably true, however, in making age comparisons, the problem is to interpret the size of treatment effects when the same treatment is applied to two or more age groups. Age group differences in treatment effects can be unambiguously interpreted; the ambiguities arise in trying to determine the cause

of these differences (Huitema, 1980). Selection effects are assumed as age is always used only as an index to represent known and unknown differences between groups that might explain observed differences in treatment effects. Of course, some age-related differences are more interesting than others and that was why an attempt was made to identify and eliminate unwanted selection biases between age groups. In general, however, selection effects as a threat to the validity of interpretation of age differences in treatment effects are inherent in the nature of developmental research and are less problematic in the present study than the interpretive ambiguities introduced by selection biases within the older age group. Here the problem is to interpret within age group differences in the effect of different treatments applied to nonequivalent groups. Even with statistical control through covariance analyses, there is no way to get an unbiased estimate of true treatment differences, since there is no way to separate the effects of selection from the effects of treatment. Since the process that led to the selection bias in the present study could not be determined, a data analytic strategy recommended by Huitema (1980) was utilized. In the case of nonequivalent group designs with unknown selection factors, he recommends comparing the results of different analyses based on different assumptions concerning the selection mode. If, as in the present case, the different analyses yield essentially the same results, there can be some confidence that the conclusions are valid. In the present study, comparisons of unadjusted and adjusted treatment effects all yielded the same result -- namely that significant mood-related memory effects were evident only in the negative mood recall condition. Because this effect was attenuated, but never eliminated even after adjustment for baseline memory performance, mood state, and/or affective response to the memory stimuli, and furthermore, was also evident in the performance of the young, there can be some confidence that this memory effect was reliable. However, it will be recognized that this significant memory effect occurred in the same experimental condition that showed the selection bias. This introduced a threat to the external validity of the present study. Nonrandom selection reduces the external validity or generalizability of a study when selection interacts with the treatment variable. Older subjects in the negative mood recall condition may have shown a genuine

mood-related memory change, but as this group was known to differ in at least one important way from the other elderly in the study, the results may be of limited generalizability. With this caution in mind, the next section will examine in more detail, the memory-related effects of the experimentally induced mood states and age differences in these effects.

Mood-Induced Memory Effects.

The preceding section provided evidence that the mood induction procedure used in the present study produced significant mood change in both young and old participants. Although mood change was demonstrated across all four experimental conditions, significant intraindividual memory change was evident only for young and old participants in the negative mood recall condition. In this condition, both level and content measures of memory performance were significantly affected by the induced negative moods. Since the memory level effect appeared to be directly related to the memory content effect, the latter will be described and discussed first.

Mood congruent memory was measured in the present study as a shift in the affective balance of the recalled items. In the neutral mood condition, there was a slight but significant bias favouring the recall of pleasant events. This is consistent with evidence indicating that in unselected samples, there is a tendency for memory to be positively biased (Matlin & Stang, 1978). The absence of age differences in affective bias in the neutral mood condition (with the exception of the previously discussed elderly group who showed an unexplainably strong positive bias) suggests that this tendency is developmentally stable. This is consistent with Hyland and Ackerman's (1988) finding examining affective bias in autobiographical memories recall and inconsistent with Slife et al.'s (1985) findings using preferred and nonpreferred nonsense trigrams. It was suggested earlier that inconsistencies between these two previously published findings may have been due to differences in stimulus meaningfulness. The present findings using relatively meaningful memory stimuli tend to support this explanation.

Of course, the primary interest in the present study was changes in affective balance in response to the induced mood change. Predictions concerning quantitative and qualitative age differences in mood congruent memory effects had

been made, but were not supported in the present study. The quantitative shift in affective balance in the negative mood recall condition was equivalent across age groups, but was qualitatively different in nature. For the young, the negative bias in this condition was due to an increased recall of unpleasant events whereas for the old, it was due to a decreased recall of pleasant events.

Hypotheses concerning age differences in the overall strength of the mood congruency effect were extrapolated from models of mood and memory interaction developed to explain mood congruency effects in young adults. It will be recalled that these nondevelopmental explanations suggest that mood states increase the accessibility of mood congruent memories through cognitive priming. Results of the present study suggest that mood states induced by the story evaluation task were equally effective retrieval cues for young and old participants.

The general use of retrieval cues by the elderly has been a topic that has received considerable attention in cognitive aging research. There has been fairly consistent support for the finding that retrieval cues are particulary beneficial to the elderly and tend to reduce age differences normally observed using free recall paradigms (e.g., Hultsch, 1975; Lawrence, 1967; Smith, 1977). There were two important differences between the present findings using mood-induced memory cuing and previous research examining the use of retrieval cues by the elderly. First, in previous research, retrieval cues have been provided by the experimenter. In contrast, the retrieval cues in the present study were presumably internally generated mood states. Second, the availability of mood-induced retrieval cues did not reduce age differences in overall memory performance in the present study. In fact, in the one experimental condition where mood congruent recall was demonstrated, age differences in memory were actually increased.

Demonstrations of reduced age differences using cued recall have been used by proponents of retrieval-based explanations of memory deficits in the elderly to support claims that the elderly have special difficulty accessing stored memories (e.g., Schonfield, 1965). More recent explanations based on the encoding specificity hypothesis (Tulving & Thompson, 1973), suggest that retrieval difficulties demonstrated by the elderly actually reflect age differences during the encoding stage

of information processing.

One such encoding-based explanation of age differences in memory performance was discussed in the introductory chapters, viz, Labouvie-Vief's (1985) hypothesis about maturational shifts in processing style leading to a qualitative shift in the nature and organization of information encoded and recalled. Enhanced mood congruent memory recall in older adults was predicted in the present study, based on theoretical proposals put forth by Labouvie-Vief and colleagues (Adams et al., in press) suggesting that the elderly may be particularly sensitive to affective meanings and encode emotionally salient information more deeply. The absence of age differences in mood congruent memory implies that both young and old were equally sensitive to affective qualities of the memory stimuli. However, rather than providing a strong disconfirmation of Labouvie-Vief's hypothesis, the nature of the to-be-remembered list may have contributed to increased emotionally-based encoding. Since the most salient characteristic of the daily event list was the dichotomy between pleasant and unpleasant events, this may have encouraged the encoding of this feature by young and old alike. A more sensitive test of Labouvie-Vief's hypothesis might require the use of stimuli that could be organized according to emotional and non-emotional criteria. Previous research has demonstrated that when stimulus material is organized categorically (Fiedler & Stroehm, 1986) or presented in an organized story format (Hasher et al., 1985), young subjects do not show mood congruent recall. However, if Labouvie-Vief's hypothesis is correct, one would predict that even under these circumstances, the elderly would continue to show mood congruent selective biases in the content of their recall.

Although results of the present study do not support Labouvie-Vief's contention that the elderly are differentially sensitive to the encoding and retrieval of affective information, the findings may be interpreted in the light of other encoding-based explanations of age-related memory change. Craik and Rabinowitz (1984) have suggested that the elderly encode episodic information in a more global, less contextually rich fashion. Although not discussed by these authors, mood-induced memory processing may represent a more global form of information processing (Kinsbourne, 1980). Certainly, the categorization of events and experiences

according to affective meanings would not provide a distinctive or specific basis for retrieval given the number of episodes potentially classified under the category of "pleasant events", for example. As the present results suggest, the affective qualities of the events did appear to be spontaneously encoded by both young and old. Whether this is because affective processing represents a more mature style of processing or a more global and general one is unresolved.

A second necessary component for mood congruent recall is cognitive priming, triggered by the current mood state. Previous research has found that cognitive priming, demonstrated as facilitated processing of a stimulus when preceded by a physically identical (Howard, McAndrews, & Lasaga, 1981), or a semantically related (Byrd, unpublished; cited in Craik & Byrd, 1982) stimulus, is unaffected by age. Results of the present study are consistent with these observations and further suggest that cognitive priming activated by internally generated mood states is also stable across the adult age range. This could be verified more directly in future studies using reaction time tasks similar to those used by Howard et al., and Byrd to examine non-emotional cognitive priming. The reaction time paradigm would also be useful in examining the duration of cognitive priming effects induced by mood. Results with non-affective stimuli have been inconsistent with regard to age differences in the duration of priming effects (Rabbitt, 1981; Moscovitch, 1982). However, as was noted previously, Ingram (1984) has speculated that individual differences in the duration of mood-activated cognitive priming may be related to individual differences in vulnerability to depression. Thus, the possibility of age differences in the duration of mood priming are as important as the apparent absence of age differences in immediate facilitation effects.

Although it has been assumed that the negative mood states induced at time of recall, acted as a retrieval cue for both young and old, this cognitive priming did not reduce age differences in overall memory performance. This was in large part the result of qualitative differences in the effect of negative mood on the two age groups. For young subjects, the negative mood states increased recall of unpleasant events, whereas for the old, negative mood states decreased recall of pleasant events. It will be recognized that this pattern of differences is inconsistent with the predicted

pattern of age differences and is inconsistent with previously reported mood congruent effects associated with negative mood states in the young (Isen, 1984; 1985). The failure of the young group's mood bias to correspond with previously published findings is puzzling. One possible explanation may relate to the mildness of the induced mood states. It has been argued that the normally observed patterns of decreased recall of mood incongruent memory items during negative mood states in young subjects is due to their use of mood control strategies to help attenuate the effect of negative moods. Although mood congruent memory effects have been observed to occur independently of the intensity of the induced mood states (e.g., Bower & Mayer, 1984), it is not necessarily the case that the use of mood control strategies is also independent of mood severity. Because the mood states induced by the present technique were presumably mild, it is conceivable that mood repair efforts were not activated by young subjects. On the other hand, the reduced recall of mood incongruent items by the elderly during the depressed mood condition suggest that in this age group, mood repair strategies were being utilized even with mild mood changes.

Further evidence of greater use of mood control strategies by the elderly comes from examination of their response to the mood induction procedure. Older subjects, particularly those entering the experiment in negative moods, resisted the negative mood inductions. In contrast, the young subjects were generally more responsive to the negative mood inductions and those that were most unhappy on entry to the experiment were most responsive. Thus, it was the young subjects in the present study who demonstrated the negative spiral of depression described by Ingram (1984). The older age group appeared more effective in the use of mood control strategies, and were consequently less emotionally labile. The hypothesis that the elderly would be less efficient in the use of mood control strategies was based, in part, on the observation of increased depression in this age group. However, in the present study the young group were, on average, more depressed at the onset of the study. Given the high incidence rate for depression among the elderly in general, it appears that elderly research volunteers may be represent a particularly optimistic and positive subsample. Since almost nothing is known about

the mechanisms of mood control, little more can be said about possible strategies used by the elderly participants to resist negative mood change while reading the negative stories or to suppress recall of unpleasant events during the negative mood retrieval condition.

The overall decline in memory recall by the elderly in the negative mood condition is also consistent with the assumption that this age group was allocating more cognitive effort to mood control than the young. Overall memory recall, in the present study, was used as an index of memory processing efficiency. According to Ellis and colleagues' (1984) resource allocation model, declines in memory processing efficiency during depressed mood states are due to increased allocation of mental effort to the processing of task-irrelevant thoughts associated with the negative mood. The decline in memory processing efficiency shown by the elderly in induced negative moods can be plausibly attributed to their allocation of cognitive resources to the process of mood repair. In contrast, young subjects, who did not appear to be using mood repair strategies on the basis of the content analysis, also did not show a drop in processing efficiency.

The preceding discussion has focused on mood induced content and processing efficiency effects observed in the negative mood recall condition. It is also necessary to explain the absence of mood-induced memory change in the negative mood learning condition and across the positive mood learning and recall conditions.

As was noted in the introduction, there has been some disagreement in the nondevelopmental literature about the locus of mood congruent memory effects at time of learning or at time of recall. Results of the present study showing mood congruency effects only at recall, support a retrieval based explanation of effects. The present study provided a clearer test of the encoding/retrieval hypothesis than previously reported studies (Bower & Mayer, 1985; Nasby & Yando, 1982). In these studies, researchers adopted a design crossing positive and negative learning mood with positive and negative recall mood. With this design it is difficult to separate the effects of mood congruency and the locus of those effects from the effects of state-dependent learning. In the present study, this problem was avoided by manipulating learning and recall moods independently and crossing each with neutral

mood inductions. The absence of mood selective learning in the present study is consistent with the conclusion reached by Blaney (1986) in a recent review of the literature on mood congruent memory. He argues that effects have been more consistently demonstrated at time of recall and studies showing effects only during learning have been methodologically flawed.

The absence of mood congruency effects in the positive mood conditions is more difficult to explain. One consideration may have been the mildness of the induced moods. The normative mood of subjects on entry to the study was mildly positive. The mood uplift after reading the positive story may not have been sufficiently different from the pre-existent mood state to produce a shift in memory performance. In fact, if one compares the pre-experimental bipolar mood ratings with the positive story mood ratings, it is apparent that these were not very different, especially for the older age group. Thus, it may be necessary to use a stronger mood induction for the positive mood condition to produce significant memory change. The decision to use a mild mood induction procedure in the present study was based on ethical considerations. Obviously, these would be less of a concern with the induction of strong positive moods. As the present results show, mild negative moods are sufficient to show mood congruent memory change although more intense negative moods may be necessary to demonstrate overall level effects in the young.

Conclusion

The present investigation examined the influence of experimentally induced positive and negative mood states on memory for pleasant and unpleasant events in two adult age groups. Significant mood-induced memory change was evident only for negative mood states induced at time of retrieval. There were no age differences in mood bias in either the neutral mood condition or in the negative mood recall condition. This suggests that both young and old had encoded affective attributes of the to-be-remembered daily event lists and were able to use the experimentally induced mood states to guide retrieval. Contrary to prediction, the elderly did not appear to show a stronger affective bias in their recall. However, it was suggested that the nature of the stimulus material may not have encouraged alternative organizations or encoding strategies. Nonetheless, the absence of age differences is

itself important and suggests that the mechanisms of mood congruent memory processing are unaffected by the aging process. This provides indirect support for theoretical models proposed in the nondevelopmental literature to explain this phenomena. These are based on the premise that affective encoding is an automatic cognitive process, as is the cognitive priming of mood congruent memories by the concurrent mood state. Since automatic processes are hypothesized to be unaffected by age (Hasher & Zacks, 1979), the absence of age differences in mood congruency is consistent with these models.

Results also indicated that mood congruent memory contributed to decreased processing efficiency in the elderly during negative mood states. The explanation and tentative interpretation of this result suggested that the effect was due to age differences in the use of mood control strategies. It had been predicted that the young subjects would be more adept at the process of mood repair, but it appeared that it was the elderly who used mood control more effectively. This was inferred from their response to the mood induction procedure and from the qualitative analysis of the mood congruent memory bias in the negative mood condition. Future study is needed to verify this interpretation and to identify the mechanisms of mood repair in both young and old.

Much of the discussion has been by necessity speculative as there is neither a theoretical framework nor an empirical data base with which to compare and interpret the present findings. The results of the present study do suggest some interesting and unexpected conclusions about the nature of mood and memory interaction in later life. So little work has been done in this area, that an experiment such as the present one uncovers many more issues that it is able to resolve.

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