ANXIETY, DEPRESSION AND BRIEF MEASURES OF COGNITIVE FUNCTIONING IN A COMMUNITY DWELLING SAMPLE OF OLDER ADULTS

by

AMIE LYNN AUSTIN

(Under the Direction of L. Stephen Miller)

ABSTRACT

Anxiety and depression can coincide with aging, but the effects of each on cognitive functioning are still under examination. Identification of psychological symptoms is important because many symptoms of anxiety and depression mimic organic disease processes such as dementing illnesses. Neuropsychological assessment can aid in differentiating between true dementing illnesses and functional deficits related to psychological symptoms. Brief screening measures such as the Mini Mental State Examination (MMSE), the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), the Geriatric Depression Scale (GDS), and the State-Trait Anxiety Inventory (STAI) are useful in detecting a variety of neurologic or psychiatric disorders and are appropriate for use with adults. The purpose of this retrospective study was to examine the relationships between anxiety, depression and cognitive functioning in an aging sample. Participants included 220 individuals, previously referred for outpatient neuropsychological assessment at the University of Oklahoma Health Sciences Center (OUHSC) Neuropsychology Laboratory. Participants were selected from this clinical database based on completion of the MMSE, RBANS, GDS and STAI. Contrary to expectations, anxiety shared only a very modest relationship with decreased overall cognitive performance when demographic variables and depression were held constant. The RBANS Attention Index score also shared a small but significant amount of variance with anxiety and depression.

INDEX WORDS: Neuropsychological Assessment; Aging; Geriatric Patients; Cognitive Ability; Dementia; Differential Diagnosis; Alzheimer's Disease; Anxiety; Depression; Neuropsychological Screening Measures

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DEDICATION

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Introduction and Literature

Changing trends in the aging population.

Life expectancy is increasing at an unprecedented rate, with persons in the United States living longer than ever before (Arias & Smith, 2003). Contributing factors include advancements in medical technologies, improved medical care, and early health interventions. This is resulting in a significant increase in the world's elderly population (aged 65 and over). To illustrate, the world's elderly population increased by approximately 9.5 million people between July 1999 and July 2000 (U.S. Census Bureau, 2000). This population is expected to continue to grow as older adults continue to live longer. Because of the projected increase in the aging population and a need for support and resources for this population, there is a need for empirical examination of the elements of successful aging including aspects of social, biomedical and psychological variables.

With the increase in the aging population there is also a rise in the prevalence of dementia. The Center for Disease Control has reported that Alzheimer's disease is the eighth leading cause of death in 2001 (Arias & Smith, 2003). At this time, there are very few modifiable risk factors for dementia. It is suspected that some psychological factors may be related, or even contributing to, later development of cognitive impairment and dementia. Some of these factors include negative affect states of depression and lesser studied anxiety (Mol, van Boxtel, Willems, & Jolles, 2006).

Accordingly, there has been a rise in interest in the relationship between negative affect states and cognitive functioning in older adults in both research and clinical realms.

If negative affect states are affecting cognitive functioning in older adults, and negative affect states are modifiable with treatment, it is logical to investigate these variables as they relate to cognitive performance. Previous investigations have lead to several questions that include the following: 1) Is cognitive performance affected by negative affect states of anxiety and/or depression in older adults? 2) If so, what is the strength of the relationship between symptoms of anxiety and depression and cognitive performance in aging adults? 3) Is general cognitive functioning affected by anxiety and depression or are specific cognitive domains affected? Stated another way, do symptoms of anxiety and depression affect cognitive functioning in a global manner or are there different effects of these symptoms on various cognitive domains? 4) Does anxiety or depression differentially affect cognitive performance?

From both the research and clinical standpoint, further investigation of the effects of emotional distress and cognitive functioning in older adults is necessary. Once appropriately identified, negative affective states can be modified. Therefore, further investigation within this area will aid in efficient and accurate detection, classification and treatment for reported cognitive changes in an aging population.

Normal cognitive changes in aging

Aging involves a range of changes in physical, emotional and cognitive functioning. Genetics, lifestyle and disease can affect the rate and type of changes that take place over a lifetime, particularly in aging adults. Normal physical changes include sensory, organ, endocrine, bone and vascular changes. Many older adults report concerns with noted changes in cognitive functioning. Cognitive changes too are a normal part of aging. Discussion of cognitive functioning includes the recognition of a variety of

domains involving attention, language, perceptual organization, memory, reasoning, and executive functioning. Of these domains, perceived memory loss is one common complaint reported by individuals as they age.

When normal age related physical, emotional, or cognitive changes occur unexpectedly or appear aberrant in some way, some concern naturally arises. Concerned patients typically consult family and/or seek professional services for further investigation. Many normal changes in cognitive domains, such as memory, can look like beginning stages of several disease processes. This can lead to uncertainty in diagnosis and a series of referrals or follow-up appointments. This is often unsettling to the aging individual, to their family and the treating medical team. The only real option for the patient and medical team is to simply wait to see whether further cognitive changes occur that may reveal a clearer diagnostic picture. This uncertainty alone can lead to feelings of anxiety and depression. Related, research has found that perceptions of memory loss correlate with experienced symptoms of anxiety and depression (Clarnette, 2001; Harwood, Barker, Ownby, & Duara, 2000; B. Schmand, Jonker, & Lindeboom). These emotional changes are not necessarily a normal part of the aging process.

Accurately detecting memory loss can be difficult in the beginning phases. For example, family members may be unaware of patient's reported changes in memory (Cutler & Hodgson, 1996; Derouesne, Labomblez, Thibault, & LePoncin, 1999; Doraiswamy, Steffens, Pitchumoni, & Tabrizi, 1998). A complicating extension of this phenomenon occurs when the older adult suspects memory decline but is unaware of the extent of the change (Derousne, et al, 1999). Cognitive changes can be expected with aging, or they could be the beginning of pathological cognitive decline or impairment.

Determining whether reported changes are within normal limits or due to a disease process is highly important. The etiology of cognitive impairment can range from a single incident insult to potential progressive neurodegenerative disease processes, such as a range of dementing disorders. Accurate diagnosis is important since different processes have very distinct prognoses and treatment options.

Mild cognitive decline and impairment

While changes in cognitive functioning are a normal part of aging, there is a transition stage between normal aging cognitive changes and more serious difficulties that could be caused by disease processes such as a dementia. If changes in cognitive functioning are more serious than expected through normal aging then these changes can be called impairment. Impaired cognitive functioning can be classified in one of several diagnostic categories. The Diagnostic and Statistical Manual of Mental Disorders-IV Text Revision (DSM-IV-TR), describes impairment of cognitive functions as an essential feature of three distinct conditions: delirium, dementia, and amnestic disorders. Each condition has additional, separate diagnostic characteristics. However, cognitive impairment is not specific for any of these conditions (Fayers et al., 2005).

One condition is mild cognitive impairment (MCI). MCI is the expression of impairment in memory, language or another cognitive function that is severe enough to be detected by others, and through formal testing, but is not severe enough to disrupt daily living skills. As stated, MCI can affect many areas of cognition including attention, language, judgment and reasoning. However, most research on MCI has focused on memory. MCI can be divided into two broad subtypes dependent on the presence or absence of memory loss. When memory is affected it is called amnestic MCI, while

nonamnestic MCI affects other functions but spares memory. Functions such as attention or language could be impaired in either subtype. Research has shown that amnestic MCI has been linked to Alzheimer's disease while nonamnestic MCI may progress to other disorders such as primary progressive aphasia or frontotemporal dementia (Busse, Hensel, Guhne, Angermeyer, & Riedel-Heller, 2006; Friedrich, 1999; Petersen et al., 1999). Many individuals with nonamnestic MCI however, may not develop any dementia but instead can remain stable or even return to normal functioning (Panza et al., 2005). These groups of individuals are those that would benefit most from further research on cognitive functioning as it relates to changes in aging.

Amnestic impairment is verified through formal testing typically when other cognitive domains beyond memory are found to be intact on screening instruments. At this stage, Activities of daily living (ADL's) are not typically negatively impacted. To be diagnosed with cognitive impairment or mild cognitive impairment (MCI), it is required that the person is functioning below what is expected for their age and education level on objective measures (Petersen et al., 1999). A measurable change in only memory often precludes the diagnosis of dementia. Research shows that those diagnosed with MCI have a greater risk for developing dementia in the future (Bowen, 1997; Christensen, Griffiths, MacKinnon, & Jacomb, 1997; Friedrich, 1999; Jonker, Geerlings, & Schmand, 2000; Kryscio, Schmitt, & Salazar, 2006; Ritchie, 2000; Schofield, Marder, Dooneief, & Jacobs, 1997; Shah, 2000). Additionally, it has been reported that approximately 20% of these individuals are actually already in the beginning stages of mild dementia (Milwain, 2000). However, if it is possible to detect early impairment, it may be possible to treat

and prevent further decline. Therefore, it appears useful to identify and discriminate between decline processes in the early phases.

Dementias

An important concern for elders, caregivers, and primary care teams alike are irreversible degenerative diseases of the central nervous system. Degenerative processes can lead to progressive cognitive and functional decline over time due to damage or disease in the brain beyond what might be expected in normal aging. Cognitive impairment could indicate an irreversible degenerative disease process such as a dementia.

The term dementia refers to a group of symptoms caused by disorders that affect the brain. These symptoms can be classified as either reversible or irreversible depending upon the etiology, if known. Because of the difficulty of determining an exact etiology in many cases, it is difficult to know whether changes indicate a reversible or irreversible process. Therefore, there is significant concern surrounding reports of suspected cognitive decline. First, detection of decline is not always easy or accurate. Second, if a process is detected, it may have a low likelihood of being reversible. However, it can still be argued that detection and treatment of symptoms may help ameliorate associated deficits. Most people would argue for exploring treatment options.

Physical and cognitive changes associated with the clinical expression of dementia are neuronal loss in specific brain regions and progressive neuronal dysfunction. These events are called neurodegeneration. Neuronal loss in particular regions and pathways leads to neurochemical deficiencies. The combination of neuronal loss and neurotransmitter dysfunction leads to clinical presentation of dementia

syndrome. Neurochemical deficits disrupt neuron to neuron communication that can involve loss of synapses, pruning of dendrites, oxidative metabolism damage and finally cell death.

Dementia is a term for a non-specific illness syndrome or a cluster of symptoms which are caused by many different specific disease processes. Cognitive functioning in memory, attention, language and problem solving are typically affected in dementia. Types of dementias include, but are not limited to, Alzheimer's disease, vascular dementia, and Dementia with Lewy bodies. Each of these diseases affects some aspects of cognitive functioning. Early stages typically include difficulties with memory while later stages of the condition typically affect a person's orientation to time, place or person. The most common of these disease processes is Alzheimer's disease (AD).

In 1984 in an attempt to establish consistent criteria for diagnosing dementia of the Alzheimer's type, the National Institute of Neurological and Communicative Disorders and Stroke together with the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) published a consensus definition. NINCDS-ADRDA criteria for a diagnosis of probable Alzheimer's disease include insidious onset and progressive impairment of memory and other cognitive functions. No motor, sensory, or coordination deficits may appear early in the disease. These criteria serve as a guide for the diagnosis of probable, possible, and definite Alzheimer's disease (McKhann et al., 1984).

In suspected dementias such as Alzheimer's disease changes to the brain can be verified post mortem. Histopathologic changes to the brain can be seen upon autopsy and include neuronal loss, neurofibrillary tangles, neuritic plaques, and amyloid angiopathy.

Research has found links between Alzheimer's disease and mutations on chromosomes 1, 14 and 21. Genes on chromosomes 19, 12, and 6 are thought to be susceptible to influence. In particular, it has repeatedly been confirmed that chromosome 19 is susceptible to the role of apolipoprotein E (ApoE). Research has determined that gene susceptibility is not the cause of the disease, but in combination with other genetic or epigenetic factors may instead affect the age of onset and increase the probability of developing AD (Cummings, Vinters, Cole, & Khachaturian, 1998).

Psychological considerations in aging

Health care professionals are increasingly confronted by patients who report concerns over perceived cognitive changes. Some elders are seeking services for perceived forgetfulness and are concerned about possible implications of such impairments. One longitudinal study attempting to study forgetfulness and memory complaints and found that forgetfulness appeared to be linked with slower general information processing speed and delayed recall at baseline. However, it did not appear to predict cognitive changes in adults after a 6 year time period. Instead, authors suggested that other factors such as anxiety and depression may be involved with reports of forgetfulness and recommended examining negative affective variables in relation with reported cognitive decline (Mol et al., 2006). As a result of studies such as this, health care professionals are becoming increasingly aware of accompanying negative affect states, such as depression.

Professionals have coined terms "pseudodementia" or "dementia of depression" to describe a severe impairment in cognition wherein the patient appears to have dementia, but there is uncertainty in diagnosis due to a suspected mediating factor (e.g.,

depression). Related, considerable reduction in independence is typically due to depression rather than a true progressive dementing illness such as Alzheimer's disease (Ganguli, Du, Dodge, Ratcliff, & Chang, 2006). This is highly debilitating and disruptive to many adults. Unfortunately, pseudodementia likely accounts for the largest number of dementia misdiagnoses (Clarfield, 1988). This is unfortunate because depression, subsumed in a diagnosis of pseudodementia, is treatable and reversible in many cases. It makes sense then to examine depression as it relates to reported and observed memory loss.

The role of depression in aging

Depression in late life is prevalent and serious, causing marked distress for patients and their families. The prevalence rate of depression reported in primary care settings often approaches 15%. This rate is over twice the prevalence rate of hypertension (McDonald, 2001). Despite symptoms of depression commonly appearing in the elderly, depression itself is not a normal part of the aging process. Depression typically results from noted changes in functioning due to physical illness and often coexists with anxiety. As a result, depression is often overlooked, undervalued or misinterpreted by primary care physicians. This not only confounds the diagnosis and treatment, but it has also been shown to have detrimental affects on general health status and patient outcomes (Bruce & Hoff, 1994). Further, patients rarely seek services beyond their primary care physician and typically accept symptoms of depression and anxiety as normal.

The biology of depression is not fully understood and continues to be examined throughout literature. Some consistent information is emerging however. For example, there seems to be consensus for a genetic basis for depression. This has been established

through family and twin studies. Neurotransmitters likely also play a role in depression. Specifically, some experts speculate that changes in serotonin, norepinephrine, and/or dopamine are related to depression (Gottfries, 2001). Many imaging studies are showing some regions of interest that appear to be different from normal samples when depression is present. Specifically, the prefrontal cortex often appears to have less activity, while the limbic system typically shows more. Further, functional imaging studies show that parts of the parietal and temporal lobes may also be working more slowly. This may result in a reduce ability to focus on the outside world.

For those familiar with aspects of depression, it is generally accepted that depression is related to cognitive deficits or decline. This pattern is seen across the lifespan regardless of age, however, elders are at particular risk for confounding difficulties. Several studies have investigated the role of depression and cognitive decline. A meta-analysis of studies investigating depression in aged depressed and non-depressed subjects with diagnosed Alzheimer's disease found that depressed subjects had significantly lower cognitive performance across tests (Christensen et al., 1997). Therefore, a general recognition of the interaction between depression and cognitive performance is taking place, but questions still remain. For example, it has been observed that depression often corresponds with cognitive decline; however, it remains unclear which comes first. A common question is whether depression precedes and correlates with cognitive decline or whether depression occurs as a response to perceived decline. Through investigation, it has been reported that memory complaints occur secondary to depression and that depression also reflects self-awareness of cognitive decline (Schmand, Jonker, Geerlings, & Lindeboom, 1997; Small et al., 2001). In a cross-

sectional study of depressed and non-depressed subjects, depressive symptoms were found to be associated with cognitive impairment but not subsequent cognitive decline. Authors concluded that substantial cognitive decline over time could not have been explained by depression alone but likely reflected incipient dementia (Ganguli et al., 2006). In a large longitudinal study of elders with depression, researchers found that depression consistently shared a negative relationship with cognitive performance (Bierman, Comijs, Jonker, & Beekman, 2005). Some studies confirm that mild depression is related to subjective memory loss for some forms of memory complaint, particularly for people without the major known genetic risk for Alzheimer's disease (Small et al., 2001). Overall, regardless of specific diagnosis, depression appears to be related to reports of cognitive decline.

The role of anxiety in aging

Anxiety in the elderly has historically been overlooked or not recognized as a serious problem. Symptoms of anxiety have also been misinterpreted as somatic symptoms related to physical illness (Turnbull, 1989). However, scientific evidence is beginning to identify risk factors related to anxiety in the elderly. These include associations with disability, substantial impairment in quality of life and increased mortality rates (de Beurs et al., 1999; Van Hout et al., 2004; Loebach Wetherell et al., 2004). With such high risks associated with anxiety, it is surprising that prevalence of anxiety rates in elder adults has received little attention despite recent increases in the amount of research on anxiety disorders (Norton, Cox, Asmundson, & Maser, 1995). This is further surprising given the findings that symptoms of anxiety are fairly common in later life (Beekman, de Beurs, & van Balkom, 2000). Accordingly, a literature review

clearly indicates that much less attention has been focused on anxiety than depression in aging populations.

The first step to investigating a phenomenon is to define it. Defining anxiety in elders is an important task when attempting to qualify it for treatment. Anxiety, like other affect states, appears to exist on a continuum ranging from simple worry to more severe levels, such as that seen in Post-traumatic stress disorder. However, there are problems with differentiating between normal states (e.g., physiological arousal) and anxiety disorders (i.e., diagnosable impairment). There appears to be no single definition of anxiety in the empirical literature since distinct fluctuations in severity and related impairment complicate examination. In addition, much of our understanding about anxiety depends upon our working definition of diagnostic criteria. Generalized anxiety disorder and social phobia are two disorders defined by severity and impairment criteria, which appropriately require a distinction between normal states and true pathology. However, epidemiological studies have shown that significant variations of prevalence rates can be obtained through small modifications in diagnostic criteria (Pelissolo, 1998). Less severe anxiety symptoms are not as easily classified.

Another difficult distinction is in determining whether anxious symptoms are simply temporary states or more stable personality traits/disorders. A few epidemiological studies have addressed this issue and concluded that categorical definitions and main personality traits are the two primary models by which anxiety should be examined (Pelissolo, 1998). Some researchers have attempted to categorize anxiety into state anxiety (i.e., perhaps transient anxiety) and trait anxiety (i.e., more chronic symptoms of anxiety) (Kvaal, Laake, & Engedal, 2001; Kvaal, Ingun Ulstein,

Inger Hilde Nordhus, & Knut Engedal, 2005; Speilberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). However, these models do not adequately address possible distinctions between anxiety states and anxiety traits. Correspondingly, these distinctions have been largely ignored in the literature, possibly due to high correlations with each other (Eysenck, Derakshan, Santos, & Calvo, 2007). Instead it appears that most research has examined anxiety states without clearly defining them.

In the real world it may be more practical to treat anxiety symptoms when they begin to become disruptive for the patient, instead of attempting to identify the pathology. As described above, fluctuations in severity and duration of anxiety symptoms are often seen in patients. Therefore, it is particularly important to accurately diagnose described anxiety symptoms as moderate to severe. This is important for several reasons, including improvement in daily functioning. Beyond functioning, individual symptoms of anxiety are often confused with other geropsychiatric disorders such as depression, delirium, dementia, or even psychosis. Reported symptoms have included impaired concentration and attention, impaired memory, dizziness, numbness, fear, severe insomnia, and hypervigilance. Therefore, the need to clarify the symptoms associated with excessive anxiety and worry, in an aging sample that may qualify for more severe diagnoses such as Alzheimer's disease, is growing. Accordingly, after examining the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), and the International Classification of Diseases, 10th Revision (ICD-10) criteria for generalized anxiety disorder (GAD), researchers are moving in the right direction by validating a set of diagnostic criteria for anxiety in suspected dementia. These criteria

include restlessness, irritability, muscle tension, fears, and respiratory symptoms in the context of excessive anxiety and worry.

In first examining anxiety, research has found that symptoms of anxiety were the only consistent variables found in patients with diagnosed MCI (Forsell, Palmer, & Fratiglioni, 2003). Specifically, whether a diagnosable anxiety disorder or disparate symptoms of anxiety, elders appear to be experiencing similar compromises in health care and quality of life. It appears that memory complaints were found to strongly relate to affective status, particularly with severe anxiety symptomatology. This is also related to subjective assessment of well-being in older adults (Derouesne et al., 1999). Unfortunately, despite the seeming consequences for compromised quality of life, appropriate care for anxiety is seldom received. This may be due to unrecognized symptoms that are either shadowed by a greater concern for the memory impairment, or symptoms are seen as a natural response to memory concerns. As a result, efforts need to be made to improve identification of anxiety in aging in order to disseminate effective treatments. In addition, appropriate referrals to specialized care professionals may have positive effects on the management of anxiety in late life (de Beurs et al., 1999).

Anxiety and cognition

It makes sense to further investigate the effects of anxiety on functioning given our present understanding of the serious consequences of anxiety in aging. One particular domain of great importance for successful and independent functioning is cognition. While there is a relatively long history of examining the effects of depression on cognition, only recently has research begun investigating the relationship between anxiety and cognition in older adults. So far, some studies show that anxiety may

negatively impact cognitive performance in screening measures and lengthier assessments.

Despite limitations, some studies have specifically examined state and trait anxiety. Trait anxiety is believed to be longstanding, while state anxiety regards present symptoms. Trait anxiety is suspected to exacerbate cognitive decline associated with normal aging (Barclay, 2005). Specific domains affected remain unknown. One study examined trait anxiety and found that it is not a valid predictor of decline in processing efficiency, as once thought. Instead findings were consistent with limited literature demonstrating the association between trait anxiety, executive dysfunction and poorer verbal learning. Results from this same study also suggested that subclinical levels of anxiety, either state or trait, interfere with neuropsychological performance (Barclay, 2005). Another study attempted to examine the effects of state and trait anxiety on attentional performance in young adults. A fourfold comparison was made between trait anxiety and state anxiety that revealed high state anxiety was associated with psychomotor alertness and high trait anxiety with perceptual alertness. No state-trait interactions were found. Researchers concluded that both dimensions of psychometric anxiety seem to have independent effects on attention, and should be analyzed separately (Mialet, Bisserbe, Jacobs, & Pope, 1996). This suggests that anxiety affects attention regardless of its classification as state or trait; however, it is not clear how this finding will generalize to older adults. These limited models suggest that it initially may be more useful to examine state anxiety over trait anxiety for an elder population.

Taken together, an ideal investigation of anxiety and aging would examine adults with isolated presentations of pure, unadulterated, stable anxiety symptoms; however,

real world patients typically present with reports of fluctuations in comorbid anxious and depressive symptoms. This highlights the call for further investigation of each of the contributing variables, namely a need to carefully examine state anxiety, depression, and comorbid anxiety and depression. Pioneering studies have reported that anxiety, comorbid with depression, may decrease cognitive reserves in the elderly over time (DeLuca et al., 2005; Deptula, Singh, & Pomara, 1993). This appears important in demonstrating the action of negative affect processes. Further investigation in this area is appropriate.

In summary, the effects of anxiety on cognitive functioning in aging adults are still under examination. Further, symptoms of anxiety have not been consistently related to specific types of cognitive tasks in the aging population. The National Institute for Mental Health has highlighted the serious need for more research on the effects of anxiety in the elder population (Pearson, 1998).

Comorbid Anxiety and Depression

Examinations of comorbid anxiety-depressive symptoms reveal that symptoms appear to be related to changes in cognitive ability and progress in a predictive manner. Studies find that the prevalence of anxiety, depressive, and comorbid anxiety and depressive symptoms tend to increase in the early phase of perceived cognitive decline (Bierman, Comijs, Jonker, & Beekman, 2007). In particular, the prevalence rate of reported anxiety, depression and comorbid anxiety-depressive symptoms appears to follow a trajectory of increased symptoms at the onset of cognitive performance decline and decreases in prevalence as cognitive functioning becomes severely impaired. However, specifics are still lacking.

Assessing cognitive changes in aging: Neuropsychological testing

The purpose of neuropsychological testing and assessments are to assess cognitive, behavioral and emotional functioning in individuals. A traditional neuropsychological assessment focuses on cognitive functioning, however, assessments also involve the thorough examination of an individual's personal, interpersonal, psychological and contextual circumstances. All of which may be affecting the brain-behavior relationship. Neuropsychological assessments are particularly useful in examining cognitive functioning and potential abnormalities in profile performance that indicates abnormal functioning.

Many older adults are reportedly experiencing subtle cognitive changes that are not easily classifiable. These individuals are instead tentatively classified as having suspected cognitive decline, or may be considered to have mild cognitive impairment (MCI). Neuropsychological assessments have traditionally consisted of extensive, complex and time consuming neuropsychological batteries such as the Luria Nebraska Neuropsychological Battery and the Halstead-Reitan Neuropsychological Test Battery. Although these batteries have been found to be valid and reliable assessment methods, the overall costs of these measures in time, as well as real dollars, are not always optimal or feasible for use with older adults. Specifically, older individuals may be prone to fatigue and are less likely to endure the lengthy assessment evaluation (Putnam & DeLuca, 1990). In addition, most current standardized neuropsychological measures have been designed to avoid ceiling effects in young people without cognitive deficits. As a result, these measures are exceedingly difficult for older adults who may be experiencing cognitive difficulties.

Alternatives to lengthier batteries are brief screening measures. The need for appropriately designed instruments for older people with suspected cognitive change, decline or suspected dementia has been addressed in the literature (Randolph, Mohr, & Chase, 1993). Some brief measures of mental status or dementia are available for use with elders. These measures include the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975), and the Dementia Rating Scale (Mattis, 1976). However, these measures have been found to be relatively insensitive to mild changes in cognition (Peterson, 1994). In addition, they do not allow for profiling of abilities across cognitive domains (Feher & Martin, 1992). Recent research recommends that clinicians assess patients through a three-step process that first involves selecting a population-appropriate primary assessment tool. Second, the clinician should maintain awareness of the effects of educational level, race, and age on scoring. Finally, the clinician should consider adding one or two other measurement tools as needed for special cases (Holsinger, Deveau, Boustani, & Williams, 2007). This approach should be clinically useful for differentiating diagnoses as well as treatment planning.

Specific Cognitive Screening measures

From combined prevalence estimates it was predicted that as many as 29.3 million individuals around the world had dementia in 2005 (Wimo, Winblad, & Jansson, 2007). Estimated costs for care are in the billions annually within the Unites States alone (Wimo et al., 2007). Beyond these numbers, many more adults have reported memory complaints. Due to this population shift and reported concerns for changes in cognitive functioning, there is an increasing need for brief, sensitive and specific screening measures that profile abilities across cognitive domains. Brief tests that screen for

cognitive impairment could aid in dementia diagnosis. Selecting a few brief assessment measures is ideal for an elder population (Holsinger et al., 2007). Several brief screening measures are establishing validity and appropriateness for use with elders (Cullen, O'Neill, Evans, Coen, & Lawlor, 2007). Some brief standardized measures, such as the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) are advantageous because they offer comparable findings to longer batteries but are more tolerable for elders and offer more information than briefer screening measures, such as the Mini-Mental Status Exam or the Dementia Rating Scale (Randolph, Tierney, Mohr, & Chase, 1998). Related, the need for accurate diagnoses early in the course of a possible dementia process is optimal. Early, accurate identification will lead to accurate and appropriate interventions, treatments, and planning and would likely reduce psychological distress that can accompany uncertainty in symptom presentation.

Comparison of the current study with previous studies

To expand upon previous research, it appears necessary to investigate mitigating factors associated with cognitive decline. Previous research has shown that symptoms of anxiety and depression appear to play a role in later development of cognitive impairment, however, findings are inconsistent. Some indications of previous research suggest that state anxiety is related to impairments in learning (Bierman et al., 2005; Wetherell, Reynolds, Gatz, & Pedersen, 2002), memory (Deptula et al., 1993; Sinoff & Werner, 2003), and attention (Hogan, 2003; Rankin, Gilner, Gfeller, & Katz, 1994). However, contradictory evidence has been found indicating that acute state anxiety symptoms (Biringer et al., 2005; Kizilbash, Vanderploeg, & Curtiss, 2002) and trait anxiety symptoms (Paterniti, Dufouil, Bisserbe, & Alperovitch, 1999) are not associated

with impaired cognitive performance in later life adults. More recent research shows that trait anxiety is associated with executive dysfunction and poor verbal learning (Barclay, 2005). However, trait anxiety is different from reported state anxiety and the affects of each, on elders, has not been examined. Further, research shows that anxiety cannot clearly be separated from depression and depression may play a significant role in cognitive changes as they relate to reports of memory impairment (Schoevers, Beekman, Deeg, Jonker, & van Tilburg, 2003b; van Balkom et al., 2000). These findings complicate our understanding of negative affect states and their role on cognitive functioning in aging adults. Clarification is obviously needed.

Despite inconsistencies in research, a review of the literature shows a strong relationship between memory complaints, negative affect and diminished quality of life in the elderly. The negative impact of subjective memory complaints on quality of life is significant and highly important (Mol et al., 2007). The literature on negative affect states as related to cognitive decline is lacking in specificity and remains controversial. However, at the very least anxiety and depression are emerging as related to cognitive decline and impaired quality of life. Both affective states however are malleable through a variety of treatment options. Therefore, early detection, diagnosis and treatment of anxiety and depression when present with memory complaints may preclude and reduce future consequences for elders.

This study proposes to investigate negative affect states of anxiety and depression to better understand the specific ways each affect cognitive performance. At this time literature hints that anxiety and depression affect overall cognitive functioning with specific deficits noted in areas of attention, learning and memory. This study proposes to

examine the specifics of these associations. An advantage of this study is a large number of participants available for examination. Over 200 participants ages 65 years or older were involved in a larger study recruited from primary care physician practices throughout central Oklahoma and were assessed for various indicators of cognitive and health functioning. All individuals were referred for suspected cognitive decline and/or memory deficits. Participants chosen for this study were not identified as cognitively impaired using gross screening instruments. Another advantage of this study is the utility in using relatively short, accurate screening measures to assess multiple domains of cognitive functioning. Short screening measures are less taxing on elders and are also advantageous to use within the clinical setting.

This study will attempt to expand upon previous findings. Researchers have not yet demonstrated a consistent connection between the symptoms of anxiety and depression with specific cognitive performance decline in processes such as attention, learning, or memory. Literature is also hinting at the importance of anxiety over depression in aging. Anxiety is most often discussed in the literature as a nonspecific mediator of age-related cognitive decline. However it is not consistently linked with specific areas of cognitive difficulty. Depression is most often reported as affecting overall cognitive functioning, however, it has also been linked with noted deficits in attention and memory. One goal of the present study is to identify domains of functioning most impacted by anxiety and depression related symptoms. This study will also attempt to separate the effects of anxiety from depression by examining the impact of anxiety on cognitive performance above and beyond depression.

Summary and specific aims

Existing literature and research into the relationship between anxiety, depression and cognitive functioning are inconsistent. The purpose of the present study was to add to the literature by further examining the impact of anxiety and depression on cognitive functioning in an aging sample. Patients included in the study were a retrospective sample of individuals previously referred for outpatient neuropsychological services at the University of Oklahoma Health Sciences Center (OUHSC). Patients were selected based on their completion of a uniform battery of neuropsychological measures including the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), the Mini Mental State Examination (MMSE), Yesavage's Geriatric Depression Scale (GDS) and the State Trait Anxiety Inventory (STAI).

Specific Hypotheses to be Tested

Based upon the literature reviewed above, the specific hypotheses of the current study included the following aims:

1. Identify the size and unique proportion of variance anxiety (STAI State-score) and depression (GDS) each shared with cognitive performance (RBANS total score) while identifying the direction of each relationship. It was hypothesized that anxiety and depression each uniquely share a significant proportion of variance and have negative relationships with cognitive performance. In other words, as anxiety and depression scores increase, cognitive performance scores correspondingly decreased.

2. Examine how much of the variability in cognitive performance (RBANS Total score) State anxiety (STAI S-scale) accounted for above and beyond depression (GDS). It

was hypothesized that anxiety accounted for significant variance above and beyond that of depression.

3. *Examine the effects of anxiety (STAI-S) and depression (GDS) on specific cognitive domains (RBANS Total and Index scores).* It was hypothesized that anxiety and depression would correlate most with measures of attention (RBANS Attention Index) and memory (Immediate and Delayed Memory Index scores).

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Chapter 2

Methods

Power Analysis

Post-hoc power analyses were conducted to determine the power of the study (Cohen, 1988). The GPower statistical package (Faul & Erdfelder, 1992) was used to perform the power analysis to detect small (.02), medium (.15) and large (.35) effect sizes with the present sample (Cohen, 1992). The models used in this study were correlational and multiple regression analyses. The models tested whether demographic variables (i.e., 3 variables of age, education, gender), and variables of negative affect (i.e., 2 distinct variable scores of STAI-S, and GDS) predicted cognitive performance on distinct RBANS Total and Index scores (i.e., 5 Index scores and 1 RBANS total score). The α for each model was set at .05 with a medium effect size ($f^2 = .15$). Post-hoc power analysis indicated that when the most predictor variables were used for multiple regression analyses (i.e., all demographic variables and both negative affect variables), power was .99. Therefore adequate power is present with a medium effect size for all models run.

Participants

From an original pool of 734 participants, this retrospective study consisted of a final count of 220 patients, between the ages of 65 and 89 years (M = 73.88, SD = 5.40 years). The original participant pool consisted of 743 participants. After controlling for age, selecting only those who were 65 years and older, the pool dropped to 420. A final pool of 220 emerged after selecting participants who scored a 23 or greater on the MMSE, who completed all assessment measures of interest and who underwent first time testing at OUHSC. Patients were referred to the Neuropsychological Assessment

Laboratory at the Department of Psychiatry and Behavioral Sciences, a neuropsychology service of the outpatient clinic associated with Oklahoma University Health Sciences Center (OUHSC) located in Oklahoma City, Oklahoma. For this particular study, individuals, ages 65 years or older came from primary care physician practices throughout central Oklahoma and were assessed for various indicators of cognitive and health functioning. All individuals were referred for suspected cognitive decline and/or memory deficits.

Data of this nature has been consistently collected from the Oklahoma Longitudinal Assessment of Health Outcomes in Mature Adults (OKLAHOMA) study, described in detail in Duff et al. (2003). Staff members eliminated those participants judged to be unable to understand and sign informed consent. Demographic data for the final sample of the 220 healthy older adults is included in Table 2.1.

Participants were chosen from this clinical database based on their completion of the variables of interest, namely the MMSE, RBANS, GDS and STAI. Potential participants diagnosed with cognitive impairment due to brain injury, stroke, dementia, or psychotic disorders were excluded from the study. Patients were not excluded based on history of other chronic medical illnesses (e.g., hypertension, hypercholesterolemia, diabetes, etc.).

Design and Procedure

The procedures and instruments used were selected to assess overall cognitive functioning. Neuropsychological assessments usually consisted of a flexible battery of tests. This battery is comprised of a core battery of tests given to all patients plus additional tests selected on the basis of individual presenting problem(s) and referral

questions. A Master's level psychometrist, pre-doctoral interns, post-doctoral fellows, or a neuropsychologist administered tests. Average testing time varied from approximately 3 to 8 hours. Appropriate breaks were included to prevent fatigue effects.

Measures

The Mini-Mental State Examination

A brief and commonly used measure of cognitive status is the Mini-Mental State Examination (MMSE) (Folstein et al., 1975). It is widely used because it is easy to administer and provides a global measure of overall mental status. The measure consists of 30 items scored 0 for a false response and 1 for a correct response. Test items may be clustered in 11 subscores that sample different cognitive processes: orientation to time (5 points), orientation to place (5 points), registration of three objects (3 points), serial subtractions (5 points), recall of three objects (3 points), naming of two objects (2 points), repeating a phrase (1 point), three-step oral command (3 points), reading (1 point), writing (1 point), and copying pentagons (1 point). Missing responses for the serial subtractions were scored 0 (Folstein et al., 1975).

Advantages of the Mini-Mental State Examination are that it is frequently used as a cognitive screening measure across health care settings and across professionals, and is typically used to communicate information about patient status. However, it has been widely criticized for its lack of specificity (Gagnon et al., 1990; Tombaugh & McIntyre, 1992), particularly for individuals with low and high education levels (Aevarsson & Skoog, 2000; Katzman et al., 1988).

Another disadvantage of the MMSE is that it has been shown to have a ceiling effect. This indicates a lack of differentiation in dementia processes. In other words, the

MMSE may not differentiate mild impairment. Instead, when evaluating cognitive deficits a combination of tests are recommended, especially for suspected dementia of the Alzheimer type (Ihl, Frolich, Dierks, Martin, & Maurer, 1992).

The MMSE was used as a screening measure for this study to insure the validity of self report of other measures of the study. A cutoff score of 23 has been suggested as the minimum score for borderline performance, yielding sensitivity of .36 and specificity of .98 (Schultz-Larson, 2007). Therefore, participants were selected based on scoring a 23 or higher on the MMSE.

The Repeatable Battery for the Assessment of Neuropsychological Status

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is a brief but comprehensive cognitive assessment. This 30-minute paper and pencil assessment is a nationally standardized, brief neuropsychological battery comprised of 12 subtests that yield five factor analytic Index scores: Immediate Memory, Visuospatial/Constructional ability, Language, Attention, and Delayed Memory (Randolph et al., 1998). Each Index score is comprised of individual subtests. Immediate Memory is comprised of a list learning task and story memory that both require immediate recall. Visuospatial/Constructional consists of figure copy and line orientation tasks. The Language index requires picture naming and a semantic fluency task, while Attention accesses digit span and coding measures. Finally, Delayed Memory tests include a list recall, list recognition, story recall, and figure recall. The standardized administration and scoring procedures outlined in the manual were utilized for all subtests except for the scoring of the Figure Recall subtest. Modified scoring procedures were utilized for scoring, as described by Duff et al., 2003.

The RBANS was originally designed as a screening measure for the assessment of dementia (Randolph et al., 1998). Since that time it has gained popularity as a clinical tool due to many advantages. The RBANS has a short administration time and is easy to administer and score. There is also a growing base of co-normed index scores and summary scores as well as supported evidence for raw score patterns. The average reliability coefficients for the indexes are all in the .80s across age groups. The reliability coefficient for the RBANS Total Score is in the .90s across age groups, with an average of .94 (Randolph et al., 1998). There are two different versions of the RBANS, form A and form B, thus allowing for repeat assessments. Research also supports the RBANS' use with a variety of populations including schizophrenia (Wilk et al., 2004) and cerebrovascular disorders (Larson et al., 2003; Larson, Kirschner, Bode, Heinemann, & Goodman, 2005). The RBANS has also been established as reliable in differentiating between Alzheimer's dementia and vascular dementia, Huntington's disease (Randolph et al., 1998), and Parkinson's disease (Beatty et al., 2003).

In a validity study of the RBANS, subjects who performed above the suggested cut-off score on the Mini Mental State Exam and the Dementia Rating Scale scored significantly lower than controls on the RBANS (Randolph et al., 1998). These findings suggest that the RBANS is more sensitive in detecting and characterizing different dementia etiologies. The RBANS was selected for this study because of its sensitivity over other brief screening measures, and extensive use across research and clinical settings.

Geriatric Depression Scale

The GDS is a self report depression measure developed specifically for use with elder patients. This measure places little emphasis on somatic complaints that often accompany normal aging and related chronic medical conditions common in this population. Emphasis instead is on other aspects of depressive symptoms appropriate for this targeted age group. The GDS has been proven both valid and reliable for measuring depressive symptoms in the elderly (Jonker et al., 2000). Yesavage and colleagues reported strong internal consistency (alpha = .94) and test-retest reliability (r = .85) for this measure (Yesavage, Brink, Rose, Lum, & Huang, 1983). This measure is a self-report measure consisting of 30 yes/no questions pertaining to potential symptoms of depression. The instrument was designed specifically for the elderly population by Spreen ad Strauss (1998) and takes approximately 5 – 10 minutes to complete. A total score is obtained by adding the point values assigned to each response (0 or 1). The following cut-off points are used to determine depression level: 0-9 normal range; 10-19 declares mild depression; 20-30, moderate to severe depression (Spreen & Strauss, 1998).

State Trait Anxiety Inventory (Form Y)

The STAI measures both state and trait anxiety and is a self-report measure consisting of 40 items pertaining to potential symptoms of anxiety. The first 20 items of the test measure state anxiety (STAI S-Anxiety scale), wherein subjects respond to the way that they are feeling in the present moment. This scale specifically measures present symptoms of acute anxiety. The second half of the test measures trait anxiety (STAI T-Anxiety scale). Respondents indicate how they generally feel. Questionnaires are scored by adding weighted (1 to 4) scores of each item using the directions and scoring key

provided in the Manual for the State-Trait Inventory (Form Y) (Speilberger et al., 1983). The raw scores range from a minimum of 20 to a maximum of 80. These scores are converted to and reported as T-scores.

Median alpha coefficients for internal consistency were .93 for the state scale (Spielberger, 1983). State and Trait subscales correlate strongly with one another (r = .72) (Stanley, Beck, & Zebb, 1996). There is strong psychometric support for the STAI when normed on younger adults (Speilberger et al., 1983). Preliminary data from older adult heterogeneous community samples and psychiatric samples suggest adequate internal consistency and convergent validity (Himmelfarb & Murrell, 1983; Stanley, Novy, Bourland, Beck, & Averill, 2001).

Traditional cut-off scores are recommended at 39/40 on the total STAI S-scale, and are used for clinically significant symptoms of a state of anxiety, however other research with elders has recommended other cut-off scores. Specifically, Kvaal et al. have shown that the optimal cut-off score on the STAI S-scale mean sum score was between 54 and 55 for elders, corresponding to the highest accuracy of 0.87. Sensitivity was 0.82, specificity 0.88, with a likelihood ratio of + 6.8. The STAI S-scale has been proven to be a useful instrument for detecting a variety of mental disorders in older people, discriminating between mentally healthy and mentally unhealthy (Kari Kvaal et al., 2005). The scale also produces a ‘Nervousness’ and ‘Well-being’ factor. The ‘Nervousness’ factor has a suggested cut-off of 15/16 while the ‘Well-being’ factor is 22/23 (Kvaal, Ulstein, Nordhus, & Engedal, 2005).

The state scale and the ‘Well-being’ and ‘Nervousness’ factors all distinguish between persons with mental disorders and those without. The scale is capable of

detecting anxiety disorders and mixed anxiety-depressive disorders. The scales are reportedly sensitive to depressive disorders in addition to personality and adjustment disorders. It seems that this test is sensitive in detecting disorders in the elderly because anxiety typically accompanies symptoms in a variety of mental disorders, especially in the elderly. Further, mixed anxiety-depressive disorders are more prevalent in geriatric patients (Schoevers et al., 2003b).

Hypotheses

This purpose of this study was to explore the relationships between negative affect states and cognitive performance in elders, using brief screening measures. Three primary goals were to:

1. Identify the size and unique proportion of variance anxiety (STAI State-score) and depression (GDS) each share with cognitive performance (RBANS total score) while identifying the direction of each relationship. *It was hypothesized that anxiety and depression each share a significant, unique proportion of variance and have negative relationships with cognitive performance. In other words, it was believed that as anxiety (STAI-S) and depression (GDS) scores increase, cognitive performance scores (RBANS total) would decrease.* Pearson's product correlations were used to examine demographic variables as each related to measures of affect states and cognitive functioning. Hierarchical regression analyses were used to examine the size and unique proportion of variance shared among the primary variables of interest.

2. Examine how much of the variability in cognitive performance (RBANS Total score) State anxiety (STAI S-scale) accounts for above and beyond depression (GDS). *It was hypothesized that anxiety accounts for more increments of variance than depression.*

Hierarchical regression analyses were used to examine the unique proportion of variance shared between each affect state and global cognitive performance.

3. Examine the effects of anxiety (STAI-S) and depression (GDS) on specific cognitive domains (RBANS Index scores). *It was hypothesized that anxiety and depression would correlate most with measures of attention (RBANS Attention Index) and memory (Immediate and Delayed Memory Index scores).* Hierarchical analyses were used to examine the individual cognitive domains as they related to depression and anxiety.

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Table 2.1: Demographic Information

Participants	Frequency	Percentage	Range	Mean	Standard Deviation
Males	90	40.9			
Females	130	59.1			
Age (years)	220		65 – 89	73.88	5.4
Education (years)	220		6 – 21	13.51	2.8
Race:					
Caucasian	203	92.3			
African American	13	5.9			
Native American	2	0.9			
Other	1	0.5			
Marital Status:					
Married	136	61.8			
Single	4	1.8			
Divorced	24	10.9			
Widowed	55	25			
Missing	1	0.5			

Chapter 3

ANXIETY AND DEPRESSION MINIMALLY AFFECT GLOBAL COGNITIVE PERFORMANCE IN A COMMUNITY DWELLING AGING SAMPLE[1]

[1]Austin, Amie L. and Miller, L. Stephen. To be submitted to *Archives of Clinical Neuropsychology*.

Abstract

Identification of anxiety and depression in older individuals with cognitive deficits is necessary for the implementation of appropriate treatments and because symptoms can mimic organic disease processes such as dementia. Neuropsychological assessment can aid in differentiating diagnoses. Brief cognitive screening measures such as the Mini Mental State Examination (MMSE), the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), the Geriatric Depression Scale (GDS), and the State-Trait Anxiety Inventory (STAI) are useful in detecting a variety of neurologic or psychiatric disorders. The purpose of this retrospective study was to examine the relationships between anxiety, depression and cognitive functioning in an aging sample. Participants were selected from the University of Oklahoma Health Sciences Center (OUHSC) Neuropsychology Laboratory database if the MMSE, RBANS, the GDS and STAI were complete. Anxiety shared only a marginal relationship with decreased overall cognitive performance when demographic variables and depression were held constant. Depression was not significant. Self reports of anxiety and depression do not appear to be strongly related to cognition in aging.

Introduction

Depression and cognition

Depression is a treatable psychiatric disorder that may be linked with cognitive decline and dementia in aging populations. Unfortunately, findings supporting these links have been inconsistent and at times contradictory (Barclay, 2005). Some studies report finding little support for a relationship between depression and overall cognitive decline (Boone et al., 1994; Comijs et al., 2004) while other studies find a relationship (Bierman et al., 2005, 2007). A large meta-analysis of depression and cognitive functioning in older adults highlighted these discrepancies. As a result, the authors recommended that more work be done to synthesize this line of research (Gonzalez, Bowen, & Fisher, 2008; Kindermann & Brown, 1997).

Regardless of contradictions, researchers continue to examine the impact of depression on cognitive functioning in the elderly and many questions about the ways that depression and cognitive performance may be linked remain. Discrepant or contradictory findings in research may be partially due to the difficulty in separating cognitive complaints from confounding negative affect states (Kindermann & Brown, 1997). Regardless, researchers and practitioners alike do not fully understand whether there is a relationship between depressive symptoms and cognitive functioning. If such a relationship does exist the type and strength of the relationship needs to be clarified.

One thing that has emerged from research is an understanding that depression is at the very least related to functional difficulties in elders and these difficulties are related to serious consequences (Alexapoulos, 2005). Clinically, depression is under diagnosed and under treated in the elderly (Gottfries, 2001). Better identification of depression paired

with appropriate treatment planning and a better understanding of the effects of depression in aging is important. It is clinically important because it is possible to distinguish late-life depression from other geriatric illnesses (Katz, 1996). Further, it is also possible to treat late-life depression and treatment appears to be related to significant improvements in functioning (Scogin et al., 2007).

Anxiety and cognition

Whether it is a diagnosable anxiety disorder or disparate symptoms of anxiety, elders appear to be experiencing similar compromises in health care and quality of life as a result of symptoms. Unfortunately, despite the seeming consequences for compromised quality of life, appropriate care for anxiety is seldom received. This may be due to unrecognized symptoms that are either shadowed by a greater concern for the cognitive impairment, or symptoms are seen as a natural response to cognitive concerns. As a result, efforts need to be made to improve identification of anxiety in aging in order to disseminate effective treatments. In addition, appropriate referrals to specialized care professionals may have positive effects on the management of anxiety in late life (de Beurs et al., 1999).

Pioneering studies (Deptula et al., 1993; Hogan, 2003) have reported that anxiety and depression have a negative effect on cognitive functioning in aging samples and hinted at the importance of anxiety beyond depression. Further examination of comorbid anxiety, with depression, found anxiety to be related to reduced cognitive reserves over time (DeLuca et al., 2005). Although potential interaction effects between negative affect states is an important consideration, anxiety appears to affect cognitive processes on its own. Although still in early phases, studies are beginning to hint at an increased potential

risk for future cognitive decline if anxiety symptoms are present at baseline (Barclay, 2005). For example, Sinoff (2003) found that participants with anxiety scored significantly lower on the Mini Mental Status Examination than non-anxious participants. Further, these patients displayed a relative risk for developing future cognitive impairment. For this group of individuals, anxiety was the only significant predictor of future cognitive decline (Sinoff & Werner, 2003). Other studies report a consistent association between anxiety and cognitive decline (Sinoff & Werner, 2003). Beyond decline, research has also found that symptoms of anxiety were the only consistent variables found in patients with diagnosed MCI (Forsell et al., 2003). Further investigation in this area appears appropriate.

Anxiety, Depression and Cognition

Presently, there appears to be a disconnect between empirical findings and clinical settings when it comes to the topic of elder adults and anxiety. The clinical opinion is that anxiety presentation in the elderly is typically comorbid anxiety-depression, however, comorbid presentation has a lower prevalence than either major depression or anxiety disorders alone (Schoevers et al., 2003). Furthermore, despite many clinicians' beliefs that most anxiety in older adults is comorbid with depression, anxiety alone is much more common than depression without comorbid anxiety (Beekman et al., 2000; van Balkom et al., 2000).

The relationship between anxiety and functioning appears important to examine both with and without the presence of depression. However, this picture is complicated by the fact that anxiety is a frequent comorbid condition of major depression for those with suspected dementia (Starkstein, Jorge, Petracca, & Robinson, 2007). Negative affect

states, impaired cognitive functioning, and possible future impairment risk are difficult topics to tease apart. Despite the difficulty in doing so, anxiety and depression both appear to play a role in cognitive change and decline. Therefore, a call for updating our knowledge base on negative affect states while bridging research and clinical worlds is necessary for appropriate identification, treatment and overall well-being of elders (Loebach Wetherell, Maser, & van Balkom, 2005). At this point research is in early phases of understanding anxiety and the role it possibly plays with cognitive change in adults. Further examination of anxiety and depression in the elderly should aid the overall conceptualization.

Specific Hypotheses to be Tested

Based upon the literature reviewed above, the specific hypotheses of the current study included the following aims:

1. Identify the size and unique proportion of variance anxiety (STAI State-score) and depression (GDS) each shared with cognitive performance (RBANS total score) while identifying the direction of each relationship. It was hypothesized that anxiety and depression each shared a significant proportion of variance and have negative relationships with cognitive performance. In other words, as anxiety and depression scores increase, cognitive performance scores decrease.

2. Examine how much of the variability in cognitive performance (RBANS Total score) State anxiety (STAI S-scale) accounted for above and beyond depression (GDS). It was hypothesized that anxiety accounted for significant variance above and beyond that of depression.

Methods

Participants

This retrospective study consisted of 220 patients between the ages of 65 and 89 years (M = 73.88, SD = 5.40 years) taken from a larger pool of 734 participants of varying ages who had completed the RBANS. After selecting adults age 65 years and older, the participant pool declined to 420, ranging from age 65 to 95 years (M = 75.24, SD = 6.20). A final N of 220 was determined after selecting those participants who scored a 23 or higher on the MMSE, had completed all other required measures, and participated in neuropsychological testing for the first time from 2001 to 2007, at OUHSC in Oklahoma City, OK.

Patients were referred to the Neuropsychological Assessment Laboratory at the Department of Psychiatry and Behavioral Sciences, a neuropsychology service of the outpatient clinic associated with Oklahoma University Health Sciences Center (OUHSC) located in Oklahoma City, Oklahoma. For this particular study, individuals, ages 65 years or older came from primary care physician practices throughout central Oklahoma and were assessed for various indicators of cognitive and health functioning. All individuals were referred for suspected cognitive decline and/or memory deficits.

Data of this nature has been consistently collected from the Oklahoma Longitudinal Assessment of Health Outcomes in Mature Adults (OKLAHOMA) study, described in detail in Duff et al. (2003). Staff members eliminated those participants judged to be unable to understand and sign informed consent. Demographic data for the final sample of the 220 healthy older adults is included in Table 3.1. Participants were chosen from this clinical database based on their completion of the variables of interest,

the MMSE, RBANS, GDS and STAI. Potential participants diagnosed with cognitive impairment due to brain injury, stroke, dementia, or psychotic disorders were excluded from the study. Patients were not excluded based on history of other chronic medical illnesses (e.g., hypertension, hypercholesterolemia, diabetes, etc.).

Design and Procedures

This retrospective examination of clinical data was gathered from the records of patients referred to OUHSC for neuropsychological testing. The procedures and instruments used were selected to assess overall cognitive functioning. Neuropsychological assessments usually consisted of a flexible battery of tests. This battery was comprised of a core battery of tests given to all patients, including the MMSE, RBANS, GDS and STAI, plus additional tests selected on the basis of individual presenting problem(s) and referral questions. A Master's level psychometrist, pre-doctoral interns, post-doctoral fellows, or a neuropsychologist administered tests. Average testing time varied from approximately 3 to 8 hours. Appropriate breaks were included to prevent fatigue effects.

Materials

The Mini-Mental State Examination

A brief and commonly used measure of cognitive status is the Mini-Mental State Examination (MMSE). It is widely used because it is useful, easy to administer, and assesses a wide range of cognitive functions. The MMSE was designed to measure global mental status. The measure consists of 30 items scored 0 for a false response and 1 for a correct response.

The MMSE was used as a screening measure for this study. A cutoff score of 23 has been suggested as the minimum score for borderline performance, yielding sensitivity of .36 and specificity of .98 (Schultz-Larson, 2007). Therefore, participants were selected based on scoring a 23 or higher on the MMSE.

The Repeatable Battery for the Assessment of Neuropsychological Status

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is a brief but comprehensive cognitive assessment. This 30-minute paper and pencil assessment is a nationally standardized, brief neuropsychological battery comprised of 12 subtests that yield five factor analytic Index scores: Immediate Memory, Visuospatial/Constructional ability, Language, Attention, and Delayed Memory (Randolph et al., 1998). The average reliability coefficients for the indexes are all in the .80s across age groups. The reliability coefficient for the RBANS Total Score is in the .90s across age groups, with an average of .94 (Randolph et al., 1998). The standardized administration and scoring procedures outlined in the manual were utilized for all subtests except for the scoring of the Figure Recall subtest. Modified scoring procedures were utilized for scoring, as described by Duff et al. (2003).

Geriatric Depression Scale

The GDS is a self report measure developed specifically for the use with elder patients. This measure places little emphasis on somatic complaints that often accompany normal aging and related chronic medical conditions common in this population. Emphasis instead is on other aspects of depressive symptoms appropriate for this targeted age group. The GDS has been proven both valid and reliable for measuring depressive symptoms in the elderly (Jonker et al., 2000). Designers of this study reported strong

internal consistency (alpha = .94) and test-retest reliability (*r* = .85) for this measure (Yesavage et al., 1983). This measure is a self-report measure consisting of 30 yes/no questions pertaining to potential symptoms of depression. The instrument was designed specifically for the elderly population by Spreen and Strauss (1998) and takes approximately 5 – 10 minutes to complete. A total score is obtained by adding the point values assigned to each response (0 or 1). The following cut-off points are used to determine depression level: 0-9 normal range; 10-19 declares mild depression; 20-30, moderate to severe depression (Spreen & Strauss, 1998).

State Trait Anxiety Inventory (Form Y)

The STAI measures both state and trait anxiety. The STAI Trait scale is capable of significantly discriminating between patients with and without an anxiety disorder. The STAI is a self-report measure consisting of 40 items pertaining to potential symptoms of anxiety. The first 20 items of the test measure state anxiety (STAI S-Anxiety scale), wherein subjects respond to the way that they are feeling in the present moment. This scale specifically measures present symptoms of acute anxiety. The second half of the test measures trait anxiety (STAI T-Anxiety scale). Respondents indicate how they generally feel. Questionnaires are scored by adding a weighted (1 to 4) scores of each item using the directions and scoring key provided in the Manual for the State-Trait Inventory (Form Y) (Speilberger et al., 1983). The raw scores range from a minimum of 20 to a maximum of 80. These scores are converted to and reported as T-scores. Median alpha coefficients for the state scale were .93, indicating strong internal consistency (Spielberger, 1983).

Results

The purpose of the present retrospective study was to investigate the relationships between anxiety, depression and cognitive functioning as measured through brief screening measures. Analyses were conducted using SPSS 15.0 (Statistical Package for the Social Sciences – Version 15.0).

An initial bivariate correlation matrix was constructed to examine the relationships between demographic variables, anxiety (STAI-S) (M = 56.8, SD = 12.2, N = 220), depression (GDS) (M = 9.4, SD = 5.9), and global cognitive performance (RBANS total) (M = 84.6, SD = 15.5). Significant Pearson product moment correlations are reported in Table 3.2. Examination of demographic variables indicated that education and gender were significantly correlated with the RBANS Total score. Since the correlation between anxiety and depression was not above .80 within this sample (r = .31, $p < .01$), it was determined that multicollinearity posed little threat to the models (Field, 2005). Further, to ensure that there were no interaction effects between the predictor variables, interaction effects were investigated through regression analyses by examining anxiety, depression and education in all their combinations. No meaningful interactions were found.

Related to the measures used in this study, this group of adults as a whole was non-anxious (STAI-S) (M = 56.8, SD = 12.2, N = 220), mildly depressed (GDS) (M = 9.4, SD = 5.9) and cognitive status was within normal limits (MMSE, M = 27.1, SD = 2.0). Mean scores and standard deviations for each measure are listed in table 3.3. Global cognitive functioning (MMSE) and depression scores (GDS) were relatively consistent across participants. The mild elevation in depression scores appears relatively consistent

with prevalence rates for the general population (Silverstein, 1999). Variation in anxiety (STAI) and global cognitive functioning scores (RBANS Total) were noted between genders (See Table 3.4). Females scored higher on measures of anxiety $t(218) = -3.82$, $p < .001$. Effect size was small, $r = .14$. Females were also lower on overall cognitive performance $t(218) = 2.18$, $p < .05$, $r = .25$. These findings appear consistent with clinical (Schaub & Linden, 2000; Schoevers, Beekman, Deeg, Jonker, & van Tilburg, 2003a; Silverstein, 1999) and educational cohort effects (Fritsch et al., 2007; van Hooren et al., 2007), also found within the general population.

To control for possible confounding demographic variables, age, gender and years of education were examined through regression analyses. Age produced no effects on RBANS Total score when years of education were controlled, therefore, age was dropped from future models. Gender was examined further and determined to be an important variable for inclusion with the model since independent t-tests concluded that females were more anxious and less educated than the males. To examine the variables for other confounds, a correlations test of dependent samples compared anxiety, depression, the GDS, STAI and the RBANS Total and revealed no significant differences between the measures.

The first hypothesis tested whether anxiety and depression shared a significant proportion of variance with cognitive performance. The second goal of the study was to examine how much of the variability in cognitive performance (RBANS Total score) State anxiety (STAI S-scale) accounted for above and beyond depression (GDS). Education was related to the RBANS Total score, while gender was determined to be an important factor for further consideration so both were added into the regression model as

the first step. Since this examination was exploratory in nature, depression was added as the second step of the model and anxiety added in the final step. Results are listed in Table 3.5 below.

Analyses of the overall model, (i.e., adding education and gender in step 1, depression in step 2, and anxiety into step 3) concluded that all 4 predictors accounted for a significant proportion of the variance in the total score (Adj R^2 = .10, F [4, 215] = 6.77, p < .001). In examining each of the variables, model 1 revealed education as significantly related to cognitive performance scores (β = .27, p < .001), accounting for approximately 8% of the variance in cognitive performance. Gender was not significant (β = -.08, p = .25). When depression was added into model 2, the variance increased less than 1% and was not significant, (β = -.09, p > .05). Finally, anxiety accounted for only a marginal amount of additional variance beyond education, gender and depression (β= -.12, p = .08; Adj R^2 change = .01, p = .08).

As an additional check, a second hierarchical regression was performed, with anxiety entered into the model before depression in order to examine the reverse influence of each on cognitive performance. Results were confirmatory, i.e., education, gender and anxiety each accounted for a significant but modest amount of variance while depression added little to the overall model (Table 3.6).

Discussion

The purpose of the present retrospective study was to investigate the relationships between anxiety, depression and global cognitive functioning as measured through brief screening measures. Previous studies examining negative affect states and cognitive performance findings have been contradictory and inconsistent. The present study was

exploratory in nature and aimed at gaining a better understanding of the relationship between depression, anxiety and cognitive performance in an aged sample.

Relationships among variables

Initial correlation analyses were broadly consistent with expectations. As predicted, inverse correlations were found between global cognitive functioning and negative affect states, indicating a negative relationship between several variables. To illustrate, as state anxiety scores increased overall cognitive performance correspondingly decreased. Demographic variables were not expected to share a relationship with cognitive performance beyond the effects of age and education. Consistent with previous research findings, age did not reliably correlate with overall cognitive performance in this older cohort, but education did, and appeared to function as a main effect within this study. The RBANS does not adjust for education, therefore education was expected to share a relationship with global cognitive performance within this study (Axelrod & Goldman, 1996; Duff et al., 2003).

Unexpectedly, gender shared a significant relationship with anxiety and the total cognitive score. Gender also shared a significant relationship with education, however, this finding is not unusual for this generational cohort. Further examination of the variables indicated a significant difference between males and females within this sample. Males were more educated and less anxious than females. These results appear consistent with cohort and clinical trends and were not considered to be due to gender differences in cognitive abilities.

Negative affect and cognitive performance

The first hypothesis examined the proportion of variance that anxiety and depression each shared with cognitive performance. Results indicated only a very modest relationship between anxiety and cognitive performance. Examining the individual variables indicated that when anxiety was added into the model before depression, while education and gender were controlled, anxiety was significant ($p < .05$). When depression was entered into the model first and controlled, anxiety still reached near significance. On the other hand, depression shared a nonsignificant relationship with overall cognitive performance when education, gender and anxiety were controlled. Further, no statistical differences were found between measures of anxiety, depression and the RBANS total score. This indicates that anxiety, at the levels reported here, is modestly important at the statistical level, but may not be important clinically.

The second goal of the study was to examine the amount of variability shared between cognitive performance and state anxiety, above and beyond depression. It was hypothesized that anxiety accounted for more variance than depression, however, again, anxiety only accounted for a very modest amount of variance beyond depression, when education and gender were entered into the model first. Taken together, results indicated that depression did not share a significant relationship with overall cognitive performance in this sample and anxiety shared only a limited relationship with reduced cognitive performance, when education, gender and depression were held constant. This suggests that anxiety's impact on global cognitive performance is not strong enough to be seen as clinically useful. Despite the practical importance of identifying anxiety and depression for treatment purposes, it appears that, at least in the population reported here, neither is

significantly linked with cognitive performance in a clinically meaningful way. Therefore, appropriate monitoring and identification of elders is particularly important when considering those individuals with reported changes in cognitive functioning, and/or qualify for a diagnosis of mild cognitive impairment. These individuals will benefit the most from appropriate identification of symptoms, appropriate classification and monitoring, and appropriate treatment planning (Petersen et al., 1999; Petersen et al., 2001).

Limitations and future directions

Although findings from the present study are modest, limitations may reduce generalizability. First, this study involved a restricted demographic sample of primarily Caucasian adults, with a relatively high mean age and education. Second, extremely cognitively impaired participants were screened out ahead of time to insure valid comparative self-report data. Finally, further investigation of the relationship between anxiety and global cognitive performance appears important since anxiety appeared to fluctuate with the inclusion and exclusion of depression. This appears to be a gray area in need of further examination. Future research should also examine individual cognitive domains that may be affected by anxiety for a better understanding of the mechanisms involved in reports of domain-specific impaired performance.

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Table 3.1: Demographic Information

Participants	Frequency	Percentage	Range	Mean	Standard Deviation
Males	90	40.9			
Females	130	59.1			
Age (years)	220		65 – 89	73.88	5.4
Education (years)	220		6 – 21	13.51	2.8
Race:					
Caucasian	203	92.3			
African American	13	5.9			
Native American	2	0.9			
Other	1	0.5			
Marital Status:					
Married	136	61.8			
Single	4	1.8			
Divorced	24	10.9			
Widowed	55	25			
Missing	1	0.5			

Table 3.2: Intercorrelations between demographics and screening measures

	1	2	3	4	5	6	7	8
1. Age in Years	--	.06	.01	-.02	-.11	-.01	-.26**	-.11
2. Gender		--	.11	-.25**	.01	.24**	-.01	-.15*
3. Race			--	.06	.03	-.07	.03	-.04
4. Ed				--	-.08	.01	.23**	.29**
5. GDS					--	.31**	.02	-.11
6. STAI-S						--	.02	-.15*
7. Mini-Mental State Exam Score							--	.61**
8. RBANS Total Index Score								--

** $p < 0.01$ (2-tailed). * $p < 0.05$ (2-tailed).

Note: Ed = Years of Education, GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State-Trait Anxiety Inventory State T score

Table 3.3: Descriptive statistics for measures

	N	Minimum	Maximum	Mean	Std. Deviation
Mini-Mental State Exam Score	220	23	30	27.4	2.0
Yesavage's Geriatric Depression Raw Score	220	1	27	9.4	5.9
Spielberger State-Trait Anxiety Inventory State T score	220	23	100	56.8	12.2
RBANS Total Index Score	220	44	133	84.6	15.5

Table 3.4: Descriptive statistics for measures broken down by gender

Gender		N	Minimum	Maximum	Mean	Std. Deviation
Male	Years of education	90	6	21	14.4	3.2
	Mini-Mental State Exam Score	90	23	30	27.4	2.0
	Yesavage's Geriatric Depression Raw Score	90	1	26	9.3	5.9
	Spielberger State-Trait Anxiety Inventory State T score	90	36	74	53.3	9.5
	RBANS Total Index Score	90	44	128	87.3	15.2
Female	Years of education	130	8	20	12.9	2.3
	Mini-Mental State Exam Score	130	23	30	27.4	2.0
	Yesavage's Geriatric Depression Raw Score	130	1	27	9.4	5.9
	Spielberger State-Trait Anxiety Inventory State T score	130	23	100	59.2	13.3
	RBANS Total Index Score	130	51	133	82.8	15.4

Table 3.5: Effects on RBANS Total cognitive performance

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education	1.51	0.37	.27***	1.47	0.36	.27***	1.54	0.37	.28***
& Gender	-2.43	2.19	-.08	-2.46	2.10	-.08	-1.46	2.16	-.05
GDS				-.23	0.17	-.09	-.12	0.18	-.05
STAI-S							-.16	0.09	-.12
Adj R^2		.08			.09			.10	
F for change in R^2		10.95***			1.77			3.11	

Note: Adj R^2 = .08 for Step 1, (p < .001); Adj R^2 = .09 for Step 2; Δ^2 = .01 for Step 2 (p = .18); Adj R^2 = .10 for Step 3; Δ^2 = .01 for Step 3 (p = .08). Note: * p < .05, ** p < .01, *** p < .001
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 3.6: Effects on RBANS Total cognitive performance

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	1.51	0.37	.27***	1.57	0.37	.28***	1.54	0.37	.28***
Gender	-2.43	2.10	-.08	-1.31	2.15	-.04	-1.46	2.16	-.05
STAI-S				-.17	0.08	-.14*	-.16	0.09	-.12
GDS							-.12	0.18	-.05
Adj R^2		.08			.10			.10	
F for change in R^2		10.95***			4.44*			.47	

Note: Adj R^2 = .08 for Step 1, (p < .001); Adj R^2 = .10 for Step 2; Δ^2 = .02 for Step 2 (p = .04); Adj R^2 = .10 for Step 3; Δ^2 = .00 for Step 3 (p = .50). Note: * p < .05, ** p < .01, *** p < .001
Note: STAI-S = Spielberger State- Trait Anxiety Inventory State T score, GDS = Yesavage's Geriatric Depression Raw Score

Chapter 4

AN EXAMINATION OF ANXIETY, DEPRESSION AND SPECIFIC COGNITIVE DOMAINS: THE USE OF BRIEF SCREENING MEASUSRES TO ASSESS COMMUNITY DWELLING AGING ADULTS[1]

[1]Austin, Amie L. and Miller, L. Stephen. To be submitted to *The Clinical Neuropsychologist*.

Abstract

This was a retrospective study aimed at identifying cognitive domains affected by anxiety and depression in adults. Identification of symptoms of anxiety and depression are important because they can mimic organic disease processes such as dementia. Brief screening measures like the Mini Mental State Examination (MMSE), and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Geriatric Depression Scale (GDS) and the State-Trait Anxiety Inventory (STAI) are useful in detecting a variety of psychiatric or neurologic disorders. The purpose of this study was to examine the relationships between anxiety, depression and specific cognitive domains of functioning in the aging. Anxiety and depression each shared significant variance with measures of attention when demographic variables were held constant, but had little impact on other cognitive domains.

Introduction

Depression is a treatable disorder that has been linked with functional decline. It may be particularly important to detect and treat depression in the elderly, due to suspected links with cognitive decline and dementia (Dotson, Resnick, & Zonderman, 2008). To date, some research is confirming a relationship between depression and specific cognitive domains (i.e., memory deficits) (Gonzalez et al., 2008). Unfortunately, findings have been inconsistent and at times contradictory (Barclay, 2005). Some studies are claiming that depression predicts cognitive decline in older adults (Chodosh, Kado, Seeman, & Karlamangla, 2007; Dotson et al., 2008), while other studies contradict this finding (Boone et al., 1994; Comijs et al., 2004). A literature review easily reveals conflicting evidence about the roles of depression on cognitive changes over time (Barclay, 2005).

Contradictory or discrepant findings may be partially due to difficulty in separating cognitive complaints from confounding negative affect states since some symptoms are reported changes in specific domains of cognitive functioning (e.g., difficulty concentrating) (Kindermann & Brown, 1997). Similarly, there are also debates on the specific domains affected, if at all. For example, a large meta-analysis of depression and cognitive functioning in older adults found some evidence to suggest a relationship between depression, learning, and memory, but again highlighted discrepancies in research findings (Gonzalez et al., 2008; Kindermann & Brown, 1997). Other studies sought to examine independent cognitive domains affected and determined that processing speed and executive dysfunction were the most common deficits coupled with late life depression (Herrmann, Goodwin, & Ebmeier, 2007; Sheline et al., 2006). A

different study utilizing a large sample size concluded that depressive mood was associated with decreased processing speed and motor functioning, but not executive control functioning (Baune, Suslow, Engelien, Arolt, & Berger, 2006). Due to these inconsistent findings, researchers do not fully understand whether such relationships exist. Beyond that, identification of specific domains and the strength of the relationship between depressive symptoms and poor performance in those domains have not been determined.

Despite empirical inconsistencies, the clinical realm needs answers. Clinically, depression is under diagnosed and under treated in the elderly (Gottfries, 2001). Because it is possible to distinguish and treat late-life depression from other geriatric illnesses (Katz, 1996) and because of potential consequences of functional decline and associated complications (Dotson et al., 2008), this line of research appears necessary and viable.

There is also a growing body of evidence supporting the idea that anxiety impairs cognitive functioning in elders (Sinoff & Werner, 2003); specific domains may be affected by anxiety as well. One study set out to determine whether comorbid anxiety disorders, specifically GAD or PD, were associated with poorer longitudinal outcomes of late-life depression. Unexpectedly, researchers found that participants with anxiety symptoms demonstrated greater decline in memory, but not other cognitive domains or functional status (DeLuca et al., 2005). It appears that memory complaints were found to strongly relate to affective status, particularly with severe anxiety symptomatology. This is also related to subjective assessment of well-being in older adults (Derouesne et al., 1999). Other studies also confirm a possible connection between anxiety and memory functioning and/or reports of memory difficulties. For example, Sinoff (2003) found that

anxious participants scored lower on memory tasks than non-anxious participants. It was also found that anxiety and memory loss were strongly inter-related (Sinoff & Werner, 2003). This could be because of impaired attention and learning, as anxiety may be affecting rehearsal and storage of information, namely working memory (Eysenck, 1979; Rapee, 1993).

Whether anxiety is affecting other specific cognitive domains remains under investigation. One study concluded that anxiety was related to attention, divided attention, and executive functioning, however, specific connections between symptoms of anxiety as they relate to particular cognitive processes are still unknown (Barclay, 2005). Some research shows that anxiety may adversely affect sustained attention, but this finding is not consistent in verbal and figural memory tasks (Rankin et al., 1994). Other research shows that anxiety can impair performance on tasks that are perceived as "difficult." This may be particularly true under test conditions (Eysenck & Calvo, 1992; Miesner & Maki, 2007). Other theorists argue that anxiety causes worry which in turn impairs performance on tasks with high attentional or memory demands (Crowe, Matthews, & Walkenhorst, 2007; Humphreys & Revelle, 1984; Sarason, 1984).

Anxiety may be affecting attention. Information processing is one area of research where attention and stages of learning and memory are examined. The Processing Efficiency theory comes from this line of research and postulates that effectiveness and efficiency are central to task performance. Effectiveness refers to response accuracy, while efficiency refers to the relationship between effectiveness and effort spent during task performance (Eysenck et al., 2007). Anxiety appears to affect processing efficiency, and thusly may be affecting measured performance. To expand further, processing

efficiency theory came from Baddeley's model of working memory (Baddeley, 2001). The idea is that working memory capacity is limited and subject to influence. Several researchers believe that anxiety may affect this process and can be observed and measured through learning and memory tasks (Dickson, 1999; Eysenck & Calvo, 1992; Eysenck et al., 2007). How elders perform according to the efficiency processing theory remains to be seen.

In review, despite some contradictory findings, growing evidence suggests that anxiety is related to cognitive functioning. In particular, attention, learning and memory tasks may be most susceptible to impairment in an aging sample. Further research on anxiety and its relationship with specific cognitive domains is warranted. Taken together, anxiety appears to be affecting cognitive functioning in global and specific ways. The examination of anxiety and its effect on cognitive functioning in an aging population are still in their early phases. However, the association is gaining acceptance as studies continue to find consistent relationships between anxiety and cognitive decline.

There are also issues with comorbid anxiety and depression. Although prevalence rates indicate higher prevalence of pure anxiety or pure depression, it is rare to review an article or see a patient who describes anxiety without reporting symptoms of depression and vice versa. Comorbid anxiety-depressive symptoms thus warrant further investigation. Research on specific anxiety disorders has shown that anxiety is related to testable decline in memory (Sinoff & Werner, 2003). This may lead clinicians to believe that anxiety is a strong mediating factor for reported memory problems. However, findings from this same study suggest that patients with comorbid anxiety disorders have a greater decline in memory in late-life when major depression is also present. Beyond

cognitive decline, the data also suggest that the onset of anxiety disorders later in life may be associated with future cognitive impairment (DeLuca et al., 2005). Inspection of negative affects states reveals that anxiety is a frequent comorbid condition of major depression for those with suspected dementia (Starkstein et al., 2007). This unfortunately complicates the picture. However, since anxiety and depression both appear to share some relationship in cognitive change and decline for older adults, and appear to particularly relate to attention and memory, we hypothesized that anxiety and depression would correlate more strongly with measures of attention (RBANS Attention Index) and memory (Immediate and Delayed Memory Index scores) than with other cognitive domains.

Methods

Participants

An original participant pool consisted of 734 adults who had completed the RBANS. After selecting adults age 65 years and older, the participant pool declined to 420. A final N of 220, ranging from age 65 to 89 years (M = 73.88, SD = 5.40) was determined after selecting those participants who scored a 23 or higher on the MMSE, had participated in neuropsychological testing for the first time at the University of Oklahoma Health Sciences Center (OUHSC) in Oklahoma City, OK, and completed all other required measures. Records examined were from 2001 to 2007.

Design and Procedures

Clinical data was gathered from the records of patients referred to OUHSC for neuropsychological testing. This examination was retrospective in nature. The procedures and instruments used were a part of neuropsychological assessments and were selected to

assess domain specific cognitive functioning. These assessments typically consisted of a flexible battery of tests, comprised of a core battery plus additional tests selected on the basis of individual presenting problem(s) and referral questions. A Master's level psychometrist, pre-doctoral interns, post-doctoral fellows or a neuropsychologist administered the tests. Testing time varied from approximately 3 to 8 hours. Appropriate breaks were included to prevent fatigue effects.

Materials

The Mini-Mental State Examination

A brief and commonly used measure of cognitive status is the Mini-Mental State Examination (MMSE). The MMSE was designed to measure global mental status. It is widely used because it is useful, easy to administer, and assesses a wide range of cognitive functions. The measure consists of 30 items scored 0 for a false response and 1 for a correct response.

The MMSE was used as a screening measure for this study. A cutoff score of 23 has been suggested as the minimum score for borderline performance, yielding sensitivity of .36 and specificity of .98 (Schultz-Larson, 2007). Therefore, participants were selected based on scoring a 23 or higher on the MMSE.

The Repeatable Battery for the Assessment of Neuropsychological Status

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is a brief but comprehensive cognitive assessment. This 30-minute paper and pencil assessment is a nationally standardized, brief neuropsychological battery comprised of 12 subtests that yield five factor analytic Index scores: Immediate Memory, Visuospatial/Constructional ability, Language, Attention, and Delayed Memory

(Randolph et al., 1998). The average reliability coefficients for the indexes are all in the .80s across age groups. The reliability coefficient for the RBANS Total Score is in the .90s across age groups, with an average of .94 (Randolph et al., 1998). The standardized administration and scoring procedures outlined in the manual were utilized for all subtests except for the scoring of the Figure Recall subtest. Modified scoring procedures were utilized for scoring, as described by Duff et al. (2003).

Geriatric Depression Scale

The GDS is a self report measure developed specifically for the use with elder patients. This measure places little emphasis on somatic complaints. Emphasis instead is on other aspects of depressive symptoms appropriate for this targeted age group. The GDS has been proven both valid (alpha = .94) and reliable (r = .85), and is a clinically sound tool for measuring depressive symptoms in the elderly (Jonker et al., 2000; Yesavage et al., 1983). This measure is a self-report measure consisting of 30 yes/no questions pertaining to potential symptoms of depression. The instrument was designed specifically for the elderly population by Spreen and Strauss (1998) and takes approximately 5 – 10 minutes to complete. A total score is obtained by adding the point values assigned to each response (0 or 1). The following cut-off points are used to determine depression level: 0-9 normal range; 10-19 declares mild depression; 20-30, moderate to severe depression (Spreen & Strauss, 1998).

State Trait Anxiety Inventory (Form Y)

The STAI measures both state and trait anxiety. The STAI Trait scale is capable of significantly discriminating between patients with and without an anxiety disorder. The STAI is a self-report measure consisting of 40 items pertaining to potential

symptoms of anxiety. Median alpha coefficients were .93 for the state scale (Spielberger, 1983), indicating strong internal consistency. The first 20 items of the test measure state anxiety (STAI S-Anxiety scale), wherein subjects respond to the way that they are feeling in the present moment. This scale specifically measures present symptoms of acute anxiety. The second half of the test measures trait anxiety (STAI T-Anxiety scale). Respondents indicate how they generally feel. Questionnaires are scored by adding a weighted (1 to 4) scores of each item using the directions and scoring key provided in the Manual for the State-Trait Inventory (Form Y) (Speilberger et al., 1983). The raw scores range from a minimum of 20 to a maximum of 80. These scores are converted to and reported as T-scores.

Results

Analyses were conducted using SPSS 15.0 (Statistical Package for the Social Sciences – Version 15.0). From the original participant pool of 734 adults, 220 participants were selected based on a score of 23 or higher on the MMSE and completed all other requirements.

Demographic variables were examined. As a whole, this group of adults was non-anxious (STAI-S) (M = 56.8, SD = 12.2, N = 220), mildly depressed (GDS) (M = 9.4, SD = 5.9) and cognitive status was within normal limits (MMSE, M = 27.1, SD = 2.0). Mean scores on measures used within this study are listed in table 4.3. Global cognitive functioning was relatively consistent between participants. Depression scores were mildly elevated but relatively consistent with prevalence rates within the general population (Silverstein, 1999). Anxiety and global cognitive performance scores, however, were different between genders. Specifically, females scored lower on overall cognitive

performance $t(218) = 2.18$, $p < .05$, $r = .25$ and higher on measures of anxiety $t(218) = -3.82$, $p < .001$, $r = .14$. See Table 4.4. However, this appears consistent with clinical (Schaub & Linden, 2000; Schoevers et al., 2003; Silverstein, 1999) and educational cohort effects (Fritsch et al., 2007; van Hooren et al., 2007) found within the general population.

An initial bivariate correlation matrix was constructed to examine the relationships between demographic variables (see table 4.1), anxiety (STAI-S) ($M = 56.8$, $SD = 12.2$, $N = 220$), depression (GDS) ($M = 9.4$, $SD = 5.9$), and specific cognitive domains (RBANS Index scores). A correlation matrix of all variables along with significant Pearson product moment correlations are reported in Table 4.2. Of the demographic variables, education was significantly correlated with several of the RBANS measures including the Immediate Memory Index ($M = 84.2$, $SD = 17.4$), Attention Index ($M = 87.3$, $SD = 15.7$), and Delayed Memory Index ($M = 82.6$, $SD = 22.0$), but was not significantly correlated with the Language Index ($M = 89.2$, $SD = 13.9$). Education and gender were both significantly correlated with the Visuospatial/Constructional Index ($M = 98.1$, $SD = 16.5$). Since the correlation between anxiety and depression was not above .80 within this sample ($r = .31$, $p < .01$), it was determined that multicollinearity posed little threat to the models (Field, 2005).

In an attempt to control for possible confounding demographic variables, age, gender and years of education were examined through regression analyses. Age produced no reliable effects on RBANS Total score when years of education were controlled ($p > .05$), therefore, age was dropped from future models. However, since gender and education shared significant relationships with global cognitive functioning, as measured

by the RBANS Total Score (*p*s < .05), both variables were kept in the model for this study. Finally, a correlations test of dependent samples compared anxiety, depression, the GDS, STAI and the RBANS Total and revealed no significant differences between the measures used.

The goal of this study was to examine each of the five RBANS Index scores through hierarchical analyses with education and gender, depression and anxiety. The purpose was to investigate hypothesized relationships and examine the utility of the model within individual cognitive domains. For each of the RBANS Index scores, education and gender were included in Model 1, depression was added in Model 2, and anxiety in Model 3. Results appear in Tables 4.5 – 4.9.

For the RBANS Immediate Memory Index scores, all four predictors together accounted for a significant amount of the variance in immediate memory test scores Adj R^2 = .07; F (4, 215) = 5.29, p < .001). Education (β = .25, p < .001) was the only significant individual variable, accounting for variance in immediate memory performance. The four predictors together accounted for a significant amount of the variance in Visuospatial/Constructional Index scores (Adj R^2 = .08; F (4, 215) = 5.95, p < .001). However, this was almost entirely accounted for by education (β = .23, p < .01). Depression and anxiety were not significant throughout the model. The four variables did not account for a significant amount of variance in Language Index scores (Adj R^2 = -.01; F (4, 215) = 0.60, p = .66). All four variables together accounted for a significant amount of variance the Attention Index score (Adj R^2 = .14; F (4, 215) = 10.16, p < .001). Of the individual variables, education and gender shared approximately 8% of the variance with attention, depression shared approximately 3% of the variance, and anxiety accounted for

an additional 5% when added to model 3. Finally, none of the variables shared significant variance with delayed memory (Adj R^2 = .01; F (4, 215) = 1.31, p = .27).

In an effort to further explore the relationship between negative affect and cognitive domains, bivariate correlations were run at the level of individual RBANS subtest scores. This was done to determine which subtests significantly contributed to the variance accounted for in the index scores identified through regression analyses. Of the Attention Index subtest scores, Digit Span $r(218)$ = -.17, p < .05 and Coding $r(218)$ = -.16, p < .05 were both significantly correlated with anxiety. Coding was the only measure to significantly correlate with depression $r(218)$ = -.15, p < .05. Correlations appear in Table 4.10.

Discussion

Contradictory and inconsistent evidence has been reported throughout research with regard to negative affect states and cognitive performance. The purpose of this exploratory, retrospective study was to investigate the relationships between anxiety, depression and specific domains of cognitive functioning as measured through brief screening measures.

Relationships among variables

Initial correlation analyses examining demographics, negative affect and specific cognitive domains were relatively consistent with expectations. As predicted, inverse correlations were found between a selection of measures of cognitive domains and negative affect states. Consistent with some previous research findings, age did not reliably correlate with the other variables, but education appeared to function as a main effect within this study. Unexpectedly, gender shared a significant relationship with

anxiety. Gender also shared a significant relationship with education, however, this finding is not unusual for this generational cohort. Further examination of the variables indicated a significant difference between males and females within this sample. Specifically, males were significantly less anxious than females and more educated. These results appear consistent with clinical and cohort trends and were not considered to be due to cognitive gender differences. However, as a result of these findings, gender was also identified as a variable of interest and was included in the models with education. Education shared a significant relationship with RBANS Immediate Memory, Visuospatial/Constructional and Attention Indexes. Gender initially shared a significant relationship with Visuospatial/Constructional index scores, before depression and anxiety were introduced into the model.

Negative affect and cognitive domains

Beyond demographic exploration, previous research findings on this same population indicated that anxiety shared marginally significant variance with global cognitive performance (Austin, Miller, Scott, & Adams, unpublished). In an attempt to expand on this research, specific cognitive domains were examined to determine potential relationships with anxiety and/or depression.

It was hypothesized that anxiety and depression would correlate with specific cognitive domains, particularly measures of attention (RBANS Attention Index) and memory (Immediate and Delayed Memory Index scores). Part of this hypothesis was supported. Specifically, negative affect states only correlated with the attention index score. Consistent with our hypotheses, anxiety shared significant variability with the RBANS Attention index score. Therefore, the RBANS Attention Index, comprised of

Digit Span and Coding subtests, was examined further. Examinations of the two subtests of the Attention Index indicated that both were statistically significant with anxiety. This demonstrated that anxiety shared a negative relationship with both auditory and visual attention. In summary, anxiety shared a significant portion of variance with attention. Further, anxiety maintained significant relationships with these measures when depression and education were held constant.

Depression initially shared a significant relationship with attention until anxiety was entered into model 3. However, the full model continued to share significant variance with attention when all four variables were present. These findings suggest that depression and anxiety both share some relationship with attention, even independent of education and gender effects. Consistent with hypotheses, as reported anxiety or depression scores increased, performance on attention measures decreased.

Specific subtest examinations indicated that measures of auditory (i.e., Digit Span) and visual scanning/visuomotor attention tasks (i.e., Coding) were impaired by anxiety. Only the visuomotor task (i.e., Coding) was impaired with reports of increased depression. Overall, results indicate that anxiety appears to plays a limited role in reduced functioning in auditory and visual attention and visuomotor abilities, while depression shares only a very modest relationship with visual attention for this particular population sample.

Possible explanations for our findings

One place to start when examining results is with the tool of measurement itself. A noteworthy finding in a study that attempted to break the RBANS into component structures found that the Attention Index involves one verbal (i.e., Digit Span) and one

visuomotor task (i.e., Coding). From that study, attention did not emerge as a single underlying construct, but instead, Digit Span loaded onto a Verbal Processing component while Coding loaded into a Visuomotor Processing component (Garcia, Leahy, Corradi, & Forchetti, 2008). The reported divergence of these subtests emphasizes the importance of examining individual subtests, in addition to index and overall performance scores, when interpreting RBANS results. According to this model, participants with elevated anxiety scores in the present study appeared to experience specific difficulties in verbal processing and/or visuomotor processing components. Those persons with elevated depression scores appeared to perform more poorly on the visuomotor processing task.

Theoretically, the present findings could also tie in well with the processing efficiency model which states that anxiety likely affects quality of task performance and response accuracy, also known as effectiveness. The model further states that anxiety may also affect the relationship between performance effectiveness and effort/resources spent on the task. This is known as efficiency. Research shows that anxiety impairs efficiency more than effectiveness (Eysenck & Calvo, 1992). To support this, several studies found efficiency decreased as more resources were invested to attain a given performance level (Eysenck & Calvo, 1992). For the present study, elders may have been taxed by the testing situation and as a result experienced increased state anxiety. Their poor performance in attention measures (e.g., verbal and/or visuomotor processing components) may have been due to compromised efficiency.

Limitations and future directions

Although findings from the present study provide some additional information about negative affect states and their relationships with specific cognitive domains,

limitations may reduce generalizability. First, this sample of participants was demographically limited in terms of race, age and education. This sample was primarily Caucasian and had a relatively high mean age and education level. Second, participants were specifically selected if they scored a 23 or higher on the MMSE. Therefore this sample represents individuals with suspected memory disturbance who were at least functioning within marginal ranges of functional status. Finally, another noteworthy issue involves the RBANS as a clinical measure. Although it is a very useful screening measure often used in research to measure verbal and nonverbal learning, memory, visuospatial/constructional, attention, and language, it does not measure executive functioning skills such as reasoning and problem solving. Executive functioning could be affected by negative affect states as well and should be investigated further. Tests that measure these abilities in conjunction with depression, anxiety and cognition could offer further insight into adult functioning, and are recommended.

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Table 4.1: Demographic Information

Participants	Frequency	Percentage	Range	Mean	Standard Deviation
Males	90	40.9			
Females	130	59.1			
Age (years)	220		65 – 89	73.88	5.4
Education (years)	220		6 – 21	13.51	2.8
Race:					
Caucasian	203	92.3			
African American	13	5.9			
Native American	2	0.9			
Other	1	0.5			
Marital Status:					
Married	136	61.8			
Single	4	1.8			
	24				
Divorced	10.9	10.9			
Widowed	55	25			
Missing	1	0.5			

Table 4.2: Intercorrelations between demographics and screening measures

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age in Years	--	.06	.01	-.02	-.11	-.01	-.26**	-.10	-.05	-.19**	-.01	-.08
2. Gender		--	.11	-.25**	.01	.24**	-.01	-.12	-.20**	-.07	-.05	-.11
3. Race			--	.06	.03	-.07	.03	.01	-.06	-.03	.05	-.10
4. Ed				--	-.08	.01	.23**	.27**	.26**	.08	.30**	.13*
5. GDS					--	.31**	.02	-.13*	-.07	-.02	-.18**	-.01
6. STAI-S						--	.02	-.06	-.15*	-.05	-.24**	-.03
7. Mini-Mental State Exam Score							--	.53**	.29**	.41**	.35**	.60**
8. RBANS Immediate Memory Index								--	.21**	.44**	.33**	.70**
9. RBANS Visuospatial/Constructional Index									--	.25**	.44**	.24**
10. RBANS Language Index										--	.30**	.44**
11. RBANS Attention Index											--	.27**
12. RBANS Delayed Memory Index												--

** $p < 0.01$ (2-tailed). * $p < 0.05$ (2-tailed).

Note: Ed = Years of Education, GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State-Trait Anxiety Inventory State T score

Table 4.3: Descriptive statistics for measures

	N	Minimum	Maximum	Mean	Std. Deviation
Mini-Mental State Exam Score	220	23	30	27.4	2.0
Yesavage's Geriatric Depression Raw Score	220	1	27	9.4	5.9
Spielberger State-Trait Anxiety Inventory State T score	220	23	100	56.8	12.2
RBANS Total Index Score	220	44	133	84.6	15.5

Table 4.4: Descriptive statistics for measures broken down by gender

Gender		N	Minimum	Maximum	Mean	Std. Deviation
Male	Years of education	90	6	21	14.4	3.2
	Mini-Mental State Exam Score	90	23	30	27.4	2.0
	Yesavage's Geriatric Depression Raw Score	90	1	26	9.3	5.9
	Spielberger State-Trait Anxiety Inventory State T score	90	36	74	53.3	9.5
	RBANS Total Index Score	90	44	128	87.3	15.2
Female	Years of education	130	8	20	12.9	2.3
	Mini-Mental State Exam Score	130	23	30	27.4	2.0
	Yesavage's Geriatric Depression Raw Score	130	1	27	9.4	5.9
	Spielberger State-Trait Anxiety Inventory State T score	130	23	100	59.2	13.3
	RBANS Total Index Score	130	51	133	82.8	15.4

Table 4.5: Effects on RBANS Immediate Memory Index

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	1.60	0.42	.26***	1.54	0.42	.25***	1.55	0.42	.25***
Gender	-1.98	2.38	-.06	-2.03	2.37	-.06	-1.90	2.46	-.05
GDS				-.33	0.19	-.11	-.32	0.21	-.11
STAI-S							-.02	0.10	-.01
Adj R^2		.07			.08			.07	
F for change in R^2		9.05***			2.94			.04	

Note: Adj R^2 = .07 for Step 1, (p < .001); Adj R^2 = .08 for Step 2; Δ^2 = .01 for Step 2 (p = .09); Adj R^2 = .07 for Step 3; Δ^2 = .00 for Step 3 (p = .85). Note: * p < .05, ** p < .01, *** p < .001
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 4.6: Effects on RBANS Visuospatial/Constructional Index

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	1.31	0.39	.22**	1.28	0.40	.22**	1.35	0.40	.23**
Gender	-4.72	2.24	-.14*	-4.75	2.24	-.14*	-3.70	2.32	-.11
GDS				-.14	0.18	-.05	-.03	0.19	.01
STAI-S							-.16	0.10	-.12
Adj R^2		.08			.08			.08	
F for change in R^2		10.10***			.57			2.88	

Note: Adj R^2 = .08 for Step 1, (p < .001); Adj R^2 = .08 for Step 2; Δ^2 = .00 for Step 2 (p = .45); Adj R^2 = .08 for Step 3; Δ^2 = .01 for Step 3 (p = .09). Note: * p < .05, ** p < .01, *** p < .001
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 4.7: Effects on RBANS Language Index

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	0.33	0.35	.07	0.33	0.35	.07	0.35	0.35	.07
Gender	-1.60	1.98	-.06	-1.60	1.98	-.06	-1.30	2.05	-.05
GDS				-.03	0.16	-.01	.00	0.17	.00
STAI-S							-.05	0.08	-.04
Adj R^2		.00			-.00			-.01	
F for change in R^2		1.04			0.04			0.31	

Note: Adj R^2 = .00 for Step 1, (p = .36); Adj R^2 = -.00 for Step 2; Δ^2 = .00 for Step 2 (p = .84); Adj R^2 = -.01 for Step 3; Δ^2 = .00 for Step 3 (p = .58). Note: * p < .05, ** p < .01, *** p < .001
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 4.8: Effects on RBANS Attention Index

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	1.70	0.37	.31***	1.63	0.37	.29***	1.75	0.37	.31***
Gender	.83	2.13	.03	.76	2.11	.024	2.66	2.13	.08
GDS				-.42	0.17	-.16*	-.23	0.18	-.08
STAI-S							-.30	0.09	-.23*
Adj R^2		.08			.10			.14	
F for change in R^2		10.67***			6.05*			11.41**	

Note: Adj R^2 = .08 for Step 1, (p < .001); Adj R^2 = .10 for Step 2; Δ^2 = .03 for Step 2 (p = .02); Adj R^2 = .14 for Step 3; Δ^2 = .05 for Step 3 (p = .001). Note: * p < .05, ** p < .01, *** p < .001
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 4.9: Effects on RBANS Delayed Memory Index

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Education &	0.89	0.54	.11	0.89	0.55	.11	0.90	0.55	.12
Gender	-3.54	3.09	-.08	-3.53	3.10	-.08	-3.32	3.22	-.07
GDS				.01	0.25	.00	.03	0.27	.01
STAI-S							-.03	0.13	-.02
Adj R^2		.02			.01			.01	
F for change in R^2		2.62			.00			.06	

Note: Adj R^2 = .02 for Step 1, (p = .08); Adj R^2 = .01 for Step 2; Δ^2 = .00 for Step 2 (p = .97); Adj R^2 = .01 for Step 3; Δ^2 = .00 for Step 3 (p = .80). Note: * $p < .05$, ** $p < .01$, *** $p < .001$
Note: GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State- Trait Anxiety Inventory State T score

Table 4.10: Intercorrelations between RBANS Subtest Scores and measures

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Gender	--	-.25**	.01	.24**	.03	-.21**	-.08	-.20**	-.26**	.08	-.06	-.02	.03	-.06	-.20**	-.21**
2. Ed		--	-.08	.01	.17*	.27**	.15*	.23**	.05	.11	.13	.33**	.09	.06	.17**	.13**
3. GDS			--	.31**	-.12	-.10	-.12	.00	.01	-.07	-.11	-.15*	-.01	.04	.01	.01
4. STAI-S				--	-.01	-.12	-.14*	-.08	-.07	-.02	-.17*	-.16*	-.09	.00	-.08	-.04
5. List Learning					--	.61**	.07	.28**	.27**	.49**	.11	.43**	.63**	.46**	.58**	.42**
6. Story Memory						--	.08	.32**	.37**	.39**	.11	.38**	.50**	.52**	.77**	.50**
7. Figure Copy							--	.36**	.02	.16*	.12	.34**	.11	.05	.08	.24**
8. Line Orientation								--	.33**	.25**	.26**	.42**	.22**	.13	.24**	.32**
9. Picture Naming									--	.38**	.09	.26**	.21**	.25**	.31**	.28**
10. Semantic Naming										--	.04	.53**	.41**	.33**	.38**	.43**
11. Digit Span											--	.18**	.03	.00	.06	.08
12. Coding												--	.27**	.33**	.31**	.32**
13. List Recall													--	.41**	.66**	.50**
14. List Recognition														--	.61**	.49**
15. Story Recall															--	.65**
16. Figure Recall																--

** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.
Note: Ed = Years of Education, GDS = Yesavage's Geriatric Depression Raw Score, STAI-S = Spielberger State-Trait Anxiety Inventory State T Score

Chapter 5

Discussion and Conclusions

Several expected and unexpected findings emerged from this study. Consistent with expectations, education shared significant variance with global cognitive performance. Unexpectedly, gender was also identified as sharing variance with global cognitive performance. Further investigation of these variables indicated that the males within this sample were more educated and less anxious than the females. These trends appear consistent with cohort and clinical trends, and were not thought to be due to cognitive gender differences. Somewhat unexpectedly, depression did not account for significant variance in global cognitive performance when other variables were held constant. Anxiety however, shared marginal variance with global cognitive performance when education, gender effects and depression were held constant. When specific cognitive domains were examined, depression and anxiety shared a negative relationship with attention. As reported anxiety or depression increased, performance in these domains appeared to decrease. Unexpectedly, anxiety and depression did not share significant variance with measures of memory.

Marginal relationships found between anxiety and cognitive performance are interesting but should be interpreted with caution. In the present study, gender appeared to be related to anxiety and global cognitive performance. However, educational and clinical differences were found between the male and female participants. Females were scoring significantly higher than males on the anxiety measure and performed worse on the global cognitive measures. Regardless of these findings, it is of interest that anxiety appeared to affect cognitive performance when education, gender and depression were

held constant. These were only marginal findings however, and should be interpreted with caution.

Contrary to some previous literature, these marginal findings support the importance of carefully attending to patients' cognitive performance over and above their negative affect. It does not appear that anxiety nor depression impact cognitive performance in a significant way in our sample, therefore clinicians should attend to reports of cognitive change with invested interest. Overall, this study appears to support the idea that anxiety and perhaps depression may be related to attentional difficulty, but those effects are unlikely to be clinically meaningful.

Possible explanations for our findings

One possible explanation for these findings involves the physiology of the older adult brain. Differences between younger and older adult performance in neuropsychological testing is well documented throughout the literature. Brain changes and accompanying performance changes are a normal part of the aging process and are expected. For example, there are inverse negative correlations between hippocampal volume and memory performance, as evidenced by cross sectional and longitudinal research. In addition, older adults may have increased stress reactivity in the testing environment. Part of the explanation for differences in stress responses between young and older adults may be due to the differences in hippocampal density between the two groups (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007). This may lend some explanation as to why adults in this study appeared to perform more poorly on several cognitive tasks as their reported state anxiety increased, but this is not a complete picture.

An investigation of pathophysiology may offer another explanation for the influence of anxiety on cognitive performance. One theory postulates that elevated cortisol levels appear to coincide with stress and aging alike (Lupien et al., 2007). Preclinical studies have informed us that the expression of anxiety symptoms and behaviors are related to changes in the hypothalamic-pituitary-adrenocortical (HPA) system and related cortisol release, which in turn may be affect global cognitive performance. Some research suggests that stress impairs cognitive and physiological measures with the most evident cognitive impairments following stress exposure (Robinson, Sunram-Lea, Leach, & Owen-Lynch, 2008). Therefore anxiety and stress appear to be influencing cognitive mechanisms. The present study offers supporting evidence for the relationship between increased reports of state anxiety and decreased overall cognitive performance.

Specific cognitive domains have also been examined in the literature and within the present study. Previous studies indicate that working memory may be susceptible to elevations in cortisol and therefore affects declarative memory. This could account for reported effects of corticosteroids on acquisition and consolidation of information (Lupien, Gillin, & Hauger, 1999). Therefore anxiety and stress could be influencing the very mechanisms needed for attending, processing and consolidation of information. However, the present study only offers evidence supporting the relationship between increased reports of state anxiety and decreased attention performance. Poor performances in memory measures were not significant.

While some research has indicated that cortisol influences cognitive functioning and anxiety responses, others have speculated about pathophysiological comparisons

between depression and anxiety. Some studies have confirmed that both depression and anxiety appear to have impaired HPA system regulation, thus supporting the idea that impairment is involved in the pathophysiology of both of these negative affect states (Erhardt et al., 2006; Reppermund et al., 2007). But depression did not share a strong relationship with overall cognitive functioning within this study, when anxiety was controlled. Correspondingly, other studies suggest that persons with depression may not necessarily express cognitive impairment. Data from one study supports assumptions that psychopathological symptoms and HPA system dysregulation can be dissociated from the effects on cognitive functioning in depressed patients. Findings indicate that levels of cortisol appeared to be unrelated to cognitive performance for some depressed patients (Reppermund et al., 2007). This may offer some explanation for the findings of this study. Ultimately, a better understanding of how the suppression effects affect the biological mechanisms of HPA system dysregulation is still needed and would provide us with more insight as to how these systems are affecting cognitive performance in elders, across disorders.

Theoretically, the present findings could tie in with the cognitive model of "processing efficiency" (Eysenck, 1979), wherein anxiety is affecting the quality of task performance and response accuracy, also known as effectiveness. Within this same model, anxiety may be also affecting the relationship between performance effectiveness and effort/resources spent on the task, also known as efficiency. It has been reported that anxiety typically impairs efficiency more than effectiveness, however (Eysenck & Calvo, 1992). Findings from studies investigating this theory indicate that efficiency decreases as more resources are invested to attain a given performance level (Eysenck & Calvo,

1992). With regard to the present study, elders may be experiencing increased state anxiety while taxed by the testing situation, thus efficiency is compromised and overall cognitive performance suffers.

Within the processing efficiency model, the effects of anxiety on specific domain functioning can be explored further. A second assumption of the processing efficiency theory is that anxiety affects the mechanisms and components of working memory, which may involve aspects of attention (Lebedev, Messinger, Kralik, & Wise, 2004). Processing efficiency theory is based on the working memory model that states there is a limited capacity to the working memory system (Baddeley, 2001). This system is comprised of a modality-free central executive involved in information processing and self-regulation. Reportedly, the central executive utilizes a phonological loop and a visuospatial sketchpad. The phonological loop is responsible for interim processing and storage of verbal information, while the visuospatial sketchpad manages visual and spatial information. These systems can be disrupted during processing (Baddeley, 1996). It is assumed that some adults may worry when stressed or anxious (Rapee, 1993). Worry and perceived stress affect the central executive, thus affecting planning or problem solving. Evidence from research on this theory suggests that worrisome thoughts, stress and anxiety interfere with phonological loop processing and storage but do not affect the visuospatial sketchpad (Rapee, 1993). Our findings indicated that anxiety could have been affecting the phonological loop processing (i.e., Digit Span), but this is only speculative.

Although the present study did not find a significant relationship between anxiety and memory systems per se, auditory and visual attention (i.e., Digit Span and Coding)

shared a relationship with anxiety. The Digit Span task requires a person to listen to a string of digits and then repeat them back in the same order. Again, this assesses auditory attention, or the possible utilization of phonological loop processing. The Coding task requires a person to write an appropriate number matched to a geometric shape. This tests visual attention and speeded visuomotor abilities. These findings are similar to a study that examined the components of the RBANS, wherein attention did not emerge as a single underlying construct but instead, Digit Span loaded onto a Verbal Processing component while Coding loaded into a Visuomotor Processing component (Garcia et al., 2008). According to each of these models, participants with elevated anxiety scores in the present study appeared to experience specific difficulties in verbal processing and/or visuomotor processing components.

Related to the processing efficiency model, the Attention Control Theory may also be important to examine. Attention control theory expands upon the processing efficiency model by proposing that attentional control is impaired while threat-related stimuli are processed. More generally, the theory supports the idea that anxiety can be distracting, either eternally (e.g., through testing) or internally (e.g., through worry), both of which can influence cognitive performance (Eysenck et al., 2007). Related investigations of this theory had similar findings. To illustrate, several studies have found that as anxiety increased participant performance decreased. For example, in a rock climbing exercise participants responded with longer climbing times and greater numbers and durations in movements as their reported anxiety increased. Although participants still performed the task, they appeared to utilize additional resources and activities (e.g., increased climbing times and increased movements) to achieve performance expectations

(i.e., decreased efficiency). Authors speculated that more effort and attentional resources were needed to complete the primary task, at the expense of attentional capacity for other peripheral information. Researchers further concluded that this indirectly indicated decreased processing efficiency (Niemenhuys, Pijpers, Raoul, & Bakker, 2008; Pijpers, Oudejans, & Bakker, 2005; Pijpers, Oudejans, Bakker, & Beek, 2006), and thus supports the processing efficiency theory as it relates to the attention control theory.

Taken together, elders in the present study may have experienced either internal or external performance threat and reported increases in state anxiety. Reported increased state anxiety shared an inverse relationship with several cognitive measures that utilize auditory and visual attention and visuomotor processing abilities. Marginally, decreased performance was noted in overall cognitive functioning as well. Overall, reported increases in state anxiety shared an inverse relationship with attention that in turn modestly related to general cognitive functioning for this elder sample.

Conclusions

Our findings indicated that anxiety shared a negative relationship with attention, and shared a marginal relationship with overall cognitive performance within this aged sample of community dwelling adults from Oklahoma. More specifically, auditory and visual attention and visuomotor abilities were identified as important areas for further investigation. Depression did not appear to significantly influence these domains in the same manner.

Physiologically, this could be due to changes in the brain related to aging. Pathophysiologically, this could be due to effects of HPA system dysregulation. Theoretically, this finding could tie in with the processing efficiency model of cognition,

wherein anxiety has a relationship with effectiveness and efficiency. Attentional control theory may further explain how anxiety affects this elder sample by requiring additional resources for task completion while reducing overall attentional capacity for specific task performance.

Further research in this area will help our understanding of related mechanisms and will provide clinicians with a better understanding of the effects of such mechanisms on overall adult functioning. Specific research recommendations include examination of these same variables with lengthier, more traditional neuropsychological assessment tools. Examination of pre- and post-measured cognitive performance in conjunction with treatments for anxiety is another viable line of research. Specific cognitive domains sharing a significant relationship with anxiety should also continue to be examined. Finally, longitudinal examination of the long term effects of anxiety on cognitive functioning in an aging sample would enhance our understanding of this complex phenomenon.

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