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THE ROLE OF ANXIETY AND DEPRESSIVE SYMPTOMS IN THE COGNITIVE FUNCTIONING OF OLD AND YOUNG WOMEN

by

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Many studies find age-related differences in cognitive performance. The focus of inquiry in this study is the contextual factors which may influence age-related differences in fluid cognitive performance. Some data suggest that older adults' cognitive performance may be more sensitive to acute anxiety states and that older adults are more likely to experience test anxiety. Similarly, depression may be associated with impaired cognitive performance, especially in older adults. An interaction was predicted, in that anxiety and depression may produce greater cognitive deficits in the elderly as compared to the young.

Forty-five community-dwelling older women and forty-six younger women were randomly assigned to one of three experimental conditions, easy, hard, and control. The hard condition was designed to increase test anxiety while the easy condition was designed to ease test anxiety. Following the condition manipulation, crystallized and fluid cognitive tasks were administered. Initial mood and education were utilized as covariates along with age and condition in a series of analyses of cognitive performance.

There are differences in the type of anxiety with which old and young approach tests, as older adults reported mildly elevated levels of worry and younger adults reported more physiological arousal. However, the age group variable was far more powerful than worry in accounting for the variance in cognitive performance. There was no association between depression and cognitive performance. While, the manipulation produced expected changes in anxiety, age had a much greater effect on cognitive performance than did the manipulation. Thus, the hypothesis that age-related differences in fluid cognitive performance are _largely_ secondary to mood variables was not confirmed.

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CHAPTER I

INTRODUCTION

The effects of aging on cognitive processes has generated a large literature and much controversy in the past 40 years. Initially, cognitive development was viewed as a growth process from childhood through early adulthood. In middle and later adulthood, cognitive processes were thought to gradually deteriorate (Jones, 1959; Schaie, 1974). This inevitable decline in cognitive functioning may be seen as parallel to the physical decline of adulthood. A unitary decline model of adult development existed in which biological deterioration drove psychological decline in older adults (Levin & Levin, 1980).

Early cognitive research provided some support for the decline model of cognitive development. Many cross-sectional studies showed a decline beginning as early as age 30 - 40 in flexibility, problem solving, and Piagetian formal operations (Guilford, 1967; Horn & Cattell, 1967). However, other functions such as the Information and Vocabulary subscales of the Wechsler Adult Intelligence Scale -Revised did not show such a marked age-related decline (Horn & Cattell, 1967). Thus some types of tasks show marked age-related decline, while others do not.

Horn (1970) attempted to integrate these discrepant findings into a two-factor model. The crystallized/fluid model has endured and retains respect. In this model of cognitive aging, intelligence is viewed as a dichotomous construct rather than the historically accepted unitary construct. Cognitive abilities and processes, which are enmeshed within a cultural context and are the result of schooling and environment, are called crystallized intelligence factors. These factors are typically stable through middle and late adulthood. In contrast, intelligence which exists outside of cultural contexts and involves the ability to adapt and integrate information is called fluid intelligence. Fluid intelligence tends to decline in adulthood. Thus, cognitive development in adulthood is characterized by both decline and stability.

While the crystallized/fluid dichotomy initially provided a reasonable model of cognitive development, further research indicated that this model was insufficient. Longitudinal studies with analyses of cohort variables indicated that the patterns of development found in cross-sectional studies were partially inaccurate (Schaie & Labouvie-Vief, 1974). Cohort effects, presumably representing social, historical, and educational differences, accounted for the decline in cognitive functioning in the middle-aged

(Schaie & Parham, 1977). Cohort factors were insufficient in accounting for all of the decline that appeared inolder age groups. Cohort factors plus other unspecified age-related factors were associated with declining scores in older age groups. Therefore, after age 60, cognitive decline in fluid factors partially appears to be a function of chronological age. The pattern of stability across age in crystallized factors persisted in the longitudinal research.

The extensive longitudinal research program described above provided evidence for cohort effects in fluid intelligence tasks. Such evidence indicates that the fluid intelligence factors were not isolated from cultural variables as earlier believed. Thus these presumably "pure" measures of intelligence could be influenced by environmental or contextual factors. With this evidence, Baltes and Willis (1981) suggested that other sources of variance for the apparent age-related declines in fluid factors should be examined. In this view, certain contextual variables that correlate with age may be responsible for the change in cognitive functioning. In contrast to the view of cognitive rigidity of old age, a contextual view accepts some plasticity in old age. Some contextual variables may be alterable, and cognitive performance thereby improved.

Contextual Factors in Cognitive Functioning

There is evidence in the developmental animal literature that complex environments induce increased size and complexity of central nervous system structures. These anatomical and physiological changes are associated with improved learning performance (Rosenzweig & Bennett, 1978). The association between a stimulating environment and enhanced learning performance has been extensively documented in young animals (Labouvie-Vief, 1985). It has long been held that the mature or adult brain was less susceptible to such environmental influence. Yet similar research on complex versus impoverished environments with older animals confounds the traditional view that "You can't teach an old dog new tricks." In a 1973 study, Cummins, Walsh, Budtz-Olsen, Konstantias, and Horsfall found that rats reared from weaning to middle age in environments of differential complexity showed the expected pattern of learning in maze tasks. The rats who had been isolated initially showed poor maze learning. Interestingly, the isolated rats showed evidence of stimulated brain growth as a result of the three weeks of maze testing. Thus, in the adult rat, a change in environment resulted in improved brain functioning. In a subsequent study, rats were reared in differential environments from weaning until old age (900 days) (Walsh

& Cummins, 1977). The usual differential effects for learning were found. In the second phase, the previously isolated rats were placed in enriched conditions. After 36 days in the enriched environment, the effects of the previous isolation were largely absent for learning tasks. Warren, Zerweek, and Anthony (1981) found that negative alterations in environment may result in a decline in learning performance in old mice. Mice were reared in normal social groups to Day 600. Then half of the mice were placed in individual cages. In testing 150 days later, the now isolated mice showed inferior performance on a number of behavioral measures and showed lower RNA levels in their cortical cells. These data suggest that plasticity is not confined to early development. Rather, growth and change can occur in old age.

A number of studies have demonstrated cognitive plasticity in older adults (Blackburn, 1988; Hofland, Willis, & Baltes, 1981; Labouvie-Vief, 1976). These studies show that older adults can benefit from cognitive training procedures and that the training results in specific improvement on the targeted tasks. Generalized training benefits are less apparent. Thus, memory training results in improvement in memory, but not problem-solving skills. These studies also demonstrate that older adults can benefit from practice, often generating successful cognitive strategies. With practice, older adults can improve their performance in a manner which approximates a traditional learning curve (Willis, 1985). Blackburn (1988) found that self-generated strategies for figural-relations tasks were more durable over time than were training strategies.

Numerous gerontologists have commented upon the myriad social losses and environmental changes that accompany old age in humans (Achenbaum, 1983; Levine & Levine, 1980). There is loss of job responsibilities with retirement or maturity of children and loss of social support due to death of family and friends. Such changes are analogous to the change of environment experienced by the mice in the Warren, Zerweek, and Anthony (1981) study. Thus social and environmental changes associated with human aging may influence the learning performance of humans. Bengston and Kuyper (Bengston, 1973) have proposed a model to account for these hypothesized environmental influences on elderly cognitive functioning. In this model, age and intellectual functioning are viewed as components of a feedback loop such that the elderly assume a role of incompetence. This loop is the result of two factors. One is the life-long socialization process which induces the individual to expect their own decline, thus entering a cycle of self-fulfilling prophecy for deterioration. The second factor is the fact that many social institutions discourage competent behavior in the elderly. Thus, internalized individual factors and external factors may combine to induce poor intellectual functioning in the elderly.

Several directions for research have developed in the effort to identify and study the contextual factors which may influence performance on cognitive tasks for older adults. The studies are cross-sectional in design and are descriptive. They do not address the issue of whether these contextual variables exert influence through cohort differences or age-related factors. However, these studies do provide evidence that cognitive performance is the result of many factors.

One direction for the study of contextual factors in cognitive performance of older adults focuses on age (or cohort) related differences in subjects' characteristics. Verbal Scale WAIS-R performance shows no age differences when education-balanced groups are utilized (Albert & Moss, 1988). In addition, Cavanaugh (1983) found that age and verbal abilities interact in memory performance. Furry and Baltes (1973) found that fatigue interferes more with the reasoning performance of older adults than with younger adults. In this study, the fatigue condition was arranged by giving an extended and difficult pretest. Increased cautiousness, or a greater concern for accuracy, has been documented in older adults (Okun & Divesta, 1978). Such cautiousness is associated with inferior performance on timed tasks which are prevalent in the cognitive literature.

Another direction for research has been to study variables associated with assessment conditions and test materials. A number of studies indicate that familiarity with task materials facilitates performance in older adults as it does in younger adults (Denney & Palmer, 1981; Poon & Fozard, 1978; Sinnot, 1975). Age-related differences in memory or problem-solving are not eliminated when familiar task materials are utilized. Researchers have attempted to manipulate motivation through monetary incentives. The rationale for this paradigm is the hypothesis that older adults may be less intrinsically motivated to excel. The findings in this area are mixed with some (Denney, 1980) finding no age by money condition interaction, and others (Erber, Feely, & Botwinick, 1980; Leech & Witte, 1971) finding such an interaction. These studies are uniformly flawed by the lack of independent confirmation that money functions as an effective reinforcer for the subjects involved in the studies.

A few studies have attempted to implicate test anxiety as a factor in the inferior cognitive performance of older adults (Ross, 1968; Whitbourne, 1976). Both Whitbourne and Ross concluded that older adults demonstrated higher levels of test anxiety and that this finding accounted for the deficit performance of the older adults. However, both these studies suffer from serious methodological flaws. Anxiety measures were taken only after the cognitive tasks. It is impossible to discern whether the differences in self-reported anxiety are related to the age-related differences in performance on the cognitive tasks. With fixed group assignment (as with age), it is necessary to compare the groups on a pretest measure of anxiety. Pretest measures of age group differences in anxiety are necessary to support the importance of test anxiety as a factor in older adults' cognitive performance.

The effects of anxiety reduction treatment on cognitive performance has also been studied (Hayslip, 1989; Kooken & Hayslip, 1984; Labouvie-Vief & Gonda, 1976; Yesavage & Jacob, 1984). This paradigm is based on the idea that older adults may suffer from significant test anxiety which impairs their performance. The assumption of high levels of test anxiety in older adults is based on anecdotal evidence which describes older subjects as inevitably making more self-deprecating remarks and the results of several anxiety-performance studies previously described. Performance or test anxiety has been extensively studied in children and young adults. A number of studies have documented a strong association between high levels of state anxiety and poor test performance (Sarason, 1980; Wine, 1971).

As a result of this research, a number of studies have taught anxiety reduction strategies to older adult subjects. Stress inoculation (Meichenbaum, 1977) and other similar cognitive therapies have been utilized more frequently than muscle relaxation strategies. Generally, anxiety reduction training in older adults has resulted in statistically significant improvement in cognitive performance over control or attention-placebo conditions. These findings occur in both community-dwelling older adults and in older adults students who label themselves as test anxious. Hayslip (1989) compared reasoning skills training with stress inoculation training and no contact in a sample of 256 community-dwelling older adults. He found that both reasoning training and stress inoculation training resulted in better problem-solving performance than the control group. There was some indication that the gains among the reasoning training group were maintained better over a month follow-up, than among the stress inoculation group. No anxiety measures were utilized in this study. The assumption of these cognitive training versus anxiety reduction studies appears to be that these are entirely separate manipulations which address separate issues. Yet, it is possible that skills training could remediate a skills deficit as well as lower anxiety.

In summary, the anxiety reduction studies provide indirect support for the notion that test anxiety plays a role in adult cognitive functioning. These treatment studies, nor the Whitbourne (1976) or Ross (1968) studies, provide evidence that performance anxiety is a particular problem for older adults. They merely demonstrate that older adults also have performance anxiety which may interfere with cognitive performance. At a theoretical level, it seems important to know whether there are age (or cohort) related differences in performance anxiety and, if so, does this greater anxiety account for a substantial portion of the difference in cognitive performance among old and young subject groups.

The Anxiety Construct

Anxiety is considered a multifactorial construct with physiological, psychological, and behavioral components. Yet numerous studies show small magnitude or insignificant correlations among self report, autonomic, and behavioral measures utilized to assess anxiety (Papillo, Murphy, & Gorman, 1988). A variety of explanations for this lack of covariation have been proposed, ranging from measurement error to theoretical assumptions about anxiety. It appears that our assumptions about homogeneous covariation are in error. Rather, there is variability in each component among individuals and within individuals as the situation varies (Papillo, Murphy, & Gorman, 1988). Fortunately, statistical techniques allow one to tease out patterns of responses associated with different stimulus conditions and anxiety constructs. Researchers must narrow and specify the anxiety construct of interest.

For the purposes of this proposal, state anxiety in testing situations is the construct of interest. Speilberger (1972) defined state anxiety as a transitory emotional state that is characterized by "subjective, consciously perceived feelings of tension and apprehension, and activation of the autonomic nervous system" (p. 39). In addition to the affective and physiological components, others have noted a cognitive component which consists of rumination around negative self-statements (Sarason, 1980). These definitions conform to the multidimensional general definition of anxiety cited above.

In a series of studies, Morris and Liebert (1969, 1970) have shown that it is the cognitive component of the anxiety construct that is closely associated with poor performance in a test setting. Morris and Liebert utilized a self-report inventory which has two general factors. The Emotionality factor corresponds to perceived autonomic states (heart rate, sweaty palms) and affective reactions to the test situation. The Worry factor consists of cognitive concern about performance (thoughts of failure consequences, self doubts). Emotionality has a mild negative relationship with cognitive performance while Worry was highly negatively related to performance. Pulse rate was unrelated to performance (Morris & Liebert, 1970).

More recent work supports the importance of the anxiety construct in cognitive performance. Deffenbecker (1980) reviews a number of studies which replicated the Morris and Liebert findings. As in the older adult studies cited above, both relaxation training and cognitive therapy result in reduced reports of anxiety (both Worry and Emotionality) and improved cognitive performance in young adults. Thus, theoretically pure treatments do not have theoretically specific effects.

There is evidence in the cognitive gerontology literature that the cognitive component of anxiety is an important factor. Yesavage and Jacob (1984) utilized the Morris and Liebert Scale as part of a treatment study comparing relaxation training and a mnemonic device for improving face-name recall in elderly subjects. Subjects with the greatest reduction in "Worry" scores showed the greatest improvement in recall scores. Change in

"Emotionality" scores was not significantly associated with change in recall scores. This study suggests that the cognitive performance of older adults may be more sensitive to the cognitive component (Worry) of the anxiety construct. This conclusion is consistent with the work of Dixon and Hultsch (1983) who found that text recall performance in older adults was significantly correlated with beliefs and feelings about memory tasks and memory. In contrast, young adults' recall correlated with their understanding of memory strategies, processes, and reported motivation. Dixon and Hultsch suggested that the memory performance of older adults may be more susceptible to affective influences than younger adults. Another study found that negative attributions and failure expectations differentially hurt the cognitive performance of older adults (Prohaska, Parham, & Teitelman, 1984). Both young and old were exposed to failure (non-solvable test items), and experimenters provided performance feedback and attributions in four conditions: poor performance due to poor ability, poor effort, or no attribution, and a no feedback, no attribution condition. On the three subsequent cognitive tasks, the young performed consistently better. There was a large age by condition interaction for one visual spatial task. Young subjects showed the best performance in the performance feedback with no attribution and in the no feedback-no attribution conditions, while the older adult performance was the worst in these two condition. The authors believe this interaction reflects the differing attributions of the two age groups when given no external attributions. This difference influences resultant cognitive performance. Thus, attribution of poor ability by the older adults results in deleterious effects. In a pretest questionnaire, there were significant age differences with older adults reporting less confidence in their intellectual abilities and less confidence about their performance on the tasks. However, the authors did not investigate the possible relationship between this pretest assessment and subsequent performance.

In summary, a number of studies converge to indicate that negative cognitive factors associated with the test anxiety construct have a deleterious effect on cognitive performance. There is evidence to suggest that older adults are more sensitive to the deleterious effect, and this sensitivity may account for some of the age-related differences found in standardized cognitive testing.

The Depression Construct and Cognitive Performance

Another contextual variable widely studied has been clinical depression. The research for the relationship between depression and cognitive function has occurred in the clinical literature rather than the cognitive development literature. Changes in cognitive performance have been noted in depressives of all age groups. Depressives preferentially remember mood congruent words (Badawi, 1984). Various studies have found that depressives show poor signal detection performance (Byrne, 1977). There are mixed findings from traditional memory studies of depressives. Jenike (1988) suggests that these mixed results reflect a pattern of memory dysfunction in which depressives perform normally on highly structured tasks and show significant deficits with less structured memory tasks. Such a pattern is similar to the memory performance of older adults where free recall shows greater deficits than recognition (Poon, 1985).

There is some evidence to suggest that older adults' cognitive performance is more sensitive to adverse effects of depression. McHugh and Folstein (1979) (cited in Cavanaugh & Wettstein, 1982) found that among patients diagnosed with Major Depression, only those over 60 showed evidence of cognitive dysfunction. These authors utilized the Mini Mental State Exam (MMSE), a battery of tasks assessing memory, attention, calculation, language, and constructional capacities. Cavanaugh and Wettstien (1982) found a nearly significant interaction between age and Beck Depression Inventory for scores from the Mini Mental

State Exam. For those under age 65, there was no relationship between severity of depression and cognitive performance. In contrast, in subjects over age 65, there was an association between increased depression scores and poor cognitive performance at $p < .06$. While this is not an impressive statistical association, this trend is a remarkable finding given the diverse cognitive functions which are grouped together in the single MMSE score.

The validity of this association is bolstered by the large literature regarding pseudodementia. Pseudodementia refers to the widespread clinical observation that profound cognitive impairment in elderly patients may remit with treatment for depression. The difficulty distinguishing early dementia from depression in older adults has resulted in numerous studies as researchers attempt to separate the cognitive dysfunctions of these two disorders (LaRue, Dessonville, & Jarvik, 1985). The difficulty in distinguishing these two disorders is such that clinical lore holds that older adults with cognitive impairment (in the absence of obvious organic pathology such as stroke) should be treated for depression first. Pseudodementia is not discussed in the depression literature of young or middle aged adults. The phenomenon of major cognitive impairment associated with depression appears almost solely in older adults.

Kennelly et al. (1985) found that increased depressive symptoms in older adults tended to exacerbate even mild fatigue effects on cognitive performance. These findings occurred in a sample of community-dwelling older adults. Scores from the Beck Depression Inventory were utilized to categorize depressed or nondepressed subjects. The mean level of depression for the depressed subjects was in the mild range. The authors believe that their results highlight the importance of preexisting depressive symptoms as a source of cognitive performance deficits in community-dwelling older adults.

Not all depressed older adults show cognitive impairment when compared to nondepressed older adults. A number of studies (Popkin, 1982; Zarit, 1981) indicate that depressed older adults often have high levels of memory complaints. However, objective evidence indicates that memory performance is equivalent between depressed and nondepressed older adults. Typically, treatment for depression results in decreased memory complaints. While Popkin (1982) found no statistically significant differences in memory performance in their normal and depressed older adult subjects, some data did suggest that the actual memory performance of the depressed subjects improved among those who responded to treatment.

The presence of conflicting findings in these studies of older adult depression and cognitive function appears to reflect the large variability found in clinical practice. As mentioned previously, the discrimination of depressed and demented older adults is difficult due to high variability in the cognitive performance in these disorders and the overlap in the cognitive performance patterns. The studies which find no average group differences in the cognitive performance of depressed and nondepressed older adults do not eliminate depression as an important influence in the cognitive functioning of some older adults.

There is conflicting evidence regarding the extent and magnitude of depression in community-dwelling older adults. A recent review describes differing results among epidemiology studies of depression among the elderly (Newman, 1989). If a continuum model of diagnosis is used, then older adults show an increased prevalence of depression over younger adults. If a categorical model of diagnosis is used, then older adults show a decreased prevalence of depression. In a careful epidemiological study utilizing Research Diagnostic Criteria (categorical model), Blazer (1987) found lower prevalence rates for Dysthymia (two or more years of minor depression) and Major Depression in older adults. However, Blazer identified two other categories of depressive pathology which do not fit Research Diagnostic Criteria. One group consists of mixed anxiety and depressive symptoms in which the level of separate anxiety or depressive symptoms do not meet current diagnostic criteria. A second group contains individuals with minor levels of depressive symptoms who do not meet the two year criterion for Dysthymia. Blazer estimates an overall prevalence of 8% for clinically significant depressive pathology. Such a rate is equal to or higher than prevalence rates in younger adults. Blazer's conclusions are consistent with Newman's review of conflicting statistics. There appears to be a lower rate of Research Diagnostic Criteria (RDC) defined Major Depression. But if one includes the symptom patterns which do not meet the RDC threshold (a continuum model), then increased rates are found.

In summary, there are data which indicate that there are increased rates of low level depressive symptoms in community-dwelling elderly. This level of pre-existing depressive pathology could adversely affect the cognitive performance of older adults in laboratory and standardized testing. Alternatively, this depressive symptom pattern may interact with other contextual variables to produce decrements in the cognitive performance of older adult groups.

Statement of Purpose

Many studies find age-related difference in cognitive performance. In many cognitive tasks, older adults show inferior performance when compared to young or middle-aged adults. However, not all intellectual tasks show a decrement in older adults. Horn proposed the fluid/crystallized model to explain the variety of changes found in adult cognitive development. Crystallized factors are cognitive abilities which are enmeshed within a cultural or environmental context. Such abilities are cumulative. These factors are typically stable or improve through middle and late adulthood. In contrast, cognitive functions which exist independent of contextual variables are called fluid factors. Fluid-type cognitive performance tends to decline in adulthood.

In contrast to previous assumptions, there is increasing recognition that performance on fluid-type cognitive tasks is influenced by contextual factors. One focus of inquiry about age-related difference in cognitive functioning has been the contextual factors which control or influence age-related differences in fluid cognitive performance.

Two contextual factors are of particular interest. There is evidence that test anxiety is associated with poor cognitive performance. Some data suggest that older adults' cognitive performance may be more sensitive to acute anxiety states and that older adults may be more likely to experience test anxiety. Similarly, depression my be associated with impaired cognitive performance, especially in older adults. There is evidence that subclinical levels of depression are relatively prevalent in community-dwelling older adults.

The role of contextual factors in the performance of fluid-type cognitive tasks is the focus of this study. In what way do the contextual factors of anxiety and depression influence the usual age-related performance differences found on standard fluid-type tasks? Is there a significant interaction between age and anxiety state, or age and depressive symptoms in the cognitive performance of community dwelling adults? How much of the age-related differences in cognitive performance may be attributed to age-related difference in mood which are brought to the testing situation or triggered by the testing situation? In order to address these questions, a quasi-experimental design with age and (simple/difficult/control task) condition as the independent variables and cognitive task performances as the dependent variables was undertaken. Initial levels of mood and years of education were included as covariates.

Prediction of Outcome

It was predicted that older adults would enter the testing situation with more anxiety and depressive symptoms than younger adults. These negative mood factors should account for a significant portion of the variance in cognitive performance which is usually attributed to non-specific age differences.

In order to address these questions, a 3 X 2 quasi-experimental design with age and (simple/difficult/control task) condition as the independent variables and cognitive task performances as the dependent variables was undertaken. Crystallized tasks were chosen in addition to fluid tasks for comparison purposes. Initial levels of mood and years of education were included as covariates.

Consistent with previous work, a main effect for age was predicted, with younger subjects performing better than older subjects on fluid tasks and on the crystallized task Similarities. Similarities is an exception to the usual findings regarding age and the crystallized-fluid dichotomy. In contrast, it was predicted that older subjects would perform better on Vocabulary, a crystallized task. A second main effect for condition was predicted, with those in the simple condition performing better than those in the difficult task. Additionally, an age by condition interaction was predicted in which the hard condition results in a larger decrement in performance for the older adults than for the younger adults. There were no a priori predictions for the control group performance.

CHAPTER II

METHOD

Subjects

There were 91 subjects, 46 undergraduates and 45 community-dwelling older women. The average age of the undergraduates was 19.6 years with a standard deviation of 3 years and a range of 18 - 32 years. The average age of the older women was 67 years with a standard deviation of 5 years and a range of 60 - 75 years. Both groups of women had an average of 13 years of education. However, the range for the older women was 8 - 20 years of education, contrasted with the range of 13 - 16 years for the younger women. See Tables 1 - 2 for individual data (Tables 1 and 2 and all subsequent tables are in Appendix A).

The older women were volunteers solicited from various community organizations. Older adult subjects received $5 for their participation, while younger subjects , who were undergraduates, received one hour credit for research participation in their Introductory Psychology class.

Only women were utilized as subjects, in order to reduce error variance stemming from gender differences in cognitive functioning. Only subjects who reported themselves currently in good health were allowed to participate. There was no attempt to screen for specific health problems, so that the subjects reflected typical community residents. A variety of health problems exist in normal older populations. It is likely that selecting the healthiest older adults by matching for health status in old and young subjects results in a serious underestimate of cognitive differences in young and old populations (Poon, Krass, & Bowles, 1984).

The Short Portable Mental Status Questionnaire (Pfeiffer, 1975) (Appendix B & Appendix C) was utilized to screen for dementia. No volunteers failed the dementia screen. Volunteers were also screened with the Beck Depression Inventory (Beck, 1961) (Appendix D). The Beck Depression Inventory has been utilized and validated in old and young populations (Fry, 1986). Those scoring above the clinical cut-off score of 16 for mild to moderate depression were referred for further evaluation as needed. Screening out clinically depressed subjects was necessary for ethical reasons as placing clinically depressed individuals in a failure task is cause for concern. In the original pool of volunteers, two older women and six undergraduates scored in the depressed range and thus did not participate in the study.

Experimenter

The principal investigator performed initial assessment of subjects and administration of the experimental condition. Three undergraduates and two graduate students served as experimental assistants. These assistants were trained to administer the cognitive dependent measures. The assistants were blind to experimental condition.

Experimental Design

To address the research hypotheses, a 3 X 2 quasi-experimental design with age and (easy/hard/control tasks) condition as the independent variables and cognitive task performances as the dependent variables was undertaken. Crystallized cognitive tasks were utilized in addition to fluid tasks for comparison purposes. Initial levels of mood and years of education were included as covariates.

Materials

Screening Measures

1. Short Portable Mental Status Questionnaire (Pfeiffer, 1975) (Appendix B) is a 10-item interview which was validated on 997 community-dwelling older adults. Over three errors indicates some degree of organic impairment. Rarely do depressed older persons make errors on mental status examinations (Fry, 1986). Scoring followed the education and racial norms established by Pfeiffer (1975) (Appendix C).

2. Beck Depression Inventory (BDI, Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) (Appendix D) is a 21-item self-report instrument that measures intensity of depressive symptoms. The BDI was designed for research purposes and is ideal for discriminating levels of depression. The BDI has been widely used in research, and found to be valid and reliable in a number of different populations. Studies indicate good reliability and validity in geriatric populations (Gallagher, Nies, & Thompson, 1982; Gallagher, Breckenridge, Steinmetz, & Thompson, 1983). There is good agreement in subjects who score above the traditional depression cutoff score of 16 and diagnoses that are established using the Schedule for Affective Disorders and Schizophrenia (SADS); this holds true in elderly populations as well. In the adult

population, scores of 0-9 are normal, 10-15 indicates mild symptoms, 16-19 mild to moderate depression. In the present study, volunteers who scored 16 or above did not participate in the study.

Mood Measures

The Beck Depression Inventory was also utilized as a mood measure. Raw scores from this inventory were utilized as a measure of depressed mood.

3. Test Anxiety Questionnaire (TAQ, Morris & Fulmer, 1976) (Appendix E) is a self-report inventory designed to measure intensity of test-specific state anxiety. It consists of 11 statements which are rated using a 6-point Likert type scale. Factor analytic studies of this scale have shown two general factors: cognitive factor labeled Worry, and autonomic arousal factor labeled Emotionality (Liebert & Morris, 1967). Further studies revealed that these two factors vary separately as a function of time preceding the test situation (Liebert & Morris, 1967). Emotionality peaks just prior to testing and drops rapidly after testing. Worry remains relatively stable for several days preceding the test and after the test. Emotionality has been found to be positively related to pulse rate, but there is no correlation between Worry and pulse rate (Morris & Liebert, 1970).

Pilot work (n = 20), performed by the present author, indicated that the TAQ is a sensitive measure of changes in mood state for old and young women in a testing situation. In the pilot work, difference scores from the TAQ showed a large main effect for task condition, F (3, 17) = 7.3, $p < .002$, with those in the difficult task condition reporting a large increase in anxiety. The main effect for age group or the interaction between age and condition were not significant. There was a trend, $p < .102$, for young adults to report greater pre-manipulation anxiety.

4. Visual Analog Scale (VAS, Bond & Lader, 1974) (Appendix F) is a self-report instrument that measures mood states. It is designed to be sensitive to minor change in mood states. The Visual Analog Scale (VAS) consists of 16 pairs of opposite adjectives connected by a 100 millimeter line. Subjects are asked to rate the way they feel on each adjective pair dimension by making a perpendicular mark on each line.

A factor analysis, performed on data obtained from 500 normal subjects, age range 16 - 64, resulted in three factors. These three factors have been labeled Alertness, Calmness, and Contentedness. These factors have been found to be sensitive to mood change in subjects treated with barbiturates and benzodiazapines. The subjects reported increased calmness after the benzodiazapine and less contentedness after the barbiturate. There was a nonsignificant trend for subjects to rate themselves more alert after placebo.

The visual analog methodology is commonly utilized to measure transient mood states in many populations. Salzman (1977) reports that this methodology is particularly useful for measuring state anxiety in the elderly. Pilot work (n = 20) with this instrument, performed by the present author, suggested that it is sensitive to mood changes induced by the experimental manipulation. In the pilot work, using difference scores from the visual analogue scales, there was a significant main effect for condition on the alertness subscale ($\underline{F}$ = 1, 17) = 4.08, $\underline{p}$ = .024); those in the difficult condition reported less alertness. There was a trend to significance for condition on the contentedness subscale ($\underline{p}$ < .18); those in the difficult condition were less contented. There was a trend toward significant interaction on the calm subscale ($\underline{p}$ < .10); here older adults in the difficult condition tended to be less calm.

Validity Measure

5. Social Desirability Scale (SDS, Crowne & Marlowe, 1960) (Appendix G) is a 33-item true-false self-report

questionnaire. It is designed to identify individuals who may be "faking good" on personality and other mood measures. The mood measures utilized in this study are extremely face valid. Due to the anecdotal evidence of older adults tendency to present themselves as adept and competent, it seemed wise to include a measure for the detection of a positive response set. If present, a response bias might obscure hypothesized relationships among target variables.

The items on this measure were derived from behaviors which are culturally sanctioned and approved, but are unlikely to occur. Internal reliability is high, and there are significant correlations with the three validity scales of the MMPI. The original validation studies were performed on undergraduates in the late 1950's. No more recent evidence of construct validity was available. However, the Social Desirability Scale continues to be widely utilized in clinical research.

Cognitive Dependent Measures

Verbal tasks were chosen for the dependent measures as the bulk of research concerning age-related differences concerns verbal performance. Thus, this study investigated the role of anxiety and depression on tasks in the mainstream of research. Utilizing verbal tasks alone reduced sources of uncontrolled variance which would differentially influence verbal and nonverbal task performance.

Both crystallized and fluid tasks were chosen. Mood-related changes were expected on fluid tasks. Crystallized tasks were included to serve as comparison measures to the fluid tasks. The following tasks were chosen to represent fluid and crystallized verbal cognitive functions.

Measures of Crystallized Verbal Functions

1. Similarities Subtest of the Wechsler Adult Intelligence Scales -Revised (Weschler, 1981) (Appendix H) is a measure of verbal concept formation. Verbal concept formation falls in the category of crystallized cognitive tasks (Stankov, 1988). It is composed of word pairs, and the subject must explain what these word pairs have in common. It is a good indicator of general intellect and has little or no memory component. Of all the verbal subtests, Similarities is least affected by the background or experience of the subject (Lezak, 1983).

Among the Verbal subtests, Similarities shows the most age-related decline (Albert & Heaton, 1988). Despite the fact that factor analysis places it with the crystallized cognitive factors (Stankov, 1988), Similarities reflects variables which are involved in age-related changes in cognitive performance. This task was scored following standard WAIS-R procedures.

2. Vocabulary Subtest of the Wechsler Adult Intelligence Scales -Revised (Weschler, 1981) (Appendix I) is a measure of crystallized cognitive factors. There are 35 words arranged in order of increasing difficulty. The examiner reads a word, and the subject must provide the definition. The subsequent score reflects the extent of the recall vocabulary as well as effectiveness of speaking vocabulary. The Vocabulary subtest is considered a good indicator of verbal and general mental ability (Lezak, 1983). Consistent with the Horn (1970) model of cognitive aging, Vocabulary scores do not decline with age; rather, they tend to improve with age (Albert & Heaton, 1988). On average, older adults produce higher Vocabulary scores than do young adults. This task was scored following standard WAIS-R procedures.

Measures of Fluid Verbal Functions

3. Word Fluency (Appendix J) is a measure of verbal productivity. Subjects are to name as many examples of a category (animals) as possible in a set period of time (semantic portion) and to name as many words beginning

with a particular letter as possible in the specified time (linguistic portion). This task involves short-term memory as subjects must keep track of words already said. It also involves strategy formation (farm animals, zoo animals), and individuals not able to generate a strategy perform poorly.

A number of studies have found that performance on this fluid-type task declines with increasing age and less education (Lezak, 1983). Normative data collected by the Neuropsychology Department at Bowman Gray School of Medicine indicate that older adults show a performance deficit on this verbal fluency task (Frank Wood, personal communication, 1987). Their performance on the linguistic portion is significantly better than on the semantic portion. A recent study shows that depressives perform as well as normal subjects on the linguistic portion of the fluency task (Calev, Nigal, & Chazan, 1989). In contrast, depressives show a deficit on the semantic portion.

The methodology for this task as utilized by Frank Wood's laboratory will be used in this study (Appendix J). There are three trials of the linguistic portion each lasting one minute. There are two trials of the semantic portion each lasting one minute. Number of words generated in the linguistic trials are summed together yielding one score for the linguistic portion. The same procedure is followed for the semantic trials. Thus, one dependent variable is linguistic fluency and another is semantic fluency.

4. Rey Auditory Verbal Learning Task (Rey AVLT; Rey, 1964) (Appendix K) consists of five presentations of a 15-word list, each followed by a recall test, presentation of a 15-word distractor list followed by a recall test, and then a final recall test of the first word list. The procedure and scoring for this task is that utilized by Frank Wood's laboratory. Thus, the Rey AVLT measures recall memory span, provides a learning curve, and elicits interference tendencies. This memory task falls in the fluid task category. Recall memory tasks usually show large age-related differences (Poon, 1985).

From this task, four dependent variables for recall memory were obtained: a) number of words recalled on the first trial, b) number of words recalled on best trial, c) number of words recalled from distractor list, d) number of words from the final recall test. These scores have been utilized by the Wood Laboratory.

Procedure

Community organizations were contacted by telephone to obtain permission to solicit older adult volunteers from their organization. The experimenter requested permission to appear at a regularly scheduled meeting to explain the study and to request assistance from members. Volunteers were contacted, and individual appointments for testing arranged.

Testing was conducted in the older adult volunteer's home or other familiar location (i.e., meeting place of their organization). The main criteria for location were ease of access for the subject and quiet setting without distractions. Undergraduate subjects were obtained from the introductory psychology subject pool following procedures designated by the Psychology Department. Undergraduates volunteered for appointment times and were tested in the Psychology Department.

At the time of testing, the experimenter obtained written consent (Appendix L) and administered the assessment instruments. The Test Anxiety Questionnaire and the Visual Analog Scale were administered first. Next, the Short Portable Mental Status Questionnaire, the Beck Depression Inventory, and the Social Desirability Scale were given. Then, the experimenter randomly assigned qualified volunteers to one of three experimental conditions such that equivalent numbers of old and young were in the three conditions. The three conditions were easy condition, hard condition, and control. The experimenter administered the manipulation task. The manipulation task was as follows. Subjects in the easy and hard conditions were told:

> Here is the first test. Do the best you can. I would like for you to think out loud while doing these tests so that I can better understand how people solve tests. You will have 5 minutes.

The subjects in the simple condition were given a list of anagrams which are easy to solve (Appendix M). The subjects in the difficult condition were given a list of anagrams of difficult words (Appendix N). After five minutes, the task was "graded" in the presence of the subject. Anagram solutions appear in Appendix O. After the manipulation, the experimenter re-administered the Test Anxiety Questionnaire and the Visual Analogue Scale in order to confirm the effectiveness of the manipulation. For subjects in the control condition, the Test Anxiety Questionnaire and the Visual Analog Scale were re-administered immediately after the Social Desirability Scale.

After the assessment measures, the experimental assistant, who was blind to condition, entered and administered the cognitive dependent measures. There were four separate dependent measure tasks, the Similarities and Vocabulary Scales from the WAIS-R, Word Fluency, and the Rey Auditory Verbal Learning Task. The order of presentation of these tasks was varied in systematic fashion.

After the administration of the cognitive dependent variables, the experimenter returned; and the Test Anxiety Scale and the Visual Analog Scale were re-administered (third time). Subjects were debriefed (Appendix P) and asked not to discuss their experience.

After the data were collected, the experimenter scored all the Vocabulary and Similarities subtests according to WAIS-R protocol. Subject numbers had been assigned in such a way so that the experimenter was blind to both age of subject and condition. After the initial scoring, a master's level clinical psychologist re-scored Vocabulary and Similarities subtests for 28 randomly selected subjects in order to calculate interscorer agreement. The correlation between the two sets of scores for the Similarities subtest was r = .924, and the correlation between the Vocabulary subtest scores was r = .956.

CHAPTER III

RESULTS

Overview

It was predicted that negative mood factors would account for a significant portion of the variance in cognitive performance which is usually attributed to age differences. Both correlational and experimental analyses addressed this prediction.

The first part of the results section consists of analyses which describe the mood of subjects at the beginning, middle, and end of the experiment and asked the questions: Are there mood differences among the old and young subjects at the beginning or end? What effect did the experimental manipulation have on the subjects' mood? It is necessary to demonstrate mood differences between old and young to substantiate the research hypothesis.

The second part reports analyses which describe the role of mood and effects of the experimental manipulation on cognitive performance. This is the primary focus of the study. Here, the interplay of mood and cognitive performance was examined, and how these two constructs varied between old and young.

Mood

Age Differences in Initial Reported Anxiety

It was predicted that older adults would enter the testing situation with greater anxiety than would younger adults. This greater anxiety would contribute to the poor performance of older adults in fluid cognitive tasks.

From the Test Anxiety Scale, three scores were obtained: total anxiety, Worry, and Emotionality. A 3 (control, easy, or hard condition) by 2 (young or old age group) univariate analysis of variance was performed on the initial Worry scores (Table 3, Appendix A). As predicted, there was a significant main effect for age with older subjects (x = 23.1) indicating greater worry than the young (x = 25.1), F (1, 85) = 3.97, p = .05 (Table 4). For the Test Anxiety Scale, higher scores indicate less anxiety. Subjects assigned to experimental conditions did not differ by condition on this initial measure. The same analyses performed on initial total anxiety and initial Emotionality scores revealed no significant effects for age, condition, or the interaction (Tables 5 and 6) with one exception. There was a statistically significant interaction between condition and age group for Emotionality. This result is considered spurious due to the fact that this was the initial

Emotionality measure, taken before any experimental manipulation had occurred.

The Visual Analog Scale is composed of three factors: depression, anxiety, and alertness. Contrary to prediction, the young (x = 71.1) reported higher initial anxiety on the Visual Analog Scale than the old (x = 49.9), F (1, 85) = 6.52, p =.01 (Table 7). On the Visual Analog Scale, higher scores indicate higher anxiety (Table 8). There was no significant main effect for condition nor for the interaction. In addition, there was a significant correlation between initial Emotionality from the Test Anxiety Scale and initial anxiety from the Visual Analog Scale, r = -.4, p = .001, whereas the correlation between initial Worry from the Test Anxiety Scale and the Visual Analog Scale anxiety was only marginally significant, r = -.18, p = .08. The relationship between Emotionality and the anxiety factor of the Visual Analog Scale suggest that the anxiety factor of the VAS reflects the physiological component of the anxiety construct.

There were no group differences in the initial scores from the Alertness factor of the Visual Analog Scale (Table 9) indicating that the old do not report difficulties with alertness as might be expected. Decreased alertness in the old would be a corollary of the hypothesis that the old would report increased initial anxiety.

Consistent with the prediction, there is some evidence that older adults enter the testing situation with increased test anxiety. Specifically, it is the Worry component, the factor closely tied with cognitive performance, which is increased in the old.

Age Difference in Initial Reports of Depressive Symptoms

A 3 (control, easy, or hard condition) by 2 (young or old age group) univariate analysis of variance was performed on scores from the Beck Depression Inventory (Table 10). While it was predicted that the older subjects would report more depressive symptoms, there were no significant effects for any variables on the Beck Depression Inventory. In fact, the level of depression was very low for both old ($x = 5.5$) and young ($x = 5.8$) subjects on the Beck Depression Inventory. However, a 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance was performed on initial depression scores from the Visual Analog Scale with different results (Table 11). Young subjects reported greater depressed mood than did the old subjects, F (1, 85) = 9.21, p = .0032. The mean initial depression score for the young was 140, while the mean score for the old was 95 (Table 12).

Relationship Between the Experimental Manipulation and Mood Changes

It was predicted that subjects in the hard condition would experience an increase in anxiety, while those in the easy condition would show a decrease in anxiety. Those in the control condition would show no change in mood prior to the administration of the dependent tasks. Additionally, it was predicted that the old would be more sensitive to the hard manipulation and show a larger anxiety response to the hard manipulation than would the young. The following analyses served to test the effectiveness of the manipulation.

A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance was performed on difference scores obtained from initial Worry score minus post-manipulation Worry score (Table 13). The only significant effect was a main effect for condition, F (2, 85) = 24.9, p = .0001, as expected. Tukey's pairwise comparisons indicate that the mean change in the hard condition was significantly different, p = .05, from changes in the easy or control conditions. There was no difference between the change scores in the easy and control conditions. The mean change in the hard condition was +5 with subjects in the hard condition reporting greater worry after the anagram manipulation task (Table 14). The mean change in the easy condition was -1.2 and in the control condition was -1.9, with these subjects reporting less worry.

A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance was performed on the difference scores obtained from initial anxiety minus post-manipulation anxiety from the Visual Analog Scale. As predicted, there was a significant main effect for condition with those in the hard condition reporting greater increases in anxiety than those in the easy or control conditions, $\underline{F}$ (2, 85) = 9.59, $\underline{p}$ = .0002 (Table 15). The mean change in the control condition was .36 (Table 16). The mean change in the the easy condition was 8.19. The mean change in the hard condition was -27, which was significantly different from scores in the easy and control condition. Tukey's pairwise comparisons indicated no significant difference between the difference scores in the easy and control conditions.

A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance was performed on the difference scores obtained from initial alertness minus post-manipulation alertness (Table 17). There was a main effect for condition, $\underline{F}$ (2, 85) = 8.38, $\underline{p}$ = .0005. with subjects in the hard condition reporting less alertness. The mean changes for hard, control and easy conditions were -37, 23, and 9 (Table 18). Tukey's pairwise comparisons indicated that the hard condition differed from easy and control conditions and that the easy and control conditions did not differ.

There was also a significant interaction in this analysis, $\underline{F}$ (2, 85) = 4.64, $\underline{p}$ = .01. Contrary to predictions, pair wise comparisons utilizing Tukey's method indicate that the young reported much less alertness in the hard condition than did the old (Figure 1; Figure 1 and all subsequent figures may be found in Appendix Q). The mean change for the young was -69 while the mean change for the old was -5 (Table 18).

Subjects in the hard condition reported the predicted changes in mood: increased anxiety, worry, and less alertness. In contrast to the prediction, mood responses in the easy condition proved to be no different from the control condition. The expected interaction between age group and condition was not found. The interaction term was not statistically significant for any variable except alertness, and here the effect was the opposite of expected. The young reported less alertness in the hard condition.

Mood Measures Taken at End of Study

The purpose of the following analyses was to discover whether the old and young subjects responded differently to the entire testing process. It would be expected that the old would report a greater increase in negative mood at the end. In addition, these analyses provided evidence concerning the power of the experimental manipulation, i.e., do the induced mood changes persist through out the collection of the dependent variables?

A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of covariance performed on the difference scores obtained from initial Worry minus final Worry yielded no significant effects (Table 19). A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance was performed on the difference scores obtained from initial anxiety minus final anxiety (Table 20). There was a main effect for condition, $\underline{F}$ (2, 85) = 3.71, $\underline{p}$ = .028. The mean change scores for the control, easy, and hard conditions were -7, 3, and -29, respectively (Table 21). Tukey's pairwise comparisons indicate that only the easy and hard conditions differed at the p = .05 level of significance. There is evidence of mild residual effects from the manipulation in this variable.

The Effects of the Experimental Manipulation and Correlational Variables on Cognitive Task Performance

The empirical basis for the relationship between the Worry construct and cognitive performance was described in the introduction. Due to this empirical relationship, all further analyses utilized Worry as the pertinent mood variable to examine. Two multivariate analyses were performed on groups of dependent variables which were conceptually related. Two univariate analyses were performed on remaining variables. These analyses are the primary focus of this study.

There was no correlational relationship between initial depressed mood as measured by the Visual Analog Scale and the dependent variables. It was predicted that depressed mood could interact with initial Worry to influence cognitive performance. This prediction did not hold. When depression was included alongside worry in the analyses of the cognitive variables, depression was a non significant variable; and there was no significant improvement in the amount of variance explained. Thus, the following results utilize initial Worry as the sole mood covariate.

Verbal Fluency

A 3 (control, easy, or hard condition) by 2 (young or old) multivariate analysis of covariance was performed on linguistic verbal fluency and semantic verbal fluency scores with education and initial Worry as covariates (Table 22). The covariates are examined first. As expected, education was a significant predictor of performance on these tasks with a Hotelling-Lawley Trace, equivalent to F (2, 82) = 3.43, p = .0372. The simple correlations between education and semantic verbal fluency and linguistic verbal fluency were r = .31 and r = .30, respectively. Thus, more years of education is associated with greater verbal fluency. It was expected that initial Worry would be a significant predictor variable. There was a slight trend for initial Worry as an overall significant predictor variable with Hotelling-Lawley Trace, equivalent to F (2, 82) = 2.11, p = .13. In the univariate analysis of semantic verbal fluency, lower initial Worry was associated with better performance, F (1, 83) = 3.81, p = .05 (Table 23). However, initial Worry was not significantly associated with linguistic verbal fluency, F (1, 83) = 2.15, p = .15 in the univariate analysis (Table 24).

As expected, there was an overall significant effect for age group with Hotelling-Lawley Trace, equivalent to F (2, 82) = 6.21, p = .0031. Univariate analyses of the verbal fluency variables indicates that age group had a significant effect on semantic verbal fluency, F (1, 83) = 10.74, p = .0015, but not linguistic verbal fluency, F (1, 83) = .04, p = .84. Young subjects had greater semantic verbal fluency than did the old subjects. The mean scores from semantic verbal fluency were 44 for the young and 37 for the old subjects (Table 25). Contrary to prediction, there was no significant main effect for condition, Hotelling-Lawley Trace equivalent to, F (4, 162) = .73, p = .57.

The multivariate analysis indicates a marginally significant condition by age group interaction Hotelling-Lawley Trace equivalent to, F (4, 162) = 2.11, p = .08. Univariate analyses show a significant interaction only for semantic verbal fluency, F (2, 83) = 3.83, p = .02 (Table 23). It was predicted that the performance of older subjects would be more impaired in the hard condition than would the young subjects' performance. Tukey's method for pairwise comparisons indicates that the performance of the young is significantly better in the hard condition than is the performance for the old (Table 25, Figure 2). This finding is also true for the control condition. Young and old perform equally well in the easy condition. The univariate interaction for linguistic verbal fluency was F (2, 83) = 0.28 , p = .76.

Recall Memory

A 3 (control, easy, or hard condition) by 2 (young or old) multivariate analysis of covariance with education and initial Worry as covariates was performed on four scores from the Rey Auditory Verbal Learning Task: the first recall, the best recall, the distractor list recall, and final free recall. Education is not a significant predictor variable, Hotelling-Lawley Trace equivalent to F (4, 78) = 1.77, p = .14 (Table 26). Neither is education a significant predictor variable in univariate analyses for three out of the four recall variables (Tables 27 - 30). There are significant simple correlations between education and these recall scores which range from r = .19 to r = .26. Similarly, initial Worry is not significant overall as a predictor variable, Hotelling-Lawley Trace equivalent to F (4, 78) = .071, p = .59, yet initial Worry shows a significant correlation with first recall r = .29, p = .005 and the best recall r = .31, p = .03. There is a simple association between lower worry and better recall performance in these two tasks. It was expected that there would be a stronger association, which would appear in the multivariate analysis, between initial Worry and recall scores.

Turning to the effects of the independent variables, there was a substantial main effect for age group, Hotelling-Lawley Trace equivalent to F (4, 78) = 27.30, p = .0001 (Table 26). Older subjects had consistently lower recall scores than did the younger subjects (Table 31). This age effect was expected, and univariate analyses show this age effect was significant at the p = .0001 level for all four of the memory variables (Tables 27 - 30).

The expected main effect for condition was marginal, Hotelling-Lawley Trace, equivalent to F (8, 154) = 1.91, p = .06 (Table 26). Univariate analyses of the recall scores failed to show any main effect for condition (Tables 27 - 30, Table 32). Contrary to prediction, the condition by age group interaction was not significant, Hotelling-Lawley Trace equivalent to F (8, 154) = .86, p = .55.

Similarities

Raw scores obtained from the Similarities task were converted to standardized scores in order to normalize the distribution. These standardized scores were utilized in all analyses of Similarities. A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance with education and initial Worry as covariates was performed on Similarities scores (Table 33). Of these variables, only education showed a significant association with Similarities scores, $\underline{F}$ (1, 83) = 5.46, $\underline{p}$ = .02. The simple correlation between education and Similarities was r = .27. This statistic indicates that more education was associated with better Similarities performance. The absence of effects for initial worry, condition, and the age group by condition interaction was unexpected. The absence of age group effects on the Similarities subtest is not consistent with other research findings.

<u>Vocabulary</u>

A 3 (control, easy, or hard condition) by 2 (young or old) univariate analysis of variance with education and initial Worry as covariates was performed on Vocabulary raw scores (Table 34). As expected, education was a significant variable, $\underline{F}$ (1, 82) = 6.15, $\underline{p}$ = .01. The simple correlation between education and Vocabulary is $\underline{r}$ = .31. This indicates that more education is associated with better Vocabulary scores. Contrary to prediction, initial Worry showed a significant association with Vocabulary, $\underline{F}$ (1, 82) = 6.77, $\underline{p}$ = .01. The correlation between initial Worry and Vocabulary is $\underline{r}$ = .31 which indicates that more initial Worry is associated with lower Vocabulary scores. This association exists after variance due to age has been partialled out.

As expected, the age group variable explained more variance than other variables in the model, F (1, 82) = 8.84, p = .004. Older subjects had a mean vocabulary score of 54 which was superior to the young mean score of 50 (Table 35). There was a significant main effect for condition, F (2, 82) = 3.32, p = .04. Tukey's method indicates that there were no significant differences at the p = .05 level for any pairwise comparison of the means from the hard, easy, and control conditions (Table 31). The mean Vocabulary scores were as follows: hard condition, x = 55; control condition, x = 51.5; and easy condition, x = 50. The age by condition interaction was not significant.

Social Desirability Scale

Scores from the Social Desirability Scale were utilized as a covariate in a series of univariate analyses of verbal fluency, Vocabulary, Similarities, and the first recall from the Rey Auditory Verbal Learning Task. The Social Desirability Scale scores were consistently nonsignificant and did not account for any variance in the cognitive dependent variables.

CHAPTER IV

DISCUSSION

The findings of this study are both consistent and inconsistent with initial hypotheses. In general, the results from cognitive tasks replicated age differences found in the literature. Results relating affect to age, and affect to cognitive performance were less consistent with predictions. Essentially, the hypothesis that anxiety has a significant explanatory role in the age differences found in fluid cognitive performance was not supported. Worry was not a major predictor of cognitive performance. Therefore, the cognitive decline noted in older adults is not explained by age differences in test anxiety.

Yet there are age differences in test anxiety. These data demonstrate that there are complex relationships among affect, cognitive performance, and age. Some tasks proved more sensitive to anxiety than did other tasks. There is evidence that old and young responded differently to the failure manipulation, and this difference influenced performance. While affect may not account for age declines in cognitive performance, it is important to consider what these data do indicate about affect, cognition, and age.

There are two general sections within the discussion. In the first section, each subsection of results is discussed in isolation from other sections, elaborating upon relationships and explaining unexpected results. In the second section, an integration of the findings is presented in a way which addresses the chief hypotheses and speculates about unexpected findings.

Predictions and Results

Initial Anxiety

Consistent with the prediction, there was evidence that older subjects enter the testing situation with more worry than do younger subjects. There was a significant age group difference in initial Worry as measured by the Test Anxiety Questionnaire. However, there were no age group differences on the Emotionality Subscale or the Total Anxiety scale of this questionnaire. Thus, the older subjects reported more cognitive ruminations about failure and poor performance than did the younger subjects. Reports of physiological manifestations of anxiety such as rapid heartrate or tense stomach did not differ between age groups.

In contrast, the young reported more initial anxiety in this testing situation as measured by the anxiety factor from the Visual Analog Scale. In order to understand this apparent inconsistency, one must examine the components of this anxiety factor. For example, the word pairs "calm-excited" and "tense-relaxed" are general words indicative of physiological arousal and are more comparable to the Emotionality factor of the Test Anxiety Questionnaire than to the Worry factor. In contrast, items on the Worry subscale (of the Test Anxiety Questionnaire, Appendix E), which focus on thoughts, are more typical of cognitive anxiety. The work of Morris and Liebert (1970), previously cited, indicates that physiological changes and cognitive states are separable factors. There is other evidence that the anxiety factor of the Visual Analog Scale is also related to the Emotionality subscale of the Test Anxiety Scale. There is a significant correlation between the anxiety factor and the emotionality scale, whereas there is a marginal relationship between the anxiety factor and the Worry subscale of the Test Anxiety Scale.

There were no age group differences in the alert factor of the Visual Analog Scale. Examination of the items from this factor, alert - drowsy, muzzy - clear-headed, mentally slow - quick witted, attentive - dreamy, interested - bored, indicates that this factor appears to be a general indicator of feelings about cognitive efficiency.

A reasonable conclusion from these data is that older subjects enter the testing situation with slightly more worry, that is, negative cognitive thoughts about their performance. There are indications that younger subjects experience mild physiological arousal, not associated with worry, as they enter the testing situation. The varying correlations and relationships among these measures of anxiety reflect the persistent difficulty in measuring the multifaceted construct of anxiety.

Initial Depression

Contrary to prediction, there were no age group differences on the Beck Depression Inventory. It was expected that more older subjects would report elevated, though subclinical levels of depressive symptoms than the young. There are several reasons for the absence of an age difference here. First, the Beck Depression Inventory was utilized as a screening instrument such that those reporting clinical levels of depression were excluded as subjects. This exclusion process resulted in a restricted range of scores making it less likely that any significant statistical relationships would be present. Secondly, there are differences between the sampling strategy in this study and the epidemiological studies in which a higher prevalence of mild depressive symptoms were found in older subjects.

The epidemiological studies (Blazer, 1987; Newman, 1989) surveyed large numbers of older people in a comprehensive fashion. In contrast, this study solicited a small number of volunteers from community organizations. It is likely that this sampling difference could account for the absence of an association between depressive symptoms and age group. Mildly depressed individuals are probably less likely to volunteer for a research project from which they receive little benefit.

Also contrary to prediction, the young subjects reported more depressed mood than the old subjects on the depression factor from the Visual Analog Scale. This age difference may reflect the general dissatisfaction of the young subjects who were completing a class requirement by participating in the experiment, in contrast to the old subjects who were doing a favor for a young woman from UNCG. The Visual Analog Scale was designed to measure transient affect (Bond & Lader, 1974) and is likely more sensitive to situational mood triggers.

Relationship between the experimental manipulation and mood changes.

The changes in mood scores from beginning to immediately post-manipulation indicates that the anagrammanipulation had the expected effect on subjects' mood. Those in the hard/failure condition reported increased Worry as measured by the Test Anxiety Questionnaire, as well as increased anxiety and less alertness as measured by the Visual Analog Scale. There were no changes in these mood variables for subjects in the easy and control conditions.

A prediction for a condition by age group interaction in which the mood of old subjects would be more negative than that of the young subjects after undergoing the hard condition was not born out in these data. There was no interaction for the Worry subscale or the anxiety factor. The alert factor did show an age by condition interaction, but in the direction opposite of the prediction. Here, the young reported feeling less alert than did the old following the hard/failure condition. Thus the young felt less alert following the hard condition, but not more worried or generally anxious than the older subjects.

A possible interpretation of this pattern is that the young were more likely to attribute their "failure" to poor concentration and effort, rather than attributions concerning their ability. Though speculative, this interpretation is supported by the work of Prohaska, Parham, and Teitalman (1984) who found that, after a failure task, young subjects were more likely to make attributions which resulted in improved performance. Attributing failure to a modifiable state such as effort or concentration tends to enhance subsequent performance as the subject believes it is possible to influence outcome and therefore tries harder. If this interpretation is correct, then in a sense the older subjects were more adversely affected by the hard/failure manipulation. If the old subjects are less likely to make attributions which enhance performance, then they are relatively disadvantaged in testing situations.

Mood changes associated with participating in the experiment.

Condition did have a significant though small effect on the anxiety factor change scores from the beginning to the end of the experiment. The anxious mood induced by the hard anagram manipulation persisted to a small degree throughout the administration of the cognitive tasks for both old and young subjects. Thus, the influence of the experimental manipulation was confirmed.

The changes in mood scores from the beginning to the end of the experiment indicates that there were no differences between age groups associated with participation in the experiment. As at the beginning, older subjects reported more Worry at the end than did the younger subjects. There was no age group effect for change scores from beginning to end for the Worry factor. Thus subjects finished the experiment in approximately the same mood as they began, and this did not vary by age group. The possibility, that the older subjects might develop test anxiety during the actual testing process which would influence performance, was not supported.

The effect of experimental and correlational variables on the dependent measures

Verbal Fluency - Fluid Factor. In the multivariate analysis of variance on verbal fluency performance, age group proved to be the most important of the several variables examined. Young subjects had a superior performance to that of the older adults. In contrast to predictions, initial Worry did not contribute significantly to the verbal fluency performance. As expected, better education was an important predictor of superior verbal fluency. The important conclusion from this multivariate analysis is that age group is the predominant variable for determining overall verbal fluency performance.

However, previous data seemed to indicate that semantic and linguistic verbal fluency utilize somewhat different processing capacities. This difference in processing is analogous to the level of processing in memory tasks in which superficial processing is associated with the linguistic aspects of words, and deeper processing is associated with the meaning of the words (Craik, 1977).

These two levels of processing capacity are also reflected in the common finding that the performance of young and old does not differ on linguistic verbal fluency. In contrast, older subjects generally show inferior semantic verbal fluency when compared to younger subjects (Frank Wood, personal communication, 1987). A frequent hypothesis for the differing performances of old and young on verbal fluency tasks is that the old have lost some processing capacity which therefore impairs their performance on tasks requiring deep or extensive processing (Hasher & Zacks, 1979; Salthouse, 1985).

Given these predicted differences in linguistic and semantic verbal fluency performance, it is important to examine the separate univariate analyses of these two dependent variables. Consistent with previous data, there was no age group effect found for linguistic verbal fluency. Additionally, there was no relationship between linguistic verbal fluency and initial Worry or experimental condition. This finding is consistent with the view that linguistic verbal fluency is a superficial processing task. Thus, it is a relatively simple task in which only education has a significant effect.

The data concerning semantic verbal fluency is also consistent with experimental hypotheses. High levels of initial Worry were associated with inferior semantic verbal fluency. This is consistent with the capacity model of processing in which Worry utilizes processing capacity, thus impairing performance on semantic verbal fluency. Age group was the most significant factor, with the younger subjects performing better than the older subjects. There was also an age group by condition interaction in which the old and young had equivalent performance following the easy condition; however, the young subjects' performance was superior to that of the old subjects following the hard or control condition.

This interaction is of particular interest as it is generally consistent with the interaction which had been predicted. The old subjects' performance was more impaired in the hard condition than in the easy condition, as was predicted. The somewhat surprising finding is the extent to which the performance of the younger was improved in the hard condition. One may speculate that the hard condition manipulation, instead of inducing a high level of Worry in the young, produces moderate Worry and arousal which stimulated the young subjects and resulted in better performance for them. Similarly, the initial level of Worry reported by the young was unchanged in the control condition and this level of Worry or arousal apparently facilitated the performance of the young.

For several other dependent variables, cognitive performance was superior in the hard and control conditions for both old and young subjects. This apparent contradiction will be discussed more fully at a later point.

Rey Recall Memory - Fluid Factor

Recall memory is a variable for which consistent age group differences have been found (Poon, 1985). The average recall performance for older adults is inferior to that of younger adults, and thus it is important to examine the role of anxiety for recall memory.

There were no a priori differential predictions for the four Rey recall memory scores. Thus, the four Rey memory scores are discussed under the unifying construct of recall memory performance. As with verbal fluency, age group was the most important variable in the multivariate analysis of recall memory. Consistently, older subjects had lower recall than did the younger subjects. This finding is consistent with numerous publications indicating that older subjects perform poorly on recall tasks relative to young subjects (Poon, 1985).

In contrast to the other cognitive tasks, education was not a significant predictor of recall memory performance. Unlike the other cognitive tasks, this memory task relies on skills and abilities which are relatively independent of school based learning. Initial

Worry was not a significant predictor of recall memory performance. Though initial Worry showed a simple correlation with two of the four recall scores, its overall effect on recall was negligible. Thus, initial Worry did not help to account for the variance related to age group in the recall memory performance, as had been predicted.

The condition variable was marginally significant, but in the opposite direction than had been predicted. Examination of the means indicates that in three out of the four recall scores, the subjects in the hard condition had better recall than those in the easy condition. It appears that the hard condition enhanced recall performance relative to the easy condition for both old and young. One may speculate that the hard condition resulted in an arousal state in which the subjects worked harder or gave more effort.

<u>Similarities Verbal Reasoning - Crystallized Factor</u>

In contrast to most crystallized factors, older adults tend to have an inferior performance to younger adults on the Similarities subtest. While the Similarities subtest may reflect accumulated learning, it also measures other skills which tend to decline with age (Albert, Wolfe, & Lafleche, 1990). It was expected that test anxiety could account for part of the age-related decline in this variable.

Education was a significant predictor variable, as better education was associated with better performance. Surprisingly, there was no age group effect for Similarities scores. Among the Verbal subtests from the Wechsler Adult Intelligence Scales -Revised (Weschler, 1981), Similarities shows the most age-related decline (Albert & Heaton, 1988). There are two likely reasons for the absence of an age group effect on the Similarities scores. First, this result may be due to sampling distribution variability. There is always the possibility of drawing a sample in which the means from two groups (which are already known to differ on the variable of interest) are the same.

A second possibility is due to the dependent cognitive measures administration by trained undergraduates. It was noted during the scoring process that the undergraduates often failed to follow the precise standardized administration instructions. They consistently failed to question or ask for clarification of borderline and ambiguous answers. Thus the answers were impoverished, and it is likely the scores would be somewhat higher if the subjects had been properly questioned. It may be that the younger subjects could have improved or clarified their answers more effectively than the older subjects, resulting in higher average scores for the young. Thus the departure from standardized administration procedures may have obscured the typical age group difference in performance as well as the effects of the other variables.

Vocabulary - Crystallized Factor

Consistent with previous work, better education was a significant correlate of good Vocabulary performance. Past work has shown that Vocabulary is influenced by previous educational experiences (Lezak, 1983). Because it reflects past learning and is considered a stable indicator of general intellectual ability, Vocabulary is often utilized as a covariate in order to equate groups statistically for past education and intelligence. In this study, Vocabulary is a dependent variable which proved to be surprisingly sensitive to the effects of several independent variables. This sensitivity, which will be discussed further, points to the need for researchers to carefully consider the sequence of tests when Vocabulary is in a battery of tests, and its purpose is to serve as an experimental control.

As a crystallized cognitive factor, it was expected that Vocabulary would not be sensitive to initial Worry. Measures of crystallized factors are thought to reflect well-learned or old knowledge. Thus, performance on measures of crystallized factors should require minimal cognitive-processing capacity. It was expected that elevated levels of Worry would only interfere with tasks which are thought to require greater amounts of processing capacity, that is, fluid cognitive tasks. Surprisingly, elevated initial Worry was a significant predictor of inferior Vocabulary scores in this study. One might speculate that the association between Worry and Vocabulary actually reflects the association between high Worry, low education, and poor Vocabulary performance. There was a substantial correlation between high Worry and low education. Thus a reasonable speculation is that those with less education perform poorly on Vocabulary and that those with less education report more Worry about testing. It is likely that education could be the crucial link between the Worry variable and Vocabulary performance. Unfortunately, this hypothesis does not fully account for the impact of initial Worry. Initial Worry was entered into the model after education. Thus, there is a significant portion of variance in the Vocabulary scores which can be attributed to initial Worry that is not shared by the education variable. One must conclude that elevated initial Worry is associated with poor Vocabulary performance, independent of past education. One explanation for this independent association of Worry and Vocabulary performance is that subjects who engage in Worry and self-doubt are less likely to guess and more likely to refuse to answer when dealing with less familiar and difficult words.

Turning to the effects of the independent variables, older subjects performed better than did the younger subjects on Vocabulary. This finding is a replication of considerable previous research in which older subjects demonstrate superior vocabulary (Albert & Heaton, 1988). The condition variable also had a significant effect on Vocabulary scores. This was an unexpected finding for the same reasons that the significance of initial Worry was a surprising finding. Vocabulary is considered to be stable knowledge, relatively impervious to temporary changes in mood or arousal. Yet in this study, subjects in the hard condition had higher Vocabulary scores than did those in the easy condition, regardless of age. Again, there is evidence that the hard condition resulted in changes which enhanced the performance of subjects. But, even then, it is surprising that the Vocabulary subtest was sensitive to the subjects' mood or arousal state. The significant effect of the hard condition is even more impressive when one considers that the variance from education and initial Worry had already been partialled out.

One explanation for the success of those in the hard condition is that they may have been more willing to guess at words of which they were not sure and were less likely to refuse an answer as a result of their more aroused and motivated state. Such behavior would likely result in higher scores as subjects are not penalized for guessing.

An additional explanation for the effect of the condition variable may be found in the relative departure from standard administration procedures that was discussed in the Similarities section. Vocabulary answers were noted to be ambiguous and sparse, and the same lack of clarification questions by the examiners was noted. Subjects in the hard condition who may have been more motivated, could have supplied more thorough, comprehensive answers which merited higher scores.

Depression and Cognitive Performance

Contrary to prediction, depression did not interact with anxiety to influence cognitive performance. There are several reasons to consider for this outcome. First, there was a highly restricted range of depression scores due to the requirement for a normal, non-depressed population. Only a highly robust effect would show a statistically significant effect with such a restricted range. Second, previous work (Cavanaugh & Wettstien, 1982; Folstein & McHugh, 1978) indicated that older adults' cognitive performance may be affected by serious, persistent levels of Major Depression. Other work (Popkin, 1982; Zarit, 1981) indicates that depressive symptoms may not result in cognitive impairment. The data presented in this study indicate that mild, transient depressed mood does not significantly impair the cognitive performance of older adults in these tasks.

Integration and Conclusions

The age-related differences in cognitive performance which have been found in previous work were replicated in this study with one exception. In comparison to other independent and correlational variables, age group consistently overwhelmed the other variables in explaining the variance in fluid cognitive performance. This study provided evidence that there are major differences in the cognitive performance of old and young adults which are not due to contextual factors.

Differences in the mood of old and young subjects upon entering the testing situation were smaller than expected. Older subjects reported a small, statistically significant elevation in Worry at the time of testing. The null results on the majority of initial mood measures would tend to indicate that the older adults did not enter the testing situation with profound negative mood.

High initial Worry demonstrated a consistent relationship with inferior cognitive performance, as was predicted. However, this relationship was much weaker than predicted and often was not significant outside of a simple correlation statistic. Age-related cognitive differences were still highly significant, even when initial Worry variance had been partialled out. Thus initial Worry or test anxiety does not account for a major portion of age-related cognitive differences. These data are inconsistent with the hypothesis that age-related differences in cognitive performance are largely due to performance anxiety.

The anagram manipulation was successful in increasing Worry, increasing anxiety, and decreasing alertness in both old and young subjects. However, the effect of the manipulation on cognitive performance was less than intended. Though the condition variable reached conventional levels of significance only with Vocabulary, an examination of means indicates that in six out of the eight dependent measures, subjects in the hard condition had the best performance. This pattern is strong evidence that the change in Worry score in the hard condition indicated movement from low to moderate levels of anxiety. Studies have established that moderate levels of anxiety enhance performance, while low and high levels of anxiety yield poor performance (Spence & Spence, 1966).

However, the results of the semantic verbal fluency task indicate that there are age differences in the response of the subjects to the manipulation. The performance of the younger adults in the hard condition was markedly superior to that of the older adults. Yet the old and young adult performance was not significantly different in the easy condition. One explanation for this interaction is that the hard/failure condition increased Worry and motivation for the young, but not for the old subjects. Similarly, the control condition did not alter the general arousal level with which they entered the testing situation.

Though the young reported Worry about their performance, they may have attributed their poor performance to lack of effort. In contrast, the older subjects reported similar levels of Worry, but may have attributed the poor performance to lack of ability or difficult task. This speculation is supported by the comments made by the subjects during the hard condition manipulation. It was often necessary to encourage the older subjects to persist the entire five minutes, whereas the younger subjects rarely required such encouragement. The older subjects tended to make comments such as "When you get my age you just don't worry about being able to do things like this." Because attributions were not measured in this study, this attributional explanation for the manipulation is of necessity speculative.

Nonetheless, validity of this explanation is supported by the similar findings of Prohaska, Parham, and Teitelman (1984) who found evidence of negative attributions about ability in older adults given a failure task. Another study investigated how old and young adults evaluate memory failures (Erber, Szuchman, & Rothberg, 1990).

Utilizing the attributional scheme (ability, effort, task difficulty, and luck) of Weiner et al. (1971), they found that older subjects were more lenient and more likely to make attributions of a difficult task to explain the memory error of both old and young targets. In contrast, young subjects were more likely to attribute mental difficulties and suggest professional evaluation for old and young targets. The authors concluded that older subjects are more tolerant of perceived mental difficulty than are young subjects.

Research in the area of metamemory also indicates that old and young approach memory tasks with different beliefs and ideas about themselves and the tasks. Metamemory is a broad domain that "includes such constructs as strategy selection and utilization, knowledge about how memory functions, and memory self-efficacy (beliefs about one's ability to remember)" (Hertzog, Dixon, & Hultsch, 1990). The memory self-efficacy component of metamemory is most relevant to this discussion. Hertzog et al. (1990) studied memory self-efficacy and memory performance in a sample of 422 adults aged 20 to 79. Typical age differences in cognitive performance were found. Lisrel models were utilized to identify relationships among the several self- report scales and performances on a variety of memory tasks. The authors concluded that memory performance determines memory self-efficacy, that is, memory performance determines one's beliefs about their memory. This conclusion is at odds with traditional views of self-efficacy (Bandura, 1986), in which one's beliefs would influence one's memory performance.

Contextual variables have been shown to adversely influence fluid cognitive performance (Deffenbecker, 1980; Furry & Baltes, 1973). In this study, measurement of test anxiety accounted for a minimal portion of age-related differences in cognitive performance. Initial Worry was a significant predictor variable only for semantic verbal fluency. There is increasing evidence that contextual variables such as effort, self efficacy, and negative affect, though important, have only small explanatory roles for the substantial age-related differences in cognitive function.

The influence of test anxiety on the crystallized task, Vocabulary, indicates that crystallized task performance is susceptible to contextual factors. Such findings provide further support for the idea that standard cognitive tasks are more complex than the fluid-crystallized dichotomy would suggest. For example, Vocabulary is a measure of accumulated knowledge, long-term recall, and attentional factors. Stankov (1988) demonstrated that there was a significant attentional component in the Vocabulary subtest. Other data indicate that the Similarities subtest measures accumulated knowledge as well as set-switching attentional factors (Albert, Wolfe, & Lafleche, 1990). Similarities is a crystallized task which usually shows age-related declines (but not in the present study). These findings suggest that the fluid-crystallized model is inadequate to describe adult cognitive development. This lack of support for the adequacy of the crystallized-fluid model continues the debate begun by Baltes and Schaie (1976). Recently, Salthouse (1988) stated that fluid (process) and crystallized (product) distinctions are necessary, but not sufficient for a theory of cognitive aging.

Strengths and Weaknesses of this Study

This project makes a significant contribution to the metamemory literature as it answers questions concerning the role of negative affect and aging on cognitive performance. Previous findings were replicated with one exception, indicating that the experiment was conducted with reasonable care and attention to method. There were multiple self report measures of affect. Thus it is reasonable to conclude that the failure to demonstrate that test-related affect could account for a substantial portion of age-related variance in cognitive performance indicates that test-related affect is not a critical component of age-related cognitive decline.

The findings are generalizable to most other studies of cognitive aging as the subjects, method, and design were similar to the paradigms followed by other laboratory studies of cognitive aging. A limitation of the study is that it does not address the role of affect in young and old for cognitive performance in naturalistic situations.

An additional weakness is that the experimental manipulation failed to produce high levels of anxiety. Therefore, it was not possible to evaluate the hypothesis that very high levels of anxiety impair older adults more than younger adults. In defense of the present study, it would appear impossible to design an ethical study in which higher levels of anxiety were induced. Certainly, this author would be unwilling to administer a more aversive procedure to volunteers. Finally, the nonstandarized administration of the Similarities and Vocabulary subtests may have obscured some significant relationships. It is not likely that these difficulties altered the thrust of the conclusions from this study.

Directions for Future Research

This study addressed the role of test anxiety in cognitive performance under research laboratory conditions. Therefore, its conclusions are limited to research settings and may not be valid in everyday situations. Additionally, anxiety was artifically manipulated. In order to discover what role that performance anxiety may play in everyday cognition and to explore the full range of anxiety, a naturalistic design could be employed. There are a number of naturalistic situations such as driver's license exams, counting change in a check out line, or following directions to an unfamiliar location in which anxiety could be measured and correlated with cognitive performance.

Another area for useful work is exploring age differences in metamemory. Combining the assessment of mood and attributions about performance into one study would further delineate the differing reactions of old and young to difficult cognitive tasks and clarify the relationship between emotion and the emotion-labeling process. For example, attributions concerning a "failure" task could be manipulated among old and young subjects and mood measured simultaneously. This manipulation would be followed by several memory tasks. In this way, the relationship between mood and attribution among old and young could be examined. Additionally, the contribution of attributions and the related mood to cognitive performance among young and old could be examined.

Conclusion

There are differences in the level of anxiety with which old and young approach tests. Though older adults report mildly elevated levels of test anxiety, these differences are of little consequence in explaining the consistent and large age group differences in cognitive performance. Increased test anxiety was associated with inferior performance on semantic verbal fluency and vocabulary. However, the robust age-related differences in memory performance were not associated with test anxiety. Thus the hypothesis that age-related differences in fluid cognitive performance are <u>largely</u> secondary to mood variables was not confirmed.

Though mood may influence performance, this variable did not determine cognitive performance in this study. Thus, the etiology of age-related cognitive change remains to be explained.

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APPENDIX A
TABLES

TABLE 1

Raw Data - Independent and Predictor Variables

SS	Age	Condition	Education	Time 1 Worry/Total Anxiety	Time 2 Worry/Total Anxiety	Time 3 Worry/Total Anxiety
1	18	easy	13	21/46	24/52	22/46
2	19	control	14	27/54	27/53	27/56
3	19	control	13	25/54	27/57	27/56
4	18	easy	13	26/54	27/57	27/57
5	19	hard	13	21/41	18/39	19/25
6	19	hard	13	16/42	10/29	17/38
7	18	easy	13	23/45	24/49	20/43
8	18	control	13	26/54	26/50	25/50
9	18	hard	13	25/51	17/40	26/53
10	19	easy	13	25/43	30/59	29/59
11	18	control	13	28/58	30/60	29/57
12	19	hard	13	18/58	17/39	30/50
13	67	easy	13	21/46	24/50	12/26
14	67	hard	11	21/46	15/38	16/38
15	75	control	12	25/53	24/54	25/55
16	21	easy	14	22/44	26/50	22/38
17	30	hard	15	29/55	24/47	26/51
18	18	control	13	27/57	28/58	29/59
19	65	easy	18	27/55	27/54	30/58
20	19	hard	13	28/58	13/28	27/56
21	18	control	13	30/60	30/60	30/60
22	19	easy	13	21/41	23/45	17/27
23	19	hard	13	28/50	17/38	22/48
24	25	control	14	28/56	25/53	25/52
25	20	easy	14	30/58	30/59	29/58
26	63	hard	18	26/55	28/57	25/53
27	75	control	14	27/57	29/60	29/59
28	62	easy	16	30/59	29/59	24/54
29	20	hard	14	21/48	18/37	20/44
30	18	control	13	27/55	27/57	26/54
31	65	control	12	22/52	23/47	11/23
32	68	hard	17	24/53	22/40	28/57
33	21	control	15	23/46	24/40	23/40
34	18	easy	13	19/40	26/54	24/44
35	20	hard	15	29/56	19/37	25/53
36	22	easy	16	25/49	15/31	16/32
37	19	easy	14	24/42	27/47	27/49
38	32	control	14	26/55	30/59	29/59
39	73	hard	8	13/25	24/52	25/49
40	73	easy	8	14/31	16/41	8/20
41	62	control	11	22/43	15/35	22/40
42	69	hard	16	30/59	26/50	28/53
43	64	easy	13	26/52	22/44	24/48
44	68	control	13	25/54	30/60	29/59

SS	Age	Condition	Education	Time 1 Worry/Total Anxiety	Time 2 Worry/Total Anxiety	Time 3 Worry/Total Anxiety
45	71	hard	13	16/37	16/37	20/43
46	70	easy	11	22/47	25/51	22/52
47	68	control	14	29/59	29/59	29/59
48	18	hard	13	27/57	22/52	27/54
49	18	easy	13	21/43	24/46	25/53
50	19	control	13	29/59	29/59	29/59
51	65	hard	12	30/60	20/45	29/59
52	75	easy	12	28/58	27/56	27/57
53	72	hard	12	16/40	13/31	14/32
54	19	easy	13	29/58	27/52	21/43
55	19	control	14	25/48	25/53	25/53
56	19	hard	13	28/58	26/55	29/59
57	19	easy	14	30/60	30/59	28/58
58	22	control	13	26/53	28/57	28/58
59	19	hard	13	29/59	25/54	28/58
60	19	easy	14	25/53	25/55	30/56
61	18	control	13	25/51	28/57	27/54
62	19	hard	13	20/45	20/45	26/56
63	20	easy	14	26/51	25/42	16/27
64	18	hard	13	22/43	11/29	12/29
65	19	control	13	30/57	30/60	30/60
66	72	easy	12	23/45	27/54	20/47
67	74	hard	12	30/60	24/54	26/56
68	67	control	12	29/59	29/59	24/52
69	72	control	15	21/38	26/53	19/39
70	66	easy	11	20/49	21/49	18/48
71	74	hard	11	21/44	14/34	18/37
72	73	control	14	21/50	23/52	24/50
73	62	control	18	19/48	26/56	24/51
74	61	control	12	8/18	10/20	5/11
75	65	hard	12	14/37	12/31	19/35
76	68	control	11	17/31	22/45	16/26
77	71	control	11	12/25	13/28	14/29
78	65	easy	14	26/56	25/50	23/53
79	62	hard	14	30/60	29/59	26/55
80	60	easy	14	24/54	30/60	23/47
81	62	hard	14	25/53	12/27	16/42
82	18	hard	13	26/54	18/43	25/50
83	18	control	13	9/28	28/58	15/40
84	60	control	22	29/59	30/60	30/60
85	63	easy	12	22/48	27/56	26/54
86	62	hard	12	30/59	30/60	29/59
87	66	hard	12	20/42	14/36	22/45
88	66	easy	12	28/57	28/52	28/58
89	71	easy	13	24/53	24/54	17/35
90	65	hard	12	24/49	21/47	27/57
91	60	control	12	30/60	30/60	30/60

Table 2

Raw Data - Dependent Variables

			Verbal Fluency		Recall Memory			
SS	Similarity	Vocabulary	Linguistic	Semantic	#1	Best	#6	#7
1	27	44	33	29	8	13	7	11
2	22	53	25	34	8	15	9	15
3	22	64	47	55	11	13	8	12
4	22	35	52	43	11	15	8	15
5	14	44	36	47	8	15	9	15
6	24	57	38	33	8	15	6	15
7	19	46	43	38	11	15	9	14
8	22	40	43	38	8	14	5	10
9	21	65	33	47	11	15	9	14
10	23	51	55	49	5	13	10	7
11	22	57	39	49	7	15	6	15
12	21	64	46	64	11	15	8	15
13	20	34	22	37	5	10	3	--
14	17	51	25	29	4	12	5	11
15	18	53	43	36	5	12	3	9
16	23	55	29	45	7	13	8	12
17	22	66	43	39	7	14	8	0
18	25	49	49	56	8	14	5	12
19	28	69	73	59	8	13	6	10
20	20	49	31	37	9	15	7	14
21	25	53	48	60	7	15	5	14
22	19	44	25	41	8	15	6	14
23	22	52	38	42	9	15	12	13
24	25	66	50	51	9	1	6	14
25	22	56	28	35	13	15	6	15
26	16	68	30	30	6	12	8	5
27	20	63	27	42	4	10	5	8
28	28	67	35	53	9	15	7	15
29	17	42	31	47	7	12	5	13
30	21	52	39	39	9	15	8	15
31	10	55	42	25	7	10	4	6
32	26	68	51	46	7	14	10	14
33	21	56	41	54	9	15	12	14
34	21	42	44	44	11	15	8	14
35	19	63	26	51	8	14	4	14
36	21	49	47	35	8	15	6	13
37	22	51	31	29	7	13	9	11
38	18	44	32	49	7	15	5	12
39	5	22	20	30	5	11	3	6
40	14	35	17	27	6	12	4	6
41	24	63	51	48	6	14	6	10
42	25	62	31	36	6	12	6	5
43	25	48	24	47	4	12	4	7
44	19	53	35	31	6	14	5	10
45	23	51	30	37	7	14	10	14
46	17	58	33	35	7	11	5	8
47	18	62	42	31	7	11	4	6
48	18	49	59	53	8	15	11	10

SS	Similarity	Vocabulary	Verbal Fluency Linguistic	Semantic	Recall #1	Best	Memory #6	#7
49	17	58	37	34	8	14	7	11
50	18	46	27	40	9	15	4	15
51	25	63	44	39	5	11	4	11
52	24	55	56	31	7	13	5	8
53	21	52	48	48	4	9	3	4
54	23	51	36	47	7	4	6	10
55	12	56	43	49	9	15	9	12
56	18	50	55	66	11	15	12	15
57	22	48	51	47	9	15	8	15
58	22	62	53	51	11	15	10	14
59	22	55	39	44	9	14	9	14
60	19	42	37	34	9	14	5	14
61	19	50	43	37	10	14	11	14
62	22	50	47	48	8	14	8	12
63	14	24	24	27	8	14	9	10
64	19	41	29	46	7	15	8	15
65	22	56	34	37	7	15	4	15
66	21	64	58	41	7	12	2	7
67	18	66	45	32	4	11	5	9
68	21	45	24	46	8	13	5	11
69	19	45	23	31	5	13	6	9
70	21	57	42	24	6	13	4	12
71	20	56	20	22	4	11	7	8
72	18	57	44	29	7	10	8	3
73	21	56	41	35	4	9	5	6
74	18	48	26	29	3	12	3	10
75	19	53	39	31	6	14	7	11
76	16	43	32	46	5	10	7	0
77	18	53	24	23	5	10	7	11
78	19	51	70	43	6	12	5	4
79	20	55	42	41	5	13	6	10
80	24	49	23	25	5	13	7	10
81	23	63	52	46	9	14	6	13
82	21	50	33	41	8	15	9	10
83	23	37	37	41	9	15	8	15
84	19	50	56	57	9	14	9	14
85	23	58	31	44	9	10	4	9
86	16	48	34	46	5	13	8	11
87	23	57	36	28	6	10	-	8
88	15	43	32	35	4	8	4	7
89	18	48	27	36	8	12	4	3
90	24	59	44	43	7	11	9	8
91	23	54	43	31	6	12	8	11

Table 3

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on Initial Worry Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	8.54	0.18	.84
Agegroup	1	96.70	3.97	.05
Condition X Agegroup	2	60.38	1.24	.29
Error	85	2070.67		

Table 4

Cell Means of Initial Worry Scores*
by Condition and Age

	control	easy	hard	
young	25.8	24.5	25.1	25.1
old	21.9	24.6	22.7	23.1
	23.9	24.5	23.9	24.1

*higher scores = less worry

Table 5

3 (Condition) X 2 (Age) Univariate Analysis of Variance on Initial Emotionality Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	4.40	0.10	.90
Agegroup	1	0.88	.04	.84
Condition X Agegroup	2	132.0	3.13	.05
Error	85	2952.68		

Table 6

3 (Condition) X 2 (Age) Univariate Analysis of Variance on Initial Total Anxiety Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	4.56	0.03	.97
Agegroup	1	127.40	1.59	.21
Condition X Agegroup	2	364.26	2.27	.11
Error	85	6828.86		

Table 7

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on Initial Visual Analog Anxiety Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	3897.32	1.16	.32
Agegroup	1	10999.61	6.52	.01
Condition X Agegroup	2	425.65	0.13	.88
Error	85	143403.56		

Table 8

Cell Means of Initial Visual Analog Anxiety Scores*
by Condition and Age

	control	easy	hard	
young	63.2	81,7	68.7	71.1
old	47.4	57.1	43.1	49.9
	55.8	69.0	55.9	60.3

*higher scores = more anxiety

Table 9

3 (Condition) X 2 (Age) Univariate Analysis of Variance on Initial Visual Analog Alertness Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	9313.27	.59	.56
Agegroup	1	5964.37	.76	.39
Condition X Agegroup	2	1792.82	.11	.89
Error	85	669283.03		

Table 10

3 (Condition) X 2 (Age) Univariate Analysis of Variance on Beck Depression Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	8.67	.23	.79
Agegroup	1	2.03	.11	.74
Condition X Agegroup	2	28.77	.76	.47
Error	85	1601.42		

Table 11

3 (Condition) X 2 (Age) Univariate Analysis of Variance on Initial Visual Analog Depression Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	7754.80	.80	.46
Agegroup	1	44860.46	9.21	.0032
Condition X Agegroup	2	4609.96	.47	.62
Error	85	414135.24		

Table 12

Cell Means of
Initial Visual Analog Depression Scores

	control	easy	hard	
young	136.56	159.47	123.53	139.78
old	104.21	95.13	86.87	95.20
	121.47	126.26	105.20	

Table 13

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on
Initial Worry Scores - Post-manipulation Worry Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	874.65	24.84	.0001
Agegroup	1	24.33	1.38	.24
Condition X Agegroup	2	66.91	1.90	.16
Error	85	1496.74		

Table 14

Cell Means of
Initial Worry Scores - Post-manipulation Worry Scores
by Condition and Age

	control	easy	hard	
young	-2	-1.2	6.8	1.1
old	-1.7	-1.1	3.3	0.17
	-1.9	-1.2	5*	.66

* significantly different at p = .05 Tukey's method

Table 15

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on Initial Visual Analog
Anxiety Scores - Post-manipulation Anxiety Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	20768.44	9.59	.0002
Agegroup	1	2073.90	1.92	.17
Condition X Agegroup	2	2050.63	0.95	.39
Error	85	92022.24		

Table 16

Cell Means of
Initial Visual Analog
Anxiety Scores - Post-manipulation Anxiety Scores
by Condition and Age

	control	easy	hard	
young	2.2	-.53	-35	-11
old	-1.7	16.4	-19	-1
	.36	8	-27*	-6

*significantly different at p = .05 Tukey's method

Table 17

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on
Initial Alert Scores - Post-manipulation Alert Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	59954.25	8.38	.0005
Agegroup	1	4863.94	1.36	.25
Condition X Agegroup	2	33159.61	4.64	.01
Error	85	303975.04		

Table 18

Cell Means of
Initial Alert Scores - Post-manipulation Alert Scores
by Condition and Age

	control	easy	hard	
young	20	22	-69*	-8
old	26	-4	-5*	5
	23	9	-37	

* significantly different from one another
at p = .05 Tukey's method

Table 19

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on
Initial Worry Scores - Final Worry Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	43.85	1.36	.26
Agegroup	1	1.76	.11	.74
Condition X Agegroup	2	31.86	.99	.38
Error	85	1372.75		

Table 20

3 (Condition) X 2 (Age) Univariate Analysis
of Variance on
Initial Visual Anxiety Scores - Final Visual Anxiety
Scores

SOURCE	df	TYPE III SS	F	p
Condition	2	16027.28	3.71	.03
Agegroup	1	551.25	.26	.61
Condition X Agegroup	2	2426.50	.56	.57
Error	85	183405.88		

Table 21

Cell Means of
Initial Visual Anxiety Scores - Final Visual Anxiety Scores

	control	easy	hard	
young	0.81	-0.87	-26.07	-8.50
old	-16.43	7.13	-31.60	-13.11
	-7.23*	3.26	-28.23*	

* significantly different from one another at p = .05 Tukey's method

Table 22

3 (Condition) X 2 (Age) Multivariate Analysis
of Covariance on
Linguistic and Semantic Verbal Fluency Scores

SOURCE	df	HOTELLING-LAWLEY TRACE	F	p
Education	2,82	.08	3.43	.04
Initial Worry	2,82	.05	2.11	.13
Condition	4,162	.036	.73	.57
Agegroup	2,82	.15	6.21	.0031
Condition X Agegroup	4,162	.104	2.11	.08

Table 23

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Semantic Verbal Fluency Scores

SOURCE	df	TYPE III SS	F	p
Education	1	347.56	5.29	.02
Initial Worry	1	250.19	3.81	.05
Condition	2	183.36	1.40	.25
Agegroup	1	705.66	10.74	.0015
Condition X Agegroup	2	503.12	3.83	.02
Error	83	5451.00		

Table 24

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Linguistic Verbal Fluency Scores

SOURCE	df	TYPE III SS	F	p
Education	1	554.94	4.65	.03
Initial Worry	1	256.85	2.15	.15
Condition	2	12.47	0.05	.95
Agegroup	1	5.18	0.04	.84
Condition X Agegroup	2	66.66	0.28	.76
Error	83	9909.97		

Table 25

Cell Means for
3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Semantic Verbal Fluency Scores

	control	easy	hard	
young	46*	39	47**	44
old	36*	39	36**	37
	42	39	41	

* significantly different from one another at p = .05 Tukey's method

** significantly different from one another at p = .05 Tukey's method

Table 26

3 (Condition) X 2 (Age) Multivariate Analysis
of Covariance on
Rey Auditory Verbal Learning Task Scores

SOURCE	df	HOTELLING-LAWLEY TRACE	F	p
Education	4,78	.09	1.77	.14
Initial Worry	4,78	.04	0.71	.59
Condition	8,154	.20	1.91	.06
Agegroup	4,78	1.40	27.30	.0001
Condition X Agegroup	8,154	.09	.86	.55

Table 27

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on First Recall
Rey Auditory Verbal Learning Task Scores

SOURCE	df	TYPE III SS	F	p
Education	1	4.39	1.82	.18
Initial Worry	1	2.76	1.14	.29
Condition	2	6.51	1.35	.27
Agegroup	1	128.74	53.27	.0001
Condition X Agegroup	2	4.90	1.01	.37
Error	81	195.74		

Table 28

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on Best Recall
Rey Auditory Verbal Learning Task Scores

SOURCE	df	TYPE III SS	F	p
Education	1	4.16	3.04	.09
Initial Worry	1	1.75	1.28	.26
Condition	2	0.38	0.14	.87
Agegroup	1	120.64	88.23	.0001
Condition X Agegroup	2	3.76	1.38	.26
Error	81	261.06		

Table 29

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on Distractor Recall
Rey Auditory Verbal Learning Task Scores

SOURCE	df	TYPE III SS	F	p
Education	1	21.77	5.47	.02
Initial Worry	1	0.34	0.08	.77
Condition	2	21.44	2.69	.07
Agegroup	1	76.62	19.24	.0001
Condition X Agegroup	2	2.31	0.29	.75
Error	81	322.59		

Table 30

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on Last Recall
Rey Auditory Verbal Learning Task Scores

SOURCE	df	TYPE III SS	F	p
Education	1	14.45	1.90	.17
Initial Worry	1	0.60	0.08	.78
Condition	2	16.46	1.08	.34
Agegroup	1	414.78	54.47	.0001
Condition X Agegroup	2	6.19	0.41	.67
Error	81	616.84		

Table 31

Agegroup Means
for 3 (Condition) X 2 (Age) Multivariate Analysis
of Covariance on
Rey Auditory Verbal Learning Task Scores

	First List	Best List	Distractor List	Last List
Young	8.6	14	7.6	13
Old	6	11.8	5.6	8.5

Table 32

Condition Means
for 3 (Condition) X 2 (Age) Multivariate Analysis
of Covariance on
Rey Auditory Verbal Learning Task Scores

	First List	Best List	Distractor List	Last List
Control	7.3	13.2	6.5	11.2
Easy	7.6	13.1	6.1	8.5
Hard	7.1	13.2	7.4	11.2

Table 33

3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Similarities Scores

SOURCE	df	TYPE III SS	F	p
Education	1	28.79	5.46	.02
Initial Worry	1	8.05	1.53	.22
Condition	2	7.82	.74	.48
Agegroup	1	0.86	.16	.69
Condition X Agegroup	2	23.14	2.19	.12
Error	83	437.96		

Table 34

3 (Condition) X 2 (Age) Univariate Analysis of Covariance on Vocabulary Scores

SOURCE	df	TYPE III SS	F	p
Education	1	436.95	6.15	.0152
Initial Worry	1	480.80	6.77	.0110
Condition	2	472.03	3.32	.0409
Agegroup	1	628.04	8.84	.0039
Condition X Agegroup	2	55.74	.39	.68
Error	82	5823.54		

Table 35

Cell Means for
3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Vocabulary Scores

	control	easy	hard	
young	51	46	53	50
old	52	53	56.5	54
	51.5	50	55	52

PLEASE NOTE

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Appendix B through K, 129-146

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APPENDIX L

Consent Form

The present study consists of several cognitive (problem-solving) tests which should last no more than 25 minutes. In addition to these tests, I will be asked to answer questionnaires concerning my mood and provide demographic information such as age and education. These questionnaires should require no more than 25 minutes. At the end of the study, there will be a 5 -10 minute relaxation session in order to decrease whatever tension may develop from participation in the study.

I agree to participate in the present study being conducted under the supervision of Dr. Rosemery Nelson-Gray, a faculty member, and Mary Melton, a doctoral student in the Psychology Department of the University of North Carolina at Greensboro. I have been informed orally and in writing about the procedures to be followed and about any discomforts or risks involved. Ms. Melton has offered to answer further questions that I may have regarding the procedures of this study. I understand that I am free to terminate my participation at any time without penalty or prejudice.

The obtained individual information is confidential. I am aware that further information about the conduct and review of human research at the University of North Carolina at Greensboro can be obtained by calling 334-5878, the Office for Sponsored Programs.

____________________ _________________________

Date Signature of Participant

APPENDIX M

Anagram Test

The following list of jumbled letters form words. Please unravel the jumbled letters and write the correct English word to the side.

tca

plhe

ees

nac

rfo

wsa

tam

nti

pho

APPENDIX N

Anagram Test

The following list of jumbled letters form words. Please unravel the jumbled letters and write the correct English word to the side.

slaai

plablauie

spcstea

ltmpreoa

gtltsio

vnrsiee

sdsguae

prrtsnei

lncuai

Appendix O

Anagram Solutions

cat	alias
can	plausible
help	aspects
see	temporal
for	glottis
was	inverse
at	reprints
tin	degauss
hop	uncial

APPENDIX P

Debriefing subject material - Control

This project is a study for my doctoral dissertation. The purpose of my dissertation is to study the role of anxiety and depressive symptoms in the cognitive performance of adults. I will be testing the hypothesis that age-related differences in cognitive functioning may be due largely to anxiety and depressive symptoms.

In this study, one third of the participants received difficult anagrams, one third received simple anagrams, and one third received no anagrams (control). As a member of the control group, you likely experienced little or no change in your mood. However, those who received the difficult anagrams likely experienced a temporary increase in anxiety or negative mood.

Finally, all participants completed several tests of verbal reasoning and memory. I will be analyzing how participants' report of mood states, age, and the difficult task effect cognitive performance.

PLEASE DO NOT TALK WITH ANYONE ABOUT THIS PROJECT. OTHER VOLUNTEERS MAY HEAR ABOUT YOUR EXPERIENCE AND THIS WOULD CHANGE THEIR PERFORMANCE AND MAKE MY STUDY WORTHLESS.

Thank you for your help

Mary Melton

Debriefing subject material - Easy

This project is a study for my doctoral dissertation. The purpose of my dissertation is to study the role of anxiety and depressive symptoms in the cognitive performance of adults. I will be testing the hypothesis that age-related differences in cognitive functioning may be due largely to anxiety and depressive symptoms.

In this study, one third of the participants received difficult anagrams, one third received simple anagrams, and one third received no anagrams. You received anagrams designed to be simple. As a result, you likely experienced little or no change in your mood. However, those who received the difficult anagrams likely experienced a temporary increase in anxiety or negative mood.

Finally, all participants completed several tests of verbal reasoning and memory. I will be analyzing how participants' report of mood states, age, and the difficult anagrams effect cognitive performance.

PLEASE DO NOT TALK WITH ANYONE ABOUT THIS PROJECT. OTHER VOLUNTEERS MAY HEAR ABOUT YOUR EXPERIENCE AND THIS WOULD CHANGE THEIR PERFORMANCE AND MAKE MY STUDY WORTHLESS.

Thank you for your help

Mary Melton

Debriefing subject material - Hard

This project is a study for my doctoral dissertation. The purpose of my dissertation is to study the role of anxiety and depressive symptoms in the cognitive performance of adults. I am testing the hypothesis that age-related differences in cognitive functioning may be due largely to anxiety and depressive symptoms.

In this study, one third of the participants received difficult anagrams, one third received simple anagrams and one third received no anagrams. You received anagrams designed to be extremely difficult. As a result, you likely experienced a temporary increase in anxiety or negative mood. However, those who received the simple anagrams likely showed little or no change in mood.

Finally, all participants completed several tests of verbal reasoning and memory. I will be analyzing how participants' report of mood states, age and the difficult anagrams effect cognitive performance.

PLEASE DO NOT TALK WITH ANYONE ABOUT THIS PROJECT. OTHER VOLUNTEERS MAY HEAR ABOUT YOUR EXPERIENCE AND THIS WOULD CHANGE THEIR PERFORMANCE AND MAKE MY STUDY WORTHLESS.

Thank you for your help

Mary Melton

Appendix Q

Figures

FIGURE 1

Graph of Cell Means of
3 (Condition) X 2 (Age) Univariate Analysis
of Variance on
Initial Alert Scores - Post-manipulation Alert Scores

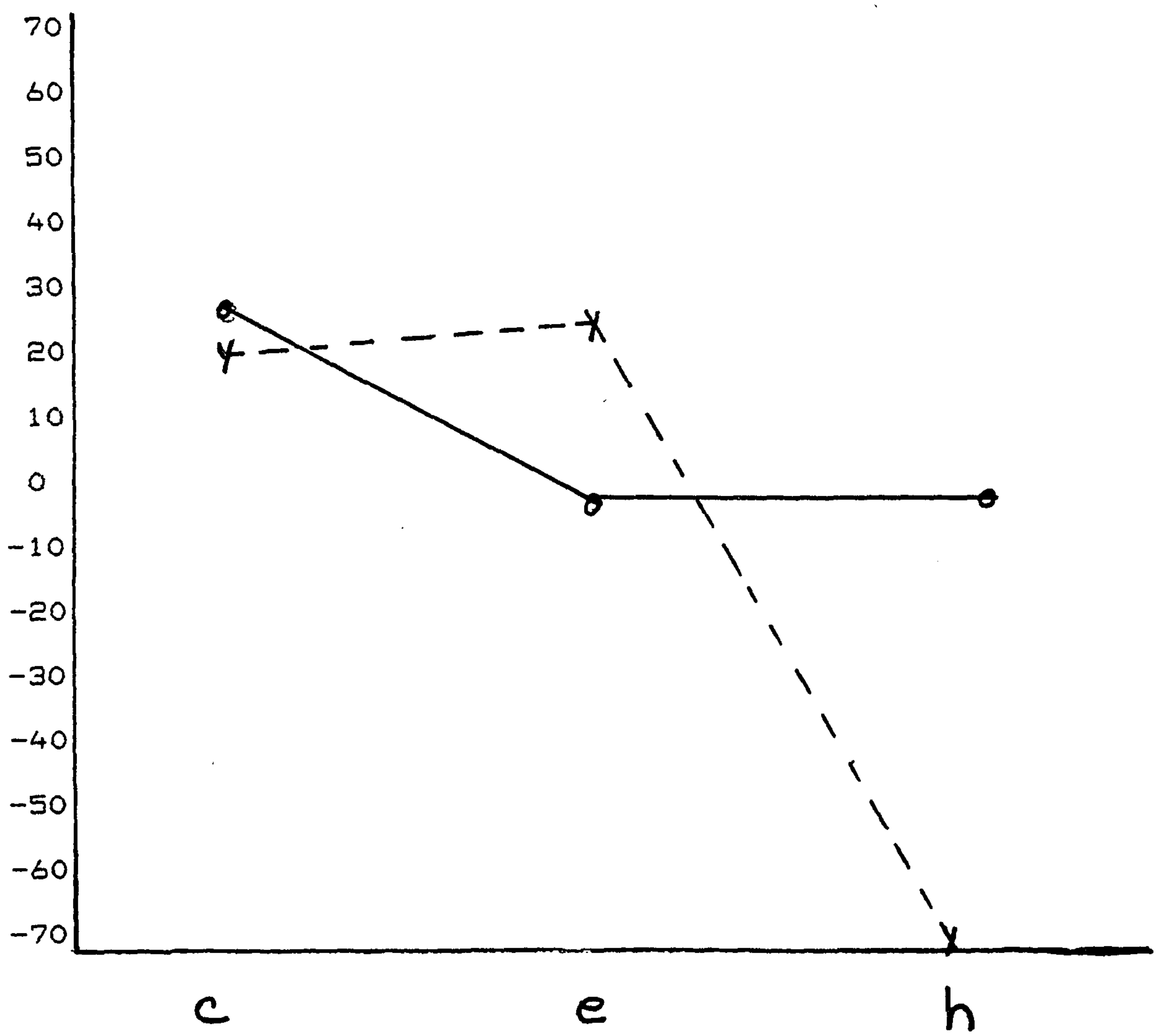

FIGURE 2

Graph of Cell Means
3 (Condition) X 2 (Age) Univariate Analysis
of Covariance on
Semantic Verbal Fluency Scores