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Appendices 3-6

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Effects of Manipulating the Mood Components of Valence and Arousal on the Specificity of Autobiographical Memory in Nondepressed Women

by

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Thesis submitted to the

School of Graduate Studies and Research

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Clinical Psychology

University of Ottawa

ACKNOWLEDGMENTS

I would like to sincerely thank Dr. Philippe Cappeliez for all of his help, encouragement, and mentorship throughout these past four years. His guidance has been an invaluable source of inspiration and motivation for me, and I would like to thank him for all I have learned. My gratitude also extends to Sunanda Kundu, whose hard work and enthusiasm for the project were an essential component of the outcome. I would also like to thank my committee members, Dr. Catherine Lee, Dr. Valerie Whiffen, Dr. Claude Messier, and Dr. Mick Sullivan for their time and insightful contributions, as well as for their helpful feedback throughout the various stages of the thesis. My friends in the program, Brian MacDonald, Francine Roussy, Luis Oliver, Yolanda Korneluk, and Barb Virley-O'Conner, have also been an integral part of these past four years, and I would like to thank all of them for their support and friendship. NSERC and OGS supported me financially throughout my graduate studies.

I am deeply grateful to Paula and to Mike for their continual encouragement and support that have helped me in so many different ways throughout these years. Also, without the loving generosity and guidance of my parents, none of this would have been possible. I am grateful them and to my sister for being great role models, and for instilling in me determination and drive. Finally, I am thankful to Cristi and to Dallas for reminding me of the truly important things in life.

ABSTRACT

A theoretically and clinically important cognitive deficit in clinical depression is the inability to be specific in recalling personal memories. This phenomenon has been coined "overgeneral memory" (Williams & Broadbent, 1986) and has, thus far, been interpreted to represent a cognitive vulnerability that renders some individuals more susceptible to depression (Williams, 1996). Although there is a general consensus that this pattern of non-specific recall is not state-dependent, most of the evidence has come from studies that have examined this effect in clinical populations. To gain a better understanding of whether overgeneral memory is independent of the current mood- state, two experiments examined this effect at the level of mood. The two components of mood, affect and arousal, were manipulated to examine their influence on the specificity of autobiographical memory in a non clinical population of undergraduate women. In Experiment 1, a modified Velten procedure was used to induce elated, depressed, and neutral mood states. Self-reported mood was measured using the POMS-SF and the PANAS-X. The results showed that the induction procedure successfully altered mood in the desired direction. The depressed group reported increased depression, tension, confusion, and fatigue, and also reduced joviality and positive affect immediately following the manipulation. The elated group, in comparison, reported increased joviality and positive affect, and also reduced depression, tension, confusion, and fatigue. The neutral group reported no change in mood. Results from the Autobiographical Memory Test, in which participants were requested to provide a self-defining memory for each of 5 positive and 5 negative cue words, revealed no differences in autobiographical memory specificity between the three groups. There were also no differences in the

proportion of general memories produced between positive and negative memory cues across the three groups. However, participants in the depressed condition produced a greater proportion of categoric compared to extended general memories, within the total proportion of general memories produced. In Experiment 2, high and low arousal states were induced through physical exercise. Participants in the low arousal condition, who exercised on a Stairmaster for 45 minutes, reported increased fatigue, and decreased vigor and depression, whereas participants in the high arousal condition, who walked briskly for 10 minutes, reported decreased fatigue and depression, and increased vigor. A low arousal state resulted in an increased proportion of overgeneral memories compared to both the control condition and the high arousal condition. A high arousal state did not influence autobiographical specificity. No cue valence effects were found, and there was no difference in the proportion of categoric or extended memories produced for the three groups. Across both Experiments 1 and 2 the postulated role of working memory in the production of generic autobiographical memories (Williams, 1996) was examined by testing how the various manipulations influenced performance on the Trail Making Tests (TMT). No differences were found among the groups in either experiment, although ceiling effects may have been involved. Taken together, the results indicate that a reduction in the arousal component of mood decreases the capacity to recall specific autobiographical memories. These results suggest that overgeneral memory is a phenomenon at least partly dependent on current mood-state, and more specifically, on the level of energy available to the person at the time of recall.

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INTRODUCTION

Numerous studies have investigated the processes that underlie changes observed in autobiographical memory during an episode of clinical depression, and how these changes play a role in the etiology and maintenance of depression. Research has shown that during an episode of depression there may be two distinct (although not necessarily independent) ways in which autobiographical memory is affected. First, there may be a change in the relative accessibility of positive and negative autobiographical memories, whereby negative memories are accessed more readily than positive memories and, second, there may be an increased difficulty in recalling specific personal events (Dalgleish & Watts, 1990; Williams, 1996; Williams & Scott, 1988). The difficulty in retrieving specific personal events has been coined "overgeneral memory" (Williams & Broadbent, 1996). The aim of this thesis is to investigate the basic factors that may contribute to produce the phenomenon of overgeneral memory. To this end, this thesis tests the effects of manipulating mood at the time of recall on the specificity of autobiographical memory. This is not done with clinical depression in order to reduce any contamination arising from the pathology of depression that may inhibit a pure consideration. This allows for a differential examination of how the different components of mood at the time of recall individually influence autobiographical memory specificity.

The observation that clinically depressed individuals have difficulties in being specific in their memory was first made by Williams and Broadbent (1986) while

conducting research on mood-congruent memory. The experiment used a cue-word paradigm in which the cues were themselves the names of positive or negative emotions (e.g., *happy, sorry, safe, angry, clumsy*). Participants were given 1 minute in each case to retrieve a specific personal memory in response to the cue-word. In addition to the expected mood-congruent memory bias, they found that depressed individuals were not readily able to retrieve specific memories in response to either positive or negative cues. Subsequent work has confirmed and added to the robustness of these findings (e.g. Brittlebank, Scott, Williams, & Ferrier, 1993; Kuyken & Brewin, 1995; Kuyken & Dalgleish, 1995; McNally, Lasko, Macklin, & Pitman, 1995; Puffet, Jehin-Marchot, Timsit-Berthier, & Timsit, 1991).

Since the observation was first made by Williams and Broadbent (1986), it has become clear that this phenomenon may contribute to emotional disturbance in several ways (Williams, 1996). If depressed patients cannot retrieve specific memories about themselves, they may experience difficulty benefiting from psychotherapy that involves remembering aspects from both one's recent and remote past. Indeed, there is some evidence to suggest that inability to be specific in one's memory strongly predicts failure to recover from clinical depression (Brittlebank et al., 1993). Lack of specificity may also impede therapeutic benefits by undermining the ability to use memory in imagining the future and in solving current interpersonal problems (Evans, Williams, O'Louglin, & Howells, 1992; Williams, 1996).

A number of important findings have emerged that have contributed to an understanding of the scope and limits of this depressive tendency. Research has shown

that this tendency interacts with both the valence and the type of autobiographical memory retrieved. Clinically depressed individuals, when compared to nondepressed controls, are significantly more likely to produce overgeneral memories in response to emotionally toned cue words, but this effect is particularly evident in the case of positive cues (Brittlebank et al., 1993; Moore, Watts, & Williams, 1988; Williams & Broadbent, 1986; Williams & Dritschel, 1988, 1992; Williams & Scott, 1988). In response to *happy*, for example, nondepressed participants tend to produce specific memories (e.g., 'the day we left to go on holiday'), whereas depressed individuals tend to retrieve general categories of memories that do no make reference to any specific episode (e.g., 'when I'm playing squash') (Evans et al., 1992). Furthermore, although an overgeneral memory can be defined as one which is either categoric (referring to an event occurring more than once) or extended (taking place over a period longer than one day) (Williams & Broadbent, 1986), research suggests that overgenerality in depressed individuals is attributable to an excess in categoric and not extended memories (Williams & Dritschel, 1992).

Thus, the conditions associated with difficulty in retrieving specific personal memories are becoming clearer, although the research is far from complete. One question that has yet to be addressed is whether overgeneral recall is an enduring characteristic of individuals vulnerable to clinical depression or whether it is something about the depressive episode itself (i.e., a particular feature of the depressive condition) that blocks access to specific memories. According to Williams (1996), overgenerality represents a cognitive style that indicates vulnerability towards clinical depression and, as

such, is independent from the current mood-state. The question of whether overgeneral memory is mood-state dependent has not been tested directly.

One reason why it remains unclear whether overgeneral memory is mood-state dependent is that most of the research conducted thus far has been on the relation between clinical mood disorders and autobiographical specificity. This tendency has been reported among parasuicidal patients (Williams & Broadbent, 1986), individuals diagnosed with major depressive disorder (Brittlebank et al., 1993; Kuyken & Brewin, 1994; Kuyken & Brewin, 1995; Kuyken & Dalgleish, 1995; Puffet et al., 1991; Williams & Scott, 1988) post-traumatic stress disorder (PTSD) (McNally et al., 1995; McNally, Litz, Prassas, Shin, & Weathers, 1994), and among patients with obsessive-compulsive (OCD) disorder having a co-morbid diagnosis of major depression (Wilhelm, McNally, Baer, & Florin, 1997). However, because the diagnosis of affective disorders is based on a wide range of clinical signs and symptoms, it is difficult to determine what characteristics of depression (if any) contribute to overgeneral recall.

One can think of depression as ranging from depressed mood, to depressive symptomatology, to a full-blown clinical syndrome (Bäckman, Hill, & Forsell, 1996). The distinction between depressive symptomatology and depression as a clinical syndrome is significant. Some authors (e.g., Williams & Dritschel, 1988) have interpreted the finding that recovered patients remain overgeneral in their memories as an indication of the independence of overgeneral memory from current mood-state. But remission from a clinical syndrome does not necessarily indicate the absence of depressive symptomatology. Depressive symptoms have, in fact, been reported to be

common among groups of individuals with low prevalence rates for major depression (Blazer et al., 1988). There is some evidence suggesting that overgeneral memory is found in those with subclinical depressive symptoms (e.g., Moffitt, Singer, Nelligan, Carlson, & Vyse, 1994), suggesting that there may be some factors related to mood changes rather than to full-blown pathology that contribute to the phenomenon.

To gain a better understanding of whether overgeneral memory is, in and of itself, mood-state dependent, this research examines the quality of autobiographical memories at the level of mood. Investigating whether the specificity of autobiographical memories is affected by mood at the time of recall represents a first step towards a better conceptualization of whether overgeneral memory is indeed state dependent. It also represents a first step towards discerning the cognitive processes involved in overgeneral memory. At this level, the components of mood can be individually tested to consider what role they might play in autobiographical memory specificity. Gaining a clearer understanding of how the different mood components differentially influence autobiographical memory may also help to understand (at least at a very preliminary level) the overgeneral memory phenomenon in clinical depression.

The aim of this thesis is to investigate overgeneral memory at the basic level of mood in order to understand what factors contribute to produce this effect. In particular, the two components of mood, namely, arousal and valence, are tested separately to determine what role they may play in autobiographical memory retrieval. Both arousal (high/low) and valence (positive/negative) are manipulated in a nondepressed undergraduate female student population to see how the specificity of autobiographical

memory is affected. This research represents a first step towards addressing the question of whether overgeneral memory is mood-state dependent, and may help to begin to delineate what factors might contribute to produce this effect. If overgeneral memory is *independent* of mood-state, as argued by Williams (1996), then mood changes at the time of recall should not impinge on the specificity of autobiographical memories. Before elaborating this point any further, it is important to understand how normal autobiographical memory is organized and explore theoretical perspectives on how depression alters autobiographical memory to produce the overgeneral tendency.

The Processes of Autobiographical Memory

Autobiographical memory can be defined as memory of the events of one's life (Conway & Rubin, 1993). Some theorists maintain that autobiographical memories are not exact copies of past experiences, but instead are reconstructions of the past that are guided by the present (Ross & Conway, 1986). This idea originates from Bartlett's theory that proposed that autobiographical memory is stored in the form of schemata that contain general information about personal experiences (Bartlett, 1932). Thus, memory is not a mere sum of discrete recollections but must be seen as a process that involves the continuous selection, organization, and reinterpretation of information.

Researchers have identified a number of structural levels that appear to contribute to the construction of memories (Conway & Rubin, 1993). In general terms, autobiographical memory can be broken down into semantic and episodic categories (Baddeley, 1992). Semantic autobiographical memories include general abstract knowledge about one's own personal history. These general semantic memories can take

the form of summaries of repeated events (e.g., holidays in Italy) and extended events (e.g., last year's Cape Cod vacation) (Conway & Bekerian, 1987a). By contrast, episodic autobiographical memories are those recollections that focus on a single, memorable event (e.g., the boating trip in Cape Cod when I caught a 5-pound fish). This kind of event specific knowledge tends to take the form of images, feelings, and highly specific details, including the retention of sensory information (Conway & Rubin, 1993).

Various models of autobiographical memory organization have been developed. One common feature among these different models is that most of them, in one way or another, suggest a hierarchical organization of personal information ranging from abstract semantic information to specific episodic information (e.g., Conway, 1992; Conway & Bekerian, 1987b; Conway & Rubin, 1993; Williams & Hollan, 1981). Consistent with the notion of a hierarchical organization of autobiographical memory, it has been proposed that retrieval of autobiographical memories requires cognitive effort, the degree of effort increasing with more specific memories (Conway, 1992; Conway & Rubin, 1993; Larson, 1992). In other words, increasingly complex levels of cognition are required to encode and retrieve more specific autobiographical memories.

Researchers have conceptualized cognitive effort in a number of different ways. Their conceptualization has included diverse cognitive resources like, cognitive capacity, attentional resources, motivation, and intention (Ellis & Ashbrook, 1988; Hasher & Zacks, 1979; Watts, Morris, & MacLeod, 1987). To say that the retrieval of specific memories is more *cognitively demanding* than the retrieval of more general memories is unclear. A number of researchers, however, have proposed that more cognitively

demanding operations require increased involvement of working memory (Baddeley, 1993; Conway & Rubin, 1993; Williams, 1996; Williams & Dritschel, 1992; Williams & Hollan, 1981).

Autobiographical Memory in Clinical Depression

In agreement with the notion of the hierarchical organization of normal autobiographical memory, Williams and colleagues have proposed that clinical depression maintains personal information at the more abstract semantic levels by affecting encoding and retrieval processes (Williams, 1996; Williams & Broadbent, 1986; Williams & Dritschel, 1988). In essence, encoding and retrieval processes are presumed to stop prematurely in depression, preventing access to specific episodic memories.

Earlier accounts of the overgenerality phenomenon (e.g., Williams & Dritschel, 1988) used *descriptions theory* of normal autobiographical memory (Williams & Hollan, 1981) as a framework from which to understand the truncated encoding/retrieval processes in depression. This framework assumes that a person encodes only a limited amount of possible information. To encode or retrieve any packet of information, a partial description is constructed and used as an index to find, search, and verify a memory packet. As explained within a descriptions framework, affective encodings tend to be general in nature, being stored as one instance of a category or series. Accordingly, the hypothesis they put forth was that depressed individuals, who tend to encode the affective aspects of situations, access "intermediate descriptions" at retrieval, thereby reducing their ability to move from more generalized categories to specific events (Williams & Dritschel, 1988).

Recently, the theory that retrieval is aborted too early in autobiographical hierarchy has been viewed as too simplistic and has been replaced by a more elaborate explanation (Williams, 1996). According to Williams, early descriptions theory made no distinction between the different types of hierarchy a person might use. In an investigation of normal autobiographical memory, Williams and Dritschel (1992) found that on those few occasions (17.3%) when normal participants produced autobiographical "errors" (i.e., they did not retrieve specific memories), the "errors" made typically fell into one of two categories. Either participants responded with a summary or category of repeated memories (which they called "category memories"), or they responded with an event that was longer than the time interval (1 day) specified by the instruction (which they called "extended memories"). Williams and Dritschel concluded that there are at least these two different and functionally independent intermediate descriptions available as retrieval strategies. A closer look at their earlier clinical data (Williams & Dritschel, 1988), revealed that overgenerality in their depressed sample was entirely attributable to an excess of categoric errors.

In light of this new research finding, Williams (1996) developed a theory to explain why individuals suffering from major depression are more likely to get into difficulty when using a categoric search strategy. According to the new theory, categoric descriptions need to be inhibited so that the retrieval of specific episodes may proceed. The ability to inhibit these relatively automatic processes and allow strategic control over recollection develops in early childhood, and is affected by reduced working memory capacity (Williams, 1996).

Williams (1996) suggested that there are two main factors in early childhood, which interact to prevent the inhibition of intermediate categoric descriptions and produce overgeneral memories in later life. First, a child's environment is such that the recollection of specific events produces negative affect. The child thus learns to regulate affect by avoiding the recollection of specific episodic information and, alternatively, retrieves information in generic form. Whenever a mnemonic cue activates categoric intermediate descriptions (e.g., "I've always failed") that begin to retrieve fragments of a negative memory (e.g., "failing my final math exam"), the search for specific memories is aborted. Second, when a search is prematurely aborted, the retrieval process continues in an attempt to access specific memories by activating other self-referent intermediate descriptions (e.g., "I failed my parents"). The end result is an elaborate network of categoric self-descriptions, or a "mnemonic interlock" (a term coined by Williams, 1996) in which these intermediate descriptions continuously activate and re-activate one another. In future attempts at retrieval, an initial cue is likely to activate other intermediate self-descriptions that prevent access to specific memories. The ultimate result is that new emotionally valent events are encoded along with many general trait self-descriptors, producing overgeneric encoding-retrieval cycles that constitute the ruminative cognitive style characteristic of clinical depression.

Williams has postulated that working memory capacity is normally needed to inhibit the relatively automatic categoric stage of recollection (Williams, 1996). If an individual does not have sufficient working memory capacity, the inhibition of categoric descriptions and, ultimately, the retrieval of specific episodes will be particularly poor.

The mnemonic interlock model proposes that overgenerality may also occur in some instances because re-experiences of early trauma or other negative episodes can actually reduce the working memory's capacity needed to get beyond the generic stage of retrieval. This is not to say that all depressed people have a history of trauma, or that all those who suffer from trauma develop clinical depression.

In summary, overgeneral memory in clinical depression has been explained by Williams in the context of a staged model of autobiographical recollections, whereby depressed individuals stop at the generic stage of the retrieval process and abort the search for more specific memories. This is assumed to occur either because these individuals have experienced negative events in their past, or because memories of their early negative experiences reduce the working memory's capacity needed to get beyond these general mnemonic categories.

Examining Overgeneral Memory at the Level of Mood: the Present Study

The main issue investigated here is whether mood at the time of recall affects the specificity of autobiographical memories. Testing if different mood components determine autobiographical memory recall, represents a first step towards understanding whether this effect is indeed mood-state independent as advocated by Williams (1996). The detection of an influence of mood at recall on autobiographical memory specificity would, at the very least, challenge this claim.

No research has examined the role that mood may play in overgeneral memory. However, this tendency has been widely studied in psychiatric populations, and a number of important findings have emerged. Below I examine first (i) what is known about

overgeneral memory from the research literature on this topic. In view of studying overgeneral memory at the level of mood I then (ii) examine mood as a construct, and provide a rationale for considering mood in terms of valence and arousal. Since Williams has advocated that working memory is involved in overgenerality I, finally, (iii) present the arguments for the involvement of working memory in overgeneral memory and for the influence of arousal on the functioning of working memory.

(i) The Phenomenon of Overgeneral Memory

There is much empirical evidence to suggest that overgeneral memory can be found in those currently suffering from an emotional disturbance. This tendency has been reported among parasuicidal patients (Williams & Broadbent, 1986), Vietnam veterans suffering from PTSD (McNally et al., 1995), and among individuals diagnosed with clinical depression (Brittlebank et al., 1993; Kuyken & Brewin, 1995; Kuyken & Dalgleish, 1995; Puffet et al., 1991).

Research further indicates that although overgeneral memory may not be confined to individuals with major depressive disorder, it is also not associated with all forms of emotional disturbance. In particular, this tendency is not found in anxious patients (Burke & Mathews, 1992; Richards & Whittaker, 1990). Richards and Whittaker examined the effects of trait anxiety (high vs. low) on autobiographical recall. Although a negative relationship was found between state anxiety and speed of retrieval to anxiety-related cue words, there was no evidence that highly anxious participants were more overgeneral in their memory. Burke and Mathews also failed to find a difference in the proportion of general memories produced between anxious patients and controls.

One common feature among those who have difficulty in retrieving specific personal episodes is that there is *some* degree of depressive symptomatology present. For example, the work by McNally and colleagues with Vietnam veterans suffering from PTSD (McNally et al., 1994; McNally et al., 1995) revealed that although these patients were more overgeneral in their memories than were controls, they were also significantly more clinically depressed, as measured by the BDI. Similarly, Wilhelm et al. (1997) reported that individuals with obsessive-compulsive disorder (OCD) had difficulty retrieving specific personal memories. However, these overgenerality effects were not a function of OCD *per se*, but were related to a co-morbid diagnosis of major depression. Early work with parasuicidal patients (e.g., Williams & Broadbent, 1986; Williams & Scott, 1988) also showed higher degrees of depressive symptomatology among this group of individuals compared to controls. The overgeneral tendency, then, seems to be specific to depression, found both in primary depression, as well as in other psychiatric disorders having associated depressive symptomatology.

Clearly, there is much evidence to suggest that clinical depression, or at least depressive symptomatology, in one way or another, is associated with autobiographical memory disturbance. What is not known, however, is whether or not the tendency to produce overly general memories is a consequence of the *state* of clinical depression or of an underlying *vulnerability* to clinical depression. There is research evidence supporting both views. Kuyken and Dalgleish (1995), for example, found no difference in recall quality in a comparison of control participants with and without a history of clinical depression. According to the authors, these results indicated that overgeneral

memory might be state-dependent. In contrast, Williams and Dritschel (1988) reported that previously suicidal patients who had taken an overdose months prior to the testing occasion, and were now recovered from clinical depression, remained significantly more overgeneral in their memories compared to nondepressed controls, suggesting that overgeneral memory is not dependent on current mood-state. This interpretation, however, remains ambiguous because the mood levels (as measured by the BDI) for the recovered patients was not different from a third group of individuals who had very recently taken an overdose (Williams & Dritschel, 1988). Nevertheless, a possible indication that overgenerality is not state-dependent is that a number of studies have found that the correlation between the level of depression and overgeneral memory is low and nonsignificant (e.g., Williams & Dritschel, 1988; Kuyken & Brewin, 1995; Kuyken & Dalgleish, 1995).

Empirical support for the argument that overgenerality is a cognitive style comes from research indicating that there may be groups of individuals with clinical depression for whom this tendency is relatively trait like. The results from the Brittlebank et al. (1993) study, for example, showed that overgeneral recall predicts failure to recover from major depression. In their study, patients who met the diagnostic criteria for major depression were interviewed during recovery on three separate occasions (admission, 3 months, and 7 months). The results indicated that overgeneral responses to positive cues at the initial assessment were highly correlated with depression severity (measured by the Hamilton Scale for Depression-HRSD) (Hamilton, 1960) at 3 both months and 7 months. Furthermore, dividing patients at initial testing into high and low overgenerality

subgroups and examining the outcome at 7 months revealed that, whereas 80% of those "specific to positive cues" had recovered from their depression, only 11% of those "overgeneral to positive cues" had recovered from their depression. These results are striking because neither severity of depression nor dysfunctional attitudes were successful in predicting the course of the illness.

Converging support for the cognitive style argument comes from studies investigating the association between trauma history and overgenerality. Kuyken and Brewin (1995) found that clinically depressed women with reported personal histories of childhood sexual abuse exhibited an increased difficulty retrieving specific autobiographical memories compared to clinically depressed women without abuse histories. Furthermore, Vietnam veterans with post-traumatic stress disorder (PTSD) have been shown to be more overgeneral in their memories, especially after having been exposed to reminders of traumatic events (i.e., a combat videotape), compared to Veterans without PTSD (McNally et al., 1994).

Another suggestion that has been offered is that overgenerality may be more a consequence of intrusive cognitions (Williams, 1996). Indeed, there is evidence supporting the relation between severity of clinical depression and levels of intrusive memories. In particular, abused women with high levels of intrusion are reported to be more severely clinically depressed (measured by the BDI) than are non-abused women and abused women with low levels of intrusion (Kuyken & Brewin, 1994). Results from the Kuyken and Brewin (1995) study further indicated that patients with high levels of spontaneous memories of childhood abuse experienced more difficulty in retrieving

specific memories compared to a control group. Intrusive thoughts, however, in and of themselves, do not seem to underlie this cognitive tendency. Although lack of specificity in the recall of personal events is found in patients with OCD (a disorder highly characterized by intrusive cognitions), this tendency occurs only when they have a co-morbid major depressive disorder (Wilhelm et al., 1997).

From the results reviewed thus far it is clear that overgeneral memory is found in those suffering from a clinical mood disorder, and there is even some evidence to suggest that some individuals may be more susceptible to this effect (e.g., Brittlebank et al., 1993; Kuyken & Brewin, 1994; Kuyken & Brewin, 1995). In line with these findings, Williams (1996) has suggested that one origin of the difficulty may be in a young child's exposure to negative early experiences affecting retrieval strategies. A child learns to retrieve personal information at a generic level for the initial purpose of regulating affect. In later years, if an individual is given instructions to retrieve a specific memory that emphasizes the self-focus element, their memories are more general. Another possibility, although not necessarily a competing view, is that the state of depression, in and of itself, causes an autobiographical memory disturbance. That is, the underlying factors contributing to overgeneral memory are changes in cognitive processing resulting from the state of depression itself. As noted, to consider this alternate view one could, as a first step, examine this phenomenon at the basic level of mood. However, up until now, there has been no systematic assessment of the relation between mood and overgenerality, and only one study (Moffitt et al., 1994) has investigated this tendency in a nonclinical population.

Moffitt and her colleagues examined the extent to which the relationships noted by Williams et al. existed in a sample of college students experiencing a negative mood. In this study, memory was assessed through both personally significant and emotionally evocative written autobiographical memories. Mood was measured using the Multiple Affect Adjective Checklist – Revised (MAACL-R). The results revealed no significant differences between participants with higher depression scores and those with lower depression scores in the number of single-event and summary memories when they were asked for a negative memory. Participants with higher scores of depressive mood, however, recalled significantly more summary memories in response to a request for a positive self-defining memory than did participants with lower scores of depressive mood.

The finding that overgeneral memory is indeed found in a nonclinical sample points to the importance of investigating this phenomenon in the context of mood. If mood is found to be the key factor influencing the tendency to retrieve generic memories, this would, at the very least, challenge current models that explicate this effect in terms of a mood state-independent cognitive style that is developed in response to early negative experiences. This is not to say that the phenomenon cannot be both a cognitive vulnerability and mood state-dependent. Indeed cognitive vulnerability factors can remain dormant until activated by a mood state (Miranda, Gross, Persons, & Hahn, 1998).

As noted, the Moffitt et al. (1994) study compared the quality in autobiographical memory between students reporting higher depression scores compared to those reporting

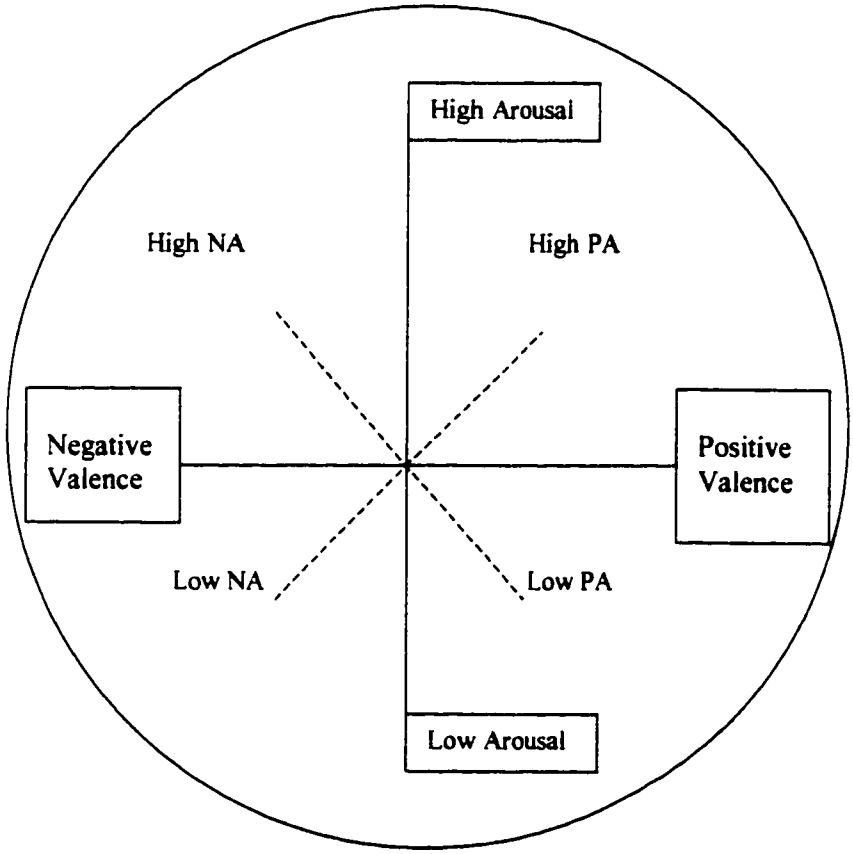
lower depression scores on a mood measure. This thesis intends to extend the research by separating the components of mood and investigating their individual influence on autobiographical memory recall. This will be accomplished by inducing mood changes in a nondepressed population where mood levels are equivalent prior to the manipulation and examining the consequent effects on autobiographical memory specificity.

(ii) The Two Dimensions of Mood: Valence and Arousal

To understand the role that mood may play in overgeneral memory, it is important first to understand mood as a construct. Several models of the structure of mood have been proposed (Russell, 1979; Russell, 1980; Watson & Tellegen, 1985). There exists a general consensus among these different models that mood (or affective states) can be characterized by a circumplex containing two main dimensions, although the models differ in terms of what these dimensions are (Larsen & Diener, 1992; Feldman, 1995; Russel, 1980; Watson & Tellegen, 1985).

A circumplex is a two-dimensional circular structure that describes the relationships among different attributes (see Figure 1). Attributes correlate highly with those attributes close by on the circumference of the circle, correlate near zero with those attributes 90 degrees around the circle, and correlate inversely with those attributes directly opposite the circle. In descriptive terms, circumplex dimensions describe affective states, so that any affective state may be defined by its placement relative to circumplex dimensions. Positing a circumplex presumes that some affective states are similar to each other yet measurably different than other affective states.

Figure 1: Valence/Arousal dimensions versus PA/NA dimensions



SOURCE: Adapted from Larsen and Diener (1992) and Watson and Tellegen (1985).

In general, there are two opposing views in the literature regarding the primary dimensions of the circumplex. Some researchers advocate the view that the primary dimensions are located along the Pleasantness-Unpleasantness (i.e., Valence) and the Arousal/Activation axes, depicted in Figure 1 by the solid lines (Russell, 1978; Russell, 1979). In contrast, Watson and colleagues contend that the Negative Affect and the Positive Affect axes are the primary dimensions of the circumplex, represented in Figure 1 by the dashed axes (Clark & Watson, 1991; Watson & Clark, 1994a; Watson & Tellegen, 1985). Researchers continue to debate whether arousal-valence or NA-PA are the primary dimensions of mood. These models are rotational variants of each other and, therefore, as noted by Feldman (1993; 1995) dimensionality may be chosen by the theoretical considerations of the researcher. With a true circumplex, no set of dimensions can be any more 'primary' than any other set because rotation of axes is entirely arbitrary in that no rotational scheme can account for any more statistical variance than any other rotational scheme (Larsen & Diener, 1992). In this thesis, mood is conceptualized from an arousal-valence perspective for reasons that will become apparent shortly. It may be useful to clarify briefly the concepts of NA/PA and arousal/valence to understand why the latter dimensions were chosen.

As noted above, Watson and colleagues have proposed a structural approach to mood that focuses on two dimensions: Negative Affect and Positive Affect (Clark & Watson, 1991; Watson, 1988; Watson, Clark, & Carey, 1988; Watson & Tellegen, 1985). NA represents the extent to which an individual is upset or distressed. Individuals experiencing high NA typical report feeling distressed, fearful, hostile, jittery, nervous,

and scornful; conversely, individuals experiencing low levels of NA describe themselves as calm and relaxed. Positive Affect, on the other hand, reflects a person's level of pleasure and enthusiasm. High PA is a state of enthusiasm, energy, mental alertness, and determination, whereas low PA is characterized by feelings of lassitude and lethargy.

The two mood dimensions, PA and NA, are largely independent of one another, and they have distinctive correlational patterns with other variables (Watson & Clark, 1997). For example, PA is related to exercise and social interaction, whereas NA is correlated with health complaints, and perceived stress (McIntyre, Watson, & Cunningham, 1990). Furthermore, the two mood dimensions are differentially related to personality traits: NA is associated with measures of neuroticism, and PA is associated with measures of positive affectivity (Clark & Watson, 1991). From this perspective, depressed mood is associated with both high NA and low levels of PA (Clark & Watson, 1991).

An alternate view of mood is that valence and arousal are its primary dimensions (Russell, 1980). In particular, valence is a bipolar factor with pleasantness (described with terms such as happy, pleased, satisfied, and content), and unpleasantness (described with terms such as sad, unhappy, blue, and lonely) at opposite ends (Diener & Emmons, 1985; Watson & Tellegen, 1985). The bipolar factor of mood is associated with a second unipolar arousal or activation factor. High activation is described with terms such as aroused, astonished, stimulated, surprised, active and intense. Low activation is described with terms such as quiet, tranquil, still, inactive, idle, and passive. From a

valence-arousal standpoint, depressed mood is characterized by negative valence and low arousal (Russell, 1978; Thayer, 1989).

According to Thayer (1989), arousal can be further subdivided into two orthogonal factors, energetic arousal and tense arousal. In essence, these terms can be considered synonymous with PA and NA respectively (see Figure 1) (Larsen & Diener, 1992). Thayer (1989) proposed that energetic arousal ranges from bodily quiescence to activation, and is closely associated with gross motor activity. This arousal system can be recognized by subjective sensations such as energy, vigor, and peppiness. The second system, namely tense arousal, mediates danger-related activities, and is associated with patterns of attention. Subjective feelings of fearfulness, anxiety, and tension describe this state. The mood of energetic arousal has a positive affective tone. In its higher levels it is closely associated with optimism and increased self-esteem, whereas in its lower levels the mood is one of reduced optimism and critical self-evaluations. Tense arousal, on the other hand, has a negative affective tone and can, in conjunction with energetic arousal, accentuate negative evaluations of the self. According to Thayer, depressed mood can be characterized by low arousal levels but, in particular, low levels of *energetic* arousal, although at least some types of depressed mood may also include high levels of tense arousal since depressed mood can be associated with anxiety (Alloy, Kelly, Mineka, & Clements, 1990).

Depressed mood, then, can either be described as a state of high NA with low PA, or it can be described as a state of unpleasant valence with low energetic arousal (i.e., low PA). Clearly, the nomenclature can result in some degree of confusion. Because the

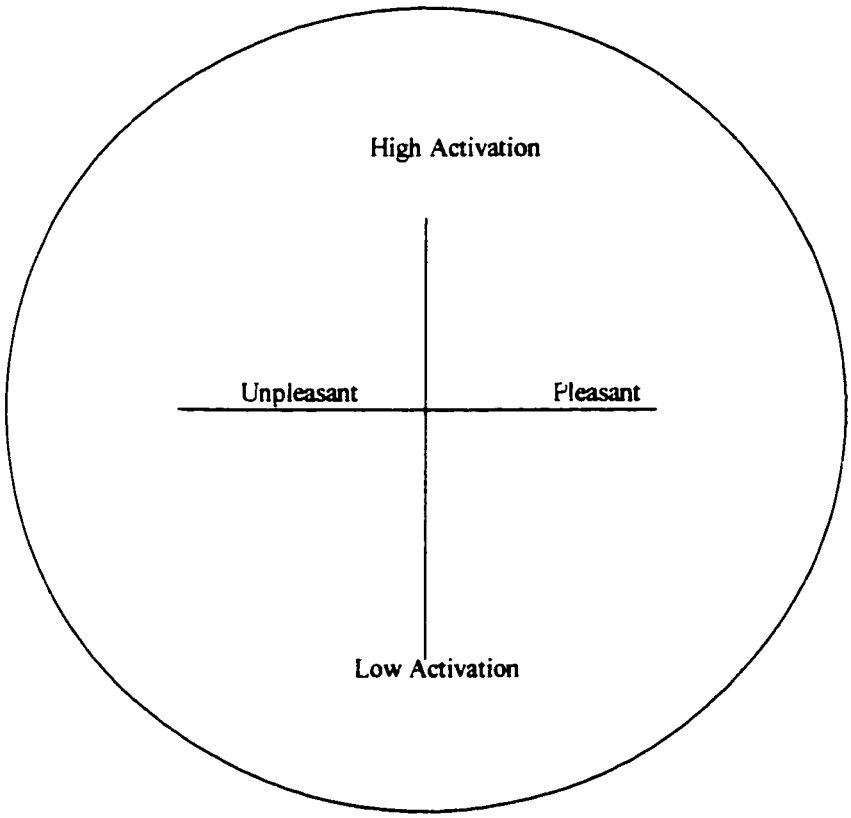
dimensions labeled PA and NA fall at 45 degrees to the Pleasant-Unpleasant and Activation dimensions, PA and NA really reflect composites of valence and activation.

Larsen and Diener have proposed a simple labeling system for the mood circumplex, presented in Figure 2. Affective states vary on hedonic valence, so that any state falling in the left half of Figure 2 is referenced with the label 'Unpleasant', and any state falling in the right half of Figure 2 is referenced with the label 'Pleasant'. Similarly, affective states vary on activation, so any state falling in the upper half of Figure 2 is referenced with the label 'High Activation' and any state falling in the bottom half of Figure 2 is referenced with the label 'Low Activation'. From this perspective, depressed mood falls somewhere between the Activated Unpleasant and Unactivated Unpleasant dimension in the circumplex.

The aim of this thesis is to assess whether the tendency to produce overly general memories is dependent on mood at recall. To accomplish this goal, it is necessary to examine differentially how the different components of mood affect the quality of autobiographical memory recall. Although differences remain in the rotation and labeling of affective dimensions, all dimensions may be defined as combinations of valence-arousal dimensions as suggested by Larsen and Diener (1992).

The broad level dimensions of valence and arousal were chosen for a number of reasons. First, lack of energy (i.e., low energetic arousal) is a dominant characteristic that has proven to be an important discriminative component of clinical depression (Christensen & Duncan, 1995). Second, there is some evidence to suggest that the

Figure 2: The Larsen and Diener (1992) Affect Circumplex



SOURCE: Adapted from Larsen and Diener (1992).

activation motivation symptoms (i.e., lack of interest, psychomotor change, loss of energy) (Blazer et al., 1988). Whereas NA and PA reflect higher order levels of mood that encompass aspects from both clusters of depressive symptoms, valence/arousal appear to be more in line with these categories. Finally, because the mnemonic interlock model proposes that component of mood is positively correlated with the specificity of autobiographical memories (Cappeliez, Leblanc, & Guirguis, 1993). Third, research suggests that depressive symptoms cluster into two main categories, reflecting affective symptoms (i.e., dysphoria, feelings of guilt, and thoughts of death-suicidal ideation) and reduced working memory capacity is one possible factor contributing to overgeneral memory, it would follow that in order to test this hypothesis it is necessary to conceptualize mood from a valence-arousal perspective. Let me elaborate this point further.

(iii) Working memory and Overgeneral Memory

The idea that working memory is affected in clinical depression is not new. Indeed, a prominent view found in the literature is that depression reduces the central executive functioning of working memory (Channon & Baker, 1994; Channon, Baker, & Robertson, 1993; Hasher & Zacks, 1988; Williams, 1996; Williams & Dritschel, 1992). The central executive is proposed to be an attentional control system that is responsible for strategy selection and for the integration of information (Baddeley, 1994). In addition, the central executive focuses attention and prevents vulnerability to distractions (Baddeley, 1994). According to Hasher and Zacks (1988), central to selective attention are inhibitory mechanisms that, when functioning normally, serve to limit entrance into

working memory to information that is along the path of a specific goal. A decrement in the functioning of the central executive results in a deficiency in these inhibitory processes which, in turn, allows more extraneous information to enter working memory (Baddeley, 1993; Hasher & Zacks, 1988).

It has been proposed that the central executive of working memory contributes to overgeneral memory by preventing the inhibition of categoric descriptions (Williams, 1996). In particular, the view advocated by Williams is that re-experiences of trauma or otherwise negative experiences reduce working memory's capacity to get beyond these general mnemonic categories. This hypothesis has not been tested directly, although there is some evidence to suggest that dysexecutive syndrome results in nonspecific memory. For example, research shows that brain damaged people (Baddeley & Wilson, 1986), the elderly (Winthorpe & Rabbitt, 1988), and young children (Nelson, 1988), all of whom are presumed to have reduced working memory capacity, show nonspecificity in autobiographical recall.

Working memory can be considered a cognitive resource that has limited capacity (Baddeley & Hitch, 1974; Salthouse, 1990), and according to Kahneman (1973), momentary capacity varies as a function of arousal. Kahneman proposed that there is a general limit on the energy available for performing mental operations, with both high and low levels of arousal having the effect of reducing attentional capacity. If we consider along with others (Russell, 1979; Russell, 1980; Thayer, 1989; Wells & Matthews, 1994) low energetic arousal as an element of depressed mood, that is, if we conceptualize mood from an arousal/valence perspective, we could assess whether this

phenomenon is state-dependent and simultaneously test the reduced capacity view advocated by the mnemonic interlock model.

The Aim of this Research

This research is designed to test the hypothesis that mood is the key factor influencing the tendency to retrieve generic memories. To this effect, the study examines how manipulations of the two components of mood, the bipolar valence dimension (pleasant vs. unpleasant) and the unipolar dimension of energetic arousal, influence the specificity of autobiographical memories in a nonclinical population. Having elaborated a procedure to produce different levels of specificity of autobiographical recall, the study also addresses the purported role of working memory in the overgeneral phenomenon. This is done by testing how the manipulation of variables affecting the specificity of autobiographical memories influence, in parallel, the functioning of working memory.

Experiments 1 and 2 separately test how the two dimensions of mood, valence and arousal respectively, affect autobiographical specificity. The postulated underlying mechanism of reduced working memory capacity is examined across both experiments.

In Experiment 1, the bipolar valence dimension of mood is manipulated through a mood induction procedure. Specifically, both pleasant and unpleasant mood states are induced through the modified Velten mood induction technique (Sinclair, Mark, Enzle, Borkovec, & Cumbleton, 1994).

The Velten procedure is usually administered verbally and individually to participants. Participants are asked to read each of 60 mood-related statements, first to themselves, then aloud, at the rate of one card per 20 seconds. The statements begin

neutrally and become progressively more elated (pleasant) or depressed (unpleasant) in content, depending on the particular induction. In the modified Velten technique, participants read the statements silently. They then read brief incubation instructions and incubate for 3 minutes prior to the first time their moods are measured. Thus, this procedure allows for group administration. The incubation period is designed to increase the duration of the induction. Research suggests that, with the inclusion of an incubation period, this procedure leads to mood change lasting up to 35 minutes (Sinclair et al., 1994). In contrast, the traditional Velten procedure produces mood effects that do not last beyond the measure of mood itself (Isen & Gorgoglione, 1983).

There has been much controversy surrounding the effectiveness of the Velten procedure, and the evidence is mixed. Some authors have criticized this procedure as producing demand characteristics whereby participants report changes in mood only because they know the expected effects of the procedure (Buchwald, Strack, & Coyne, 1981; Polivy & Doyle, 1980). Others have argued that the Velten procedure has a genuine effect on mood that is independent of demand characteristics (Westermann, Spies, Stah, & Hesse, 1996). Still others conclude that the Velten procedure is a powerful manipulator of mood (Goodwin & Williams, 1982). Two meta-analyses (Larsen & Sinnett, 1991; Westermann et al., 1996) have found a large mean effect size for Velten mood induction, pointing to the efficacy of this technique. In the present study, the modified Velten procedure was chosen because of the duration of the mood effects. Furthermore, Gouaux and Gouaux (1971) reported that women are more

susceptible to the effects of the Velten technique than are men and only women were tested in the present study.

Men were excluded from the study because research suggests that women are more likely to use rumination, and men distraction, in coping with dysphoric mood (Nolen-Hoeksema, 1991). Research has further shown that dysphoric individuals who are induced to ruminate are more likely to recall negatively biased autobiographical memories in free recall and in response to prompts for memories than are dysphoric individuals who distract themselves from their mood (Lyubomisrsky, Caldwell, & Nolen-Hoeksema, 1998). The same study also found that dysphoric rumination leads to recalling negative events as occurring relatively frequently, and positive events as occurring relatively infrequently, whereas this same effect is not found with dysphoric distraction. Including men in this study may have produced gender differences on the autobiographical memory test because men would have most likely used distraction strategies after an induced depressed mood. Therefore, the results may not have been an adequate reflection of how mood at recall affects autobiographical memory retrieval.

In Experiment 2, energetic arousal is manipulated through physical exercise. There is much research investigating the effects of exercise on mood state (for a review see Yeung, 1996). The literature generally supports the view that mood improves with both aerobic and anaerobic physical exercise (Doyne et al., 1987). Numerous studies have found that moderate levels of exercise significantly reduce negative affect and increase positive affect (McGowan, Talton, & Thompson, 1996; McInman & Berger, 1993; Moore, 1993; Stein & Motta, 1992). More importantly, however, research

suggests that energetic arousal increases in the short-term with moderate exercise (Maroulakis & Zervas, 1993; Thayer, 1989). Thayer (1989) found that brisk walks of five to ten minutes can enhance energetic arousal for up to one or two hours. Other studies have confirmed these findings, and have found that moderate exercise increases the vigor component of mood, as measured by the Profile of Mood States test (e.g., Maroulakis & Zervas, 1993; McGowan et al., 1996). On the other hand, acute strenuous exercise results in an initial period of fatigue followed by increased energy a short while later (Thayer, 1989). Studies have shown that with more rigorous training protocols, the relationship between physical activity and affect is not always positive (Raglin, 1990; Raglin, Morgan, & O'Conner, 1991; Steptoe, Edwards, Moses, & Mathews, 1989). High intensity exercise may be associated with significant increases in negative affect and fatigue (Berger & Owen, 1992; Fleury & Bard, 1990; Koltyn, Lynch, & Hill, 1998; Pronk, Crouse, & Rohack, 1995; Steptoe & Bolton, 1988; Steptoe & Cox, 1988). These studies have found that high-intensity exercise leads to increases in tension/anxiety and fatigue, whereas positive mood changes are seen following low-intensity exercise only (e.g., Steptoe & Cox, 1988).

Across both Experiment 1 and Experiment 2, the functioning of the central executive in working memory is tested using the Trail Making Test (Armitage, 1946). The Trail Making Test measures attention functions. It is given in two parts, A and B. In part A, participants are required to draw lines connecting 25 consecutively numbered circles. In part B, participants must connect the same number of consecutively numbered and lettered circles by alternating between the two sequences. This test was chosen

because attention is mediated by central executive functioning (Baddeley, 1992), and research suggests that depressed mood can have deleterious effects on attention (Hasher & Zacks, 1988; Lezak, 1983; Watts, Dalgleish, Bourke, & Healy, 1990; Wells & Matthews, 1994). Furthermore, because the effects of the induction techniques are time-limited, it was necessary to use a test where the administration was not lengthy.

Based on previous research (Cappeliez et al., 1993) showing that the activation and not the affective component of mood affects autobiographical specificity, it was expected that manipulating valence (Experiment 1) would not produce differences in autobiographical memory specificity, whereas manipulating arousal (Experiment 2) would affect the specificity of autobiographical memory. This hypothesis was further substantiated by studies that have found that the correlation between the extent to which memory is overgeneral and current depressed mood is nonsignficant (Williams, 1996; Brittlebank et al., 1993 Kuyken and Brewin & Brewin, 1995), suggesting that the valence of mood does not contribute to this effect. From a theoretical standpoint, the notion that working memory capacity is needed to retrieve specific memories (Williams, 1996), coupled with the notion that low arousal reduces working memory capacity (Baddeley, 1992; Kanheman, 1973) would also suggest that overgeneral memory is associated with arousal rather than with valence of mood.

It was expected that inducing low levels of arousal would have the effect of reducing the specificity of autobiographical memories and that inducing high levels of arousal would have the effect of increasing the specificity of autobiographical memories. Similarly, reduced working memory functioning was expected in the low arousal

condition, with the opposite effect expected in the high arousal condition. No differences in working memory functioning were expected from changes in valence.

Experiment 1

Experiment 1 assessed the relation between the affective component of mood and overgeneral memory. Participants were randomly assigned to one of three induction conditions: 1) elated valence; 2) depressed valence; or 3) neutral control. Both the affective and the arousal dimensions of mood were assessed before the introduction of the induction procedure to ensure that there were no initial differences between the three groups.

Each subject was then given a packet of modified Velten cards inducing elated, depressed, or neutral moods according to the condition to which they were assigned. Both the affective and the arousal dimensions of mood were again tested after the manipulation to ensure that the affective component had changed in the desired direction. Both autobiographical specificity and working memory were then tested. Finally, mood was again measured at the end of the experiment to ensure that the effects of the induction procedure had been maintained throughout the testing phase.

Previous research (Cappeliez et al., 1993) suggests that it is the activation, and not the affective, component of depression that affects autobiographical specificity. Thus, it was expected that manipulation of the affective dimension of mood would not affect autobiographical recall. That is, no difference in the specificity of autobiographical memory was expected for participants with induced elated and depressed affective states

compared to the neutral control group. Furthermore, no differences in central executive functioning were expected between the three groups.

Method

Participants.

The participants in Experiment 1 were ninety-three undergraduate women from the University of Ottawa. Participants were randomly assigned to one of three mood induction conditions (elated valence, depressed valence, or neutral control) such that there were thirty-one participants per condition. One participant was excluded from the data analysis because she did not complete the Autobiographical Memory Test properly (i.e., she did not provide a memory for any of the 10 cue words). Therefore, for the data analysis there were 30 participants in the elated valence condition, and 31 participants in each of the two other conditions. Based on Cohen's (1992) power calculations, it was determined that the necessary *N* for power of .80 to detect a large difference between three populations at }=.05 is 21 and at }=.01 is 30.

Participants were recruited on a volunteer basis from undergraduate courses. A research assistant visited undergraduate classes to describe the study and sign-up sheets were passed around to the students, who would sign up if interested in participating. Posters describing the study were also distributed across campus, and interested participants were invited to call the lab to sign-up.

Measures

Beck Depression Inventory (BDI). The BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), is a widely used, 21 item self-report measure of depressed

mood on which respondents mark one of four responses appropriate to their emotional state over the past 2 weeks. The validity of the BDI as a measure of depressive symptomatology has been widely established (for a review see Beck, Steer, Garbin, 1988; Richter, Werner, Heerlein, Kraus, & Sauer, 1998). In short, the BDI has high internal consistency, content validity, and discriminant validity in differentiating depressed from non depressed individuals. Test-retest reliability in non-psychiatric populations is .90 (Beck et al., 1988). This measure has been used both in research and clinical settings.

In this study, the BDI was used as a screening measure for participants. In particular, any participant having a score of 15 or above on the BDI was excluded from the statistical analysis. In normal populations, BDI total scores greater than 15 may indicate possible depression (Beck & Steer, 1987).

Autobiographical Memory Test (AMT). The emotional cue words used by Williams and Broadbent (1986) were used. There were five positive words (*happy, safe, interested, successful,* and *surprised*), and five negative words (*sorry, angry, clumsy, hurt,* and *lonely*). However, instead of the words being orally read to the participants as in the Williams and Broadbent (1986) paradigm, they were presented on a two-sided sheet of paper. Following Singer and Moffitt's (1991-92) procedure used with an undergraduate population, participants in this study were instructed to write down a self-defining memory for each word.

Singer and Moffitt's scoring manual for single event and summary memory narrative types was used to score the autobiographical memories. In the manual, single event narrative types are defined as "a sequence of actions or images identifiable as a

unique occurrence and located in a discrete time period in an individual's life" (i.e., on a particular day). The defining feature of a summary narrative is "its lack of a discrete connection to a particular moment in time. It locates events in larger time frames and/or blends unique events into an amalgam meant to represent all of its constituent experiences".

Two independent judges blind to which condition the participant had been assigned to individually scored each memory as either a single (or specific) event or as a summary (or general) memory. The interrater agreement for scoring of single event and summary memory narratives was 90 percent, $k=.82$, $p<.0001$.

Not all subjects provided a memory narrative for each of the ten cue words. The mean proportion of total omissions for the entire sample (neither specific nor general responses made) was .4% in the depression valence induction group, .4% in the neutral valence induction group, and .2% in the elation valence induction group. Analysis of Variance showed that these differences between the groups were not significant, $F<1$.

Profile of Mood States – Short Form (POMS-SF). The POMS-SF(Shacham, 1983), an abbreviated form of the POMS (McNair, Lorr, & Droppleman, 1981), is a 37-item state-mood questionnaire ("right now" form). The POMS-SF yields both an overall Total Mood Disturbance score as well as scores for each of the six subscales retained from the original POMS-SF: fatigue, tension, vigor, anger, depression, and confusion-bewilderment. Each scale score is derived from participants' responses to a number of adjectives describing how people may feel (e.g., tired, worthless, tense, relaxed), each adjective rated on a 5 (0-4) point scale. This scale was used to measure

arousal levels [i.e., high energetic arousal (or vigor), and low energetic arousal (or fatigue)], as well as to measure negative valence (i.e., depression).

The POMS-SF vigor scale consists of the mood descriptors *lively, active, energetic, cheerful, full of pep,* and *vigorous.* The fatigue scale consists of the mood descriptors *worn out, fatigued, exhausted, weary,* and *bushed*; and, finally, the depression scale consists of the descriptors *unhappy, sad, blue, hopeless, discouraged, miserable, helpless,* and, *worthless.*

The POMS measure has been shown to have high discriminant validity in that the scales are consistently more highly related to corresponding measures of mood than noncorresponding mood scales (Nyenhuis, Yamamoto, Luchetta, Terrien, & Parmentier, 1999). Its validity is further established by correlations with other measures of mood state (the VAMS), and measures of depression (the BDI) and anxiety (the STAI) (Nyenhuis et al., 1999). Psychometric evaluation of the POMS-SF reveals that internal consistencies for the subscales is comparable to those for the original POMS (Curran, Andrykowski, & Studts, 1995). Furthermore, correlations between total mood disturbance and subscale scores on the POMS-SF and those from the original POMS have all been shown to exceed .95 (Curran et al., 1995). As noted by Curran et al., a lack of normative data available with the original POMS is currently a drawback to the use of the POMS-SF. The POMS-SF, however, is suitable for use in situations in which the responses of two or more groups or are compared, or changes in responses within groups are measured.

The Positive and Negative Affect Schedule – Extended Form (PANAS-X).

The PANAS-X (Watson & Clark, 1994b) is an extended form of the original 20-item PANAS (Watson, Clark, & Tellegen, 1988). The PANAS-X contains 11 scales, including *fear, sadness, guilt, hostility, shyness, fatigue, joviality, self-assurance, attentiveness, serenity,* and *surprise.*

Each scale is comprised of different mood descriptors. For example, items in the joviality scale include *happy, enthusiastic,* and *energetic.* Participants rate the extent to which they experience each mood descriptor at that moment. These rating are made according to a 5-point scale: 1 = very slightly or not at all; 2 = a little; 3 = moderately; 4 = quite a bit; and 5 = very much. Total scores for the different scales are obtained by summing the ratings, given the 10 relevant mood descriptors. Thus, the possible range of scores for each affect is from 10 to 50.

The PANAS-X was used to measure positive affect and joviality. This measure was chosen because whereas the original PANAS scales are general factor scales that assess the shared variance among many types of affect, the PANAS-X scales provide a more differentiated assessment of essentially the same content domain (Watson & Clark, 1997).

Watson and Clarke (1994b; 1997) have reported extensive data demonstrating the reliability and validity of these scales. Internal consistency reliabilities, for example, have been shown to range from .83 to .90 for Positive Affect, and from .88 to .94 for Joviality. Furthermore, the PANAS-X has been shown to have convergent validity with the POMS, as well as with other measures of mood and symptomatology (e.g., BDI,

STAI) (Watson & Clarke, 1994b). The PANAS-X has also been shown to be sensitive to intraindividual mood fluctuations (Watson & Clarke, 1994b), and therefore, can be used validly to assess short-term changes in state affect. Psychometric data with undergraduate students has shown that the Mean for 'right now' ratings of Positive Affect is 29.0 (sd=8.0), and of Joviality is 21.7 (sd=7.5).

Trail Making Test. The Trail Making Test (Armitage, 1946) is given in two parts, A and B. The participant must first draw lines to connect consecutively numbered circles on one work sheet (Part A) and then connect the same number of consecutively numbered and lettered circles on another work sheet by alternating between the two sequences (Part B). The participant is urged to connect the circles 'as fast as you can' without lifting the pencil from the paper. The examiner points out errors as they occur, and the participant must correct the errors before continuing. The score is the number of seconds taken to connect the circles for each work sheet.

The TMT is a well-established, sensitive test of visual search and sequencing, backed by a solid body of research and normative data (for a review see Spreen and Straus, 1998). Reliability of the Trail Making test has been reported as .98 for Part A and .67 on Part B (Lezak, 1983). The TMT has also been reported to have high construct validity (see Spreen and Strauss, 1998). Normative data are provided by Spreen and Strauss. The mean for normal adults between the ages of 20-29 on Trails A is 27.4 (9.6), and on Trails B is 58.7 (15.9).

Pilot Study

A pilot study was conducted to test the efficacy of the modified Velten mood induction procedure. Twenty-four undergraduate women participated in the pilot study. Participants were randomly assigned to the elated induction condition, the depressed induction condition, or the neutral induction condition. Participants were asked to complete the POMS-SF and the PANAS-X both immediately before and after reading the statements corresponding to their condition.

The results showed that for the depression induction there was a significant increase in their depression score at posttest, $t(7)=3.121$, $p<.05$. Furthermore, there was a significant decrease in joviality, $t(7)=4.556$, $p<.01$, and positive affect, $t(7)=3.813$, $p<.01$. Finally, there was an increase in anger, $t(7)=2.733$, $p<.05$, and a decrease in vigor, $t(7)=4.347$, $p<.01$. These results suggest that the manipulation can effectively change mood. It is not surprising that inducing a depressed mood results in a decrease in positive affect and joviality. This finding is consistent with the view that depression is characterized more by the absence of positive affect, rather than the presence of negative affect (Watson, Clark, Tellegen, 1988). A decrease in vigor, however, was not expected. This finding may be due to the fact that the vigor subscale includes a rating for 'cheerful' that may be less endorsed when a depressed mood is induced.

There were no significant changes in any of the mood dimensions between pretest and posttest for the neutral group, as expected. Participants in the elation induction condition showed a significant increase in joviality, $t(7)=2.547$, $p<.05$, and a decrease in

fatigue, $t(7)=2.517$, $p<.05$. These findings confirmed that the modified Velten induction procedure successfully affects the valence dimensions of mood.

Procedure

Participants were tested either individually or in a group of three. Following the signing of a consent form (Appendix 1), participants were randomly assigned to the elation valence induction condition, to the depression valence induction condition, or to the neutral control induction condition. Participants were told that before the mood induction procedure they would have to report their feelings on two short questionnaires. They were also informed that they would have to repeat these questionnaires after the mood induction procedure, as well as complete a number of additional tests. The experimenter emphasized that it was important that participants respond very honestly on the mood measure, because it would create problems if this technique were used for future research when it was ineffective.

In addition to verbal instructions, participants received written directions based on the modified Velten instructions (see Appendix 2). These are the same instructions used by Sinclair et al. (1994). These instructions emphasized that participants should raise their hands if they felt that they could not continue, and they explained that participants should be concentrating on building the mood for 3 min after they completed the statements (the incubation instructions).

Prior to the mood induction procedure all participants completed the BDI, the POMS-SF (Appendix 3) and the PANAS-X (Appendix 4). Packets containing either elation, neutral or depression induction cards were then randomly distributed to

participants within blocks of three. Participants were told that they would be asked to read each statement in the packet and think about it. They were also told that they should wait to go on to the next statement until the experimenter asked them to. Participants were told that if the induction 'got to be too much' they should raise their hands and the experimenter would stop the procedure. No participant ended the study prematurely.

Participants read each of the 60 Velten statements at the rate of 1 per 15 sec. The statements were typed on 1.5 in. X 8.5 in. pieces of paper and stapled together in a packet. After completing the last statement, participants read instructions designed to facilitate incubation of the mood, developed by Sinclair et al. (1994). For example, the incubation instructions in the elated condition were as follows:

> Now that you're feeling very happy, concentrate on this feeling. Let it flow. Let it build. Feel the mood. Feel it stronger. Think about other things that have happened in your life that have made you very, very happy like doing some things you love to do, or like being with good friends, doing fun enjoyable things. Concentrate on it. As you do, you'll feel the mood build. It'll become more intense, more happy. This, in turn, will make you think of other things in your life that have made you very, very happy. The mood will build. Let it. Feel it become more intense. Feel it stronger. It will happen. Do and think whatever you can to build this very happy mood. Feel very, very happy. Close your eyes. Begin now.

In all conditions, participants were given a 3-min period to build the mood. At the end of the incubation period, participants repeated the POMS-SF and the PANAS-X. The AMT

was then administered. The following instructions were read for the participants for the autobiographical memory task.

> I'm a going to show you a list of 10 words. For each word I want you to write down the first self-defining memory that comes to mind. A self-defining memory has the following attributes:
>
> 1. It is a memory that is at least one year old.
> 2. It is a memory from your life that you remember clearly, and that still feels important to you even as you think about it right now.
> 3. It is a memory that helps you understand who you are as an individual and might be a memory you tell someone else if you wanted that person to understand you in a more profound way.
> 4. It is a memory related to the word that you are going to see.

The Trail Making Test was also administered. Administration of AMT and the Trail Making test varied randomly. Finally, participants once again completed the POMS-SF and the PANAS-X. The participants were then debriefed by the experimenter. Those who were in the depression condition were exposed to the elation cards prior to leaving.

Results

The Results section is subdivided into three parts to answer three separate questions. The first question was whether the groups were comparable in their mood ratings before the mood induction manipulation was introduced (i.e., Time 1). To answer this question, the mood subscales of the POMS-SF and the PANAS-X were submitted to a Multivariate Analysis of Variance.

The second question was whether the mood manipulations worked in the desired direction, and whether the effects lasted until the end of the testing phase. Specifically, the question of interest was whether the depression induction group reported increased scores on subscales related to negative mood, the elation induction group reported increased scores on subscales related to positive mood, and the neutral group reported no change in any of the mood dimensions after the manipulation (Time 2). Further, did the mood changes last until the end of the testing phase (i.e., Time 3)? To this end, separate 3 (Condition – Elated Valence, Depressed Valence, Neutral Valence) X 3 (Time – Time 1, Time 2, Time 3) ANOVAs were performed with Time as a repeated measure.

The third and final question that was addressed was what effect did the three mood manipulations have on the specificity of autobiographical memories, as well as on working memory. To determine what effect the mood induction had on the specificity of autobiographical memory, a percentage was calculated for the number of general memories produced by each participant out of the total number of memories they produced. Similarly, a percentage was calculated for the number of positive general memories produced, and for the number of negative general memories produced. A one-way ANOVA was performed on the mean proportion of general memories for each condition. To test whether there was a difference in the proportion of general memories with respect to Cue Valence, a 3 (Condition – Depressed Valence, Elated Valence, Neutral Valence) by 2 (Cue Type – positive, negative) ANOVA was performed with Cue Type as a within subjects variable. To test the effects of mood induction on working

memory, one-way ANOVAs were performed on the mean amount of time taken to complete Trails A and Trails B for participants in each condition.

Question 1: Were there any difference in self-reported mood between the three groups before the mood induction manipulations?

A one-way ANOVA was performed on the mean BDI scores for the three condition groups. The results showed no significant differences in the BDI scores of the three groups, $F(2, 89)=1.591$, $p>.05$.

The six mood subscales of the POMS-SF and the two mood subscales of the PANAS-X (joviality and positive affect) administered at Time 1 were analyzed using a multivariate Analysis of Variance. The results showed no significant differences among the groups for either the POMS subscales, $F(2, 89)=1.62$, $p>.05$, or the PANAS-X subscales, $F(2, 89)=2.82$, $p>.05$. Taken together these results indicate that there were no differences in self-reported mood between the three groups before the introduction of the mood manipulation.

Question 2: Did the mood manipulations work in the desired direction?

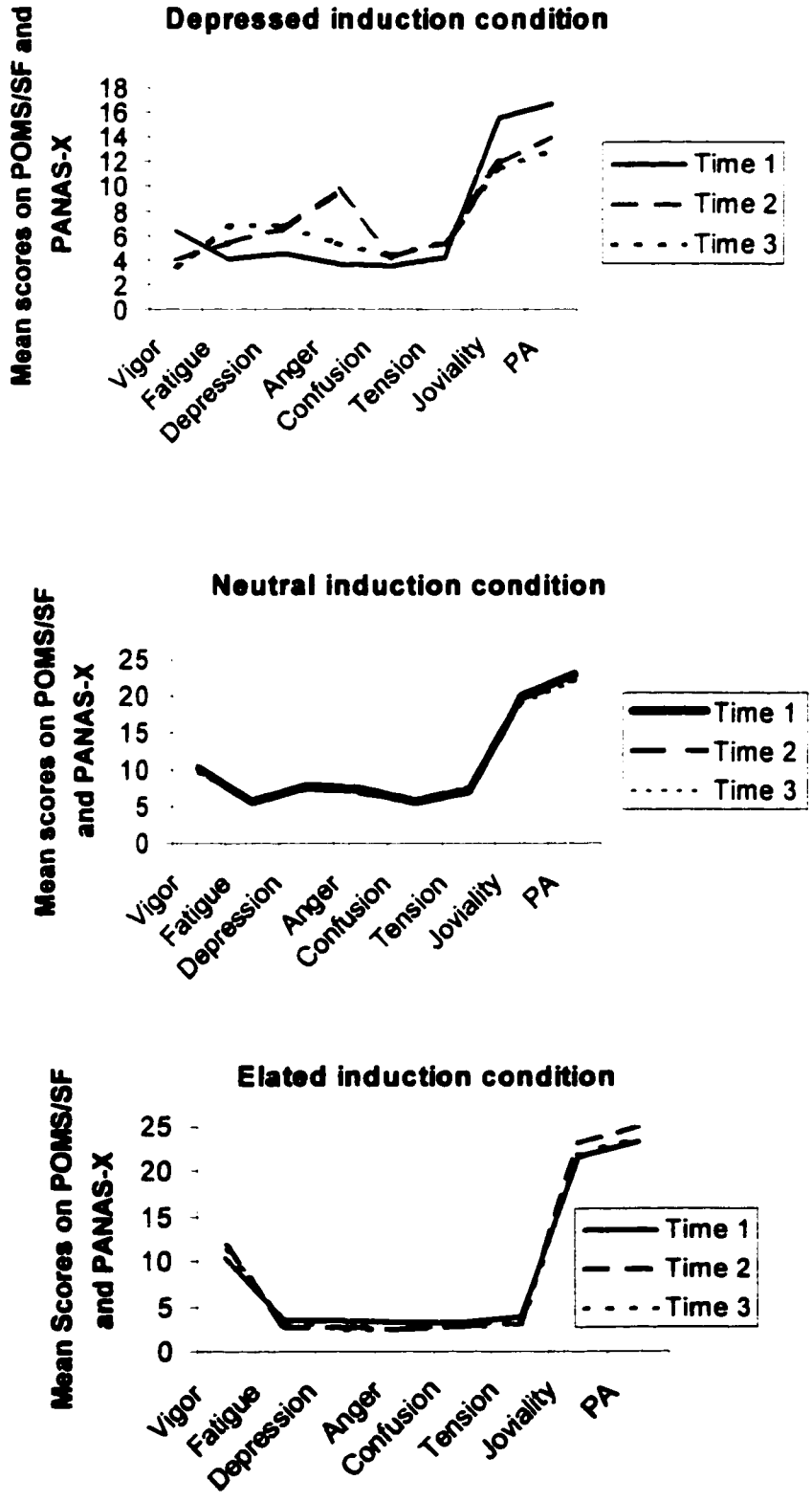
The overall mean scores of the mood subscales for each group are presented in Table 1 and Figure 3.

Significant Condition by Time Interactions were found for tension, $F(2, 89)=5.30$, $p<.0001$; depression, $F(2, 89)=10.65$, $p<.0001$; vigor, ($F(2, 89)=9.41$, $p<.0001$; fatigue, $F(2, 89)=8.67$, $p<.0001$; confusion, $F(2, 89)=2.66$, $p<.05$; joviality, $F(2, 88)=9.76$, $p<.0001$; and positive affect, $F(2, 88)=7.75$, $p<.0001$.

Table 1: Mean Scores for the POMS-SF and PANAS-X Mood Subscales Across Time for each of the Velten Induction Conditions

Condition			Time 1	Time 2	Time 3
Depressed Valence Induction					
	POMS-SF	Fatigue	4.16 (4.04)	5.45 (4.60)	6.81 (4.68)
		Vigor	6.35 (6.66)	3.97 (5.04)	3.23 (4.21)
		Depression	4.48 (5.45)	6.52 (6.89)	6.77 (7.26)
		Anger	3.74 (5.15)	9.65 (27.37)	5.45 (5.42)
		Confusion	3.61 (3.22)	4.26 (3.65)	4.35 (3.80)
		Tension	4.23 (4.13)	5.35 (3.89)	5.58 (4.29)
	PANAS-X	Joviality	15.54 (8.57)	11.94 (5.37)	11.54 (5.40)
		PA	16.77 (8.28)	14.03 (5.79)	12.90 (4.82)
Neutral Valence Induction					
	POMS-SF	Fatigue	5.68 (4.76)	5.55 (4.87)	5.81 (4.71)
		Vigor	10.26 (5.74)	10.68 (5.74)	9.74 (6.03)
		Depression	7.74 (8.06)	7.51 (8.29)	7.71 (8.12)
		Anger	7.35 (7.29)	6.84 (6.98)	6.94 (6.86)
		Confusion	5.68 (4.87)	5.71 (5.04)	5.81 (4.82)
		Tension	7.19 (5.11)	7.74 (6.02)	7.68 (5.86)
	PANAS-X	Joviality	20.12 (7.84)	19.52 (7.51)	19.00 (7.62)
		PA	23.06 (9.09)	22.41 (8.70)	22.26 (8.91)
Elated Valence Induction					
	POMS-SF	Fatigue	3.33 (3.93)	2.63 (3.41)	3.33 (3.74)
		Vigor	10.33 (6.42)	11.47 (6.56)	10.93 (6.81)
		Depression	3.50 (4.65)	2.70 (4.14)	2.53 (3.79)
		Anger	3.20 (5.24)	2.47 (4.69)	2.37 (4.25)
		Confusion	3.20 (3.09)	2.77 (2.98)	3.17 (3.22)
		Tension	3.77 (4.22)	3.03 (3.96)	3.00 (3.81)
	PANAS-X	Joviality	21.58 (9.37)	23.17 (9.57)	21.69 (9.23)
		PA	23.31 (9.92)	24.97 (10.32)	23.59 (9.84)

Figure 3: Mean Mood Scores on POMS-SF and PANAS/X Across Time for each Condition



The main effect of Condition was significant for tension, $F(2, 89)=6.87$, $p<.01$; depression, $F(2, 89)=4.26$, $p<.05$; vigor, $F(2, 89)=11.47$, $p<.0001$; fatigue, $F(2, 89)=3.57$, $p<.05$; confusion, $F(2, 89)=3.77$, $p<.05$; joviality, $F(2, 88)=11.38$, $p<.0001$; and positive affect, $F(2, 88)=11.35$, $p<.0001$. The main effect of Time was significant only for vigor, $F(2, 89)=6.41$, $p<.01$; fatigue, $F(2, 89)=10.67$, $p<.001$; joviality, $F(2, 88)=10.69$, $p>.0001$; and positive affect, $F(2, 88)=7.76$, $p<.01$.

To test whether the same results for the depression subscale would be obtained when controlling for fatigue, a 3 (Condition – Elated Valence, Depressed Valence, Neutral Valence) X 3 (Time – Time 1, Time 2, Time 3) ANOVAs was performed with Time as a repeated measure, and fatigue scores at Time 1, Time 2, and Time 3 as covariates. The results continued to show a significant Time by Condition interaction, $F(2, 86)=8.34$, $p<.001$).

Given the significant two-way interactions, planned comparisons were used to examine the Time 1 – Time 2, and Time 2 – Time 3 differences for the mood dimensions for each of the groups.

The results showed that, for the neutral induction group, tension, depression, fatigue, confusion, and vigor did not differ significantly between Time 1 and Time 2 (tension: $t(30)=1.00$, $p>.05$; depression: $t(30)=.68$, $p>.05$; fatigue: $t(30)=.48$, $p>.05$; confusion: $t(30)=.12$, $p>.05$; vigor: $t(30)=1.14$, $p>.05$) or between Time 2 and Time 3 (tension: $t(30)=.23$, $p>.05$; depression: $t(30)=.66$, $p>.05$; fatigue: $t(30)=.54$, $p>.05$; confusion: $t(30)=.52$, $p>.05$; vigor: $t(30)=1.43$, $p>.05$), as expected. Also, no differences in joviality scores or positive affect scores were found between Time 1 and Time 2

(joviality: $t(30)=1.14$, $p>.05$; positive affect $t(30)=1.42$, $p>.05$) or between Time 2 and Time 3 (joviality: $t(30)=1.25$, $p>.05$; positive affect: $t(30)=.35$, $p>.05$). Thus, participants in the neutral induction condition maintained the same mood throughout the experiment.

For the depressed valence induction group, tension, $t(30)=3.18$, $p<.001$, depression, $t(30)=3.28$, $p<.001$, and confusion, $t(30)=3.07$, $p>.01$ significantly increased between Time 1 and Time 2, and stayed at that level at Time 3 (tension: $t(30)=.88$, $p>.05$; depression, $t(30)=.59$, $p>.05$; confusion, $t(30)=.44$, $p>.05$). The vigor dimension of mood significantly decreased between Time 1 and Time 2, $t(30)=5.18$, $p<.0001$, and remained at this level at Time 3, $t(30)=2.02$, $p>.01$. Fatigue increased between Time 1 and Time 2, $t(30)=3.97$, $p<.0001$, and between Time 2 and Time 3, $t(30)=4.53$, $p<.0001$. Finally, joviality and positive affect significantly decreased at Time 2 (joviality: $t(30)=4.30$, $p<.0001$; positive affect: $t(30)=4.16$, $p>.0001$), and remained lower than baseline at Time 3 (joviality: $t(30)=.89$, $p>.05$; positive affect: $t(30)=2.46$, $p<.05$). These results suggest that the depression induction procedure was successful in changing mood in the desired direction.

For the elated valence induction group, joviality, $t(28)=3.67$, $p<.01$, and positive affect, $t(28)=3.00$, $p<.01$ significantly increased at Time 2 and remained higher than baseline at Time 3 (joviality: $t(28)=1.94$, $p>.05$; positive affect $t(28)=1.60$, $p>.05$). Tension, $t(29)=2.92$, $p<.01$, and depression, $t(29)=3.45$, $p<.01$ significantly decreased between Time 1 and Time 2, and remained unchanged between Time 2 and Time 3 (Tension: $t(29)=1.46$, $p>.05$; Depression $t(29)=1.044$, $p>.01$). Vigor significantly increased between Time 1 and Time 2, $t(29)=2.95$, $p<.01$, and did not change between

Time 2 and Time 3, $t(29)=1.46$, $p>.01$. In contrast, fatigue significantly decreased between Time 1 and Time 2, $t(29)=2.97$, $p<.01$, and returned to baseline at Time 3, $t(29)=2.50$, $p<.05$. Finally, confusion did not differ between Time 1 and Time 2, $t(29)=1.90$, $p>.05$, or between Time 2 and Time 3, $t(29)=1.29$, $p>.05$. These results demonstrate that the elation induction procedure successfully affected mood in the desired direction.

To compare mood scores at Time 2 between the groups, separate one way ANOVAS were performed for each mood subscale. The results showed significant differences between the groups on all subscales except positive affect (tension: $F(2, 89)=7.53$, $p<.001$; anger: $F(2, 89)=14.54$, $p<.0001$; confusion: $F(2, 89)=4.13$, $p<.05$; depression: $F(2, 89)=4.38p<.05$; fatigue: $F(2, 89)=4.39$, $p<.05$; vigor: $F(2, 89)=15.51$, $p<.0001$; joviality: $F(2, 89)=17.54$, $p<.0001$). A closer examination of these differences using post-hoc analyses where alpha was corrected with a Tukey's HSD revealed that the depressed group reported less joviality and vigor compared to the neutral group (joviality: Mean difference=-7.58, p=.000; vigor: Mean difference=-6.71, p=.000) and the elated group (joviality: Mean difference=-11.26, p=.000; vigor: Mean difference=-7.50, p=.000), and more fatigue compared to the elated group (Mean difference=2.81, p=.035). The elated group reported less confusion (Mean difference=2.94, p=.014), depression (Mean difference=4.81, p=.017), fatigue (Mean difference=2.92, p=.028), and tension (Mean difference=4.71, p=.001) compared to the neutral group, and increased joviality (Mean difference=11.26, p=.000) compared to the depressed group.

Additional analyses on the depression subscale were also conducted. The results revealed significant group differences for the depression score at Time 1, $F(2, 89)=4.38$, $p<.05$, Time 2 $F(2, 89)=3.99$, $p<.05$, and Time 3, $F(2, 89)=5.17$, $p<.01$. A closer examination of these differences using post-hoc analyses where the alpha was corrected with a Tukey's HSD revealed that at both Time 1 and Time 2 the differences were between the neutral and the elated group (Time 1: Mean difference=4.24, p=.025; Time 2: Mean difference=1.71, p=.017). Differences at Time 3 were between the elated group and the depressed group, Mean difference=1.71, p=.04, and between the elated and the neutral group, Mean difference=5.12, p=.009. Thus, at Time 3, both the neutral group and the depressed group reported higher depression scores compared to the elated group.

Question 3: What effect did the mood manipulation have on the specificity of autobiographical memories and on working memory?

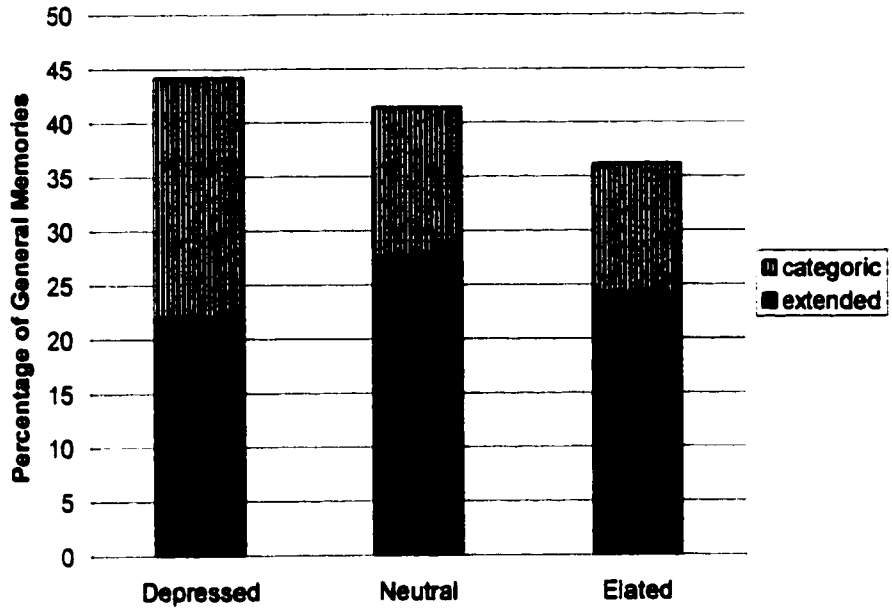
Autobiographical Memory:

There was no difference between the groups in the total number of responses to the cue-words, $F<1$. The mean percentage of general memories for each condition are presented in Table 2 and Figure 4. The results revealed no significant difference in the proportion of general memories across the three induction groups, $F(2, 89)=1.94$, $p>.05$. Power calculations for this analysis revealed that the observed power was .392, with an effect size of .042. To achieve power of .80 with this small effect size (i.e., to detect a significant difference among the groups), the sample size would need to be increased to over 80 subjects per group. No significant difference in the proportion of general

Table 2: Percentage of Memories that were General Personal Memories Across Each Velten Induction Condition

	Induction Condition		
Cue Valence	Depressed	Elated	Neutral
Negative	42.42 (22.47)	37.17 (18.08)	39.52 (23.78)
Positive	46.39 (23.92)	35.50 (19.84)	43.23 (20.76)
Both Combined	44.21 (15.67)	36.20 (25.08)	41.45 (17.46)
categoric	22.25	12.20	13.87
extended	21.96	24.00	27.58

Figure 4: Percentage of General Memories Broken down into Categoric vs. Extended Memories for each Induction Condition



memories across the three groups was found when controlling for fatigue at Time 2 and using it as a covariate, $F(2, 88)=1.10$, $p<.05$. Pearson correlation coefficients were computed to examine whether fatigue and depression scores at Time 2 correlated with the proportion of general memories. Analyses revealed that the proportion of general memories produced correlated significantly with fatigue at Time 2 ($r=.212$, $P=.043$), but not with depression at Time 2, ($r=.076$, $P=.474$). Partial correlations revealed that fatigue at Time 2 correlated significantly with the proportion of general memories even when controlling for depression at Time 2 ($r=.227$, $P=.030$).

To test whether there was a difference in the proportion of general memories with respect to cue valence, a Condition (depressed valence/elated valence/neutral valence) by Cue Type (positive/negative) ANOVA, with Valence as a within subjects variable was performed. The mean proportions for each cue type across the groups are presented in Table 2. The results revealed that the main effect of Condition, $F(2, 89)=1.96$, $p\geq.05$, Valence, $F<1$, and the Condition by Valence interaction, $F<1$, were not significant.

General memory responses were further subdivided into either categoric (memory response that summarized a number or category of events e.g., when my dad would read me bed time stories, or extended e.g., my three month trip to Europe). One way ANOVAs were performed on both categoric and extended memories. The resultsshowed that, within the total number of general memories produced, there no difference in the proportion of extended memories between the elated (71%), neutral (66%) and depressed (53%) groups, $F(2, 89)=2.6$, $p>.05$. However, within the total number of general

memories, differences were found in the proportion of categoric memories produced, $F(2, 89)=3.73$, $p<.05$ (see Figure 4).

All pairwise comparisons between groups were examined in planned contrasts analyses. Alpha was controlled using Tukey's HSD procedure. Planned contrasts revealed that the depressed group produced more categoric general memories (47%) compared to the elated group (29%), Mean difference=-18.5, p=.024. No difference was found between the neutral group (34%) and the elated group, Mean difference=-5.97, p=.667, or between the neutral group and the depressed group, Mean difference=-12.59, p=.167. Thus, it appears that inducing depressed mood increases the proportion of categoric general memories, compared to an elated mood, within the total proportion of general memories produced (see Table 2).

Working Memory:

One way ANOVAs were performed on the mean amount of time taken to complete Trails A and Trails B for participants in the three conditions. No difference was found in the amount of time taken to complete either Trails A (elated: X=28.95 sec; neutral: X=31.69 sec; depressed: X=31.87 sec), $F(2, 89)=1.10$, $p>.05$, or Trails B (elated: X=63.12 sec; neutral: X=63.40 sec; depressed: X=68.71 sec), $F<1$. These scores fall within the normal range for adults aged 20-29 (see Spreen and Strauss, 1998).

Discussion

The results from Experiment 1 suggest that the valence component of mood might not contribute to the overgeneral memory phenomenon. When mood was experimentally altered either to an elated or a depressed state through the modified Velten procedure, the

proportion of general memories produced was not influenced compared to a neutral condition. There was also no difference found in the proportion of general memories with respect to cue valence. These results support the hypothesis that the valence component of mood does not seem to be a factor that affects the specificity of autobiographical memories.

To afford a valid comparison of overgeneral memory between the three groups at Time 2, it was essential that the mood manipulation successfully altered mood in the desired direction for the three induction groups. A comparison of the mood reported before the manipulation (Time 1) and after the manipulation (Time 2) in each induction group revealed that mood was successfully changed by the induction procedure in the expected direction in the depressed and in the elated conditions, and not in the neutral condition. Thus, at the very least, we can rule out the possibility that no differences were found because mood at Time 2 was not different from mood at Time 1 in the induction groups. Furthermore, no differences were found in self-reported mood between the groups at Time 1, indicating that the groups had comparable moods before the introduction of the manipulation. It should be noted that the standard deviations were large across the mood subscales, suggesting that there was quite a bit of variability in mood among the participants. However, the standard deviations found are comparable to those reported by other researchers using the POMS (e.g., Nyenhuis et al., 1999).

Differences in self-perceived mood after the induction procedure were found for the elation and depressed induction groups and not for the neutral induction group. More specifically, participants in the depressed group reported feeling more depressed,

confused, and tense immediately following the manipulation. They also reported reduced vigor and increased fatigue, as well as reduced joviality and positive affect. Participants in the elated group reported increased joviality and positive affect and reduced depression. They also reported increased vigor and decreased fatigue. For both these groups the mood changes remained until the end of the testing phase, which is consistent with the findings reported by Sinclair et al. (1994) of the long-lasting effects of the modified Velten procedure.

A comparison of mood scores at Time 2 between the groups revealed that the depressed group reported less joviality and vigor compared to the neutral and elated groups, and more fatigue compared to the elated group. The elated group reported less confusion, depression, fatigue, and tension compared to the neutral group, and increased joviality compared to the depressed group. These findings demonstrate that the induction procedure successfully altered mood such that there were differences between the groups at Time 2.

Although the results showed that the mood manipulation worked in the desired direction, it must be noted that the depression scores seem higher at all three times for the neutral group than the other two groups. Analyses revealed that at both Time 1 and Time 2 the differences were between the neutral and the elated group, with the neutral group reporting higher depression scores. Differences at Time 3 were between the elated and the depressed group, and between the elated and the neutral group. Thus, both the neutral group and the depressed group reported higher depression scores compared to the elated group.

Why the neutral group differed from the elated group at baseline with respect to the depression score remains unclear. Participants were randomly assigned to the valence condition in blocks of three and, at times, participants who knew one another were tested together. It may be that a particular group was more distressed and unfortunately all participants were assigned to the same condition. However, it can be argued that this most likely does not change the interpretation of the results. First, BDI scores did not differ significantly among the three groups, suggesting that their level of distress was comparable. Second, the mood manipulation successfully altered mood in the desired direction for all three groups. Although the neutral group reported higher depression scores at baseline, their mood did not change at Time 2, whereas the elated group became more elated and the depressed group became more depressed. More importantly, however, the pattern of changes on the POMS-SF and PANAS-X were consistent with the induction conditions. That is, scores on subscales related to negative affect (confusion, tension, and depression) increased for the depressed group and decreased for the elated group. The opposite effect was found on subscales related to positive affect (joviality, vigor, and positive affect). It is important to view the pattern of the mood changes, and not just the changes in one subscale.

Nonetheless because depression scores at Time 2 did not differ between the neutral group and the depressed group, it may be possible that the proportion of general memories produced by the neutral group was skewed. That is, it may be possible that the proportion of general memories produced by this group was greater than would have been the case otherwise. If the valence component of mood does affect autobiographical

specificity, it is unlikely that this group would have produced fewer overgeneral memories compared to the elated group. A pairwise comparison of the proportion of general memories between the elated and depressed groups indicated that the difference was not significant, Mean difference=-8.00, p=1.33. This suggests that even if the neutral group had produced fewer overgeneral memories than was the case, a group main effect would probably not have arisen. However, replication of this study is needed to clearly ascertain whether the null effect is in fact real.

The results from Experiment 1 also showed that whereas participants in the depressed group did not produce a greater proportion of general memories, they did produce a greater proportion of *categoric* general memories (within the total number of general memories) compared to the elated group, but not the neutral group. This finding suggests that a depressed mood may contribute to an increase in categoric memories.

The findings also showed that there was no difference among the three groups with respect to the amount of time taken to complete both Trails A and Trails B. These results support the prediction that no differences in working memory ability would be found between the groups. Because the hypothesis for both the Autobiographical Memory Test and the Trail Making Test predicted the null hypothesis, it is difficult to ascertain whether no effects were found because the hypothesis was confirmed, or if other factors were involved contributing to a false negative. However, given the small effect size (.04), it could be argued that even if power increased by increasing the number of subjects per condition, significant differences might still not be found. The hypothesis for Experiment 2 predicts that the arousal component of mood does affect

autobiographical specificity. A clearer understanding of the effects of valence on autobiographical memory will be gained once all of the results are taken together.

One limitation with Experiment 1 that must be addressed is the possible priming effects of the incubation instructions that were used in the modified Velten procedure. In particular, the incubation instructions developed by Sinclair et al. (1994) have specific directions eliciting memories. This may have had the effect of increasing the specificity of autobiographical memory, contributing to the null findings. This limitation can be addressed in a number of ways. Incubation instructions were given across all conditions and, therefore, the same priming effect should apply to all groups. That is, autobiographical memory specificity would most likely be increased in all three groups. Of course the magnitude of the effect may have differed among the groups. Although the neutral group was instructed to think of neutral thoughts during the incubation phase, priming effects may have been less prominent in their case. If the elated and depressed groups were indeed more susceptible to priming effects, it seems reasonable to assume that the autobiographical memories affected would correspond to their condition. That is, because the elated group was instructed to think of instances when they felt happy, an increased specificity in *positive* memories would be expected. In contrast, individuals in the depressed group, who were instructed to think of times in their lives when they were unhappy, would most likely produce more specific *negative* memories. No valence effects were found, however. Replication of this Experiment using different mood induction procedures that do not specifically elicit memories (e.g., music or film) is

needed in order to minimize priming effects, and address this limitation with the current study.

Experiment 2

Experiment 2 assessed the relation between the arousal component of mood and overgeneral memory. Participants were randomly assigned to one of three induction conditions: 1) high energetic arousal; 2) low energetic arousal; or 3) control. Participants in the high energetic arousal induction condition walked outdoors with the experimenter for 10 minutes. Participants in the low energetic arousal induction condition exercised on a Stairmaster for 45 minutes. Participants in the control condition sat quietly for 5 minutes.

Both the affective and the arousal dimensions of mood were assessed before the introduction of the induction procedures to ensure that there were no initial differences between the groups. Both the affective and the arousal dimensions of mood were also tested after the manipulation and at the end of the testing phase to ensure that the desired mood changes were maintained throughout the testing phase. The Autobiographical Memory Test and Trail Making Test comprised the testing phase. Measures used in Experiment 2 were the same as the ones used in Experiment 1.

On the lines of previous research (Cappeliez et al., 1993) the manipulation of the energetic component of mood was expected to affect autobiographical memory. Specifically, compared to a control condition, participants whose energetic arousal was experimentally increased were expected to be more specific in their personal memories, whereas participants whose energetic arousal was experimentally decreased were

expected to have less specific memories. Working memory functioning was also expected to differ between the conditions. Compared to the control condition, executive functioning was expected to decrease when energetic arousal decreased, and to increase when energetic arousal increased.

Method

Participants.

The participants in Experiment 2 were University of Ottawa undergraduate women who volunteered for the study. One hundred and five participants were randomly assigned to one of three induction conditions: 1) high energetic arousal; 2) low energetic arousal; and 3) control, such that there were 35 participants per condition. Four participants were excluded from the data analysis because of the presence of depressive symptomatology (BDI > 15). Therefore, for the data analysis there were 35 participants in the high energetic arousal condition, and 33 participants in the two remaining conditions. The same recruitment procedure used in Experiment 1 was used in this study.

Measures.

The measures used in Experiment 2 were the same as those used in Experiment 1.

The interrater agreement for scoring of single event and summary memory narratives was 92 percent, $k=.84$, $p<.0001$. Not all subjects provided a memory narrative for each of the ten cue words. The mean proportion of total omissions (neither specific nor general responses made) was 5.4% in the low arousal induction group, 5.5% in the high arousal induction group, and 4.2% in the control group. Analysis of Variance showed that these differences between the groups were not significant, $F<1$.

Pilot Study

A pilot study was conducted to test the effects of the low arousal manipulation on mood. The high arousal condition was not piloted because the positive effects of moderate exercise on vigor have been already largely established (e.g., Thayer, 1989; McGowan et al., 1996; Maroulakis & Zervas, 1993; Steptoe & Cox, 1988). Nine participants exercised on a Stairmaster for 45 minutes. Participants were asked to complete the POMS-SF and the PANAS-X before exercising and immediately after exercising. The results showed a significant increase in fatigue at posttest, $t(8)=4.87$, $p<.001$, and no change in vigor, $t(8)=.778$, $p>.05$. Also, there was no change in depression scores between pretest and posttest, $t(8)=1.67$, $p>.05$, or in joviality scores, $t(8)=1.53$, $p>.05$. These findings confirmed that the low arousal induction procedure successfully decreased arousal without affecting vigor or the bipolar valence dimensions of mood.

Procedure

The procedure for Experiment 2 was similar to the one used in Experiment 1. Participants were tested either individually or in a group of three. Groups of participants were randomly assigned to the low arousal induction condition, the high arousal induction condition, or the control condition prior to arriving to the laboratory so that they could bring the appropriate attire.

Prior to the manipulation, all participants completed the POMS-SF and the PANAS-X questionnaires. Participants in the high arousal manipulation condition walked outdoors for 10 minutes with the experimenter. The experimenter set the pace of

the walk, which was vigorous, but not overtaxing. Participants in the low arousal manipulation condition exercised on a Stairmaster at the University of Ottawa gym for 45 minutes and participants in the control condition sat quietly for 5 minutes. Three participants stopped the Stairmaster after 30 minutes due to subjective fatigue. Participants in the low arousal condition were not allowed to use a Walkman or read during the exercise because these activities may have confounded the mood changes. After the manipulation, all participants completed the POMS-SF and the PANAS-X. The AMT and the Trail Making Test were then administered in random order. The POMS-SF and the PANAS-X were re-administered after the completion of the AMT and Trail Making Tests. The same instructions used in Experiment 1 were used in Experiment 2. The participants were then debriefed.

Results

As in Experiment 1, the Results section is subdivided into three parts to answer three separate questions: 1) were there any differences between the groups in self-reported mood at Time 1; 2) did the mood manipulations work in the desired direction; and 3) what effects did the mood manipulations have on the specificity of autobiographical memories and working memory. The same analyses used in Experiment 1 were used in Experiment 2.

Question 1: Were there any difference in self-reported mood between the three groups before the mood induction manipulations?

A one-way ANOVA was performed on the mean BDI scores for the three condition groups. The results showed no significant differences in the BDI scores of the three groups. $F(2, 98)=4.11$, $p>.05$.

The six mood subscales of the POMS-SF and the two subscales of the PANAS-X administered at Time 1 were analyzed using a multivariate Analysis of Variance. The results showed no significant group main effect for either the POMS-SF, $F<1$, or the PANAS-X, $F<1$. Thus, at Time 1 the groups did not differ with respect to their mood.

Question 2: Did the mood manipulations work in the desired direction?

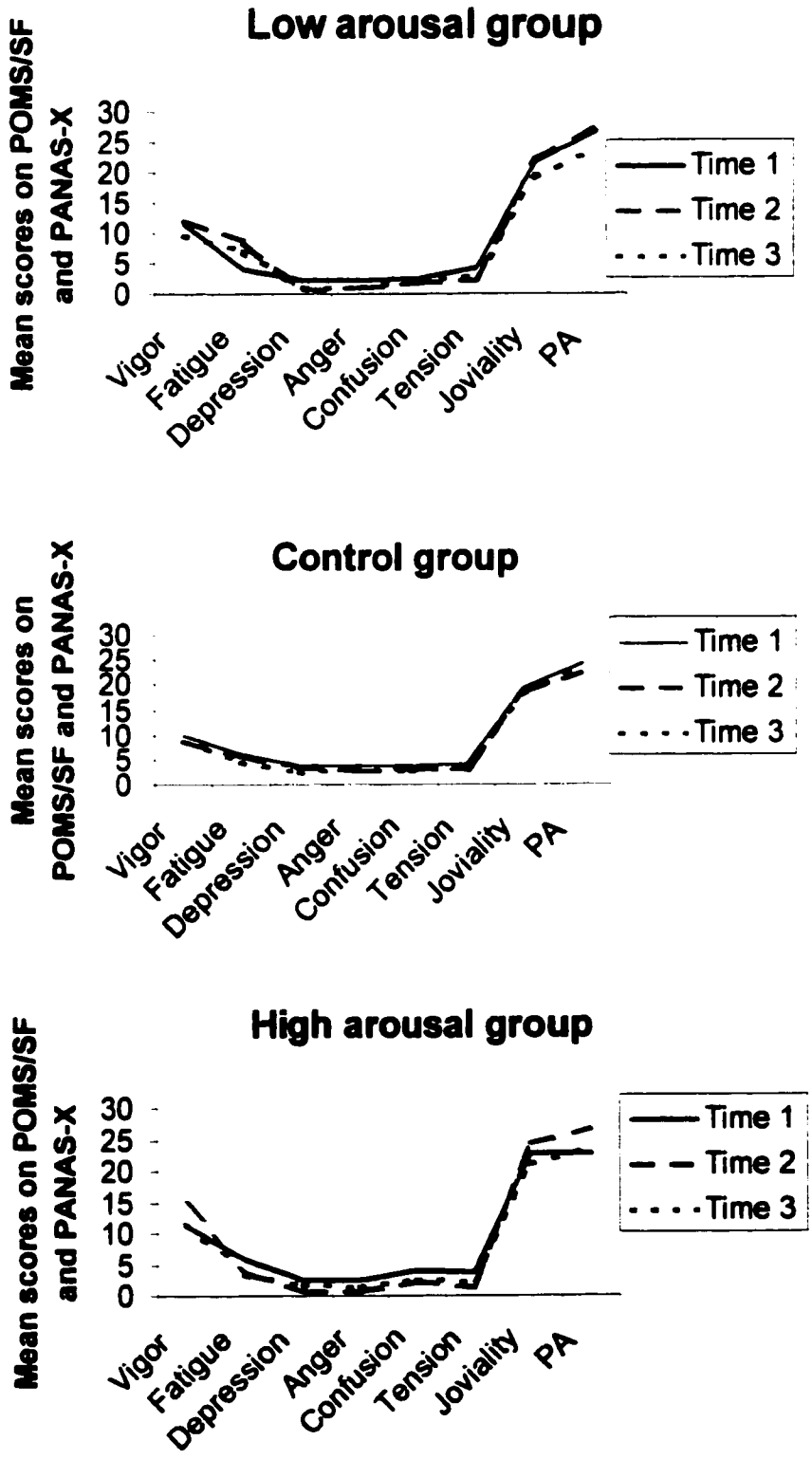
The overall mean scores of the mood subscales for each group are presented in Table 3 and Figure 5.

Significant Condition by Time Interactions were found for fatigue, $F(2, 97)=11.28$, $p<.0001$; depression, $F(2, 97)=2.58$, $p<.05$; vigor, $F(2, 97)=3.28$, $p<.05$; and positive affect, $F(2, 97)=2.48$, $p<.05$. The main effect of Condition was significant for anger, $F(2, 97)=4.89$, $p<.001$, depression, $F(2, 97)=6.31$, $p<.001$, fatigue, $F(2, 97)=2.67$, $p<.01$, and vigor, $F(2, 97)=3.37$, $p<.05$ dimensions of mood, and non significant for tension, $F(2, 97)=1.56$, $p>.05$, and confusion, $F<1$. The main effect of Time was significant for all mood dimensions except fatigue (anger: $F(2, 97)=8.10$, $p<.0001$; depression: $F(2, 97)=11.91$, $p<.0001$; vigor $F(2, 97)=6.95$, $p<.001$; confusion: $F(2, 97)=10.52$, $p<.0001$; tension: $F(2, 97)=17.98$, $p<.0001$; fatigue: $F(2, 97)=2.60$, $p<.05$; joviality $F(2, 97)=8.02$, $p<.0001$; positive affect $F(2, 97)=4.29$, $p<.05$).

Table 3: Mean Scores for the POMS-SF and PANAS-X Mood Subscales Across Time for each of the Arousal Induction Conditions

Condition		Time 1	Time 2	Time 3
Low Arousal				
POMS-SF	Fatigue	4.20 (4.02)	8.74 (5.83)	7.24 (6.20)
	Vigor	11.48 (4.51)	12.22 (5.47)	9.74 (6.20)
	Depression	2.17 (4.05)	.63 (1.50)	.82 (1.80)
	Anger	2.14 (4.31)	.83 (1.71)	.85 (1.88)
	Confusion	2.51 (2.81)	2.02 (1.84)	2.44 (2.50)
	Tension	4.43 (4.08)	2.26 (2.81)	2.82 (2.71)
PANAS-X	Joviality	21.94 (7.03)	22.11 (8.76)	19.08 (7.47)
	PA	27.02 (8.14)	27.37 (9.55)	23.94 (8.72)
Control				
POMS-SF	Fatigue	6.15 (4.72)	5.67 (4.97)	4.54 (5.73)
	Vigor	9.85 (9.84)	8.82 (7.80)	8.55 (6.92)
	Depression	3.73 (3.77)	3.45 (4.09)	2.18 (3.28)
	Anger	3.66 (4.78)	2.58 (3.49)	2.85 (4.62)
	Confusion	3.79 (3.56)	2.91 (3.43)	2.58 (3.24)
	Tension	4.03 (3.88)	3.09 (3.84)	3.55 (4.44)
PANAS-X	Joviality	19.52 (9.10)	18.27 (10.29)	17.70 (9.94)
	PA	24.42 (10.27)	22.52 (11.90)	23.94 (10.60)
High Arousal				
POMS-SF	Fatigue	5.85 (4.08)	3.76 (4.75)	3.33 (4.61)
	Vigor	11.21 (4.97)	14.45 (6.20)	11.61 (5.11)
	Depression	2.36 (2.26)	.58 (1.54)	1.48 (2.44)
	Anger	2.30 (2.20)	.55 (1.30)	1.18 (2.10)
	Confusion	3.91 (3.16)	2.18 (3.38)	2.51 (3.06)
	Tension	3.52 (3.00)	1.33 (1.90)	2.21 (2.69)
PANAS-X	Joviality	22.97 (7.95)	24.18 (7.08)	20.76 (6.49)
	PA	25.85 (8.72)	26.67 (7.61)	23.64 (6.69)

Figure 5: Mean Scores on POMS-SF and PANAS-X Across Time for each Condition



To test whether the same results for the fatigue subscale would be obtained when controlling for depression, a 3 (Condition – Elated Valence, Depressed Valence, Neutral Valence) X 3 (Time – Time 1, Time 2, Time 3) ANOVAs was performed with Time as a repeated measure, and depression scores at Time 1, Time 2, and Time 3 as covariates. The results continued to show a significant Time by Condition interaction, $F(2, 4)=13.57$, $p<.001$), and a significant Condition main effect $F(2, 94)=6.87$, $p<.01$).

Due to the significant two-way interaction, planned comparisons were used to examine the Time 1 – Time 2, and Time 2 – Time 3 differences for the mood dimensions for each of the groups.

The results showed that, for the control group, fatigue did not differ significantly between Time 1 and Time 2, $t(32)=1.05$, $p>.05$, but did significantly decrease between Time 2 and Time 3, $t(32)=2.09$, $p<.05$. Vigor and positive affect did not significantly differ between Time 1 and Time 2 (vigor: $t(32)=1.67$, $p>.05$); positive affect: $t(32)=1.82$, $p>.05$), or between Time 2 and Time 3 (vigor: $t(32)=.38$, $p>.05$; positive affect: $t(32)=1.65$, $p>.05$). Paired t-tests also showed that, for the control group, the depression dimension of mood did not significantly differ between Time 1 and Time 2, but did significantly decrease between Time 2 and Time 3, $t(32)=2.67$, $p<.05$.

For the low arousal group, fatigue significantly increased between Time 1 and Time 2, $t(34)=3.93$, $p<.0001$, and significantly decreased between Time 2 and Time 3, $t(33)=2.40$, $p<.05$. However, participants remained significantly more fatigued at Time 3 than at Time 1, $t(33)=2.45$, $p<.05$, indicating that the effects of the arousal induction were most likely maintained throughout the testing phase. Vigor, on the other hand, did not

significantly change between Time 1 and Time 2, $t(34)=.689$, $p>.05$, but did significantly decrease between Time 2 and Time 3, $t(33)=3.38$, $p<.01$. Depression significantly decreased between Time 1 and Time 2, $t(34)=2.63$, $p<.05$, but did not significantly differ between Time 2 and Time 3, $t(33)=.676$, $p>.05$. Finally, positive affect did not significantly change between Time 1 and Time 2, $t(34)=.201$, $p>.05$, but significantly decreased between Time 2 and Time 3, $t(32)=3.03$, $p<.01$.

For the high arousal group, vigor significantly increased between Time 1 and Time 2, $t(32)=3.38$, $p<.01$, and significantly decreased between Time 2 and Time 3, $t(32)=2.73$, $p<.01$. There was no significant difference between vigor at Time 1 and Time 3, $t(32)=.488$, $p>.05$, suggesting that by the end of the study they had returned to pre-induction baseline. Fatigue significantly decreased between Time 1 and Time 2, $t(32)=2.77$, $p<.05$, and remained unchanged between Time 2 and Time 3, $t(32)=1.17$, $p>.05$. Self-reported depression significantly decreased between Time 1 and Time 2, $t(32)=4.6$, $p<.0001$, and slightly but significantly increased between Time 2 and Time 3, $t(32)=2.69$, $p<.05$, back to its pre-induction level. Finally, positive affect did not significantly differ between Time 1 and Time 2, $t(32)=.658$, $p>.05$, and significantly decreased between Time 2 and Time 3, $t(32)=3.38$, $p<.01$.

Taken together these results suggest that the manipulation worked in the desired direction. Specifically, participants in the low arousal condition reported increased fatigue, participants in the high arousal condition reported increased vigor, and participants in the control condition reported no change in arousal after the manipulation (although there was a decrease in self-perceived depression and fatigue at Time 3).

Question 3: What effect did the mood manipulation have on the specificity of autobiographical memories and working memory?

Autobiographical Memory Test

There was no difference between the groups in the overall number of responses to the cue-words. A one-way ANOVA was performed on the mean proportion of general memories for each condition. The mean percentage of general memories for each condition is presented in Table 4 and Figure 6.

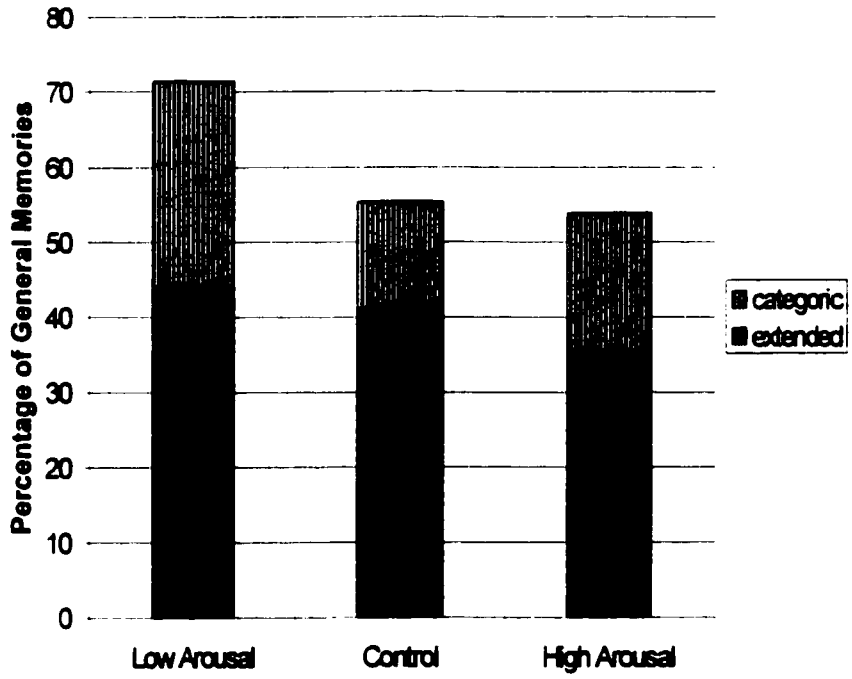
The results revealed a significant Condition main effect, $F(2, 98)=6.70$, $p<.01$. This main effect was significant even after controlling for depression scores at Time 2, $F(2, 97)=4.48$, $p<.01$). All pairwise comparisons between groups were examined in planned contrasts analyses. Alpha was controlled using Tukey's HSD procedure. Planned contrasts showed the participants in the low arousal condition were more overgeneral in their memories (71.43%) compared to the high arousal participants (53.95%), Mean difference=17.7, p=.004, and the control participants (55.36%), Mean difference=16.06, p=.009. There was no significant difference in the proportion of general memories produced between the high arousal participants and the control participants, Mean difference=1.41, p=.963. Power calculations for this analysis revealed that the observed power was .91, with an effect size of .12. Thus, the power of this analysis to detect a minimal difference among the groups was quite high, adding confidence to the results.

To test whether there was a difference in the proportion of general memories with respect to cue valence, a Condition (low arousal/high arousal/control) by Cue Type

Table 4: Percentage of Memories that were General Personal Memories Across Each Arousal Induction Condition

	Induction Condition		
Cue Valence	Low Arousal	Control	High Arousal
Negative	75.23 (21.29)	56.57 (25.73)	54.70 (28.26)
Positive	67.46 (23.59)	54.03 (23.62)	52.45 (30.54)
Both Combined	71.43 (19.29)	55.36 (20.35)	53.95 (25.86)
categoric	27.42	14.24	18.48
extended	44.01	41.12	35.47

Figure 6: Percentage of General Memories Broken down into Categoric vs. Extended Memories for each Arousal Condition



(positive/negative) ANOVA, with Valence as a within subject variable was performed. The mean proportions for each cue type across the groups are presented in Table 4. The results revealed a significant main effect of Condition, $F(2, 98)=6.77$, $p<.01$. The main effect of Valence, $F(2, 98)=2.65$, $p>.05$, and the Condition by Valence interaction, $F<1$ were not significant.

General memory responses were also further subdivided and scored as either categoric, or extended. One way ANOVAs were performed on both categoric and extended memories. The results showed that, within the total number of general memories produced, there were no differences in the proportions of extended memories between the high arousal (66%), control (72%) and low arousal (64%) groups, $F<1$. Also, within the total proportion of general memories produced, there were no differences found in the proportion of categoric memories between the three groups (high arousal: 34%, control: 28%, low arousal: 36%, $F<1$) (see Figure 6).

Working Memory:

One way ANOVAs were performed on the mean amount of time taken to complete Trails A and Trails B for participants in the three conditions. No difference was found in the amount of time taken to complete either Trails A (low arousal: X=25.32; control: X=28.15; high arousal: X=25.39), $F(2, 98)=1.21$, $p>.05$, or Trails B (low arousal: X=58.57; control: X=65.45; high arousal: X=65.24), $F(2, 98)=1.06$, $p>.05$. The mean time taken to complete both Trails A and Trails B across all conditions fall within the normal range (Spreen & Strauss, 1998).

Discussion

Participants whose energetic arousal is experimentally reduced recall less specific personal memories than did controls. Participants whose energetic arousal is experimentally increased do not differ from controls in terms of autobiographical memory specificity. These results suggest that overgeneral memory may be state-dependent, and a function of low arousal.

The percentage of overgeneral memories that was found in the low arousal group (71%) is comparable to the one reported by Moffit et al. (1994) for undergraduate students endorsing higher depression scores (74%). In clinical populations, the percentage of overgeneral memories has been reported to range from 42% to 56% (Brittlebank et al., 1993; Wilhem et al., 1997; Williams & Broadbent, 1986; Williams & Dritschel, 1992). In this study, as well as in the Moffit study, students were asked for a *self-defining* memory, contributing to the increase in overgeneral memories produced. If the same protocol used for clinically depressed individuals had been used in an undergraduate population, namely if students had been asked for a *specific* memory, ceiling effects would have most likely resulted, masking any differences in overgeneral recall.

It was expected that the high-arousal group would be more specific in their memories than controls. The findings were not significant. One possibility may be that the mood changes in this group were more transient. Indeed the results from the POMS-SF indicate that the vigor component of mood had returned to its pre-induction level at Time 3. These results contradict those of Thayer (1989) demonstrating long-term

positive effects of moderate exercise on the energetic arousal component of mood. The discrepancy between these results and those of Thayer remains unclear, although research has suggested that the time course for exhilaration and vigor following moderate exercise are different, with the increase in exhilaration being more sustained (Steptoe, Kearsley, & Walters, 1993). Furthermore, participants in this study were required to complete a number of tests immediately following the high arousal induction procedure, and this may have somehow negatively affected their mood. Another possibility is that the length of the brisk walk may not have been long enough to sustain positive changes on energetic arousal. Other authors (e.g., McGowan et al., 1996; Maroulakis & Zervas, 1993) have used low impact aerobic classes of 1 hour duration as an index of moderate exercise.

The results from Experiment 2 also showed that the main effect of cue valence was not significant. Furthermore, no differences were found in the proportion of categoric versus extended memories produced. An interpretation of these findings will be presented in the General Discussion.

The high and low arousal groups did not differ from controls in their performance on the Trail Making Test. One possibility for this finding may be that working memory is not involved in autobiographical memory retrieval. Another possibility why no differences were found may be that the three groups performed at ceiling levels. Reduced performance on this test has been found for individuals with major depression (Fisher, Sweet, & Pfaelzer-Smith, 1986; Franke, Maire, Hardt, & al., 1993; Lees-Haley & Fox, 1990). However, experimentally changing arousal levels may not be sufficient to

affect attention. Further studies should address this issue, and use central executive tests that are more sensitive to changes in arousal.

The results from Experiment 2 further indicate that the induction techniques appropriately affected arousal in the desired directions. Some interesting findings, however, warrant attention. First, the overall mood for the control group did not change throughout the experiment, as expected. However, this group reported feeling less fatigued and depressed at the end of the study (Time 3) compared to Times 1 and 2. Why fatigue and depression decreased is not clear as neither the valence nor the arousal component of mood was experimentally manipulated. One possibility may be that completing the cognitive tasks served to reduce fatigue and depression scores, although this seems unlikely because the same effect was not found in Experiment 1.

Second, the arousal component of mood was successfully altered in both the low and high arousal conditions. More specifically, participants who exercised on a Stairmaster for 45 minutes reported increased fatigue throughout the study and reduced vigor at Time 3. In contrast, walking outdoors for 10 minutes resulted in increased vigor and decreased fatigue at Time 2. The effects of experimentally increasing vigor, however, did not last as long as expected. In particular, by the end of the study participants reported that they felt less vigorous compared to immediately after the walk, although they still remained less fatigued compared to Time 1.

Third, experimentally changing arousal levels reduced self-reported depressed mood in both high and low arousal conditions. This finding is consistent with studies that have reported increased perceptions of positive well-being and reduced depression post

exercise (Doyne et al., 1987; Lox & Rudolph, 1994; McGowan & Talton, 1996; McIntyre et al., 1990). This finding adds support to the view that the valence component of mood does not affect autobiographical specificity. Based on previous research (e.g., Williams, 1996; Williams & Broadbent, 1986, Evans et al., 1992), one might expect that a lowered depressed mood may result in an increase in autobiographical specificity or, at the very least, no difference compared to a control group. The present results, however, indicate that even though the low arousal reported reduced depression on the POMS-SF, they were still significantly more overgeneral in their memories compared to the control and high arousal conditions. Furthermore, the high arousal group also reported feeling less depressed at Time 2, but they did not differ from the control groups in terms of autobiographical specificity. These results suggest that arousal and not valence affects the retrieval of specific autobiographical memories.

General Discussion

Overgeneral Memory and Mood Changes: Arousal vs. Valence

The aim of this thesis was to examine whether the overgeneral memory phenomenon that has been demonstrated in clinically depressed patients (Moore et al., 1988; Evans et al., 1992; Williams, 1996; Williams & Broadbent, 1986; Williams & Dritschel, 1988) could also be observed in nondepressed students in whom mood changes were induced. The two components of mood, valence and arousal (Feldman, 1995), were experimentally manipulated in a nondepressed undergraduate student population of women, and the consequence on the specificity of autobiographical recall was examined.

The results from Experiment 1 revealed that the proportion of general memories produced does not change when the valence component of mood is manipulated. Participants whose mood was experimentally altered to either an elated or a depressed mood-state did not differ in terms of the proportion of general memories they produced compared to participants whose mood was unchanged. Experiment 2, on the other hand, showed that the arousal component of mood might be a factor influencing autobiographical memory specificity. Experimentally inducing low arousal through strenuous exercise increased the tendency to produce general memories in response to positive and negative cue words. No difference was found in the proportion of general memories produced by participants whose arousal was experimentally increased and a control group.

Taken together, the results support the hypothesis and indicate that a reduction in energy leads to a decrease in the capacity to recall specific autobiographical memories. Such a reduced energy, being a feature of depression, may explain, at least in part, why clinically depressed individuals have difficulty recalling specific autobiographical memories. Thus, it is possible that overgeneral memory may be state-dependent and mediated by changes in arousal. These findings, at the very least, challenge the position that this phenomenon is uniquely attributable to a long-term cognitive vulnerability that persists despite short-term changes in mood (Williams, 1996). This is not to say that state dependency and cognitive vulnerability are mutually exclusive. Overgeneral memory can be both a cognitive vulnerability and a state dependent phenomenon. Cognitive vulnerability factors can remain dormant until activated by a mood state

(Miranda et al., 1998). In the case of overgeneral memory, it may be low arousal that initiates this cognitive style.

Williams (1996) has argued that evidence for overgeneral memory as a cognitive vulnerability that is state-independent comes from studies that have found that patients in remission from clinical depression remain impaired in their memory compared with nondepressed controls. As an example, Williams and Dritschel (1988) reported that the proportion of specific memories produced by recovered patients was not reliably different from current patients, but both of these groups were significantly different from controls. If overgenerality is, at least in part, a function of low arousal, as suggested by the present results, the possibility remains that recovered patients in their study maintained overgeneral recall because of continued low levels of arousal. Indeed, their results showed that recovered patients and current patients showed a significantly greater mood disturbance compared to the control group; in particular they were significantly more depressed and *fatigued*. Studies assessing the overgeneral phenomenon in recovered patients who are no longer in a dysphoric state are needed to examine critically the notion that overgeneral memory is not state dependent.

The Brittlebank et al. (1993) study has also been cited as evidence supporting the theory that overgenerality is a persistent, state-independent feature related to cognitive vulnerability. In their study, overgeneral recall at initial assessment was highly correlated with failure to recover from depression at follow-up. One limitation with their study, however, is that overgeneral recall was not assessed at follow-up and, therefore, it remains unclear whether overgenerality was maintained by the mood state and, more

specifically, by continued low levels of arousal. Furthermore, if overgeneral memory is related to reduced working memory capacity as has been proposed (Evans et al., 1992; Williams, 1996), one would expect a reduced ability to problem solve (Baddeley, 1986). It is not surprising that individuals who are initially more overgeneral might recover less quickly from depression compared to individuals who have more cognitive resources available to them and, therefore, greater problem solving capabilities.

Another finding that has been interpreted as an indication of the independence of overgeneral memory from current mood state is that the correlation between level of depression (as measured by the BDI) and overgeneral memory is low and nonsignificant (Kuyken & Brewin, 1995; Kuyken & Dalgleish, 1995; Williams & Dritschel, 1988). Although the BDI includes somatic and affective items assessing dimensions of depressive conditions overlapping with both arousal and valence of mood, it also contains several items measuring the cognitive symptoms of depression. These studies report the correlation between overgeneral memory and the overall BDI score. Thus, they do not specifically address the relationship between arousal and overgeneral memory. Future research could use pure measures of arousal to assess whether arousal levels correlate with overgeneral memory.

If the phenomenon of overgeneral recall were mood-state dependent as is suggested by the present research, one would expect this memory deficit to be modifiable. The results from two studies examining this effect in clinical populations have suggested that overgenerality might normalize on recovery. Kuyken and Dalgleish (1995) compared previously depressed with never depressed individuals and found no

difference between them in their tendency to retrieve general memories. More recently, Williams and colleagues have shown that overgenerality in memory can be reduced by treatment (Williams, Teasdale, & Segal, in press). In their study, depressed patients in remission were randomly allocated to receive either treatment-as-usual or a program of treatment designed to reduce risk of relapse (Mindfulness-Based Cognitive Therapy - MBCT). Patients completed a cue-word autobiographical memory test before and after treatment to examine whether overgeneral memory would change. Results showed that patients in the MBCT group showed increased specificity, and a significant reduction in the number of generic memories. Of interest, however, patients' mood in either group did not change at follow-up as measured by the Hamilton Rating Scale for Depression. The researchers concluded that, because mood change could not explain this effect, this could be taken as evidence that overgeneral memory is not mood-state dependent. However, they recognized the possibility that some other variable (like the amount of energy expended on tasks) could explain the change in memory in the MBCT group. MBCT involves training that includes instructions to focus more carefully on everyday events and to allow cognitions to occur without trying to avoid or suppress them, as well as relaxation, yoga, stretching, and meditation techniques. Thus, this therapeutic approach involves some form of exercise, and it is possible that this could have contributed to the reduction in the tendency to retrieve generic memories. It is also possible that the change in memory reported was due to the instructions to focus more carefully on everyday events, having the effect of increasing memory specificity.

In summary, the results from the present study suggest that the overgeneral memory phenomenon may be mood-state dependent, and a function of low arousal. These findings present a challenge to the claim that overgenerality is independent of mood-state (Williams, 1996). If overgeneral recall is influenced by level of arousal, one might expect that increasing arousal would increase the specificity of autobiographical recall. The results from Experiment 2 did not support this hypothesis. One possibility is that increasing arousal does not enhance recall, suggesting that autobiographical specificity is not along an arousal continuum. Another possibility is that the manipulation did not work as well as expected. Although the vigor component of mood increased for this group immediately following the manipulation, it had returned to its baseline level by the end of the testing phase. These findings contradict those reported by Thayer (1989) demonstrating long-term positive effects of moderate exercise on the energetic arousal component of mood. It is not entirely clear why there was a discrepancy between the present results and those of Thayer. One possibility may be that 10 minutes of walking was not enough to produce sustained changes in mood in an undergraduate population of women who may need more rigorous exercising for prolonged benefits. Other researchers have used different exercise protocols such as 30 minutes of weight training or 1 hour aerobic classes (e.g., Maroulakis & Zervas, 1993; McGowan et al., 1996) to test the long-term effects of moderate exercise on mood. Replication of the study using different exercise protocols or perhaps a longer walking period is needed in order to gain a better understanding of how arousal might mediate autobiographical recall.

Overgeneral Memory and Valence of Retrieval Cue

Previous research has suggested that the tendency to retrieve general memories in clinically depressed individuals is particularly strong in response to positive cue words (e.g., Moore et al., 1988; Williams & Broadbent, 1986; Williams & Dritschel, 1988). The results from Experiment 1 and Experiment 2 found no difference in the proportion of general memories produced in response to positive versus negative valenced words. Inducing a depressed or elated mood did not increase the likelihood of being less specific in the recall of positive or negative memories. Likewise, manipulating arousal levels did not produce a main effect of valence. One possibility may be that severity of depression is a factor in valence effects in memory (Goddard, Dritschel, & Burton, 1997). Thus, the overall tendency for memory to be overgeneral may be related to level of arousal, whereas the tendency to be more overgeneral in positive than negative memories may be related to *depression*.

Williams and Dritschel (1988) suggested that depressed patients are particularly vulnerable to suffer difficulties when attempting to retrieve hedonic memories because successful recollection requires a match between encoding and retrieval cues. When a person is clinically depressed, there may be less positive contextual cues available to help search for specific memories. Valence effects in memory, then, may be more related to recent life events. The present findings are consistent with this view. In Experiment 1, the valence aspect of mood was manipulated. If valence effects are in fact related to recent life events, an induction technique would mostly likely not be sufficient to produce a mismatch between encoding and retrieval cues and to generate this effect.

Categoric Versus Extended Overgeneral Memories

Research on the effects of clinical depression on autobiographical memory has also shown that depressed individuals produce an excess of categoric general memories (e.g., 'when I played squash') as opposed to extended general memories (e.g., 'my vacation in France') (see Williams, 1996). Thus, increased overgenerality in clinical populations is wholly attributable to an excess of categoric errors. Williams has argued that categoric memory represents a long-standing cognitive style that developed in early childhood for the initial purposes of regulating affect (Williams, 1996).

The results from the present study challenge the claim that categoric retrieval is exclusively a long-standing cognitive style by showing that it might be altered by mood. Specifically, Experiment 1 showed that although an induced depressed mood did not lead to an overall increase in the proportion of general memories produced, it did increase the proportion of categoric general memories produced (compared to the elated group) within the total number of general memories. Changes in arousal level (Experiment 2), however, did not result in differences in categoric retrieval within the total number of general memories produced. Thus, it may be the case that levels of arousal influence the amount of overgeneral memory, but mood valence influences the *type* of memory retrieved. Why an induced depressed mood leads to an increase in the proportion of categoric memories remains unclear. Further research is needed to clarify this issue.

Overgeneral Memory and Working Memory

Another aim of the present study was to explore the relationship between overgenerality and working memory. Several researchers have argued that the cognitive

mechanism underlying the overgenerality of autobiographical memory observed in clinical depression is a reduction in working memory capacity manifested by a reduction in attentional resources (Goddard et al., 1997; Williams, 1996; Williams & Dritschel, 1992). In this context, it made sense to examine the influence of mood manipulations on working memory functioning.

In parallel with the hypothesis on the specificity of autobiographical memory, we formulated the hypothesis that manipulating valence would not affect working memory, whereas manipulating arousal would have an effect on working memory functioning. Neither arousal nor valence manipulations produced differences in performance on the Trail Making Test (TMT) between the groups. One interpretation is that working memory is not involved in overgeneral memory. The literature, however, suggests otherwise. A number of studies have found a relationship between reduced attentional resources and overgeneral recall (Goddard et al., 1997; Phillips & Williams, 1997). For example, Phillips and Williams (1997) found that autobiographical memory specificity decreased with increasing levels of cognitive impairment. Others have found the retrieval of specific memories to be positively related to social problem solving skills (e.g., Goddard et al., 1997; Evans et al., 1992). Winthorpe and Rabbitt (1988) further reported increasing general memory with reduced working memory capacity in elderly people.

Before ruling out working memory from the explanation of overgeneral autobiographical memory on the basis of these results, procedural characteristics of the present experiments need to be highlighted. The negative results may have to do with the

choice of the TMT to study working memory. The TMT was chosen for this research out of the necessity to use a test with a short administration time given that the effects of induction are generally short-lived (Chartier & Ranieri, 1989). Although there is evidence to suggest that clinical depression can interfere with TMT performance (Lees-Haley & Fox, 1990), the effects of mood induction may not be strong enough to highlight differences in scores between groups. Indeed, other studies have shown that the effects of mood induction on tests of attention are not large (Brand, Verspui, & Oving, 1997). Thus, it is possible that the lack of differences between groups may be due to the groups performing at ceiling levels.

Another indication that performance on the TMT may have been at ceiling levels is that research has shown that exercise affects cognitive performance in the short-term, but only for cognitively complex tasks. There is evidence to suggest that exercise-induced arousal is inversely related to cognitive performance, with increasing exercise being detrimental to performance (Gutin, 1973). Acute submaximal exercise results in short-term improvements of cognitive functioning, but acute exercise of maximal activity can have a negative effect on cognitive ability. However, the nature of the cognitive task affects performance, with exercise having an impact on the performance of complex cognitive tasks but no impact on the performance of simple cognitive tasks (Weingartner, Cohen, Murphy, Martello, & Gerdt, 1981). The TMT may have been too simple a task to pick up differences in performance among non depressed undergraduate students.

The Influence of Low Arousal on the Specificity of Overgeneral Memory

Although the present study did not examine the overgeneral memory phenomenon in the context of clinical depression, its results open up the possibility that this phenomenon might be mood-state dependent in that condition, as well as a function of low arousal. This claim contrasts with Williams' (1996) claim that overgenerality is mood-state *independent.* According to Williams, overgeneral memory represents a cognitive style (i.e., an enduring characteristic) that renders some more vulnerable to clinical depression.

It may be that, as Williams has claimed, overgeneral memory does indeed represent a cognitive vulnerability to clinical depression. This study did not directly test this hypothesis and, therefore, his theory cannot be disputed. However, the present results have shown that overgeneral memory may be influenced by arousal levels at the time of recall. This opens up the possibility that this phenomenon may be state-dependent and a consequence of the low arousal that is characteristic of clinical depression. It also opens up the possibility that overgeneral memory can be modified by changes in arousal levels. If overgeneral memory in clinical depression is mood-state dependent, this does not negate the claim that this phenomenon indicates vulnerability to depression. Indeed cognitive vulnerability factors can remain dormant in vulnerable individuals until activated by negative mood. Research has, in fact, shown that although depressed individuals who have recovered from clinical depression remain more overgeneral compared to nondepressed controls, their memory does become more specific when they are no longer clinically depressed (Brittlebank et al., 1993).

The present results also showed that changes in arousal at the time of recall influenced autobiographical memory specificity equally across both positive and negative memory cues. This is not the usual pattern of results observed in clinical populations where the tendency for overgeneral memory is more prominent for positive cues. One possibility is that depressed individuals retrieve more specific negative memories compared to positive memories as a result of their negative mental set. Specifically, clinically depressed persons may have negative contextual cues more readily available to them either as a result of increased negative life events or as a result of the tendency to focus more on negative information. The present findings also showed that the tendency for categoric retrieval may be related to the valence component of mood. Thus, a *depressed mood* could contribute to schematic retrieval.

Taken together, these results suggest that one possibility of the underlying cognitive mechanisms leading to overgeneral recall is that low levels of arousal results in overgeneral memory in general, whereas *depressed mood* produces categoric retrieval. Valence effects in autobiographical memory may be more a consequence of the degree of depression. A tentative hypothesis is that an interaction between arousal and valence could serve to maintain clinical depression. The specifics of this hypothesis are discussed below. Briefly, however, low arousal might result in an increase in overgeneral recall independent of the valence of the memories. Thus, depressed individuals are generally less able to remember specific memories and, as a consequence, also less able to problem-solve. Depressed mood may produce categoric (i.e., schematic) recall leading to the activation of schemas that may be, depending on the severity of the depressed mood,

depressogenic in nature and negatively valenced. Information, then, is maintained at a general level and schematic processed. Access to both specific positive and specific negative memories is hindered, but this effect is more prominent in the case of positive memories as a result of the predominance of negative schemas. This reduction in the accessibility of positive contextual cues reinforces negative cognitions that could serve to maintain the depression.

If overgeneral memory is indeed state dependent and a function of low arousal, it seems likely that this phenomenon is related to reduced working memory functioning. Although the present findings did not support this conclusion, limitations with the study may have contributed to finding the null effect. A tentative model of overgeneral memory in clinical depression is presented with the understanding that the results did not support the hypothesis that overgeneral memory is related to reduced working memory functioning. Nonetheless, the view that overgeneral memory is a function of reduced working memory capacity is not new (e.g., Evans et al., 1992Williams, 1996; Williams & Dritschel, 1992; Phillips & Williams, 1997) and, therefore, the claim being made here is not unprecedented. It is also important to note that, without further inquiry, the conclusions from these findings cannot be rightly generalized to a clinically ill population and, therefore, the model presented here is merely speculative and goes beyond the present data set yet invites future researchers to test its validity. It is also important to note that the results from this study represent a *first step* towards conceptualizing overgeneral memory as mood-state dependent. The next step may be to extend this research to a clinical population.

The Combined Effects of Arousal and Valence of Mood in the Production of Overgeneral Memory: A Model of Overgeneral Memory

So what is the mechanism that could be operating to produce overgeneral recall in clinical depression? Based on the present results, the assumption is that low arousal or low energy characteristic of the *state* of depression serves to produce overgeneral recall and that the underlying mechanism may be a reduction of the capacity of the central executive component of working memory. Schematic categoric representations, however, are activated as a result of a depressed mood (i.e., valence).

The central executive can be considered a cognitive resource that has limited capacity (Baddeley & Hitch, 1974; Salthouse, 1990), and according to Kahneman (1973), momentary capacity varies as a function of arousal. Low arousal may affect the central executive by reducing its capacity and thereby impairing its higher order inhibitory and strategizing mechanisms (the SAS). The view that the SAS is impaired in depression and affects retrieval has been previously advocated (Phillips & Williams, 1997; Williams & Dritschel, 1992). However, whereas these researchers have argued that difficulty with retrieval is not due to a functional restriction of SAS operation due to mood, but is rather due to a structural limitation, the opposite is proposed here. In particular, impaired SAS functioning is believed to be a direct consequence of low arousal and, therefore, to be a transient phenomenon.

The central executive is responsible for processing information that requires the use of a sequence of strategies such as organizing and structuring, higher order reasoning, problem solving, as well as accessing information from long-term memory (Baddeley,

1992; Baddeley, 1993). When the capacity of this attentional system to function appropriately is challenged, the result would be a decrease in performance on tasks that require more of its resources. Reduced capacity would affect the role of the central executive's higher level supervisory attentional system to initiate the selection of appropriate strategies (Baddeley, 1992) necessary for the retrieval of specific personal memories. According to Williams and Dritschel 'if the SAS fails to operate appropriately, the goal description of the search will be inadequately specified. Consequently, insufficient discriminable and constructible cues for searching memory are generated. Commonalities in events are automatically abstracted by such a system, and will be the output if there is insufficient specificity in the retrieval cue' (Williams & Dritschel, 1992, p. 404).

In addition to overriding existing activities, the SAS is responsible for maintaining and monitoring goals. This system focuses attention and prevents vulnerability to distraction (Baddeley, 1992). A decrement in attentional gating would enable the entrance into working memory of information that is task irrelevant (Hasher & Zacks. 1988). According to Hasher and Zacks (1998), central to selective attention are inhibitory mechanisms which, when functioning normally, serve to limit entrance to working memory to information that is along the path of a specific goal. A decrement in functioning of the central executive would result in a deficiency in these inhibitory processes that, in turn, would allow more extraneous information to enter working memory. If depressed mood increases categoric retrieval, then it may be the case that negative schematic models of experience dominate the memory system. Thus, a

deficiency in inhibitory mechanisms would have the effect of occupying attentional resources with depression-relevant thoughts. In turn, this would reduce the number of positive contextual cues, resulting in valence effects in autobiographical recall (i.e., overgenerality would be most prominent in the case of positive memories). Low arousal in the absence of a depressive mental set would result in overgeneral recall without the valence effect.

To summarize, the position advanced here is that there is an energetic factor, namely low arousal, which results in the overgeneral tendency. Low arousal reduces the capacity of the central executive which, in turn, results in impaired SAS functioning. SAS functioning is necessary for the retrieval of specific memories as this system is responsible for higher order cognitive operations. Concurrently, depressed mood leads to categoric recall, namely, the activation of schematic models of experience. It is the interaction of the effects of low arousal and depressed valence that may maintain clinical depression. Furthermore, impaired SAS leads to a disruption of inhibitory mechanisms, allowing negative content to clutter working memory, and thereby reducing positive contextual information that is necessary for the retrieval of specific positive memories.

Limitations with the Study

A number of limitations with this study need to be addressed. First, in Experiment 1, the hypothesis was a null effect. The limit with testing a null effect is that you cannot prove it, only disprove it. Given the relatively low effect size, the possibility remains that with more participants, an effect would have been found. Power analyses revealed that over 80 subjects per condition would have been needed to have enough

power given the effect size. However, besides power, confidence with the results of a given study also comes from the adherence to a rigorous experimentation. On this score there is all reason to believe that the valence manipulation worked. That is, participants' moods successfully changed in the desired direction, suggesting that differences between the groups did exist during the testing phase. In this regard, the pattern of mood changes observed and not simply changes on individual subscales is quite telling. Participants in the depressed induction condition reported feeling more tense, depressed, confused, and fatigued, as well as having less joviality and positive affect following the induction procedure. On the other hand, participants in the elated condition reported feeling less tense, depressed, confused, and fatigued, as well as having more joviality and positive affect following the induction procedure. The results from Experiment 1 should not be viewed in isolation, but must be taken in context with the results from Experiment 2. The designs in both experiments were identical, with the exception of the manipulation used, yet the results on overgeneral tendency were contrasted.

A second question raised of the design of this study is that the modified Velten procedure used in Experiment 1 may have elicited demand effects, whereby participants' reported changes in mood were the reactions to the experimenter's instructions. In other words, in order to comply with 'what was expected of them', they may have reported mood changes when none actually existed. Although demand effects were not directly assessed in this study, there is indirect evidence that they were not generated. If participants were influenced to respond in function of the experimenter's demands, they would be expected to report more valence-congruent memories and less valence-

incongruent memories. The results showed no difference in the number of memories produced between the two valenced conditions and the neutral condition, suggesting that this was not the case. Replication of this study could include a questionnaire at the end of the study specifically asking participants about the nature of their mood changes.

A third concern with this study is that the modified Velten procedure used in Experiment 1 may have produced priming effects that may have contaminated the results. The incubation instructions developed by Sinclair et al. (1994) have specific directions eliciting memories. The elated group is asked to think of things that have happened in their lives to make them happy, the depressed group is asked to think of things that have happened in their lives to make them depressed, and the neutral group is asked to think of neutral thoughts. These instructions may have had the effect of increasing the specificity of autobiographical memory by activating memories before the introduction of the Autobiographical Memory Test. Incubation instructions, however, were given across all conditions and, therefore, the same effect should have applied to all groups. That is, if autobiographical memory specificity increased as a result of the incubation instructions, it would be reasonable to assume it increased in all three groups. It could be argued, however, that the magnitude of the effect might have differed among the groups, with the neutral group being the least affected. If indeed the elated and depressed groups were more susceptible to priming effects, it seems reasonable to assume that only autobiographical memories corresponding to the valence of the condition would be affected. That is, because the elated group was instructed to think of instances when they felt happy, an increased specificity in *positive* memories would be expected. In contrast,

individuals in the depressed group, who were instructed to think of times in their lives when they were unhappy, would most likely produce more specific *negative* memories. However, no valence effects were found, potentially arguing against priming effects.

The decision to use the modified Velten procedure was taken keeping in mind the possible cost of priming and demand effects. This procedure was chosen because of the duration of its effects (Sinclair et al., 1994). It was imperative to choose a mood induction procedure where the effects lasted longer than the duration of the procedure itself particularly because the hypothesis was the null effect. That is, no differences in the specificity of autobiographical memories were expected between elated, depressed, and neutral conditions. No reasonable argument for the null hypothesis could be made if the mood changes were short-lived. A pilot study using film revealed that the mood changes that were observed using this mood induction procedure were extremely time-limited. The effects of music have also been shown to be fairly time-limited (Westermann et al., 1996). However, the mood changes produced by the modified Velten procedure have been reported to last 35 minutes (Sinclair et al., 1994), and it was for this reason that this procedure was chosen.

A fourth limitation with this study was the test chosen to investigate working memory functioning. As noted, the possibility remains that the TMT produced ceiling effects such that any differences between groups were essentially eliminated. Working memory measures that are more sensitive to changes in mood in a nondepressed undergraduate population are needed to assess properly the role of this system in autobiographical recall. Using mood induction techniques limit the choices of tests, as a

result of the time-limited effects. Nonetheless, more cognitively complex tests that would reveal differences between working memory functioning, if differences exist, would be more appropriate in future research.

A final limitation with this study is that one must be very cautious to extrapolate from results that are based on an undergraduate population of women to a clinically depressed population of mixed gender. Experimental induction cannot adequately be used as models of naturally occurring depression in the realm of memory research (Hertel & Rude, 1991). Again, the purpose of this research was to investigate the phenomenon at the basic level of mood to assess whether specific mood variables were involved in overgeneral recall. The decision to test only women was based on the finding that men respond to dysphoric mood with distraction (Nolen-Hoeksema, 1991) and that distraction affects the retrieval of autobiographical memories (Lyubomirsky et al., 1998). Thus, if males had been included in the sample, they may have responded differently to the mood manipulations, making the results less interpretable. It would have been difficult to know whether finding a null effect in Experiment 1 was due to the fact that the valence of mood at recall does not affect autobiographical memory specificity, or whether it was a result of the coping style used by males in the sample. However, the inclusion of only women greatly limits the generalizability of findings. Future research could address this by examining gender differences in overgeneral memory, both in clinically depressed samples and in dysphoric samples.

Future Directions

This research has extended our understanding of the relationship between mood, arousal, and autobiographical memory recall, and has produced new lines of inquiry for future research. A number of directions are possible. Replication of these findings is needed to increase the generalizability of findings beyond the present sample. Also, the relationships among arousal, working memory, and autobiographical memory require further investigation. Using working memory tests that are more complex in nature is needed to test whether the absence of differences found in TMT performance in both experiments is an artifact of the experimental procedure.

This research calls into question the idea that overgeneral memory is independent from mood-state. An investigation of the role of arousal in overgeneral memory in a clinically depressed population could be the next step for a deeper insight about this phenomenon. It would be interesting to investigate the effects of experimentally increasing arousal levels on autobiographical specificity in a depressed sample. Future research could also clarify the role of valence in categoric retrieval, and begin to delineate how the two components of mood differentially affect autobiographical recall. An examination of gender differences in overgeneral memory would also contribute to knowledge in this area.

Clinical Implications

Psychotherapy, to a large extent, involves the deliberate recollection of recent events and, at times, remote past events. Therapeutic work proves difficult with patients who find it hard to go beyond the general description of events in their lives. Problem

solving abilities, affected by working memory functioning, are also needed for therapeutic gains. Thus, understanding the underlying cognitive mechanisms maintaining overgeneral memory is important from a therapeutic perspective.

If overgeneral memory were indeed state dependent and a function of low arousal, this would have various implications for therapy. Techniques aimed at increasing arousal, for instance, could be integrated into the therapeutic realm as a means of increasing the specificity of memory. Exercise as homework could also be part of a structured therapy plan to help patients increase arousal levels. Increased arousal levels, in turn, might serve to increase access to specific memories and thus allow patients to access more positive memories. This could have the effect of breaking the focus on negative information that constitutes the characteristic ruminative style of depression. Increased arousal may also help to break schematic processing of information that likely serves to maintain depression. Long-standing maladaptive schemas could more easily be replaced with better adaptive schemas. Greater problem solving capabilities could also result from increased working memory functioning, allowing patients to more readily think of alternate solutions to their difficulties.

Increased arousal could also impact behavioral activation whereby depressed patients would be more capable of introducing different activities into their lives. For some depressed individuals, behavioral activation may be a first step towards recovery. And according to some therapies (e.g., Cognitive Behavior Therapy) behavioral activation is an integral part of the recovery process. Thus, if overgeneral memory is indeed influenced by arousal levels, this could potentially impact both cognitive and

behavioral components of therapy and, ultimately, have a positive impact on depression. Extending this research into the clinical realm, however, is needed before fully understanding the impact of these findings on the treatment of depression.

Conclusion

The aim of this research was to investigate overgeneral memory at the level of mood to gain a clearer conceptualization of whether this phenomenon is mood-state dependent. The effects of manipulating the two components of mood on the specificity of autobiographical memory were tested. This was done in order to isolate the phenomenon of overgeneral memory from clinical depression. This procedure effectively reduced any contamination arising from the pathology of depression that could have inhibited a pure consideration of the factors involved. The findings posed at least some problems for the view that overgeneral memory is independent of current mood-state as advocated by Williams (1996).

The results suggested that overgeneral memory may be a function of low arousal. In particular, experimentally manipulating the valence component of mood did not affect autobiographical specificity, whereas experimentally decreasing arousal resulted in an increased proportion of general memories. These results challenge William's premise that this phenomenon is a cognitive vulnerability independent from mood-state. If overgeneral memory were a cognitive style, one would not expect to be able to induce this effect in a nondepressed population by simply changing levels of arousal.

Neither manipulating valence nor arousal produced valence effects in memory. One hypothesis is that whereas overgeneral memory is a function of low arousal, the

tendency for this effect to be more prominent for positive memories is related to the negative mental set characteristic of clinical depression. The results also showed that an induced depressed mood produced an increased proportion of categoric memories, suggesting that categoric retrieval may be mediated by the valence component of mood. Future research should address this question.

The hypothesis that overgeneral memory is related to reduced working memory functioning was not supported. One possibility is that the measure used (the TMT) was not the best test choice for two reasons: 1) it is not a cognitively complex test and, therefore, ceiling effects most likely resulted; and 2) it is more a measure of attention and psychomotor speed rather than central executive functioning (Lezak, 1995). Replication of this study is needed both to extend the findings beyond the present sample, and to examine the interaction between low arousal, overgeneral memory, and working memory using a working memory test that reduces the possibility of ceiling effects.

The findings from the present study are both theoretically and clinically significant. From a theoretical perspective, the results introduce the view that arousal may be a mediating factor in overgeneral recall. From a clinical perspective, the finding that arousal may be implicated in overgeneral memory opens the possibility for new interventions that target arousal to help increase patients' access to specific memories and, ultimately, may help change the ruminative and negative style of thinking characteristic of depression. Future research should help us draw a clearer understanding of the role of arousal in overgeneral memory in depression, as well as the role of valence in categoric retrieval.

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Appendix 1: Consent Forms

a. Experiment 1

b. Experiment 2: high arousal

c. Experiment 2: low arousal

d. Experiment 2: control

CONSENT FORM

Carolina Cristi
University of Ottawa
(613) 562-5800 ext. 4456

I, _____, am interested in participating in this study on mood and memory conducted by Carolina Cristi, doctoral student and supervised by Dr. Cappeliez, Professor at the School of Psychology of the University of Ottawa. The purpose of the study is to better understand how mood affects autobiographical memory and working memory.

If I agree to participate, my participation will consist of reading 60 statements that have been designed to help you change your mood, filling out a number of short mood questionnaires, and completing some autobiographical and working memory tests.

I understand that the procedure will be as follows. First, I will fill out two short mood questionnaires that will ask me to state how I feel. I will then read 60 cards that have mood-related statements typed on them. I will then repeat the mood questionnaires that will require me to state how I feel after reading the statements. After I have completed the mood questionnaires, I will complete two additional tests examining my memory.

One test will ask me to remember and write down personal memories in response to different words presented by the experimenter. The second test will require me to connect sequences of numbers, and numbers and letters. The entire session will last about 45 minutes. No personal information will be disclosed, and the test results will be kept strictly confidential.

I understand that since part of this activity deals with personal information and mood-induction, it may induce emotional reactions that may, at times, be negative. I have received assurance from the researchers that every effort will be made to minimize this occurrence. My participation is strictly voluntary and I am free to withdraw from the study at any moment or refuse to participate without any penalty. If I am uncomfortable with any particular question I may refuse to answer.

I have also received assurance from the researchers that the information I will share will remain strictly confidential. There are two copies of this consent form, one that the researchers keep and one that I keep. If I have any questions or concerns, I may call Dr. Cappeliez at 562-5800 ext. 4806.

PARTICIPANTS SIGNATURE:_____
DATE:_____

RESEARCHER'S SIGNATURE:_____
DATE:_____

CONSENT FORM

Carolina Cristi
University of Ottawa
(613) 562-5800 ext. 4456

I, _____, am interested in participating in this study on physical activity and memory conducted by Carolina Cristi, doctoral student and supervised by Dr. Cappeliez, Professor at the School of Psychology of the University of Ottawa. The purpose of the study is to better understand how physical activity affects autobiographical memory and working memory.

If I agree to participate, my participation will consist of walking outdoors with the experimenter for 10 minutes, filling out a number of short mood questionnaires, and completing some autobiographical and working memory tests. I understand that the procedure will be as follows. First, I will fill out two short mood questionnaires that will ask me to state how I feel. I will then walk outdoors with the experimenter for 10 minutes. I understand that the experimenter will set the pace of the walk, which will be vigorous but not over taxing. After the walk, I will repeat the mood questionnaires that will require me to state how I feel at that moment. After I have completed the mood questionnaires, I will complete two additional tests examining my memory. One test will ask me to remember specific personal memories in response to different words. For another test (the Trail Making Test) I will be required to connect numbers, and numbers and letters. This will last about 45 minutes. No personal information will be disclosed, and the test results will be kept strictly confidential.

I understand that since part of this activity deals with personal information, it may induce emotional reactions which may, at times, be negative. I have received assurance from the researchers that every effort will be made to minimize this occurrence. I also understand that since part of this activity deals with physical exercise, it may induce reactions which may, at times, be negative. I understand that I am free to withdraw from this study at any time. I also agree that if I feel dizzy, faint, or if I feel my heartbeat racing, I will stop exercising and I will inform the experimenter. Furthermore, if at any time I wish to refrain from further exercise for any reason whatsoever, I am free to do so without penalty.

My participation is strictly voluntary and I am free to withdraw from the study at any moment or refuse to participate without any penalty. If I am uncomfortable with any particular question I may refuse to answer.
I have also received assurance from the researchers that the information I will share will remain strictly confidential. There are two copies of this consent form, one that the researchers keep, and one that I keep. If I have any questions or concerns, I may call Dr. Cappeliez at 562-5800 ext. 4806.

PARTICIPANTS SIGNATURE:_____
DATE:_____

RESEARCHER'S SIGNATURE:_____
DATE:_____

CONSENT FORM

Carolina Cristi
University of Ottawa
(613) 562-5800 ext. 4456

I, _____, am interested in participating in this study on physical activity and memory conducted by Carolina Cristi, doctoral student and supervised by Dr. Cappeliez, Professor at the School of Psychology of the University of Ottawa. The purpose of the study is to better understand how physical activity affects autobiographical memory and working memory.

If I agree to participate, my participation will consist of exercising on a Stairmaster for 45 minutes at the University of Ottawa gym, filling out a number of short mood questionnaires, and completing some autobiographical and working memory tests.

I understand that the procedure will be as follows. First, I will fill out two short mood questionnaires that will ask me to state how I feel. I will then exercise on the Stairmaster for 45 minutes. After exercising, I will repeat the mood questionnaires that will require me to state how I feel at that moment. After I have completed the mood questionnaires, I will complete two additional tests examining my memory. One test will ask me to remember specific personal memories in response to different words. For another test (the trail-making test) I will be required to connect a sequence of numbers, and connect a sequence of numbers and letters. The session will last about 75 minutes. No personal information will be disclosed, and the test results will be kept strictly confidential.

I understand that since part of this activity deals with personal information, it may induce emotional reactions which may, at times, be negative. I have received assurance from the researchers that every effort will be made to minimize this occurrence. I also understand that since part of this activity deals with physical exercise, it may induce reactions which may, at times, be negative. I understand that I am free to withdraw from this study at any time. I also agree that if I feel dizzy, faint, or if I feel my heartbeat racing, I will stop exercising and I will inform the experimenter. Furthermore, if at any time I wish to refrain from further exercise for any reason whatsoever, I am free to do so without penalty.

My participation is strictly voluntary and I am free to withdraw from the study at any moment or refuse to participate without any penalty. If I am uncomfortable with any particular question I may refuse to answer.

I have also received assurance from the researchers that the information I will share will remain strictly confidential. There are two copies of this consent form, one that the researchers keep, and one that I keep. If I have any questions or concerns, I may call Dr. Cappeliez at 562-5800 ext. 4806.

PARTICIPANTS SIGNATURE:_____
DATE:_____

RESEARCHER'S SIGNATURE:_____
DATE:_____

CONSENT FORM
Carolina Cristi
University of Ottawa
(613) 562-5800 ext. 4456

I, _____, am interested in participating in this study on physical activity and memory conducted by Carolina Cristi, doctoral student and supervised by Dr. Cappeliez, Professor at the School of Psychology of the University of Ottawa. The purpose of the study is to better understand how physical activity affects autobiographical memory and working memory.

If I agree to participate, my participation will consist of sitting quietly for 5 minutes, filling out a number of short mood questionnaires, and completing some autobiographical and working memory tests.

I understand that the procedure will be as follows. First, I will fill out two short mood questionnaires that will ask me to state how I feel. I will then sit quietly for 10 minutes. Afterwards, I will repeat the mood questionnaires that will require me to state how I feel at that moment. After I have completed the mood questionnaires, I will complete two additional tests examining my memory. One test will ask me to remember specific personal memories in response to different words. For another test (the trail-making test) I will be required to connect a sequence of numbers, and connect a sequence of numbers and letters. The entire session will last about 35 minutes. No personal information will be disclosed, and the test results will be kept strictly confidential.

I understand that since part of this activity deals with personal information, it may induce emotional reactions which may, at times, be negative. I have received assurance from the researchers that every effort will be made to minimize this occurrence.

My participation is strictly voluntary and I am free to withdraw from the study at any moment or refuse to participate without any penalty. If I am uncomfortable with any particular question I may refuse to answer.

I have also received assurance from the researchers that the information I will share will remain strictly confidential. There are two copies of this consent form, one that the researchers keep, and one that I keep.

If I have any questions or concerns, I may call Dr. Cappeliez at 562-5800 ext. 4806.

PARTICIPANTS SIGNATURE:_____
DATE:_____

RESEARCHER'S SIGNATURE:_____
DATE:_____

Appendix 2: Instructions for Velten Mood Induction

Instructions for Velten Mood Induction

Today we're going to see how easily you can change your mood. You will be presented with a set of cards that have mood-related statements typed on them. As you read the cards, you will find that your mood changes progressively to become like the mood represented on the cards. With concentration, you will find that the mood will change even further. People who have done it find that they really get into it. They've also found that it's interesting to learn how to change their own moods. I hope that, if you get anything out of this, it's the knowledge that you can change your mood. If you learn how to talk yourself into a mood, you can learn how to talk yourself out of mood.

As you can see, this research is very important to me. It's important that you concentrate very hard and try to 'get into the mood'. Please don't talk while you're doing this, because other people will be reading different statements, thinking different thoughts, and trying to feel differently than you. Also, please concentrate hard. Another thing is, it's very easy to react to the mood induction. What I mean by this is that you start feeling your mood change and try to fight it. Please don't do this. Just go with the flow. Let your mood change.

This procedure is designed to make you feel in a certain way. These statements will gradually change your mood. After you've done this, I'll have you read a brief description of how to build the mood even further. Then you'll sit for a few minutes, with your eyes closed, and concentrate on building the mood. You'll think of things that make you feel more like the mood. I have you do this because thinking about a feeling builds it. You'll probably experience it. Simply concentrate on what you're reading, thinking, and feeling, and the mood will build.

Now please read the instructions in front of you. After you've read through the instructions, put the sheets in front of you so I'll know you are ready to continue. I'll tell you when to begin and when to go to the next card in the packet.

SUBJECT READS INSTRUCTIONS

We're ready to begin. Don't go on to the next statement until I tell you to. One final thing, if the induction gets to be too much, raise your hand and I'll stop you. Please concentrate and the mood will build. The first page of the packet indicates what mood condition you're in.

Open the packet to the page marked Card 1 and begin now.

Appendix 3: POMS-SF

Appendix 4: PANAS-X

Appendix 5: Autobiographical Memory Test

Appendix 6: Trail Making Test (A and B)

Appendix 7: Recruitment Poster

RESEARCH PROJECT

I am doing research on the effects of physical activity and mood on autobiographical memory. My name is Carolina Cristi, I am a doctoral student in Psychology at the University of Ottawa. My thesis supervisor is Dr. Philippe Cappeliez.

The purpose of the study is to better understand how our physical activity and mood affects how we remember things from our past. We would like to know if you would be interested in participating in this study.

All participants will be entered in a draw for $200.00

Call Carolina at 562-5800, ext.4456 for more information.

Carolina 562-5800 ext. 4456	Carolina 562-5800 ext.4456	Carolina 562-5800 ext.4456	Carolina 562-5800 ext.4456	Carolina 562-5800 ext.4456	Carolina 562-5800 ext.4456