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ABSTRACT

THE EFFECTS OF ANXIETY ON MEMORY PERFORMANCE IN THE ABLE ELDERLY

By

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Anxiety, depression, and memory difficulties are probably the most common mental health concerns facing the elderly today. Differentiating anxiety and depression has been a long-standing problem in psychopathology research (Nelson & Novy, 1997; Alexopoulos, 1991). The first aim of this study was to differentiate the symptoms of anxiety and depression in community dwelling older adults (N= 47, Mean age = 71.5). State anxiety as measured by the STAI-S did not correlate significantly with either depression measure. However, trait anxiety as measure the STAI-T (BDI $r = .342$, $p < .05$; GDS $r = .387$, $p < .01$) and worry as measured by the Penn State Worry Questionnaire (BDI $r = .411$, $p < .01$; GDS $r = .458$, $p < .01$) correlated significantly with depression.

It is a commonly held belief that our affect influences our cognitive abilities. The cognitive sequelae of depression in the elderly have attracted great attention (LaRue, 1992); however, the influence of anxiety on cognitive performance and cognitive complaints is extremely understudied in older adults (Salzman & Lebowitz, 1991). This study examined the influence of anxiety on memory performance. Before the participants completed the memory tasks they heard manipulation instructions in an effort to increase

anxiety (anxiety instructions) or decrease anxiety (relaxation instructions). Results suggest that hearing the anxiety evoking instructions increased anxiety and hindered memory performance. However, overall state anxiety was not a significant predicator of memory performance. On a more speculative level, although the correlations between state anxiety and memory performance and the regression models were not statistically significant, there was a consistent negative relationship between state anxiety and memory performance; does this suggests that state anxiety hinders memory performance? Notably, this negative relationship was largest on the most complex task (free recall) and smallest on the least complex task (recognition). It was also predicted that there would be a differential relationship of strategy use as a function of anxiety with optimal strategy use occurring at intermediate levels of state anxiety. This hypothesis was not confirmed; strategy use was not significantly correlated with state anxiety levels.

This study also allowed us to investigate the combined effects of state anxiety, worry and trait anxiety on performance. We expected trait anxiety and state anxiety to interact to predict memory performance. Contrary to these predictions, individuals who experience state anxiety at the time of testing and who have high levels of trait anxiety did not experience exaggerated negative effects of anxiety on memory performance. Finally, the present study examined the effect of anxiety on memory complaints in a sample of able elderly. Trait anxiety as measured by the STAI-T correlated significantly with memory complaints ($r = -.411$, $p < .01$); however, state anxiety and worry (as measured by the PSWQ) did not correlate significantly with memory complaints.

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INTRODUCTION

Every age has a dominant emotion. The first half of this century was the Age of Anxiety, and its emotional tone was captured by Sigmund Freud. Freud lived through the death throes of the Hapsburg Empire, and then though the horrors of World War I and its chaotic aftermath. Freud watched a world order that had stood for hundreds of years dissolve and a new one struggle to be born. Times when all values crumble and the future is unpredictable are times fraught with anxiety. Anxiety was the dominant emotion Freud saw in his patients, and it was the dominant theme of contemporary writing, film and painting. Small wonder that Freud believed that all neuroses and almost all human action stemmed from anxiety. All the other emotions — depression, awe, anger, embarrassment, shame and guilt — were just footnotes.

— Martin Seligman, in What You Can Change and What You Can't: The Complete Guide to Successful Self Improvement

According to recent population estimates, there are over 51 million people in the United States (21% of the total population) who are at least 55 years of age (US Bureau of Census, 1987 as cited in LaRue, 1992). By 2030, it is projected that one in every three Americans will be 55 years old or older. This age group is by far the fastest growing segment of the population (Tranel, Benton, & Olson, 1997). With the growing number of

older adults, the importance of understanding aging and common disorders of later life is difficult to exaggerate.

An increasing number of healthy older adults are seeking advice and treatment for cognitive problems (La Rue, 1992). In particular, memory difficulties are often cited (Williams, Denney & Schadler, 1983). Memory decline with age has become such a common concern among older adults that researchers and clinicians who work with geriatric patients have recommended the development of a new diagnostic entity, "Age Related Cognitive Decline" (ARCD) to be included in the Diagnostic and Statistical Manual of Mental Disorders (Caine, 1993). The criteria proposed for ARCD includes both memory dysfunction and subjective complaints (Crook, Bartus, Ferris et al., 1986).

Complaints of anxiety and depression are also encountered more frequently in this age group (Zarit & Knight, 1996). Symptoms of depression can be found in 15% of community dwelling older adults (Blazer, 1989). In addition, generalized anxiety disorder and other anxiety disorders including phobias, obsessions, and compulsions are also among the most common problems reported in later life (Blazer, George, & Hughes, 1991). However, differentiating anxiety and depression at the mood, symptom, and syndromal levels has been a long-standing problem in psychopathology research (Nelson & Novy, 1997; Alexopoulos, 1991). Differentiating anxiety and depression is important because comorbid conditions like anxiety and depression may or may not be functionally related, and determining the presence or non-presence of a relationship is a crucial aspect of treatment planning (Clarkin & Kendall, 1992).

It is also a commonly held belief that our affect influences our cognitive abilities. The cognitive sequelae of depression in the elderly have attracted great attention (LaRue,

1992). Eysenck (1979) stated that anxiety also clearly affects the amount of memory capacity available for task performance. However, the influence of anxiety on cognitive performance and cognitive complaints is extremely understudied in older adults (Salzman & Lebowitz, 1991). Several investigations have been conducted on the relationship between anxiety and sustained attention and memory in younger adults but there is very little research of this type with older populations (Rankin, Gilner, Gfeller, Katz, 1994). It is therefore essential that we investigate the influence of anxiety on memory performance and memory complaints in older adults.

Anxiety

Anxiety can cause significant distress. Gurian and Miner (1991) have defined anxiety as "a subjective state of internal discomfort, dread and foreboding, accompanied by nervous system arousal. Different from fear, anxiety tends to occur without conscious or apparent stimulus." (pp.34) There are eleven DSM-IV categories specific to anxiety in adults: panic disorders, agoraphobia, specific phobias, social phobias, obsessive-compulsive disorder, post-traumatic stress disorder, acute stress disorder, generalized anxiety disorder, anxiety disorder due to a general medical condition, substance-induced anxiety disorder, and anxiety disorder not otherwise specified.

There is a continuum of anxiety levels. If anxiety is mild, it can be helpful in planning and coping (Salzman, 1991). On the other hand, in more extreme forms it is characterized by dread, anticipation of threat, fear, extreme worry, and preoccupation with the future. When anxiety causes these symptoms it can interfere severely with daily living (Salzman, 1991). Individuals with moderate to severe levels of anxiety can

experience cognitive, emotional, and physical symptoms. The cognitive symptoms of anxiety include decreased concentration, memory, and attention. Feelings of dizziness, impending faintness, heart palpitations, and sensations of "going crazy" are also associated with anxiety. Difficulty falling asleep and changes in appetite are almost always present. Symptoms of severe anxiety may be similar to those associated with gastrointestinal, cardiovascular, endocrine, or neurological illness. Symptoms such as nausea, abdominal burning, belching, constipation, and diarrhea can be signs of anxiety as well as gastrointestinal disease. Tightness in the chest, breathing difficulties and tachycardia are often misinterpreted as early signs of a heart attack. Poor memory, poor attention and poor concentration may be feared by the anxious person as symptoms of Alzheimer's disease (Salzman, 1991).

The term "anxiety" is currently used to refer to two different but related constructs. It is often used empirically to describe a distressing emotional state. It is also used to describe a personality trait (Spielberger, Gorsuch & Lushene, 1970). Cattell and Scheier first introduced the concepts of state and trait anxiety in 1961. State anxiety refers to transient feelings of tension, apprehension, nervousness, worry, and activation or arousal of the autonomic nervous system. Trait anxiety refers to more enduring anxiety levels and anxiety proneness. That is, individual differences in the tendency to perceive situations as stressful and dangerous. Trait anxiety may reflect the probability that an individual will experience state anxiety in a given situation; for instance individuals who are high in trait anxiety are more likely to experience elevations in state anxiety when exposed to threatening situations (Spielberger, Gorsuch & Lushene, 1970).

Do older adults experience anxiety? There is universal agreement among geriatric

psychiatrists that anxiety exists both as a disorder and a symptom in the elderly (Shamoian, 1991). There have been many studies that have reported high prevalence rates of anxiety disorders and anxiety symptoms in older adults. In recent epidemiology studies 5% of adults over 65 were determined to have diagnosable anxiety disorders (Flint, 1994; Regier, Boyd & Burke, 1988). One such study found phobias to be the most commonly reported disorder in women over sixty-five, and the second most prevalent disorder for men over sixty-five (Myers, Miller, Metzger, & Borkovec, 1984). In another epidemiological study, Lindesay, Briggs and Murphy (1989) found a 3.7 percent prevalence rate for generalized anxiety disorder and 10 percent prevalence rate for phobic disorders in individuals over sixty-five.

However, anxiety symptoms that do not meet the criteria for specific syndromes occur in much larger percentages of the population. Himmelfarb and Murell (1984) reported that 17.1 percent of males and 21.5 percent of females experience symptoms of anxiety that do not meet clinical levels but are severe enough to warrant some form of therapeutic intervention. In a nationwide study of 2,460 adults living in private housing Gurin, Veroff and Feld (1983) found that 10% of elderly adults were anxious; this is twice the rate in younger adults. Researchers have shown that the rates of anxiety symptoms increase linearly with age, with rates double that of adolescence observed in later life (Warheit, Bell, Schwab, & Buhl, 1986).

Studies documenting the distribution of benzodiazepines (minor tranquilizers) reported rates ranging form 17% to 50% in older adults (Salzman, 1991). In another study Parry, Baltes, Mellinger, Cisin & Manheimer (1973) found that 19.4% of persons over the age of 65 had used minor tranquilizers or sedatives in the year preceding the

interview. This makes older individuals the largest consumers of anti-anxiety medications.

On the other hand, several studies have reported that current and life time prevalence of anxiety disorders and anxiety symptoms decrease with increasing age. Blazer, George and Hughes (1991) found the prevalence of anxiety disorders was higher for the 45 to 64 age group than the 65+ age group. Furthermore, they reported lifetime prevalence was also lower for the 65+ age group. Other researchers have reported similar findings: lower rates of anxiety in later life (Meyer et al., 1984; Robins et al., 1984).

There are many reasons why studies may disagree about the prevalence rates of anxiety in the elderly. Older adults are thought to under-report anxiety symptoms. Specifically, Blazer et al. (1991), suggested that a higher threshold of discomfort may be required for reporting of symptoms in later life. Older adults might attribute anxiety symptoms to medical illness, whereas younger adults might be more prone to report their symptoms as anxiety. In addition, the somatic manifestation of anxiety makes its diagnosis difficult in later life. Anxiety is often confused with common geriatric illnesses, and many anxious adults seek treatment from their internist rather than from a psychologist or psychiatrist (Katon, 1986). Older adults have different concerns and the source of the symptoms might therefor be shifted. Older persons also tend to attribute agitation, fears, and aches and pains to the normal aging process and so deny and under report anxiety (Gurian and Milner, 1991). Anxiety and depression are often confused in older adults as the overlap of signs and symptoms makes it difficult to distinguish between the two syndromes (Alexopoulos, 1991). These factors suggest that the prevalence rates which have been reported for anxiety disorders, and especially anxiety

symptoms, might be underestimates of the true number of cases.

Elderly women appear to be afflicted by late life anxiety more than men. Blazer, George, and Hughes (1991) reported that Murphy and her colleagues (1986) found the prevalence rate of generalized anxiety disorder to be 6% in women over forty five and only 1% in men over 45 years of age in the Stirling County Study. Furthermore, she reported that the rates of Generalized Anxiety Disorder increased for women as age increased but declined in men. Using the Spielberger State-Trait Anxiety Scale, Himmelfarb and Murrell (1984) also found that anxiety occurs more frequently and severely in women than in men.

There are many reasons why older adult experience anxiety. For some later life brings retirement and relaxation. For others it can be a period of extreme loneliness, worthlessness, and hopelessness (Smith, Sherill, & Colenda, 1995). Elderly adults may experiences multiple losses that contribute to sadness and anxiety as well as fear of death. Chronic illness, financial limitations, and diminished functioning are also likely to take their toll on older adults. Other common causes of anxiety in later life include late onset neurotic disorders, life-long recurrent anxiety, late onset acute phobic anxiety, hypocondraisis, early dementia, paranoid psychotic states, obsessional states, withdrawal reactions, medicine and caffeine (Shamoian, 1991). Despite the high prevalence rate, distressing affect and intense worry, anxiety has been relatively neglected and extremely understudied in older adults (Salzman & Lebowitz, 1991). Depression is also amoung the most common concerns of older adults group (Zarit & Knight, 1996).

Depression

Depression is generally associated with despondent mood and/or loss of interest and pleasure in nearly all activities. Unresolved grief, guilt, loneliness, and anger with symptomatology including insomnia, despair, lethargy, anorexia, loss of interest, and somatic complaints are often experienced by older adults (Butler & Lewis, 1977). Depression may refer to a mood, a symptom, or a disorder (Wasylenki, 1987). Depressed mood refers to feelings of sadness, disappointment, discouragement and related emotions. The symptom of depression refers to changes in affect that are associated with certain events, medical illness, drug effects or other psychological disorders. The disorder of depression can have cognitive, emotional, vegetative, and motor components.

The rate of depression is thought to increase with age (Zarit & Knight, 1996) but some recent studies have found the opposite (Regier et al., 1988). Older adults may be more prone to milder forms of depression and less prone to certain severe depressive syndromes (LaRue, 1992). Prevalence rates of depressive disorders occur in less than 5% of individuals over sixty-five (Friedhoff, 1991, Gallo & Lebowitz, submitted). However, symptoms of depression can be found in 15% of community dwelling older adults (Blazer, 1994). Rates of depression reach levels of 15% to 25 % among nursing home residents and those with chronic physical illness (Friedhoff, 1991).

The Relationship Between Anxiety and Depression

Differentiating anxiety and depression at the mood, symptom, and syndromal levels has been a long-standing problem in psychopathology research (Nelson & Novy, 1997; Alexopoulos, 1991). Three positions have been taken in dealing with the

differentiation of anxiety and depression (Alexopoulos, 1991). Anxiety and depression have been viewed as part of a continuum with both being symptoms of one disorder: the unitarian position. The opposite of this position suggests that anxiety disorders and depressive disorders are independent and can be separated into distinct classes. Finally, the tripartite position suggests that depression and anxiety have both shared and unique features (Clark & Watson, 1991).

The unitarian position is supported by studies examining the use of psychotropic drug distribution. For example, tricyclic antidepressants have been shown to have about equal effectiveness in treating both anxiety and depressive disorders (Paykel, Rowan, Roa, & Bhat, 1982; Johnstone et al., 1980). However, it is possible that psychotropic drugs may not be diagnosis specific. Alexopoulos (1991) investigated the frequency of anxiety symptoms for in-patient older adults who met DSM-III criteria for depression, with a significant portion of their population meeting criteria from both depression and dementia (approximately 41%). Sixty-one percent of their sample experienced mild psychic symptoms of anxiety (e.g., tension, apprehension, fear, and irritability) and fifty-three percent of the sample population reported mild somatic symptoms of anxiety (e.g., dry month, indigestion, heart palpitations). This study suggests that many individuals with depressive disorders also experience symptoms of anxiety.

The position that suggests that anxiety disorders and depressive disorders are independent and are two distinct disorders (e.g., cognitive specificity) has also been supported. Mash and Barkley (1996) offered the following distinction between anxiety and depression: "Individuals with a depressive schema for instance, process and interpret information about themselves, their work, and the future in a negatively biased fashion

(the cognitive triad; Beck, Rush, Shaw & Emery, 1979), whereas persons with an anxiety schema interpret environmental stimuli with a cognitive focus on future threat" (Kendall, Howard & Epps, 1988).

Burns and Eidelson (1998) found that the nonspecific symptoms depression and anxiety are distinct and cannot be combined into a cluster of negative affect symptoms. They used structural equation modeling to test the tripartite model of depression and anxiety (Clark & Watson, 1991) in outpatients seeking treatment for mood disorders, outpatients seeking treatment for substance abuse, and college students. This tripartite model proposes that anxiety and depression have both shared and unique characteristics (the tripartite model is discussed in more detail below). Burn and Eidelson found that the tripartite model did not fit any of the sample's data. The nonspecific symptoms of depression and anxiety did not load onto a single negative affect factor suggesting that these two disorders do not have symptoms in common and are best represented as two separate and distinct syndromes.

Roth, Gurney, Garside, and Kerr (1972) reported that anxiety and depression have different courses and outcomes. Studies using anxiety and depression scales have also been successful in separating the two groups (Alexopoulos, 1991). Roth and colleagues (1972) were able to separate groups of patients with diagnosis of anxiety, depression, or phobias by using scores on several anxiety and depression measures. They concluded that anxiety and depression are distinct syndromes. Using the Present State Examination, Wing, Cooper, and Sartorius (1974) , also were able to distinguish the symptomology of depression and anxiety and identify two separate groups.

Nelson and Novy (1997) investigated the psychometric distinctiveness of self-

reported anxiety and depression in chronic pain suffers. Their findings demonstrated that it is possible to distinguish different dimensions of anxiety and depression using the State Trait Anxiety Inventory -State subscale to measure anxiety (STAI-S) and the Beck Depression Inventory (BDI) to measure depression. They further suggest that the BDI and STAI-S scales appear to be well suited for assessing depression and anxiety respectively in chronic pain sufferers.

Although there is frequent comorbidity between anxiety and depression, a primary diagnosis of anxiety is more likely to appear alone, than a primary diagnosis of depression which is usually accompanied by anxiety (Clarkin & Kendell, 1992). Furthermore, in a review of the literature Stavrakaki and Vargo concluded that anxiety and depression can be classified as separate disorders both clinically and statistically (1986).

The tripartite model was proposed by Clark and Watson (1991). They suggested that depression and anxiety have common and unique features. Elevated levels of negative affect (e.g., distress) characterize both anxiety and depression; however, low levels of positive affect are unique to depression and psychological hyperarousal is unique to anxiety. To investigate the common and specific dimensions of self-reported anxiety and depression, Clark, Steer, and Beck (1994) administered the Beck Depression Inventory (BDI) and the Beck Anxiety Inventory (BAI) to 844 outpatients and 420 undergraduates. They found that one second-order general distress or negative affect factor accounted for more than 40% of the extracted variance in the BDI and BAI. After controlling for the general distress factor, depression and anxiety emerged as first order factors, each accounting for over 20% of the extracted variance. To estimate the

generaliziability of these factors, Steer, Beck, Clark, and Ranieri (1995) administered the Beck Depression Inventory and the Beck Anxiety Inventory to 1,000 outpatients diagnosed with various types of psychiatric disorders and found similar results.

Comorbid conditions like anxiety and depression may or may not be functionally related, and determining the presence or non-presence of a relationship is a crucial aspect of treatment planning (Clarkin & Kendell, 1992). A great majority of research differentiating anxiety and depression to date has used clinical samples (Paykel, Rowan, Roa, & Bhat, 1982; Johnstone et al, 1980; Alexopoulos, 1991; Nelson & Novy, 1997). These samples are not representative of the population, and so the results might not be generalizable. Thus, it was important that we examined this relationship in normal healthy older adults. In addition, most research has tried to distinguish anxiety disorders from depression disorders. As mentioned previously symptoms of anxiety and depressive that do not meet the criteria for specific syndromes occur in much larger percentages of the population (Jeste et al.,1999). It is therefore also important to determine if anxiety can be distinguished from depression at the symptom level.

Two measures of depression, the Beck Depression Inventory (Beck et al., 1961) and the Geriatric Depression Scale (Yesavage, Brink, Rose et al., 1983), and two measures of anxiety, the State Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970) and the Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), were administered to differentiate the symptoms and increase our understanding of the distinction between depression and anxiety in community dwelling older adults.

Beck, Stanley, and Zebb (1995) examined the psychometric properties of the Penn State Worry Questionnaire. They reported that the PSWQ significantly correlated

with the Beck Depression Inventory (r = 0.41), the State-Trait Anxiety Inventory- State (r = 0.40), and the State-Trait Anxiety Inventory-trait (r = 0.58). Meyer, Miller, Metzger, and Borkovec (1990) reported lower correlations between the PSWQ and the BDI (r = .36) in student samples. Molina and Borkovec reported that in clinical samples (e.g., Generalized Anxiety Disorder) the PSWQ did not correlate significantly with the BDI or the Hamilton Scale for Depression. Rankin, Gfeller, Gilner (1993) reported that the inter-correlation between the Geriatric Depression Scale and The State-Trait Anxiety Inventory for Children was significant (r = 0.51). In 1979 the STAI underwent a major revision to develop a "purer" measure of anxiety that would provide a firmer basis for discriminating between anxiety and depresssion, hence several items were eliminated from the STAI-X when creating the STAI-Y (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

Anxiety and depression clearly affects the amount of memory capacity available for task performance (LaRue, 1992; Eysenck, 1979). Memory decline with age is one of the most common concerns among older adults (La Rue, 1992). It is therefore of utmost importance to understand how these emotions affect older adult's memory performance.

The Effects of Anxiety and Depression on Cognition

It is a commonly held belief that our affect influences our cognitive abilities. The cognitive sequelae of depression in the elderly have attracted great attention (LaRue, 1992). Depressed patients frequently complain of problems with memory, attention and concentration, and on neuropsychological testing it is not unusual to find evidence of cognitive impairment associated with depression (for reviews, see Caine, 1986; Johnson & Magaro, 1987; Marcopulos, 1989; Miler, 1975; Niederehe, 1986; Levy-Cushman &

Abeles, 1998). In addition, even mild depression is associated with an increase in memory complaints (Levy-Cushman & Abeles, 1998). Eysenck (1979) stated that anxiety also clearly affects the amount of memory capacity available for task performance. However, the influence of anxiety on cognitive performance is understudied in older adults (Salzman & Lebowitz, 1991). Several investigations have been conducted on the relationship between anxiety and sustained attention and memory in younger adults but there is very little research of this type with older populations (Rankin, Gilner, Gfeller, J. D, Katz, 1994). It was therefore essential that we investigate the influence of anxiety on memory performance in older adults.

Eysenck's Theoretical Overview of Anxiety

Eysenck (1979) combined the views of several theorists to create a more complete model of how anxiety affects memory and learning that would be consistent with available empirical evidence. Eysenck first stated that there is a distinction between state and trait anxiety. State anxiety is responsive to situational factors whereas trait anxiety (being a stable personality characteristic) is not. Therefore, state anxiety is more predictive of task performance than trait anxiety.

Eysenck also proposed that anxiety is composed of both cognitive and motivational components. Leibert and Morris (1967) found that test anxiety is comprised of two conceptually distinctive components: worry (the cognitive component, involving performance expectations and negative self-appraisal) and emotionality (involving levels of physiological functioning) (as cited in Eysenck, 1979). This dual nature of anxiety can be explained by a theory proposed by Schacter and Singer (1962). They argued that all

emotions result in highly similar physiological states, and it is the cognitive state that determines which emotion is experienced.

Eysenck takes the position that worry (the cognitive component of anxiety) and other task-irrelevant activities associated with anxiety will impair performance. This is because task-irrelevant information involved in worry and cognitive self-concern competes with task-relevant information for space in the processing system. Hence, individuals who are anxious must divide their attention between the task at hand and their worry; where individuals who are not anxious or less anxious can devote more of their processing resources to the performance task.

Eysenck further argues that the part of the processing system that is most involved in the processing of task-irrelevant and task-relevant information is working memory. The working memory model comprises a limited central processing space resembling attention, an articulatory loop which holds information in a speech based form, and a visuo-spacial scratch pad which is specialized for spatial and visual coding (Baddeley & Hitch, 1974). In working memory information is manipulated in addition to being stored. Task irrelevant cognitive activities such as worry take up space in working memory and hence produce decrements in the quality of performance. The degree of the decrement will depend on the demands placed on working memory by the task-irrelevant information (e.g., worry).

This view is similar to that of Craik and colleagues. He proposed that memory performance is the result of an interaction between external and internal factors. The external factors include the amount of environmental support provided by the encoding and retrieval situations (e.g., the availability of prior knowledge that might foster rich

encoding) and by the form of the task. The major internal factor is the processing resources a person has available for memory. Hasher and Zacks (1979) propose that older adults have less processing resources such as attention and working memory. Older adults are less able to complete resource demanding memory tasks than younger adults. Therefore older adults may be much more susceptible than younger adults to task irrelevant cognitive activities such as worry take up space in working memory and hence produce decrements in the quality of performance.

On the other hand, Eysenck proposed that highly anxious individuals will attempt to compensate for decrements in performance and limits in working memory space by increasing their effort expenditure. Kahneman (1973) argued that the amount of effort we expend on a task depends on the individual's evaluation of the task demands, the more demanding the task is perceived to be the more effort that will be expended. Since anxious individuals must process both task-irrelevant and task-relevant information, it follows that the task demands for anxious individuals are greater than for those who are not anxious. Therefore anxiety leads to a greater allocation of resources to effort. Kahneman also noted that as the processing demands increase the discrepancy between the supply of effort and task demands will grow. Therefore the increased effort by highly anxious individuals will only partially compensate for the greater processing demands on working memory by task irrelevant information.

In summary, Eysenck suggests that anxiety activates two competing processes. First, worry will impair memory performance because it preempts some of the available space in working memory. On the other hand, the increased task demands cause an increase in effort, which enhances performance by increasing attentional capacity.

The Yerkes-Dodson Law

The Yerkes-Dodson Law (1908) describes the relationship between performance efficacy, arousal level, and task difficulty. The first assertion is that there is a curvilinear relationship between arousal and performance, with the optimal levels of performance being associated with intermediate levels of arousal. The second assertion is that the optimal level of arousal varies inversely with the level of task difficulty. Therefore arousal (and perhaps anxiety) will interact with task difficulty.

One problem with the Yerkes-Dodson theory is that the concept of task difficulty is ill defined (Eysenck, 1982). Human memory, in particular retrieval, has been studied experimentally using several memory tasks including free recall, cued recall, and recognition (Craik, 1983). Retrieval is initiated by presentation of cues, self-generation of cues (as in free recall), or by stimuli encoded in normal perception (Craik, Naveh-Benjamin, Govoni, & Anderson, 1996). When we try to remember something some attentional resources are necessary to maintain a retrieval mode in the cognitive system. Additional resource demanding operations are also likely to be necessary because often the retrieval information presented by itself is inadequate to invoke recollection. These additional resources are most likely to be required in free recall, then cued recall, and least likely in recognition (Craik, Naveh-Benjamin, Govoni, & Anderson, 1996). In addition, Craik (1983) suggested that free recall is more likely to involve conscious operations (remembering to remember in the absence of cues) than recognition. Craik et al. (1996) found that, as the paradigm shifts from recognition to free recall, divided attention is associated with a drop in memory performance. Hence, based on these

findings, there is evidence that task difficulty decreases as the paradigm shifts from free recall through cued recall to recognition. Craik (1986) found that age differences in memory performance are smallest on recognition tasks and largest on free recall tasks. Furthermore, Craik and McDowd (1987) found that the resource demands of a free recall task as compared to a recognition task were differentially greater in older adults. Performance on a secondary task showed that recall was associated with greater resource costs than was recognition and this effect was amplified by age. These studies lend support for assuming that older adults have reduced memory resources and hence it is possible that older adults may find all types of memory tasks more difficult. It is possible that, although it has been establish that recognition tends to place lower demands on working memory in younger adults, this may not be the case in older adults. Since the optimal level of arousal should vary inversely with the level of task difficulty, it is important to determine if recognition is in fact an "easy task" for older adults.

It should also be noted that Yerkes and Dodson did not propose an explanation for the interaction between arousal level and task difficulty. However, using Eysenck's model it is possible to assume that difficult processing tasks make greater demands on working memory than easy tasks. Since more anxious individuals have less available working memory resources it is logical that the detrimental effects of anxiety will be more pronounced on difficult tasks such as free recall than on simpler tasks like cued recall and recognition. Furthermore, since anxiety restricts working memory capacity it will also tend to reduce the extensiveness of elaboration and encoding which also requires available working memory capacity (Mueller, 1979). Therefore, it would also be expected that anxiety will affect strategy use.

A Review of Studies of Anxiety on Memory Performance in the Elderly

A number of studies have examined the effects of anxiety on younger adults' memory performance (see Eysenck, 1982; and Hockey, 1986, for reviews). The effects are not uniform but instead depend on factors such as the type of anxiety and the difficulty of the task performed. In general, decrements in performance have been associated more consistently with high state anxiety than high trait anxiety (Hockey, 1986; Hodges & Durham, 1972). However, the effects of both types of anxiety interact with task difficulty, with the effects of anxiety generally being greater for harder tasks (Eysenck, 1982). There have been few investigations on how older adult's affective processes affect their cognitive performance (Fisk, 1996, Salzman & Lebowitz, 1991). In addition, those studies that do exist have been plagued with inconsistent and contradictory findings (Davidson, Dixon, & Hultsh, 1991). A review of the literature examining the effects of anxiety in the elderly follows.

There have been several studies of the relationship between state anxiety and memory performance in older adults however; the results have been inconsistent. Koenders et al. (1993) studied the relation of state anxiety and memory performance in 35 older adults with memory dysfunction. They found that state-anxiety appeared not to be associated with memory performance or with severity of dementia. Koenders and colleagues suggested that further study is required to ascertain whether the associations reported are specific for anxiety and differ from those of other emotional states such as depression.

Fisk (1996) also examined the influence of state anxiety and arousal on learning and memory tasks in younger and older adults; he found that arousal level was negatively related to learning performance. However, individual differences in anxiety had no effect on learning. It is notable however, that Fisk developed the scales that were used in this study. Waldstein et al. (1997) also found that self-reported levels of anxiety did not predict performance on measure of attention, learning, memory, mental flexibility, and eye hand coordination in young and middle aged men.

On the other hand, Hill and Vandervoort (1992) examined the relationship between state anxiety and free recall performance in 74 elderly community dwelling adults who completed a memory-training program. They found that state anxiety was negatively associated with recall performance but was not related to amount of time spent studying. Rankin and colleagues also examined the influence of state anxiety on memory performance in older adults (Rankin, Gilner, Gfeller, & Katz, 1994). Twenty community dwelling elderly (10 high in state anxiety and 10 low in state anxiety) were administered the logical memory, visual reproduction, and digit span subtests of the Weschler Memory Scale-Revised (WMS-R). There was a significant difference between the two groups on digits forward but not digits backward or the other memory tests. They suggested that anxiety may have an adverse effect on sustained attention, which may not be evident on verbal or figural memory tests.

Ross (1968) contrasted old and young subjects on a series of verbal paired-associate tasks. The tasks were proceeded by one of three instructional conditions: supportive, neutral, or challenging. Overall, older adults took longer to master the learning task than did their younger counterparts. It was postulated that the anxiety or

stress associated with the challenging instructions interfered with the older subjects performance but this was not the case for younger participants. However the relationship between anxiety and performance was difficult to determine because the participants reported their level of anxiety during the task anecdotally.

The relationship between MMPI-2 measures of depression, anxiety, and psychotic thinking and attention span (digit span), verbal list learning, and memory test performance (Wechsler Memory Scale- Revised) was examined in 48 male patients with closed head injuries and in 80 males from a psychiatric inpatient sample (Gass, 1996). In both samples anxiety as measured by the MMPI-2 significantly predicted attention span and memory but was not predictive of learning. MMPI-2 scores correlated with factor scores derived from the Logical Memory and Visual Reproduction subtests of the WMS-R. It is possible that MMPI-2 measures are associated with cognitive inefficiency secondary to intrusive thoughts, preoccupation, distractibility, or anxiety over possible failure. Other cognitive tasks, such as list learning (which involves repeated trials), may be less vulnerable to adverse cognitive effects of emotional distress and other psychological systems.

Jonker, Smits, and Deeg (1997) found that anxiety subscale of the Metamemory in Adulthood Questionnaire (MIA) predicted immediate, delayed, and prospective memory test performance in older adults; higher levels of anxiety leading to decrements in performance. There is some agreement that the self-efficacy dimension of the MIA, which measures self-perceived memory capacity, predicts memory performance (Hertzog, Dixon, & Hultsch, 1990; Cavanugh & Poon, 1989). However, Jonker and colleagues suggested that anxiety during testing is more important to memory functioning

than the self-efficacy dimension of the MIA. Davidson, Dixon and Hultsch (1991) reported that neither memory anxiety, or anxiety about one's own memory abilities, as measured by the MIA or state anxiety had an impact on memory performance in participants under sixty-nine years of age. However, they reported that anxiety did have a disruptive effect on memory performance as measured by free recall tasks in the elderly (those over sixty-nine years of age). On the other hand, earlier studies examining anxiety found that the Achievement and Anxiety subscale of the MIA was not a predictor of performance on memory tests (e.g., Cavanaugh & Poon, 1989; Hertzog, Dixon, & Hultsch, 1990). Neither was there a significant relationship between memory-related anxiety as measured by the MIA Anxiety subscales and actual performance (Dixon & Hultsch, 1983). Dixon, Hertzog, and Hultsch (1986) explained the absence of a relationship in these studies by suggesting that MIA Anxiety subscales are related to state anxiety levels and that the elderly individuals who are concerned about their memory ability, experience greater state anxiety in anticipation of, or during, an actual memory-demanding situation regardless of their performance. Cavanaugh and Murphy (1986) also suggested that not all measures of anxiety are equally powerful.

Cockburn and Smith (1994) examined the effect of anxiety on prospective memory in older adults and found that the type of errors made is differentially related to low and high anxiety and to age. Cockburn suggests that errors can occur because of failure during encoding, either of intention, resulting in there being no record of the activity that should be performed or because of failure at the retrieval stage. In the prospective memory tasks used in this study, the Rivermead Behavioral Memory Test, the participant attempts successively to encode and store the instructions, activate the

intention to respond when the appropriate context appears, retrieve an appropriate response and execute the correct response. More incorrect responses were found for individuals high and low in anxiety than for those at intermediate levels, suggesting that performance is curvilinear function of anxiety, similar to those they would be expected based on Eysenck's model (see above). It was argued that anxiety activates a checking procedure and corrects erroneous responses (so more anxious individuals are less likely to ask for the wrong item). However, maintaining an effective monitoring system via increased anxiety has its costs, and these are manifested in reduced working memory capacity. This leads to blocks in the system (failures of retrieval of previously stored information-- e.g. subjects needing to be prompted). Errors of asking for the wrong item, or making no response will be associated with low anxiety; errors failing to make a correct response until prompted, or knowing one had to ask for something without recalling what it is, will tend to be associated with high anxiety.

Trait Anxiety

Most studies have found decrements in memory span with state anxiety (Mandler, 1979), but the results are somewhat more inconsistent for trait anxiety (Eysenck, 1979). State and trait anxiety are separate but related constructs. Differences in trait anxiety do not invariably translated into differences in state anxiety, hence it is not surprising that the results have been inconsistent for trait anxiety (Eysenck, 1979). Since state anxiety and trait anxiety are not always related to one another, and individuals who are high in trait anxiety do not experience increases in state anxiety in all situations, an interesting question is how these two types of anxiety interact to produce changes in performance. Trait anxiety refers to enduring anxiety levels. In this way trait anxiety can be viewed as

a chronic stress.

One possibility is that increased levels of trait anxiety can heighten the effects of state anxiety and hence increase the detrimental effects of anxiety on working memory capacity. Trait anxiety may lead to hyperarousal to environmental demands (e.g., memory demanding tasks) and a decreased capacity to adjust to the demand (Fleming, Baum, Davidson, Rectanus, & McArdle, 1987). It has been found that when the psychological demands on the body are chronic, like those of trait anxiety, the body will respond with a persistently high level of arousal (McEwen & Stellar, 1993). This continuous arousal may lead to an underlying pathological state. For example, Lepore, Miles, and Levy (1997) found that when college students reported experiencing high levels of chronic stresses as compared to low levels of chronic stress they experienced exaggerated physiological responses to acute challenges, slower recovery from acute challenges, elevated psychological distress, and reported more illness. If the hyperarousal theory holds true we would expect individuals who have high levels of trait anxiety to experience exaggerated detriments from state anxiety during memory testing.

On the other hand it has been proposed that exposure to previous or chronic stress may have a beneficial effect (H. Eysenck, 1983). The inoculation theory proposes that exposure to a chronic stress (trait anxiety) increases our resistance to subsequent challenges. Individuals can experience direct tolerance, in which exposure to one stressor reduces subsequent impact of the same stress or they can experience cross-tolerance where exposure to one type of stress reduces the impact of another stress on performance. For example, Norris and Murrell (1988) examined the impact of floods on older adult's level of anxiety and distress. They reported that older adults who had previously

experienced flood disasters did not experience an increase in anxiety or distress as a result of subsequent flood disasters whereas the opposite was true for older adults without prior experience with flood disasters. If the inoculation hypothesis holds true we would expect older adults who experience high levels of trait anxiety to be protected from the detrimental effects of state anxiety during memory testing.

To our knowledge there has been very little research that has examined the effects of trait anxiety on memory performance. Koenders et al. (1993) studied the relation of state and trait anxiety on memory performance in 35 older adults with memory dysfunction. They found that state-anxiety appeared not to be associated with memory performance or with severity of dementia; however, trait-anxiety was positively associated with memory performance but negatively associated with the severity of dementia. This is one of the only studies to examine the influence of trait anxiety on memory performance in older adults.

Sorg and Whitney (1992) reported that traditionally, short-term memory capacity have been assessed with word span or digit span tests. The authors suggest that perhaps we should look at Baddeley and Hitch's working memory model where information is manipulated in addition to being just stored. Sorg and Witney wished to examine how working memory capacity is affected by trait anxiety and determine how situational stress interacts with trait anxiety in producing changes in working memory capacity in 30 college students. They predicted that the combined effects of high trait anxiety and situational stress would reduce memory performance. The high anxiety subjects performed significantly worse under the stress than the no stress condition and the high anxiety subjects performed significantly better than low anxiety subjects under the non-

stress condition. In general, their data conform with the curvilinear function often obtained when performance is plotted against arousal (Easterbrook, 1959; Eysenck, 1982; Yerkes & Dodson, 1908). High trait anxiety subjects suffer from lower working memory capacity when placed under additional stress. This study lends support to the theory that trait anxiety may lead to hyperarousal to environmental demands (e.g., memory demanding tasks) and a decreased capacity to perform well.

There seems to be clear evidence that anxiety affects cognitive performance at least in younger adults, but it seems unclear as to how and to what extent. This study examined how both state and trait anxiety affect memory performance in older adults. It further examined how state and trait anxiety interact to produce changes in memory performance. Using multiple measures of anxiety and memory tasks of differing complexities also afforded us the opportunity to test Eysenck's model of anxiety in older adults. An understanding of the influence of affect on cognitive performance is essential because diagnosis and treatment decisions are in part based upon the amount and intensity of elders' affective complaints (Zarit, 1980).

Memory Complaints

An understanding of memory complaints is also essential because diagnosis and treatment decisions are in part based upon the amount and intensity of elders' memory complaints (Zarit, 1980). Fifty to eighty percent of older adults have subjective memory complaints (Lowenthal, Berkman, Buehler, Pierce, Robbinson and Trier, 1967). However, most empirical work has also demonstrated that memory complaints are not directly related to memory performance (Kahn, Zarit, Hilbert & Niederehe, 1975;

Rosavage, 1990; Zelinski, Gilewski, & Schaie, 1993, Popkin, Gallagher, Thompson & Moore, 1982; Bolla, Lindgren, Bonaccorsy, et al., 1991). The proposed diagnostic criteria for Age Related Cognitive Decline are dependent upon the presence of subjective complaints in addition to memory impairment. The variable relationship between memory complaints and objective performance has caused some to question this criterion (Caine, 1993).

Previous studies suggested that depression is an important component of memory complaints among elderly adults (Kahn, Zarit, Hilbert & Niederehe, 1975; Popkin, Gallagher, Thompson & Moore, 1982; Dartigues, Mazaux. Dequae, Letenneur, Giroire, Barberger-Gateau, 1994; Poitrenaud, Malbezin & Guez, 1989, Levy-Cushman & Abeles, 1998). However, the influence of anxiety on memory complaints is not well studied in older adults (Salzman & Lebowitz, 1991).

Cavanaugh and Poon (1989) examined the relationship between metamemory (beliefs about one's memory ability) and memory performance. The anxiety measure of the Metamemory in Adulthood Questionnaire (MIA) correlated with the Short Inventory of Memory Experiences for younger adults but not for older adults. However the anxiety scale of the MIA specifically measures anxiety about memory performance and not general anxiety.

McDougall (1994) examined the effects of depression, health status, self efficacy, and demographic variables on metamemory of older adults. Metamemory was measured using the Metamemory in Adulthood Questionnaire which is a measure of memory components of knowledge, beliefs, and affect and is composed of seven subscales. McDougall reported that there was no relationship between the seven metamemory

subscales and age. However, memory efficacy, both level and strength, were significantly correlated with anxiety. Memory efficacy is an individual's judgment about how well they can organize and execute a course of memory actions required to deal with prospective and unpredictable situations. Memory efficacy provides a mechanism to understand an individual's influence over their motivation and their own behavior.

Hultsch, Hertzog and Dixon (1987) found that older adults tend to report less memory capacity, more decline in memory functioning, and believe they have less control over their memory ability than young adults. They also reported that women show greater anxiety about their memory in memory demanding situations. However, there did not appear to be an age effect on level of anxiety. Thus the findings with these samples were inconclusive.

The present study will examine the effect of anxiety on memory complaints in a sample of able elderly. Anxiety will be measured using the State Trait Anxiety Inventory (STAI, Spielberger, Gorsuch & Lushene, 1970) and the Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990) and memory complaints will be measured using the Memory Assessment Clinics Self-Rating Scale (MAC-S, Revised, Winterling, Crook, Salama & Grobert, 1986).

In summary, the first aim of this study was to differentiate the symptoms of anxiety and depression in community dwelling older adults. There seems to be clear evidence that anxiety affects cognitive performance at least in younger adults but it is unclear as to how and to what extent. This study investigated the effect of anxiety on memory performance in community dwelling elderly adults. Furthermore, the effects of

anxiety on memory performance at different levels of task complexity was examined (e.g., free recall, cued recall, and recognition). In addition, this study investigated how anxiety influences strategy use on memory tasks. The effects of both state and trait anxiety on memory performance in older adults were studied. How state and trait anxiety interacted to produce changes in memory performance was examined. Finally, the present study examined the effect of anxiety on memory complaints in a sample of able elderly.

Hypotheses

1. Symptoms of depression and symptoms of anxiety were expected to emerge as two separate constructs in community dwelling elderly.

Scores on the Beck Depression Inventory (BDI; Beck et al., 1961) and the Geriatric Depression Scale (GDS; Yesavage, Brink, Rose et al., 1983) would be highly correlated. Scores on the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch & Lushene, 1970) and the Penn State Worry Questionnaire (PSWQ, Meyer, Miller, Metzger, & Borkovec, 1990) would be highly correlated. Correlations between the depression and anxiety measures would be significantly weaker. Further items on the BDI and GDS were expected load on one construct (depression) whereas items from the STAI and PSWQ will load onto a second factor (anxiety).

2. There would be a differential relationship of memory performance as a function of level of anxiety, with the optimal levels of performance being associated with intermediate levels of state anxiety.

Specifically, a differential relationship was expected to appear when examining

the relationship between scores on the State-Trait Anxiety Inventory - State (STAI, Spielberger, Gorsuch & Lushene, 1970) and memory performance as determined by scores on the California Verbal Learning Test (CVLT, Delis, Kramer, Kaplan & Ober, 1987).

3. There would be a differential relationship of memory performance as a function of level of state anxiety at different levels of task complexity.

Optimal performance will occur on a task of low complexity (the recognition trial of the CVLT) whereas state anxiety will hinder performance on more complex tasks (free recall trial and cued recall trial of the CVLT).

4. It was expected that state anxiety would influence strategy use, we expect optimal levels of strategy use being associated with intermediate levels of state anxiety.

Specifically, a differential relationship was expected to appear when examining the relationship between scores on the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch & Lushene, 1970) and strategy use as determined by score on the California Verbal Learning Test semantic and serial cluster ratio scores (CVLT, Delis, Kramer, Kaplan & Ober, 1987).

5. Trait anxiety and state anxiety were expected to interact to predict memory performance.

Specifically, we expected individuals who experience state anxiety, as measured by the STAI-S at the time of testing and who have high levels of trait anxiety, as

measured by the STAI-T and worry as measured by the Penn State Worry Questionnaire, to experience exaggerated effects of anxiety on memory performance.

6. Anxiety was expected to be positively correlated with memory complaints.

Scores on the State Trait Anxiety Inventory and the Penn State Worry Questionnaire were expected to be negatively correlated with scores on the Memory Assessment Clinics, Inc. Self Rating Scale (MAC-S; Revised, Winterling, Crook, Salama and Grobert, 1986) (low scores on the MAC-S represent more memory complaints).

METHOD

Participants

The participants were a subset of community dwelling elderly recruited through advertisement and through letters sent to retired faculty and staff of MSU for the ongoing Michigan State University (MSU) Psychological Clinic Aging Research Project. Each individual was offered two assessments of their mood and memory, as well as a seven-session workshop designed to teach relaxation and cognitive strategies for the relief of memory difficulties. Individuals were tested just prior to participation in the workshop (pre-test) and just after completing the workshop (post-test). This study only used data collected during the pre-test assessment. The sample consisted of 47 participants who ranged from 56 to 87 years of age ($\underline{M}$ = 71.47; $\underline{SD}$ = 8.33). Of the 47 participants all were Caucasian but one; and 19 were male and 28 were female. They had a mean education level of 15.17 years ($\underline{SD}$ = 3.02). Adults with significant health problems were excluded from the sample. Overall this sample exhibited very low levels of depression: scores on the Beck Depression Inventory ranged from 0 to 19 ($\underline{M}$ = 5.73) and scores on the Geriatric Depression Scale ranged from 0 to 16 ($\underline{M}$ = 4.93). Levels of trait and state anxiety were much more variable. State anxiety scores as measured by the STAI-S ranged from 20 (5th percentile) to 50 (99th percentile) ($\underline{M}$ = 31.38, 48th percentile). Trait anxiety as measured by the STAI-T ranged from 20 (3rd percentile) to 61 (100th percentile) ($\underline{M}$ = 33.15, 53rd percentile). The trait of worry as measured by the Penn State Worry Questionnaire (PSWQ) ranged from 17 to 65 ($\underline{M}$ = 35.30). Individuals with

severe depression as determined by scores of 30 or higher on the BDI or 20 or higher on the GDS were referred elsewhere for treatment.

Pilot Participants

To determine if the anxiety instructions impacted the participant self-reported levels of state anxiety, the instructions were first tested on a sample that consisted of 15 undergraduate students form Michigan State University. These students, who were completing Introduction to Psychology (Psych 101) ranging from 18 to 24 years of age (M = 19.60; SD = 1.72). Three were male and 12 were female. They had a mean education of 13.5 years (SD = 1.4). Overall, this sample exhibited very low levels of depression: scores on the Beck Depression Inventory ranged from 0 to 8 (M = 3.1). State anxiety as measured by the STAI-S ranged from 20 (2nd percentile) to 43 (77th percentile) (M = 29.13, 33rd percentile). Trait anxiety as measured by the STAI-T ranged from 22 (3rd percentile) to 48 (100th percentile) (M = 31.93, 37th percentile).

Procedure

Forty-seven participants were tested individually. After obtaining informed consent the experimenter administered the Mini-Mental Status Exam (MMSE, Folstein, Folstein, & McHugh, 1975). The participant then completed the State Trait Anxiety Inventory-State subscale (STAI-S, Spielberger, Gorsuch & Lushene, 1970) to obtain an estimate of each participant's baseline level of state anxiety. The participants then completed a non-interfering task which took approximately 10 minutes.

Half the subjects were randomly assigned to the relaxation-anxiety condition. In this condition participants received the relaxation instructions before the first half of the California Verbal Learning Test (CVLT) and then received the anxiety instructions

before beginning the second half of the CVLT. The other half were assigned to the anxiety-relaxation condition. In this condition participants received the anxiety instructions before the first half of the California Verbal Learning Test (CVLT) and then received the relaxation instructions before beginning the second half of the CVLT. The instructions were counterbalanced using a within-subjects design. The experimenter then administered the first manipulation instructions. The participants in the relaxation-anxiety heard the following relaxation instructions:

> This exercise is just for practice. We are trying to determine if this measure works, so just do you best.

Those individuals in the anxiety-relaxation heard the following anxiety instructions:

> This exercise is very important and gives us an accurate indication of your memory functioning, so do your best.

All participants then completed half (ten) of the items on the STAI-S. The STAI-S has respectable internal consistency with older adults (STAI-S $\underline{\alpha}$ =.85). Hence, by administering half of the items on the scale we should be able to generate a score approximately equivalent to administering the full scale. This also helped avoid practice effects. The administration of the items on the STAI-S were counterbalanced with half of the participants in both conditions (relaxation-anxiety and anxiety-relaxation) completing the first ten items of the STAI-S and the other half of the participants completing the last ten items of the STAI-S. Participants then completed the first half of the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan & Ober, 1987). This included all parts before the twenty-minute delay, with particular importance to this study, the short delay free recall trial, and the short delay cued recall trial. At this time there was a twenty

minute delay in the CVLT during which a series of non-interfering tasks were administered.

After the delay the experimenter administered the second anxiety manipulation. Those subjects who were in the relaxation-anxiety condition now received the anxiety instructions (see above), whereas those participants in the anxiety-relaxation condition now received the relaxation instructions (see above). All participants then received ten items of the STAI-S. Participants who received the first ten items of the STAI-S after the first anxiety manipulation now received the second ten items, whereas those who completed the second ten items during the first manipulation now completed then first ten items. Then all participants then completed the second half of the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan & Ober, 1987). This includes all parts after the twenty-minute delay including the long delay free recall trial, the long delay cued recall trial, and the recognition trial.

At the completion of testing the participants were asked to complete a self-report packet. This packet was usually taken home by the participants and returned a few days later in the interest of time. This packet contained questions about demographic information, the Beck Depression Inventory (Beck et al., 1961), the Geriatric Depression Scale (Yesavage, Brink, Rose et al., 1983), the Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), the State Trait Anxiety Inventory-Trait subscale (STAI-T, Spielberger, Gorsuch & Lushene, 1970), and the Memory Assessment Clinics Self-Rating Scale (MAC-S, Revised, Winterling, Crook, Salama & Grobert, 1986).

The administration of the instruments took approximately two hours.

Pilot Study

The anxiety manipulation that was used in this study was first pilot tested on fifteen college students from Michigan State University. The same procedure as above was used, except the college students were not be asked to complete the self-report packet. The order of the manipulation was counterbalanced as above.

Measures

a. Beck Depression Inventory (BDI; Beck et al., 1961) Including items addressing mood, sense of pessimism and guilt, social withdrawal, sleep disturbances, loss of energy, and weight and appetite, this 21-item 4-point scale addresses the intensity of depressive symptoms. Beck et al. (1961) reported high internal consistency (r = .93). Good test-retest reliability has also been reported (r = .74) after a three month interval (Miller & Seligman, 1973). Studies with the elderly show that the BDI has respectable internal consistency and stability for use in research with this population (Spitzer, Endicott, & Robins, 1978). It has a high detection rate for major and minor depressive disorders, with a misclassification rate of approximately 16-17% using customary BDI cutoff scores (Gallagher, Nies, & Thompson, 1982; Gallagher, Breckenridge, Steinmetz & Thompson, 1983). It seems to be a useful instrument for identification of depressed elderly.

b. Geriatric Depression Scale (GDS; Yesavage, Brink, Rose et al., 1983)- The GDS consists of 30 yes-no items. Designed specifically for use with older patients, this instrument surveys mood quite extensively with additional items to assess cognitive complaints and social behavior. Yesavage et al. (1983) suggested that the GDS is a reliable measure. Test-retest reliability was calculated by having subjects complete the questionnaire twice, one week apart. A correlation of .85 was obtained (p <.001).

Convergent validity was found between the GDS, the Zung Self-Rating Scale of Depression (r = .86), and the Hamiliton Rating Scale for Depression (r = .83). Furthermore, the GDS appeared to have respectable internal consistency (r = .94) and stability for use with the elderly. According to Yesavage et al. (1993), this scale is especially suitable for detecting depression in the elderly because it avoids classification errors due to poor physical health.

c. Penn State Worry Questionnaire (PSWQ, Meyer, Miller, Metzger, & Borkovec, 1990) The PSWQ was developed to measure the trait of worry that evaluates a) typical tendency of the individual to worry b) the excessiveness or intensity of worry experience and c) the tendency to worry in general without restricting the topic to one or a small number of situations. This scale consists of 16 items all rated on a 5-point Likert scale, ranging from "not at all typical of me" to "very typical of me." Meyer et al., 1990 found good convergent validity with the STAI-Trait, r(389) = .64, this was substantially higher than with STAI-State, r(395) = .49 or with the BDI r(154) = .36. Meyer et al. (1990) also reported substantial test-retest stability r = 92, P < .001. In another study the PSWQ was found to be stable over periods of two weeks, r(56) = .75, P < .001, and 4 weeks, r(52) = .74, P <.001 in college students (Meyer et al., 1990). Furthermore, the PSWQ appeared to have respectable internal consistency (α = .95). Beck, Stanley, and Zebb (1995) investigated the psychometric properties of the PSWQ in older adults with Generalized Anxiety Disorder (n = 47, mean age = 67.9) and normal controls (n = 94, mean age = 67.5). The PSWQ appeared to have good internal consistency in both of these groups (control α = .803, GAD α = .803). Adequate convergent validity was also demonstrated; in the control sample the PSWQ correlated significantly with the STAI-S (.56), the STAI-

T (.38), and the BDI (.45). Beck et al. (1995) stated that the PSWQ displayed adequate psychometric properties with older adults and suggested that further use of this scale with geropsychology population is justified.

d. State Trait Anxiety Inventory (STAI, Spielberger, Gorsuch & Lushene, 1970)- an anxiety measure which contains a state scale which assesses transient feelings of anxiety and a trait scale which assesses more enduring anxiety levels. Stanley, Beck and Zebb (1996) reported substantial test-retest stability (.62 state, .84 trait, $P < .001$). Furthermore, the STAI appears to have respectable internal consistency with older adults (STAI-T α = .79, STAI-S α =.85). Support exists for the use of this questionnaire with older adults (Himmelfarb & Murrell, 1983; Patternson, Sullivan, and Spielberger, 1980). The State Trait Anxiety Inventory for Children also has been shown to be a reliable and valid instrument to use with older adults; with regard to internal consistency the alpha coefficient was determined to be 0.86 (Rankin, Gfeller & Gilner, 1993). The STAI-C is similar to the adult version except the directions are more specific and each item only has three choice alternatives as opposed to the original STAI which provides four-choice alternatives.

e. California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan & Ober, 1987)- The CVLT is a learning task which assesses verbal learning and memory and requires learning lists of words presented in successive trials. The CVLT was designed to go beyond traditional memory tests, and quantify additional indices such as the encoding strategy used (semantic versus serial clustering), the types of errors made, vulnerability of memory to time and interference conditions, and the degree to which memory performance improves with the aid of cues. The normative sample found test-retest

reliability to be .59, good internal consistency ($\underline{\alpha}$ = .74), and split half reliability as 0.63. Rosenbaum (1984) reported that the CVLT is a very sensitive indicator of subtle memory deficits. Over a one year interval Rosenbaum reported the test-retest reliability to range from .26 (percent middle recall) to .79 (long-delay cued recall). Delis, Kramer, Kaplan, & Ober (1987) found that the total immediate recall of list A across the five trials correlated highly ($\underline{r}$ = .66) with the WMS-R General Memory Index as well as with other WMS-R variables.

e. Memory Assessment Clinics Self-Rating Scale (MAC-S, Revised, Winterling, Crook, Salama & Grobert, 1986)- Designed to assess subjective memory complaints this questionnaire contains 21 Ability items and 24 Frequency of Occurrence of memory problems items. All rated on a 5-point Likert scale, ranging from very good to very poor. Crook and Larrabee (1990) factor analyzed the performance of 1,106 subjects for a normative sample of adults ranging from 18- 92 years. West, Crook, and Larrabee (1991) showed concurrent validity of this scale. Five Ability factors were identified and labeled Remote Personal Memory, Numeric Recall, Everyday Task Oriented Memory, Word Recall/ Semantic Memory, and Spatial and Topographic Memory. On the Frequency scale, five scales were also identified, and these were labeled Word and Fact Recall, Attention and Concentration, Everyday Task-Oriented Memory, General Forgetfulness, and Facial Recognition. Crook and Larrabee (1991) reported substantial test-retest stability across 3-week intervals Ability Total $\underline{r}$ = .88 - . 94, Frequency Total $\underline{r}$ = .89 - .92).

f. The Mini-Mental Status Exam (MMSE, Folstein, Folstein, & McHugh, 1975) is a 30-item test created to briefly screen for cognitive functioning. It assesses orientation,

immediate recall, attention, calculation, language abilities, and constructional dyspraxia. Scores range from 0, indicating severe impairment to 30, indicating unimpaired mental status. It was standardized on a sample of healthy older adults ($\underline{M}$ = 74 years) whose scores ranges from 24.6 to 27.6 (Folstein, Folstein, & McHugh, 1975). Demented persons scored between 9.6 and 12.2, with no overlap between these two groups. A cut-off score of 24 is often used to identify scores suggestive of impairment (Lezak, 1995).

RESULTS

Pilot Study

The effect of manipulation on anxiety

The effects of the manipulation instructions on anxiety were examined separately for each treatment order. Undergraduate participants in Order 1 heard the anxiety instruction first followed by the relaxation instruction. Participants in Order 2 heard the relaxation instructions first followed by the anxiety instructions.

Order 1 (anxiety instructions followed by relaxation instructions)

A one-way repeated measures ANOVA was conducted with the factor being instructions (anxiety vs. relaxation) and the dependent variable being state anxiety. The mean state anxiety score (measured using 10-items from the STAI-S) after hearing the anxiety instructions was 13.5. The mean state anxiety score after hearing the relaxation instructions was 13.6. This difference was not significant (Wilks' lambda = .993, (F 1,7) = .052, $p < .83$).

Order 2 (relaxation instructions followed by anxiety instructions)

A one-way repeated measures ANOVA was conducted with the factor being instructions (anxiety vs. relaxation) and the dependent variable being state anxiety. The mean state anxiety score (on a 10-item form of the STAI-S) after hearing the relaxation instructions was 13.9. The mean anxiety score after hearing the anxiety instructions was 14.0. This difference was not significant (Wilks' lambda = .992, (F 1,6) = .045, $p < .84$).

Anxiety level measured by a 10-item form of the STAI-S immediately after the

first manipulation (time 1) did not correlate significantly (r = .061) with the level of manipulation administered (level = anxiety vs. relaxation). Anxiety level as measured by a 10-item form of the STAI-S immediately after the second manipulation (time 2) also did not correlate significantly (r = .062) with the level of manipulation administered.

These results suggest that hearing the anxiety instructions did not increase the undergraduate participants' level of anxiety. However, it was expected that the older adults would be more sensitive to these instructions. Older adults participating in this study had responded to advertisements looking for individuals who have concerns about their memory. Therefore, they were expected to have significantly more anxiety about their memory performance than would undergraduates completing requirements for their Psychology 101 class. In an effort to insure a greater impact of the manipulation of anxiety level in the older adult participants, the relaxation manipulation instructions were altered slightly. The pilot participants heard the following relaxation instructions:

> "This exercise is just for practice. We are trying to determine if this measure works, so just do you best."

Our research team felt that the last statement "so do your best," might be the most salient piece of the instructions and might promote anxiety. In view of this the relaxation instructions for the older participants were changed to read:

"This exercise is just for practice. We are just trying to determine if this measure works."

The anxiety instructions for the older participants were not changed.

Hypothesis I

It was predicted that symptoms of depression and symptoms of anxiety would emerge as two separate constructs in community dwelling elderly. Scores on the Beck Depression Inventory (BDI; Beck et al., 1961) and the Geriatric Depression Scale (GDS; Yesavage, Brink, Rose et al., 1983) were expected to be highly correlated. Scores on the State-Trait Anxiety Inventory (STAI, Spielberger, Gorsuch & Lushene, 1970) and the Penn State Worry Questionnaire (PSWQ, Meyer, Miller, Metzger, & Borkovec, 1990) were expected to be highly correlated. Correlations between the depression and anxiety measures were expected to be weaker. This hypothesis was partially confirmed.

The BDI total score correlated significantly with the GDS total score ($r = .793$, $p < .01$), indicating that the two measures of depression used in this study were correlated. Total scores on STAI-S (state anxiety) and STAI-T (trait anxiety) were significantly correlated ($r = .430$, $p < .01$). The STAI-S total score correlated significantly with the PSWQ total score ($r = .392$, $p < .01$), and the STAI-T correlated with the PSWQ total score ($r = .482$, $p < .01$). These findings indicated that all measures of anxiety used in this study were significantly correlated with one another.

Depression as measured by the BDI total score and the GDS total score did not significantly correlate with state anxiety as measured by the STAI-S total score. However, depression was found to be significantly correlated with trait anxiety as measured by both the STAI-T and the trait of worry as measured by the PSWQ. Depression correlated with trait anxiety as measured by the STAI-T total score (BDI $r = .342$, $p < .05$; GDS $r = .387$, $p < .01$) and worry as measured by the PSWQ total score

(BDI $r = .411$, $p < .01$; GDS $r = .458$, $p < .01$). See Table 1 for a summary of the correlations between anxiety and depression.

Further, it was predicted that items from the BDI and GDS would load on one construct (depression) whereas items from the STAI and PSWQ would load onto a second distinct factor (anxiety). It was impossible to run a principle components factor analysis using all items from the BDI, GDS, STAI, PSWQ because many of the items, in particular items from the BDI and GDS, had no variance. For this reason the total scores for the GDS, BDI, STAI-S, STAI-T, and PSWQ were entered into a principle components factor analysis with Varimax rotation. The rotated solution, as shown in Table 2, yielded two interpretable factors. As predicted the GDS and the BDI loaded highly onto factor 1 (depression) but not factor 2 (anxiety). The STAI-S, STAI-T and the PSWQ loaded heavily onto factor 2 (anxiety) but not factor 1 (depression).

The effects of the manipulation instructions

Recall that before the participants completed the memory task they heard the manipulation instructions. The instructions were given in an effort to increase anxiety (anxiety instructions) or decrease anxiety (relaxation instructions) before the participants completed the memory tasks. After the first manipulation instructions (relaxation or anxiety) were presented, participants completed a 10-item version of the STAI-S and the CVLT short delay free and cued recall tasks. For convenience of reference this period will be referred to as Time 1. After the second manipulation instructions (anxiety or relaxation) were presented, participants completed a 10-item version of the STAI-S, the CLVT long delay free and cued recall tasks, and the CVLT recognition task. For

convenience of reference this period will be referred to as Time 2.

The effects of manipulations on anxiety

A Latin Square design of order 2 was used to examine the effects of the manipulation instruction on anxiety. In this design the SS and df for any one of the three factors (here Order, Time, and Manipulation) are algebraically (and thus numerically, up to rounding and truncation error) identical with the SS and df for the interaction of the other two factors. The results of this analysis indicated a significant effect of the manipulation instructions on state anxiety F (1, 45) = 4.69, p = .036.

Repeated-measures analysis of variance were also performed separately within Order 1 and within Order 2. The independent variable for each analysis was type of instruction (anxiety versus relaxation). The three dependant variables, each measured at Times 1 and 2, were STAI-S state anxiety and CVLT free and cued recall performance scores. Participants in Order 1 heard the anxiety instruction first followed by the relaxation instruction. Participants in Order 2 heard the relaxation instructions first followed by the anxiety instructions.

Order 1 (anxiety instructions followed by relaxation instructions)

A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being state anxiety. The mean state anxiety score for the anxiety condition was 19.0. The mean anxiety score for the relaxation condition was 18.1. The results of the ANOVA (Wilks' lambda = .952, F = 1.16 (1, 23), $p < .29$) indicated there was not a significant effect of the manipulation (relaxation vs. anxiety) on state anxiety when the anxiety instructions were administered first followed by the relaxation

instructions. Notably, however, directions of the differences are consistent with the view that participants were more anxious after the anxiety instructions than after the relaxation instructions.

Order 2 (relaxation instructions followed by anxiety instructions)

A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being state anxiety. The mean state anxiety score after hearing the relaxation instructions was 15.8. The mean state anxiety score after hearing the anxiety instructions was 17.1. The results of the ANOVA indicated a significant effect of the manipulation instructions on state anxiety when the relaxation instructions were administered first followed by the anxiety instructions, Wilks' lambda = .841, $\underline{F}$ (1, 22) = 5.04, $\underline{p}$ = .035.

Correlations between the manipulations and anxiety

Anxiety measured immediately following the first manipulation correlated significantly with the level of manipulation administered (level = anxiety vs. relax) ($\underline{r}$ = -.313, $\underline{p}$ < .03), suggesting that hearing the manipulation instructions increased the participants level of anxiety at time 1. However, the manipulation did not significantly correlate with state anxiety at time 2.

Comparisons between anxiety at Time 1 and Time 2

A paired samples t-test was conducted to evaluate whether there was a difference between anxiety measured by a 10-item version of the STAI-S after the first manipulation instructions and anxiety measured by a 10-item version of the STAI-S after the second manipulation instructions, overall. The results indicated that anxiety after the first

manipulation instructions (M = 17.4, SD = 5.12) was not significantly different than anxiety after the second manipulation instructions (M = 17.6, SD = 4.80), t (46) = -.37, p = .72. The mean difference between anxiety measured after the first manipulation instructions and anxiety measured after the second manipulation instructions was -.19.

The effect of manipulation on memory performance

A Latin Square design of order 2 was used to examine the effects of the manipulation instruction on free recall memory performance. The results of this analysis indicated a near significant effect of the manipulation instructions on free recall memory performance F (1, 43) = 3.65, p = .063.

Order 1 (anxiety instructions followed by relaxation instructions)

The effect of the manipulation instruction on memory performance was also examined seperately for each order. A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being free recall memory performance. The mean free recall performance after hearing the anxiety instructions was 8.1 words. The mean free recall performance after hearing the relaxation instructions was 8.8 words. The results of the ANOVA indicated a significant effect, Wilks' lambda = .841, F (1, 22) = 4.160, p = .054.

A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being cued recall memory performance. The mean cued recall memory performance after hearing the anxiety instruction was 9.6 words. The mean cued recall performance after hearing the relaxation instructions was 9.4 words. The results of

the ANOVA indicated the manipulation instructions did not have a significant effect on cued recall memory performance when the anxiety instructions were administered first followed by the relaxation instructions.

Order 2 (relaxation instructions followed by anxiety instructions)

A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being free recall memory performance. The mean free recall performance after hearing the relaxation instruction was 8.1 words. The mean free recall memory performance after hearing the anxiety instructions was 7.9 words. The results of the ANOVA did not indicate a significant effect of the manipulation instructions on free recall memory performance when the relaxation instructions were administered first followed by the anxiety instructions. Notably, this pattern is the same as in the previous order: individuals who heard the relaxation instructions outperformed individuals who heard the anxiety instructions.

A one-way repeated measures ANOVA was conducted with the repeated-measures factor being manipulation instructions (anxiety vs. relaxation) and the dependent variable being cued recall memory performance. The mean cued recall memory performance after hearing the anxiety instructions was 8.9 words. The mean cued recall memory performance after hearing the relaxation instructions was 8.9 words.

Recognition memory performance

Recognition memory performance was measured only at Time 2 and therefore we could not analyze this data using repeated measures ANOVA. The recognition (hits) performance after hearing the relaxation instruction was 13.7 words. The mean

recognition (hits) performance after hearing the anxiety instructions was 12.9 words. Notably, this pattern suggests that individuals who heard the relaxation instructions outperformed individuals who heard the anxiety instructions. See Table 3 for a summary of CVLT performance means by order and condition.

Hypotheses II & III

It was expected that there would be a differential relationship of memory performance as a function of level of anxiety, with the optimal levels of performance being associated with intermediate levels of state anxiety. Specifically, it was predicted that this relationship would appear when examining the relationship between state anxiety as measured by scores on the State-Trait Anxiety Inventory (STAI) and memory performance as determined by scores on the California Verbal Learning Test (CVLT).

Further, it was predicted that the relationship between state anxiety and memory performance would vary as a function of task complexity. It was thought that optimal performance would occur on tasks of low complexity (the recognition trial of the CVLT) whereas state anxiety would hinder performance on more complex tasks (e.g., cued recall trial and the free recall trial of the CVLT).

Comparisons between short delay free recall and long delay free recall

First it was important to determine if there was an effect of time on memory performance. To do this a paired samples t-test was conducted to evaluate whether there was a difference in short delay free recall memory performance and long delay free recall memory performance, overall. The results indicated that mean short delay free recall ($M = 8.09$, $SD = 2.82$) was not significantly different than the mean long delay free recall

memory performance (M = 8.36, SD = 2.88), t (44) = -1.13, p = .266. The mean difference between short delay free recall and long delay free recall was .27 out of a possible score of 16 on both measures.

Comparisons between task complexity

Since the optimal level of arousal should vary inversely with the level of task difficulty, it was first important to determine if the three memory tasks used in this study actually differed in level of difficulty for older adults. A series of paired samples t-tests were conducted to evaluate whether there was a difference between the three level of task difficulties: free recall, cued recall and recognition. The results indicated that each level of task complexity was significantly different from the other two with free recall being the most complex and recognition being the least complex. long delay free recall (M = 8.36, SD = 2.88) was significantly different than long delay cued recall (M = 9.13, SD = 2.58), t (44) = -3.69, p = .001. The mean difference between long delay free recall and long delay cued recall was -.78. Long delay free recall (M = 8.36, SD = 2.88) was significantly different than recognition hits (M = 13.33, SD = 2.21), t (44) = -10.80, p < .001. The mean difference between long delay free recall and long delay cued recall was -4.98. Long delay cued recall (M = 9.13, SD = 2.58) was significantly different than recognition hits (M = 13.33, SD = 2.21), t (44) = -10.12, p < .001. The mean difference between long delay free recall and long delay cued recall was -4.20.

Within-subjects analysis

A MANOVA was conducted to examine the within-subjects effects, with order of the manipulation instructions as a between subjects factor, time as a within subjects factor, anxiety as a within-subjects covariate and memory performance as the dependent

variable. There were no significant within-subjects effects for either free recall memory performance or cued recall memory performance. Since there were no within-subjects effects, we examined each time separately to look at the pattern of the between-subjects effects.

Between-subjects analysis

a. Free recall performance- The scatterplots for the relationship between state anxiety and free recall performance, as shown in figures 1 and 2, demonstrate that the predicted curvilinear relationship between these two variables did not occur. The scatterplots suggested a more linear relationship between anxiety and performance such that as state anxiety increases free recall memory performance decreases. Linear regression analyses were conducted to evaluate the relationship between anxiety and free recall performance. At Time 1 (after the first manipulation instructions) anxiety as measure by an abbreviated form of the STAI-S (10-items) did not correlate significantly with memory performance as measured by the CVLT short delay free recall trial (r = -.217). However, the negative correlation suggested that anxiety had a negative impact on free recall memory performance. State anxiety, as measured by an abbreviated version of the STAI-S, was not a significant predictor of memory performance as measured by the CVLT short delay free recall trial at the time of the first manipulation instuctions. Only about 5% of the total score variance in free recall memory performance was accounted for by its linear relationship with state anxiety (R^2 = .05).

At time 2 (after the second manipulation instructions) anxiety as measure by an abbreviated form of the STAI-S (10-items) was almost significantly correlated with memory performance as measured by the CVLT long delay free recall trial (r = -.27, p <

.07). Again, the negative correlation suggested that anxiety had a negative impact on free recall memory performance. State anxiety, as measured by an abbreviated version of the STAI-S, was almost a significant predictor of memory performance as measured by the CVLT long delay free recall at the time of the second manipulation. Approximately 11% of the variance in free recall memory performance was accounted for by its linear relationship with state anxiety ($R^2 = .107$, $p < .06$).

b. Cued recall performance- The scatterplots for the relationship between state anxiety and cued recall performance, as shown in figures 3 and 4, also demonstrates that the predicted curvilinear relationship between these two variables did not occur. The scatterplots suggested a more linear relationship between anxiety and cued recall performance such that as state anxiety increases cued recall memory performance decreases. A linear regression analyses were conducted to evaluate this relationship. At Time 1 anxiety as measure by an abbreviated for of the STAI-S (10-items) did not correlate significantly with memory performance as measured by the CVLT short delay cued recall trial ($r = -.11$). However, again the negative correlation suggests that anxiety is having a negative impact on cued recall performance. State anxiety, as measured by an abbreviated version of the STAI-S, was also not a significant predictor of memory performance as measured by the CVLT short delay cued recall trial at Time 1. Only about 5% of the total score variance in free recall memory performance was accounted for by its linear relationship with state anxiety ($R^2 = .046$).

At Time 2 anxiety as measured by an abbreviated form of the STAI-S (10-items) was not significantly correlated with memory performance as measured by the CVLT

delay cued recall (r = -.15). However, again the negative correlation suggests that anxiety had a negative impact on cued recall memory performance. State anxiety, as measured by an abbreviated version of the STAI-S, was also not a significant predictor of memory performance as measured by the CVLT long delay cued recall at the time of the second manipulation instructions. Only about 3% of the total score variance in free recall memory performance was accounted for by its linear relationship with state anxiety (R^2 = .032).

c. Recognition performance- The scatterplot for the relationship between state anxiety and recognition performance, as shown in figure 5, demonstrates that the predicted curvilinear relationship between these two variables did not occur. The scatterplot suggested a more linear relationship between anxiety and recognition memory performance such that as state anxiety increases recognition memory performance decreases. A linear regression analysis was conducted to evaluate the relationship between anxiety and recognition performance. Recognition performance was measured only after the second manipulation instructions. Anxiety as measure by an abbreviated form of the STAI-S (10-items) was not significantly correlated with memory performance as measured by the CVLT recognition hits (r = -.037). State anxiety, as measured by an abbreviated version of the STAI-S, was also not a significant predictor of recognition memory performance as measured by the CVLT recognition trial. Approximately 4 percent of the variance in recognition memory performance was accounted for by its linear relationship with state anxiety (R^2 = .039).

It is interesting to note that although the correlations between state anxiety and

memory performance are not statistically significant there is a consistent negative relationship between anxiety and performance. This suggests that state anxiety hinders memory performance. Notably, this negative effect is largest on the most complex task (free recall) and smallest on the least complex task (recognition). See Table 5 for a summary of the correlations between state anxiety and memory performance.

Hypothesis IV

It was expected that optimal strategy use would occur at intermediate levels of state anxiety. Specifically, a differential relationship was expected to appear when examining the relationship between scores on the State-Trait Anxiety Inventory-State (STAI-S) and strategy use as determined by the California Verbal Learning Test semantic and serial cluster ratios scores (CVLT).

The scatterplots for these two variables, as shown in figures 6 and 7, showed that the predicted curvilinear relationship between anxiety and strategy use did not occur. Linear regression analyses were conducted to evaluate if strategy use could be predicted from state anxiety level. The correlation between state anxiety (as measured by the STAI-S) and use of semantic cluster strategy use (as measured by the CVLT semantic cluster ratio) was 0.022. State anxiety did not explain any of the variance in semantic clustering strategy use. The correlation between state anxiety (as measured by the STAI-S) and serial cluster strategy use (as measure my the CVLT serial cluster ratio) was -.091. Less than 1 percent of the variance in serial cluster strategy use was accounted for by its linear relationship with state anxiety. Overall, level of state anxiety did not affect strategy use.

Hypothesis V

Trait anxiety and state anxiety were expected to interact to predict memory performance. Specifically, we expected individuals who experience state anxiety, as measured by the STAI-S at the time of testing and who have high levels of trait anxiety, as measured by the STAI-T and worry as measured by the Penn State Worry Questionnaire, to experience exaggerated effects of anxiety on memory performance.

First a linear regression analysis was conducted to evaluate if state anxiety could be predicted from trait anxiety. As expected, individuals with higher levels of trait anxiety tended to have higher levels of state anxiety at statistically significant levels. The correlation between state anxiety (as measured by the STAI-S) and trait anxiety (as measured by the STAI-T) was .55 ($p < .001$). The correlation between state anxiety (as measured by the STAI-S) and the trait of worry (as measured by the Penn State Worry Questionnaire) was .41 ($p < .006$). Approximately 31 percent of the variance in state anxiety was accounted for by its linear relationship with trait anxiety as measured by the STAI-T ($R^2 = .31$). Approximately 17 percent of the variance in state anxiety was accounted for by its linear relationship with the trait of worry as measured by the PSWQ ($R^2 = .17$).

Next a multiple linear regression analysis was conducted to evaluate if memory performance could be predicted from trait anxiety, the trait of worry, and state anxiety. Contrary to predictions the combined effects of state anxiety, trait anxiety, and worry were not significant predictors of memory performance. For correlations between anxiety and memory performance, see Table 5. Ten percent of the variance in memory performance, as measured by the CVLT short delay free recall, was accounted for by its

linear relationship with trait anxiety, worry, and state anxiety as measured by the STAI-T, PSWQ and the 10 items of the STAI-S measured immediately after the first manipulation instructions, respectively ($R^2 = .10$). Approximately 9 percent of the variance in memory performance, as measured by the CVLT long delay free recall, was accounted for by its linear relationship with trait anxiety, worry, and state anxiety as measured by the STAI-T, PSWQ and the 10 items STAI-S measured immediately after the second manipulation ($R^2 = .09$).

Multiple linear regression analyses were conducted to evaluate if memory performance could be predicted from trait anxiety, state anxiety, and the interaction between state and trait anxiety. Contrary to predictions the combined effects of state anxiety, trait anxiety, and the interaction of state and trait anxiety were not significant predictors of memory performance. Approximately 5 percent of the variance in memory performance, as measured by the CVLT short delay free recall ($R^2 = .05$), and 4 percent of the variance in memory performance, as measured by the CVLT long delay free recall ($R^2 = .04$), was accounted for by its linear relationship with trait anxiety, state anxiety and the interaction between state and trait anxiety.

A multiple linear regression analysis was conducted to evaluate if memory performance could be predicted from worry (as measured by the PSWQ), state anxiety, and the interaction between state anxiety and worry. Similarly, the combined effects of state anxiety, trait anxiety, and the interaction between state anxiety and worry were not significant predictors of memory performance. Approximately 4 percent of the variance in memory performance, as measured by the CVLT short delay free recall ($R^2 = .04$), and 2 percent of the variance in memory performance, as measured by the CVLT long delay

free recall (R^2 = .02), was accounted for by its linear relationship with worry, state anxiety and the interaction between state anxiety and worry.

Hypothesis VI

Anxiety was expected to be positively correlated with memory complaints. Specifically, it was predicted that scores on the State Trait Anxiety Inventory and the Penn State Worry Questionnaire would be negatively correlated with scores on the Memory Assessment Clinics, Inc. Self Rating Scale (MAC-S; Revised, Winterling, Crook, Salama and Grobert, 1986). Recall that low scores on the MAC-S represent more memory complaints. This hypothesis was only partially confirmed.

Worry as measured by the PSWQ and state anxiety as measured by the STAI-S did not correlate significantly with memory complaints as measured by the MAC-S the total score, the MAC-S ability subtotal or with the MAC-S frequency subtotal. However, trait anxiety as measured STAI-T total score correlated significantly with the MAC-S total score (r = -.411, p < .01) and the frequency of memory problems reported on the MAC-S frequency subtotal (r = -.43, p < .01) but did not correlated with the MAC-S ability subtotal. Trait anxiety as measured by the STAI-T also correlated significantly with many of the factors on the MAC-S including: global memory complaints, facial recall, forgetfulness, task memory, attention, and spatial memory.

DISCUSSION

Anxiety and depression are two of the most common problems facing older adults today. However, differentiating anxiety and depression at the mood, symptom, and syndromal levels has been a long-standing problem in psychopathology research (Nelson & Novy, 1997; Alexopoulos, 1991). In addition, older adults often seek advice and treatment for cognitive problems (La Rue, 1992). It is a commonly held belief that our affect influences our cognitive abilities. The cognitive sequelae of depression in the elderly have attracted great attention (LaRue, 1992); however, the influence of anxiety on cognitive performance and cognitive complaints is extremely understudied in older adults (Salzman & Lebowitz, 1991). Eysenck (1979) stated that anxiety clearly affects the amount of memory capacity available for task performance.

The objective of this study was to examine the effect of anxiety on memory performance in the able elderly. The first aim of this study was to differentiate the symptoms of anxiety and depression in community dwelling older adults. There seems to be clear evidence that anxiety affects cognitive performance at least in younger adults but it seems unclear as to how and to what extent. This study investigated the effect of anxiety on memory performance in community dwelling elderly adults. Furthermore, this study investigated the effects of anxiety on memory performance at different levels of task complexity (e.g., free recall, cued recall, and recognition). We were also able to examine if altering the instructions before the memory measures was administered (anxiety provoking vs. relaxation provoking) affected anxiety and memory performance. In addition, we examined the impact of anxiety on strategy use. The effects of both state

and trait anxiety on memory performance in older adults were also investigated. It was further examined how state and trait anxieties interact to produce changes in memory performance. Finally, the present study examined the effect of anxiety on memory complaints in a sample of able elderly.

The Relationship Between Anxiety and Depression

Symptoms of depression and anxiety are two of the most common problems reported in later life. However, differentiating depression from anxiety has been a long-standing problem. Understanding the relationship between these two conditions is of utmost importance because the co-presence of anxiety and depression has been found to increase the risk of suicide over the risk associated with depression alone (Clark et al., 1995). Increased rates of suicide have been reported when depression and anxiety co-occur and these increased rates have been found in many groups including the elderly (Kunik, 1993). Most research differentiating anxiety and depression to date has used clinical samples (Paykel, Rowan, Roa, & Bhat, 1982; Johnstone et al, 1980; Alexopoulos, 1991; Nelson & Novy, 1997). These samples are not representative of the population, and so the results might not be generalizable. Thus, it was important that we examined this relationship in normal healthy older adults. In addition, most research has tried to distinguish anxiety disorders from depression disorders. As mentioned previously, symptoms of anxiety and depression that do not meet the criteria for specific syndromes occur in much larger percentages of the population (Jeste et al., 1999). It was therefore also important to determine if anxiety could be distinguished from depression at the symptom level.

Participants in this study completed two measure of depression, the Beck Depression Inventory (Beck et al., 1961) and the Geriatric Depression Scale (Yesavage, Brink, Rose et al., 1983), and two measure of anxiety, the State Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970) and the Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990). It was predicted that symptoms of depression and symptoms of anxiety would emerge as two separate constructs in community dwelling elderly. This hypothesis was partially confirmed. State Anxiety as measured by the STAI-S did not correlate significant with either depression measure. However, trait anxiety as measure both the STAI-T and worry as measured by the Penn State Worry Questionnaire correlated significantly with depression. Depression correlated with trait anxiety as measured by the STAI-T total score (BDI $\underline{r} = .342$, $\underline{p} < .05$; GDS $\underline{r} = .387$, $\underline{p} < .01$) and with worry as measured by the PSWQ total score (BDI $\underline{r} = .411$, $\underline{p} < .01$; GDS $\underline{r} = .458$, $\underline{p} < .01$). Previous studies have found that mood and symptom measures of depression and anxiety correlate almost as highly between constructs as within constructs. After reviewing the literature Clark, Steer, and Beck (1994) concluded that self reported measure of depression and anxiety correlate on average between .62 - .70. Notably, previous research has been conducted largely on psychiatric patients and/or college students (e.g., Clark, Steer, & Beck, 1994). Hence the findings of this study suggest that the symptoms of depression and anxiety appear to be more distinguishable in older population than in the cohorts previously studied.

This study also examined if depression and anxiety would emerge as two separate factors when the items from all scales used were entered into a factor analysis. It was impossible to run a principle components factor analysis using all items from the BDI,

GDS, STAI, PSWQ because many of the items, in particular items from the BDI and GDS, had no variance. For this reason the total scores (GDS total score, BDI total score, STAI-S total score, STAI-T total score, PSWQ total score) from these scale were entered into a principle components factor analysis with Varimax rotation. From this analysis two factors emerged. As predicted the GDS and the BDI loaded highly onto factor 1 but not factor 2 and the STAI-S, STAI-T and the PSWQ loaded heavily onto factor 2.

Overall, this study seems to suggest that at the symptom level anxiety and depression have unique as well as shared characteristics and are "comorbid conditions." Feinstein originally coined the term comorbidity in 1970 to refer to "any distinct additional clinical entity that has existed or that may occur during the clinical course of a patient who has the index disease under study." Anxiety and depression are often referred to as comorbid syndromes, not only because they often co-occur but also because many of the symptoms that define these two disorders are shared. In meta-analysis Clark (1989) found that 57% of depressed patients met criteria for an anxiety disorder; other studies have found similar rates of comorbidity (e.g., Kessler et al., 1994). Anxiety and depression share expectations of hopelessness and negative affect. However, anxiety is associated with physiological hyperarousal whereas adhedonia is thought to uniquely define depression. Although, there seems to be substantial evidence that anxiety and depression have shared and unique characteristics the nature of the relation between these characteristics is unclear. Several three-factor models have been proposed to explain the relationship between anxiety and depression.

Alloy et al. (1990) proposed a model in which the interplay between hopelessness and helplessness is used to explain the differences and overlap between anxiety and

depression. They suggest that individuals who are uncertain about their ability to control important situations would experience pure anxiety. Individuals who are sure about their helplessness but uncertain that the negative outcome will occur experience a mixed syndrome. Individuals who are both sure about their helplessness and are sure that the negative outcome will occur (hopeless) experience a pure depression with despair, loss of interest, and suicidality. Hence, in this model depression and anxiety share expectations of helplessness but differ in expectations of hopelessness.

One of the most well validated three factor models is the tripartite model as proposed by Clark and Watson (1991). Recall that this model offers a bridge between the unitary negative affect theory and competing theories that highlight the differences between depression and anxiety. The tripartite model also suggests that depression and anxiety have common and unique features. Both anxiety and depression are characterized by elevated levels of negative affect that is characterized as a tendency to be distressed, worried, anxious, self-critical and to have a negative view of oneself. However, low levels of positive affect and a loss of interest in pleasure (anhedonia) are unique to depression whereas physiological hyperarousal (somatic anxiety) is unique to anxiety. Significant empirical support exists to support this model. In 1995 Watson and colleagues administered the Mood and Anxiety Questionnaire (MASQ) to five samples (three student, one adult, and one patient); three replicable dimensions matching those described by Watson and Clark in 1991 consistently emerged. Psychophysiological studies have offered further support to the tripartite model. The three symptoms groups display distinctive patterns of brain activity; (e.g., anxious arousal is linked to hyperactivation of the right parietotemporal region whereas low positive affect is associated with

hypoactivation of this same region (Mineka, Watson, & Clark, 1998)). Although there is an impressive array of evidence to support the tripartite model, one problem is that anxiety disorders are heterogenous and subsume a large variety of symptoms; a single factor such as anxious arousal does not seem to account for the diversity of symptoms subsumed by anxiety disorders.

Barlow and his colleagues (1996) proposed a three-factor hierarchical model to account for the broad array of symptoms seen in anxiety disorders. They suggest that anxious apprehension, which essentially represents the negative affect component of the tripartite model, represent the shared component (the higher order factor) of all anxiety disorders, as well as depressive disorders. In addition to the shared component, each anxiety disorder contains a specific characteristic that distinguishes it for the others.

Mineka, Watson and Clark (1998) suggest a comprehensive model that integrates Clark and Watson's (1991) tripartite model and Barlow's hierarchical model of anxiety disorders. In this model each syndrome has both common and unique components. The shared component is negative affect or general distress, which is common to both anxiety and mood disorders and is responsible for the overlap between these disorders. Each disorder also includes a unique component that distinguishes it from the other disorders. For example, anhedonia, disinterest, and absence of positive affect represent the unique components of depressive disorders. Anxious arousal is no longer considered a general characteristic of anxiety disorders, but rather it assumes a more limited role as a component of certain anxiety disorders. Mineka and colleagues propose that all of the anxiety disorders, with the possible exception of Generalized Anxiety Disorder contains a large amount of general distress variance and have their own unique component.

However, for the most part, they have not yet specified what these specific components are for each of the anxiety disorders.

This study seems to lend evidence for a three factor model of the relationship between depression and anxiety. The findings of this study suggest that there is a significant overlap between depression and trait anxiety but that state anxiety can be distinguished from depression. State anxiety refers to transient feelings of tension, apprehension, nervousness, worry, and activation or arousal of the autonomic nervous system. State anxiety seems to define what Clark and Watson (1991) considers the unique characteristics of anxiety or what or what Mineka and colleagues (1998) propose as the specific component of panic. Trait anxiety refers to more enduring anxiety levels, distress and anxiety proneness. Hence trait anxiety is more representative of negative affect, what Clark and Watson and colleagues refer to as the common factors of anxiety and depression.

The Manipulation

Again, recall that before the participants completed the memory task they heard the manipulation instructions. These instructions were given in an effort to increase anxiety (anxiety instructions) or decrease anxiety (relaxation instructions) before the participants completed the memory tasks. The instructions were counterbalanced using a within-subjects design (anxiety-relaxation vs. relaxation-anxiety). State anxiety measured immediately after hearing the anxiety instructions was significantly different than state anxiety measured immediately after hearing the relaxation instructions in the anxiety-relaxation group ($\underline{M}_{anxiety}$ = 19.0 vs. $\underline{M}_{relaxation}$ = 15.8). When the relaxation instruction

were read first (relaxation-anxiety group), state anxiety measured immediately after the hearing anxiety instructions was not statistically significantly different than when it was measured immediately after the relaxation instructions were read ($\underline{M}_{anxiety}$ = 18.1 vs. $\underline{M}_{relaxation}$ = 17.1). Notably, however, the pattern suggests that even in the relaxation-anxiety group, individuals were more anxious after hearing the anxiety instructions than after hearing the relaxation instructions. Overall, these results suggest that the manipulation instructions used in this study had an impact on the participant's levels of state anxiety such that hearing the anxiety instructions increased state anxiety.

The effects of the manipulation instructions on memory performance were also examined. When the anxiety instructions were read first (anxiety-relaxation group), free recall memory performance after hearing the anxiety instructions was significantly lower than free recall memory performance after hearing the relaxation instructions ($\underline{M}_{anxiety}$ = 8.1 vs. $\underline{M}_{relaxation}$ = 8.8). When the relaxation instruction was read first (relaxation-anxiety group), free recall memory performance after hearing the relaxation instructions was not statistically significantly different than free recall memory performance after hearing the anxiety instructions ($\underline{M}_{relaxation}$ = 8.1, $\underline{M}_{anxiety}$ = 7.9). Notably, the pattern is the same as above, the participants' free recall memory performance was better after hearing the relaxation instructions than after hearing the anxiety instructions. Overall, the instructions the participants heard (anxiety vs. relaxation) had an impact on their free recall memory performance such that hearing the anxiety instructions hindered memory performance. The impact of the manipulation instructions had a smaller impact on less complex tasks (cued recall and recognition).

It is very interesting that minor alterations in the instructions impacted both

anxiety levels and memory performance in older adults. Recall that Ross (1968) contrasted old and young subjects on a series of verbal paired-associate tasks. The tasks were proceeded by one of three instructional conditions: supportive, neutral, or challenging. Overall, older adults took longer to master the learning task than did their younger counterparts with effects being greatest when the task was proceeded by the challenging instructions. It was postulated that the anxiety or stress associated with the challenging instructions interfered with the older subjects performance but this was not the case for younger participants. It is possible that the anxiety provoking instructions used in this study had a similar affect to those observed by Ross and interfered with memory performance by increasing anxiety or perhaps evoking some other physiological or psychological process that hindered performance.

The Effects of State Anxiety on Memory Performance

Eysenck (1979) stated that anxiety clearly affects the amount of memory capacity available for task performance. However, the influence of anxiety on cognitive performance is extremely understudied in older adults (Salzman & Lebowitz, 1991). Several investigations have been conducted evaluating the relationship between anxiety and sustained attention and memory in younger adults but there is very little research of this type with older populations (Rankin, Gilner, Gfeller, J. D, Katz, 1994). It was therefore essential that we investigate the influence of anxiety on memory performance in older adults.

The Yerkes-Dodson Law (1908) describes the relationship between performance efficacy, arousal level, and task difficulty. The first part of the law states that there is a

curvilinear relationship between arousal and performance, with the optimal levels of performance being associated with intermediate levels of arousal. The second statement is that the optimal level of arousal varies inversely with the level of task difficulty. Therefore arousal (and perhaps anxiety) will interact with task difficulty. Eysenck suggested that anxiety activates two competing processes. First, worry will impair memory performance because it preempts some of the available space in working memory. On the other hand, the increased task demands cause an increase in effort, which enhances performance by increasing attentional capacity.

Based on the theories of Yerkes-Dodson and Eysenck it was predicted that a differential relationship of memory performance as a function of level of anxiety would appear, with the optimal levels of performance being associated with intermediate levels of state anxiety. Further, it was predicted that there would be a differential relationship of memory performance as a function of state anxiety at different levels of task complexity with optimal performance occurring on a task of low complexity (e.g., recognition). These hypotheses were not confirmed, there were no significant within-subjects effects of anxiety on memory performance. Furthermore, the predicted curvilinear relationship between anxiety and memory performance did not occur. The scatterplots suggested a more linear relationship between anxiety and performance such that as state anxiety increases memory performance decreases. Notably, the Yerkes-Dodson law suggests a curvilinear relationship between performance and arousal. It is difficult to know if the measures of anxiety used in this study are valid indicators of autonomic arousal in the way Yerkes-Dodson defined it. In fact, trait anxiety was reported to only generally correlate with blood pressure (Chesney et al., 1981). In addition, several studies with

older adults have failed to find a curvilinear relationship between anxiety and memory performance in older adults (e.g., Koenders et al., 1993; Fisk, 1996; Hill and Vandervoort, 1992).

It is interesting to note that, although the correlations between state anxiety and memory performance and the regression models were not significant, there was a consistent negative relationship between state anxiety and memory performance, suggesting that state anxiety hinders memory performance. Notably, this negative relationship was largest on the most complex task (free recall) and smallest on the least complex task (recognition). See table 2 for a summary of the correlations between state anxiety and performance.

One possible explanation for these results is that older adults have diminished efficiency of inhibitory processes compared to younger adults (Hasher & Zacks, 1988). On a variety of cognitive tasks (e.g., reading with distraction, negative priming, directed forgetting) Hasher, Zacks and colleagues (1988; Hasher, Zacks, & May, 1999) have shown that older adults are more affected by task irrelevant information; this provides evidence of a decreased inhibitory efficiency. Hasher, Zacks and colleagues have proposed that inhibitory processes are vital for working memory performance because they prevent access of goal irrelevant information to working memory, delete no longer relevant information from working memory, and restrain prominent responses from dominating working memory. If these inhibitory processes break down, working memory will become cluttered with information that is not relevant to the task at hand. Anxiety as measured in this study could have aspects that evoke thoughts that are not germane to the task, especially thoughts of worry about performance and cognitive deficits. It is possible

that older adults are less able to inhibit these thoughts, that may be triggered by state anxiety, compared to younger adults; thus they perform more poorly overall. This would be consistent with the negative correlations we observed between anxiety and performance. Anxiety may have different effects for older adults than for younger adults because the impairing aspects of anxiety will overwhelm any positive effects (e.g., increased effort).

Anxiety had the strongest correlation with free recall memory performance and the weakest correlation with recognition performance. Recall, that Craik (1986) found that age differences in memory performance are smallest on recognition tasks and largest on free recall tasks. Furthermore, Craik and McDowd (1987) found that the resource demands of a free recall task as compared to a recognition task were differentially greater in older adults. Performance on a secondary task showed that free recall was associated with greater resource costs than was recognition and this effect was amplified by age. Therefore, goal irrelevant thoughts are more likely to interfere with more complex tasks like free recall than simpler tasks such as recognition.

Salthouse (1988, 1990) offers another explanation for the declines in older adults memory performance. He attributes age-related changes in cognitive functioning to a reduction in the quantity of some essential processing resource. Processing resource deficits have been proposed in attentional capacity, working memory capacity, and speed of processing. Salthouse (1990) suggests that there are three key aspects to the process resources hypothesis for declines in cognitive functioning with age. The first assumption is that the resources are important determinant in age differences in cognition. The second key aspect is that the processing resources are assumed to enable or enhance

cognitive functioning. Finally, the resources are thought to be relevant to many types of cognitive tasks. In many ways, the notion of processing resources is similar to the concept of **g** in psychometric intelligence. Both **g** and processing resources were proposed to account for commonalties of performance in what appears to be distinct types of cognitive tasks. The processing resource interpretations of age differences in cognitive functioning have been investigated using:

a) Secondary task procedures to obtain estimates of the reserve processing capacity, or residual resources, available to adults of different ages

b) The examination of the relationship between hypothesized resource demands and task performance in different age groups

c) The use of statistical techniques to examine the effects of controlling an index of resource quality on the magnitude of age differences in cognitive performance.

Salthouse (1990) reported that at least some of age related differences in cognitive functioning could be attributed to a reduction in simultaneous storage and processing of information. While Salthouse does not address the impact of anxiety on storage and processing of information, it is certainly possible that reductions in storage and processing of information is impacted differentially as a consequence of anxiety.

Another possibility for the pattern of results found is that older adults may come into the study at a motivation level or an anxiety level that prevents any beneficial effect of anxiety from occurring. In other words, older adults may be performing at or near their maximum effort and thus anxiety only has a negative effect on their performance. Participants in this study were expected to be highly motivated because of the way they

were recruited and the instructions they were given at the outset of the study. Older adults that participated in this study were ones that responded to advertisements looking for those who have concerns about their memory. Therefore, these individuals could already be highly anxious about their memory performance, so any additional anxiety the testing situation or manipulation instructions induced would not have a positive effect on performance. Kahneman (1973) noted that as the processing demands increase the discrepancy between the supply of effort and task demands will grow. Therefore the increased effort by highly anxious individuals will only partially compensate for the greater processing demands on working memory by task irrelevant information. Thus, we would find the trend we observed with consistently negative correlations between anxiety and memory performance.

Anxiety has several components including feelings of distress, worry, apprehension, self-criticalness, having a negative self-view of oneself as well as physiological hyperarousal. Perhaps self reported measures of anxiety only tap into certain aspects of anxiety. Specifically, perhaps individuals are not good at self-reporting the physiological aspects of anxiety. Although the State-Trait Anxiety Inventory is highly face valid measure and has a high degree of internal consistency it may not be highly correlated with physiological measures of anxiety (e.g., blood pressure, heart rate, adrenaline level, and galvanic skin response). The State Trait Anxiety Inventory manual (Spielberger, Gorsuch & Lushene, 1983) does not provide validity data to suggest that this measure correlates with physiological measures of anxiety. In fact, trait anxiety was reported to only generally correlate with blood pressure and was found to have no systematic relationship with Type-A behavior (Chesney et al., 1981). It is possible that it

is the physiological hyperarousal that has the most significant impact on memory performance rather than feelings of worry and distress. In fact, the original Yerkes-Dodson law describes the relationship between performance efficacy and arousal level. If self-reported anxiety measures, such as the STAI, are not tapping into the physiological arousal component of anxiety we would not expect to observe the predicted curvilinear relationship suggested by Yerkes-Dodson. Future research should use both physiological and self-report measures of anxiety when investigating the relationship between anxiety and memory performance.

Strategy Use

Since state anxiety is believed to restrict working memory capacity it was thought that it would also reduce the extensiveness of elaboration and encoding of information because these processes require available working memory capacity (Mueller, 1979). Therefore, it was expected that anxiety would affect strategy use. It was predicted that optimal levels strategy use would occur at intermediate levels of state anxiety. This hypothesis was not confirmed; strategy use was not significantly correlated with state anxiety levels. It is thought that perhaps the strategies measured on the CVLT, serial strategy use, which involves learning the words in order, and semantic strategy use, which involves learning the words in groups (e.g., fruits), are overlearned. Since these strategies are fairly easy and have probably been used by the participants all their life, they may not require additional space in working memory and hence will not be subject to the effects of state anxiety.

Trait Anxiety

Previous studies have found decrements in memory span with state anxiety (Mandler, 1979), but the results are somewhat more inconsistent for trait anxiety (Eysenck, 1979). State and trait anxieties are separate but related constructs. Since state anxiety and trait anxiety are not always related to one another, and individuals who are high in trait anxiety do not experience increases in state anxiety in all situations, an interesting question is how these two types of anxiety interact to produce changes in memory performance. One possibility is that increased levels of trait anxiety can heighten the effects of state anxiety and hence increase the detrimental effects of anxiety on working memory capacity. Trait anxiety may lead to hyperarousal to environmental demands (e.g. memory demanding tasks) and a decreased capacity to adjust to the demand (Fleming, Baum, Davidson, Rectanus, & McArdle, 1987). On the other hand, it has been proposed that exposure to previous or chronic stress may have a beneficial effect (H. Eysenck, 1983). The inoculation theory proposes that exposure to a chronic stress increases our resistance to subsequent challenges.

This study allowed us to investigate the combined effects of state anxiety, worry and trait anxiety on performance. We expected trait anxiety and state anxiety to interact to predict memory performance. Specifically, we predicted that individuals who experience state anxiety, as measured by the STAI-S at the time of testing and who have high levels of trait anxiety, as measured by the STAI-T, to experience exaggerated effects of anxiety on memory performance. This study also allowed us to investigate the interaction between the trait of worry, as measured by the Penn State Worry Questionnaire, and state anxiety.

As expected individuals with higher levels of trait anxiety tended to have higher levels of state anxiety at statistically significant levels. Approximately 30 percent of the variance in state anxiety was accounted for by its linear relationship with trait anxiety as measured by the STAI-T. However, the combination trait anxiety, worry, and state anxiety did not significantly predict performance and only accounted for 10% of the variance in short delayed free recall and 9% of the variance in long delay free recall performance. Notably, the combined effect of trait anxiety, worry, and state anxiety did explain slightly more of the variance in short delay free recall performance than did state anxiety alone (10% vs. 6%).

Memory Complaints

A positive correlation between anxiety and memory complaints was hypothesized. Previous studies suggested that depression is an important component of memory complaints among elderly adults (Kahn, Zarit, Hilbert & Niederehe, 1975; Popkin, Gallagher, Thompson & Moore 1982; Dartigues, Mazaux. Dequae, Letenneur, Giroire, Barberger-Gateau, 1994; Poitrenaud, Malbezin & Guez, 1989). However, ther is insufficient research on the influence of anxiety on memory complaints in older adults (Salzman & Lebowitz, 1991). In addition, most of these studies examined clinical populations, such as individuals suffering from depression (Popkin, Gallagher, Thompson and Moore, 1982) or late onset dementia (Kahn, Zarit, Hilbert & Niederehe, 1975). There were some doubts that results of these studies should be generalized to the majority of older adults who are living independently in the community. For instance, it is thought that clinical patients tend to complain more about memory problems and that those with

dementia have inaccurate perceptions of their memory ability. It seemed important to examine the effect of anxiety on memory complaints in normal healthy older adults. Trait anxiety as measure by the STAI-T correlated significantly with memory complaints; however, state anxiety and worry (as measured by the PSWQ) did not correlate significantly memory complaints.

On shortcoming of this study is the timing for the administration of the measures. State anxiety (STAI-S) was measured at the time of testing. In the interest of time, measures of trait anxiety and worry (STAI-T and the PSWQ) and the memory complaints measure (MAC-S) were characteristically sent home with the participant and returned a few days later. State anxiety is an emotional reaction that exists in a given moment in times at a particular intensity. Spielberger, Gorsuch and Lushene (1983) reported that the STAI-S scale has been found to be a sensitive indicator of changes in transitory anxiety. For example, Spielberger, Gorsuch and Lushene (1970) found that the mean state anxiety scores were substantially higher for both men and women when they were asked to respond with how they "would feel just prior to the final examination in an important course" than when given the standard instructions. Since state anxiety is highly responsive to stress, it is unlikely that the participants level of state anxiety was the same while they were in their own home completing the memory complaints questionnaire as when they were completing the memory assessment. Given this consideration, this study does not provide the opportunity to make valid conclusion about the relationship between state anxiety and memory complaints. Future research examining the relationship between state anxiety and memory complaints should obtain a measure of both at the same time.

This study also found that the trait of worry as measured by the Penn State Worry Questionnaire (PSWQ) did not significantly correlate with memory complaints but that trait anxiety as measured by the State-Trait Anxiety Inventory was significantly correlated with memory complaints. One possible explanation for this is the type of items on these anxiety scales. The PSWQ was designed to identify chronic worriers who tend to worry in general without restricting the topic (Molina & Borkovec, 1994). Hence, the items tend to be very general (e.g., my worries overwhelm me, and I worry all the time). Whereas the State-Trait Anxiety Inventory trait scale addresses many of the symptoms of anxiety, and in particular, there is a heavy emphasis on the cognitive symptoms of anxiety (e.g., I have disturbing thoughts, it is easy for me to make decisions, and some unimportant thoughts run though my mind and it bothers me). It may be that the heavy loading of cognitive questions on the STAI-T leads to its strong correlation with memory complaints. In addition, the population sampled tended to have fairly low scores on the PSWQ ($\underline{M}$ = 35.3). Molina and Borkovec (1994) reported that the mean worry score in a sample of 1323 individuals who were not chosen on the basis of any criteria to be 47.65. This suggests that the cohort examined in this study tend to have very low levels of worry and may not be representative of the population at large. Therefore, it may be beneficial for future research to examine the relationship between worry and memory complaints in populations with more average levels of worry before ruling out the possibility that there is a relationship between these two variables.

Limitations of Study

Some limitations of this study should be noted. First, the population is somewhat

exceptional, and the generalizability of the results may be limited accordingly. Our participants were better educated than the national average and many were drawn from higher socioeconomic levels, and were generally in good physical health. These individuals also likely had access to high quality health care. Such factors could play in the role of preserving memory functioning and decreasing anxiety and depression. However, it could be argued that that this group actually provides a purer test of the relationship between anxiety and objective performance because the potential influences of low education, chronic health problems, and so forth were reduced.

Future Research

Himmelfarb and Murell (1984) reported that 17.1 % of males and 21.5 % of females experience symptoms of anxiety severe enough to warrant some form of therapeutic intervention (Himmelfarb & Murell, 1984). Prevalence rates of Age Related Cognitive Decline, a condition in which includes both memory dysfunction and subjective complaints, have been reported to be 34.9% and 55.8% in random samples of elderly adults (Lane & Snowdon, 1989; Reinikainen et al., 1990). Given the large prevalence rates of anxiety and memory problems in older adults it seems imperative that we continue to investigate these two conditions at both a symptom and syndromal level. It is a commonly held belief that our affect influences our cognitive abilities and the influence of anxiety on cognitive performance and cognitive complaints is extremely understudied in older adults (Salzman & Lebowitz, 1991). It is important to note that although anxiety was generally not a significant predictor of memory performance in this study, the pattern of results strongly suggests that anxiety has a deleterious effect on

memory performance particularly on more complex tasks. In addition, the findings suggest that anxiety invoking instructions hinders performance. There were only 47 participants in this study. Continuing this type of work is crucial because it is thought that these effects would reach statistical significance with a larger sample size. An understanding of how anxiety effects memory performance is essential because diagnosis and treatment decisions for dementia are in part based upon the presence of disturbed affect (Zarit, 1980).

As mentioned early it is difficult to know if self-report measure of anxiety tap into the physiological arousal component of anxiety. Therefore, future research should use both physiological and self-report measures of anxiety when investigating the relationship between anxiety and memory performance. It may also be possible to also use imaging data as a physiological measure of anxiety. Also, this study did not measure state anxiety and memory complaints at the same time. Since state anxiety is highly responsive to stress it is unlikely that the participants' level of state anxiety was the same while they were in their own home completing a self report packet questionnaires (including the memory complaints measure) as when they were completing the memory assessment. Future research examining the relationship between state anxiety and memory complaints should obtain a measure of both at the same time.

Table 1

Coorelations between anxiety and depression

	BDITOTAL	GDSTOTAL	STAI-S	STAI-T	PSWQ
BDI Total Score	1.000	.793**	.254	.342*	.411
GDS Total Score	.793**	1.000	.209	.387**	.458**
STAI-S	.254	.209	1.000	.430**	.392
STAI-T	.342*	.387**	.430**	1.000	.482**
PSWQ	.411**	.458**	.392**	.482**	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 2

Rotated Component Matrix- Factor Loadings for Depression and Anxiety Measures

	Component	
	Depression	Anxiety
BDI Total Score	.911	.182
GDS Total Score	.924	.192
STAI-S Total Score	7.894E-03	.845
STAI-T Total Score	.267	.759
PSWQ Total Score	.419	.654

Notes: Extraction Method: Principle Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 3

CVLT performance means by order and condition

		Condition	
		Anxiety	Relaxation
Order 1	Free recall	8.1	8.8
	Cued recall	9.6	9.4
Order 2	Free recall	7.9	8.1
	Cued recall	8.9	8.9
	Recognition*	12.91	13.74

Notes: Order 1 = anxiety instructions followed by relaxation instructions

Order 2 = relaxation instructions followed by anxiety instructions

* Recognition performance was measured only at Time 2 was subject only to condition (anxiety vs. relaxation) and not order

Figure 1

Relationship between state anxiety and free recall performance at the 1st manipulation

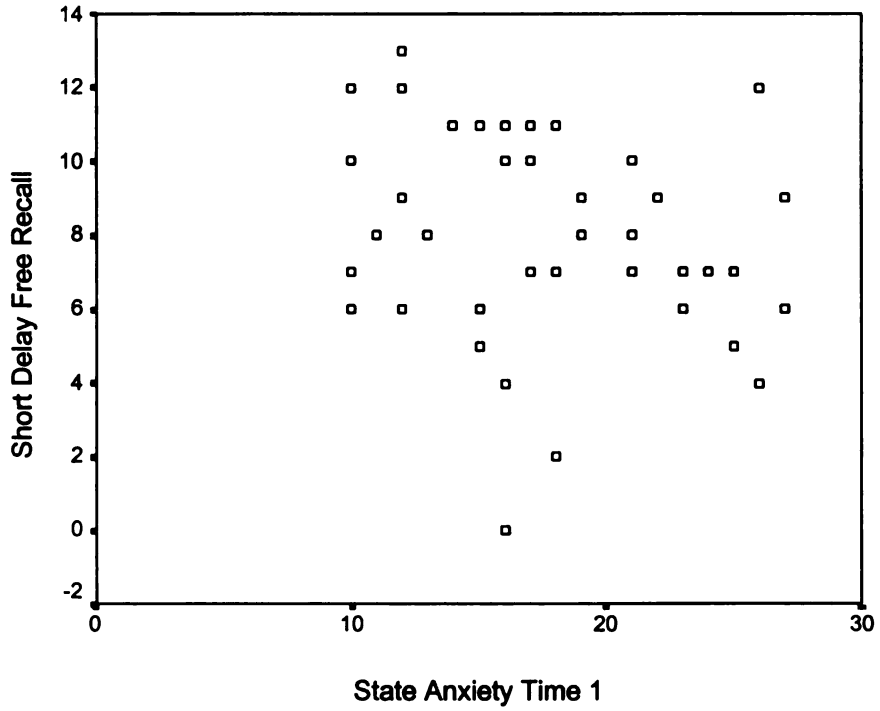

Figure 2

Relationship between state anxiety and free recall performance at the 2nd manipulation

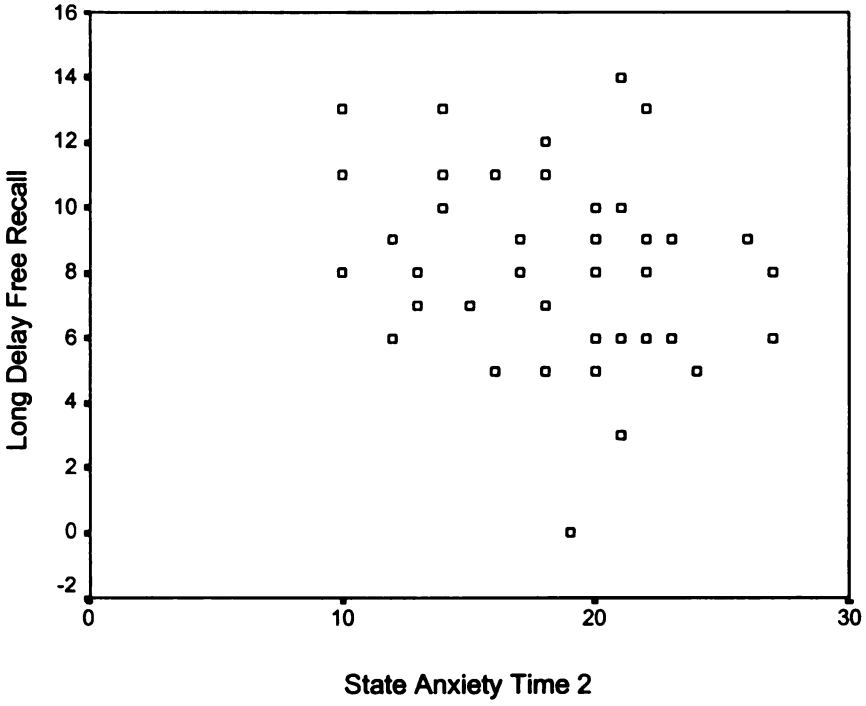

Figure 3

Relationship between state anxiety and cued recall performance at the 1st manipulation

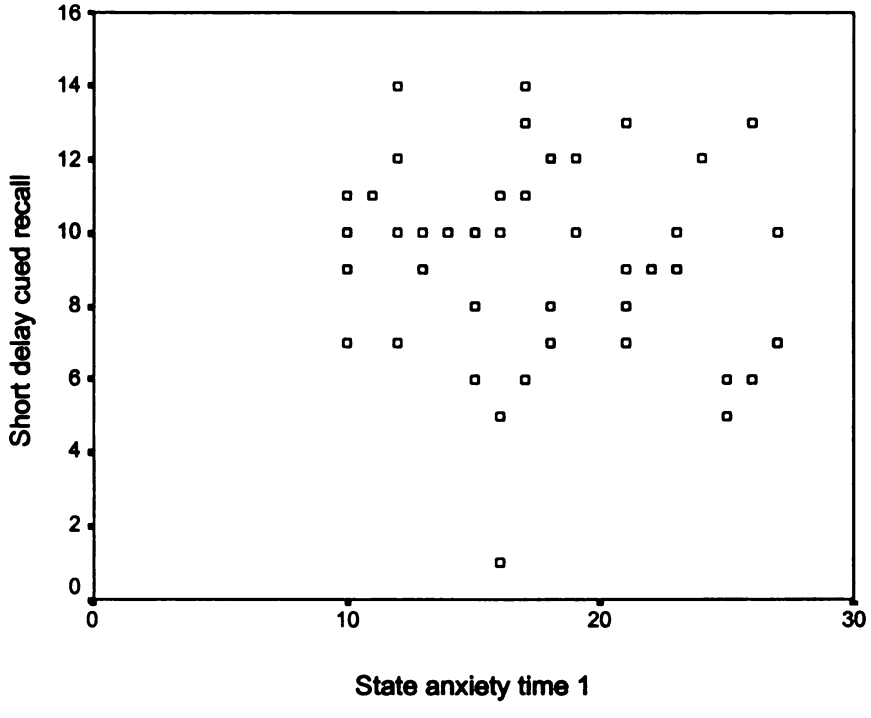

Figure 4

Relationship between state anxiety and cued recall performance at the 2nd manipulation

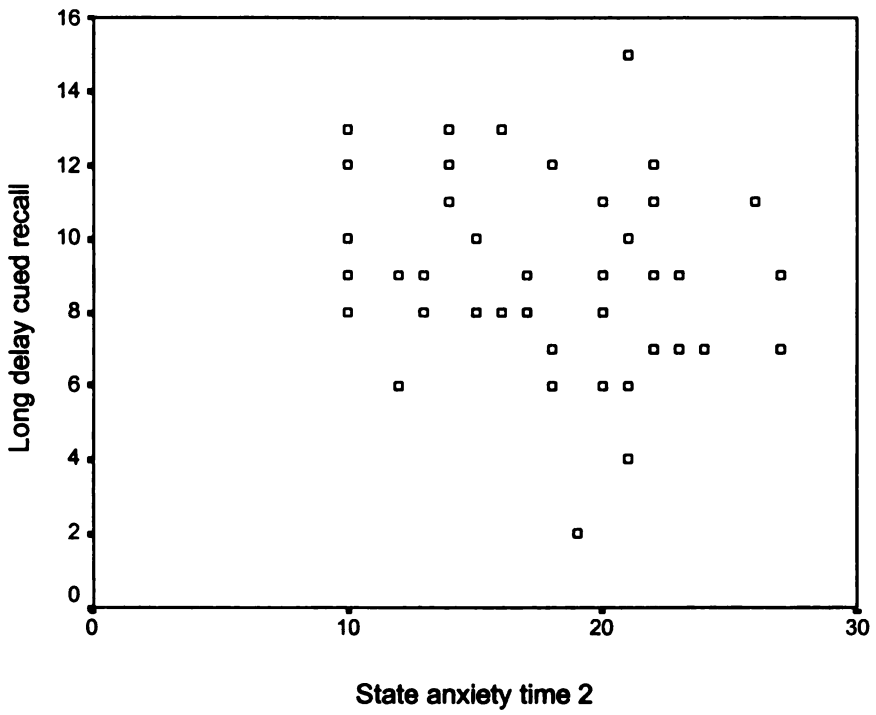

Figure 5

Relationship between state anxiety and recognition performance

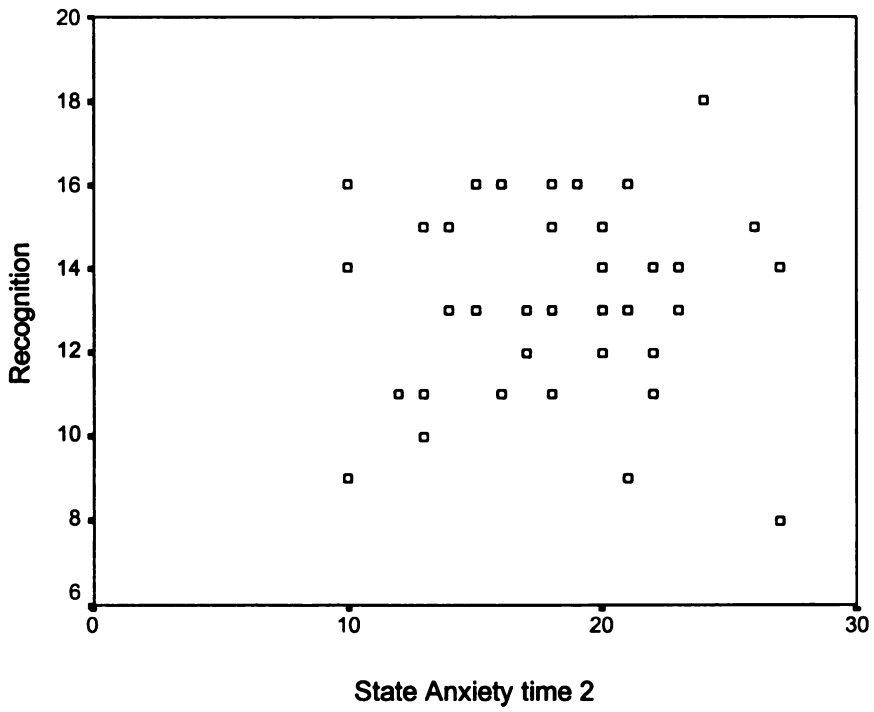

Table 4

Pearson Correlations Between Memory Performance and State Anxiety

	SDFR	SDCR	LDFR	LDCR	RH	M1	M2
Short Delay Free Recall (SDFR)	1.000	.830**	.845**	.792**	.240	-.217	-.295*
Short Delay Cued Recall (SDCR)	.830**	1.000	.831**	.847**	.264	-.111	-.203
Long Delay Free Recall (LDFR)	.845**	.831**	1.000	.872**	.282	-.124	-.265
Long Delay Cued Recall (LDCR)	.792**	.847**	.872**	1.000	.331*	-.078	-.146
Recognition Hits (RH)	.240	.264	.282	.331*	1.000	.105	-.037
Anxiety at manipulation 1 (M1)	-.217	-.111	-.124	-.078	.105	1.000	.741**
Anxiety at manipulation 2 (M2)	-.295*	-.203	-.265	-.146	-.037	.741**	1.000

Note. ** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Figure 6

Relationship between state anxiety and semantic cluster strategy use

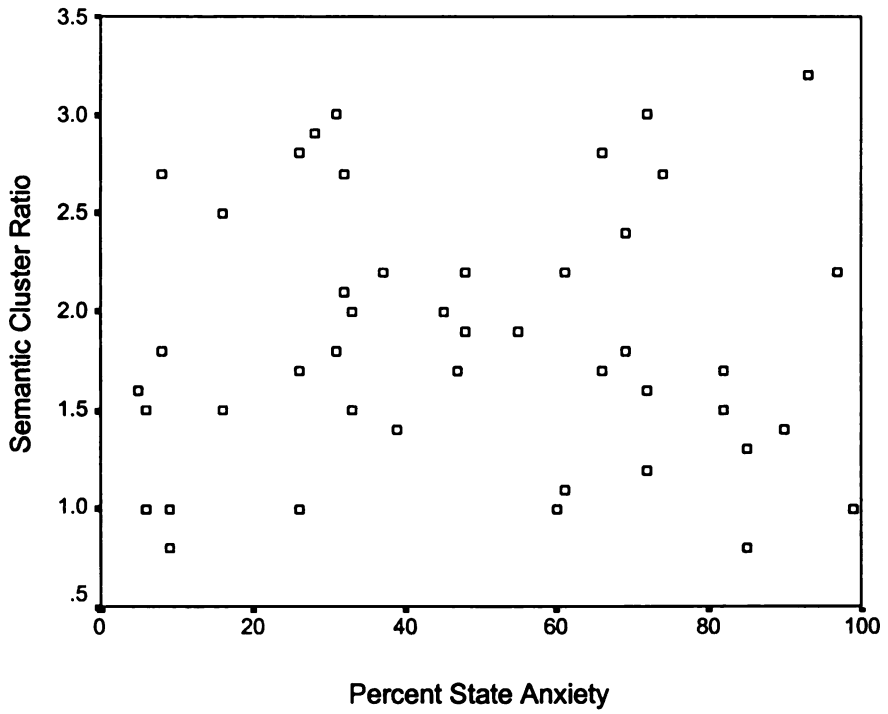

Figure 7

Relationship between state anxiety and serial cluster strategy use

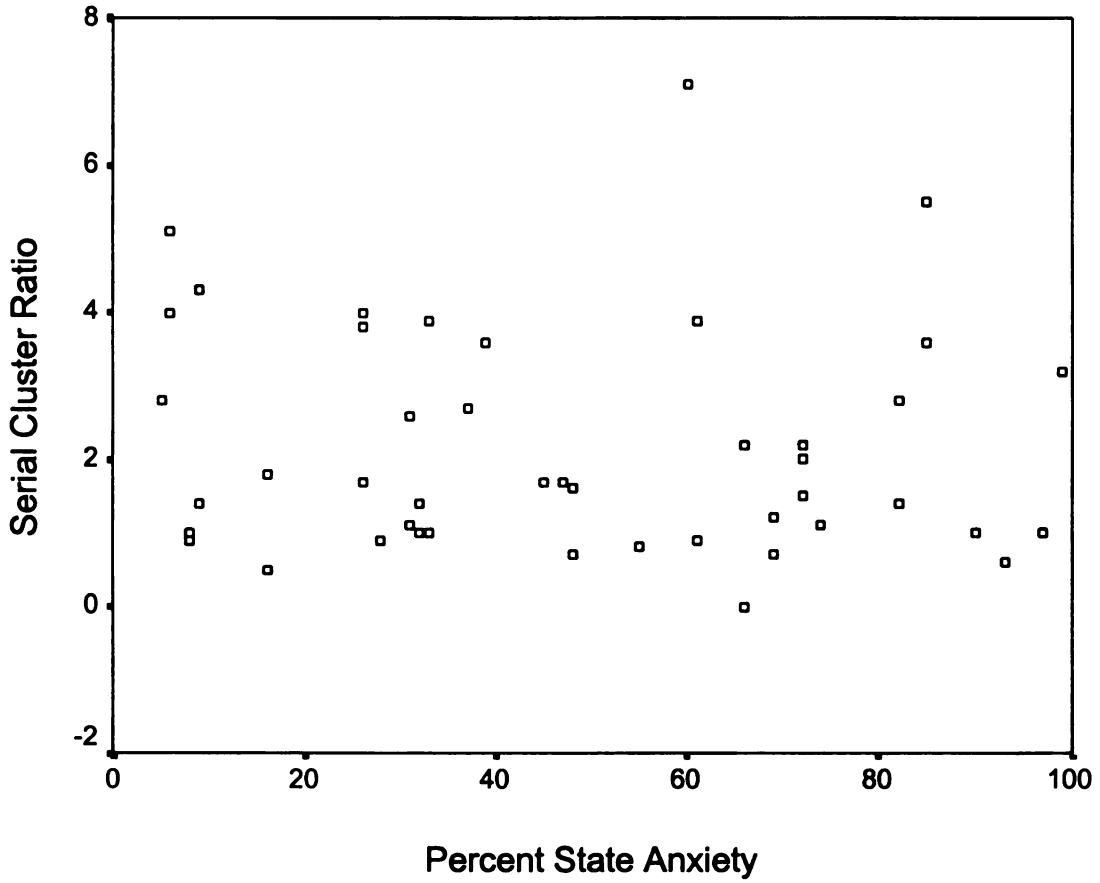

Table 5

Pearson Correlations Between Free Recall Memory Performance and Anxiety

	SDFR	LDFR	STAI-T	PSWQ	STAI-S1	STAI-S2
Short delay free recall (SDFR)	1.000	.845 **	.030	-.214	-.217	-.295*
Long delay free recall (LDFR)	.845 **	1.000	.047	-.106	-.124	-.265
Trait Anxiety (STAI-T)	.030	.047	1.000	.550 **	.280	.167
Penn State Worry Questionnaire (PSWQ)	-.214	-.106	.550 **	1.000	.324*	.202
State Anxiety 1	-.217	-.124	.280	.324*	1.000	.741**
State Anxiety 2	-.295*	-.265	.167	.202	.741**	1.000

Note: * Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

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