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The effect of hypertension on cognitive performance in older adults: Self-evaluation as a mediator.

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The effect of hypertension on cognitive performance in older adults: Self-evaluation as a mediator

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The effect of hypertension on cognitive performance in older adults: Self-evaluation as a mediator

The purpose of the present study was to investigate several sources of inter-individual variability which have been shown to be related to cognitive performance in elderly adults. Cognitive performance includes performance on measures of intelligence, learning, and memory. Past research on age-related cognitive changes has focused on describing universal trends, such as declines in performance in various types of memory (e.g. Poon, 1985). However, it became apparent to researchers in the field, that large individual differences in cognitive performance were present among elderly individuals (e.g. Baltes & Willis, 1981; Schaie, 1983) and recent research has focused on attempting to explain this variability within the elderly population (e.g. Berry, 1989; Krauss, 1980; Lachman & Leff, 1989).

In order to explain this variability many researchers have adopted a contextual approach. The contextual approach to cognitive development focuses on the role that characteristics of tasks, individuals, and situations play in cognitive performance (Berry, 1989). Particularly in the area of cognitive aging it is no longer seen as sufficient to use chronological age to explain age-related differences in cognition. Instead, characteristics of tasks, individuals, and situations have been investigated to uncover the mechanisms involved in these age-related differences and have been found to be important determinants of cognitive

performance in the elderly (Arbuckle, Gold, & Andres, 1986). The present study focused on several characteristics of individuals to explain age-related differences in cognitive performance. The characteristics examined included health status and self-evaluation variables.

One important source of inter-individual variability among elderly individuals is health status. Poor health in general, and hypertension in particular, has been shown to be associated with both cognitive declines and affective differences. Hypertension has been associated with increased anxiety (Friedman & Bennett, 1977; Wilkie, Eisdorfer, & Nowlin, 1976), increased depression (Heine, Sainsbury, & Cheynometh, 1969), and decreased performance on various cognitive measures (Hertzog, Schaie, & Gribbon, 1978; Shultz, Dineen, Elias, Pentz, & Wood, 1979; Wilkie & Eisdorfer, 1971).

Another source of inter-individual variability that has received much recent attention is personality. Although the traditional conception of personality focuses on patterns of traits (e.g. Costa & McCrae, 1980, 1988), recent literature has emphasized the importance of utilizing self-evaluation and domain-specific measures in order to demonstrate changes in adult personality and relationships between personality and performance in particular areas (e.g. Berry, West & Dennehey, 1989; Lachman, 1986a; Lachman, Baltes, Nesselroade, & Willis, 1982). The present study examined self-evaluations which included trait and state anxiety, depression, intellectual self-efficacy, and locus

of control in intellectual contexts.

Both anxiety and depression have been shown to be negatively related to performance on various cognitive measures such as memory (Costa, Fozard, McCrae, & Bosse, 1976; Hodges & Durhan, 1972; Kennelly, Hayslip & Richardsen, 1985). Anxiety is particularly relevant to the study of cognition in the elderly because in test taking situations, the elderly are often more anxious than the young (Eisdorfer, 1968; Powell, Eisdorfer, & Bogdonoff, 1964; Whitbourne, 1976). Anxiety is especially relevant when studying the effects of health on cognition as elderly adults with health problems tend to have higher anxiety than healthy older adults (e.g. LaRue & D'Elia, 1985). Depression is also particularly relevant to the study of cognition in the elderly. Although incidences of major depression may actually decline with age, depressive symptoms may increase with age (Murrell & Meeks, 1991). In addition, older adults with health problems, lower social class and weak social support are more at risk for developing depressive symptoms as a result of life-event stresses such as bereavement, caregiving, and health events (Murrell & Meeks, 1991).

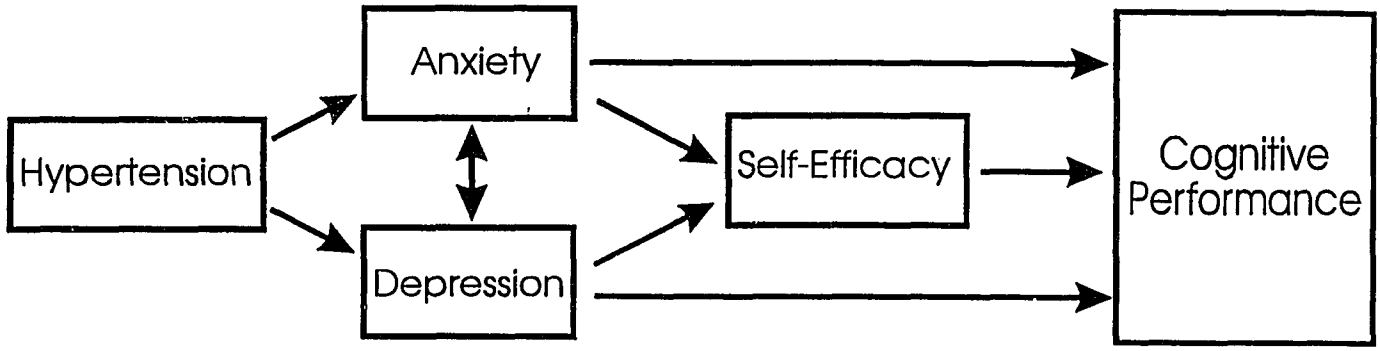
Self-efficacy and locus of control are two other self-evaluative variables which have been shown to be related to cognitive performance in the elderly (Lachman, Baltes, Nesselroade, & Willis, 1982; Lachman, Sternberg & Trotter, 1987; Powell & Centa, 1972; Samuel, 1980) and to health (Ciricelli, 1987; Lachman & Leff, 1989). Self-efficacy can be defined as

people's judgments of their capabilities to attain certain goals or types of performance (Bandura, 1986). Locus of control refers to an individual's belief in his personal control over situations (Lachman, 1981). In the present study the measures of self-efficacy and locus of control were specific to the intellectual domain.

Several studies have documented age-related differences in both self-efficacy and locus of control which indicate that the elderly are especially vulnerable to self-expectations of failure which lead them to reduce their efforts on cognitive tasks (Berry, West, & Dennehey, 1989; Lachman & Leff, 1989; West et al., 1984). Several psychologists have hypothesized that anxiety and depression are related to cognitive performance through self-efficacy. West, Boatwright, and Schlesser (1984), for example, believe that affect influences an individual's self-perceptions or expectations and that these expectations then mediate both cognitive self-assessments and actual performance. In the present study it was hypothesized that the effect of hypertension on cognitive performance was mediated by this relationship between affect and self-expectations. This process is illustrated in Figure 1. West, et al., (1984) used measures of life-satisfaction, anxiety, and depression to measure affect in their elderly sample. In the present study affect was measured by state and trait anxiety and depression. Depression was defined as depressive symptomology or mood rather than the presence of clinical depression.

Figure 1

Path Model of Cognitive Performance



The present study attempted to integrate health status, self-evaluation, and cognition in the elderly by examining the relationship between various measures of self-evaluation and cognitive performance in elderly hypertensive and normotensive subjects. Since hypertension has been shown to be related to both decreased performance on various cognitive measures (Hertzog, et al., 1978; Schultz, et al., 1979), increased anxiety (Friedman & Bennett, 1977) and depression (Heine, et al., 1969) and occurs in approximately 50% of Americans over 65 (USDHEW, 1979), it was felt to be a relevant measure of health status in the present study. Measures of anxiety, depression, intellectual self-efficacy, locus of control in intellectual contexts, and both self-assessed and laboratory measures of memory were utilized to determine: (a) the effect of hypertension on self-evaluation characteristics and cognition in elderly adults and (b) the relative influence of hypertension and self-evaluation on cognitive performance.

In addition, the present study attempted to determine whether there was a significant relationship between affect and cognitive performance, perhaps, mediated by self-efficacy and locus of control.

Review of Literature

The review of literature is divided into two sections: cognitive deficits and hypertension and self-evaluation and hypertension. The section on cognitive deficits reviews literature related to speed of processing, intelligence, working

memory, and self-assessed memory. The section on self-evaluation reviews literature related to anxiety, depression, self-efficacy, and locus of control.

Cognitive Deficits And Hypertension

In the psychology of aging, relations between health and behavior have received much recent attention (e.g. Siegler, Nowlin, & Blumenthal, 1980; Siegler & Costa, 1985). Hypertension, in particular, has been associated with declines in scores on the Primary Mental Abilities Test (Hertzog et al., 1978), WAIS scores (Shultz et al., 1979), various neuropsychological tests (Vanderploeg, Goldman, & Kleinman, 1987), and poor performance on non-verbal material and psychomotor tests (Wilkie & Eisdorfer, 1971). Several important methodological differences occur in these studies particularly in regard to subject selection.

Speed of processing. Slowing of response speed was one of the first behaviors associated with hypertension. Boller, Vrtunski, Mack, and Kim (1977) found significant slowing of reaction time in unmedicated hypertensives. Similarly, King (1956) found hypertensives were consistently slower than normotensives in lift reaction time, tapping, and fingertip dexterity. Spieth (1965), using men 35-59 years old, found that while untreated hypertensives were significantly slower than non-hypertensive subjects on a composite score derived from the Trail Making Test Parts A and B, digit symbol substitution, and serial reaction time, treated hypertensives were not.

In contrast, Light (1975) using subjects 18-59 years of age, found slowing of response speed but only in subjects taking medication. Light concluded that hypertension is not always related to response slowing. A methodological difference in Light's study compared to other studies previously cited was that Light's subjects stopped taking their medication 3 to 21 days prior to testing and were given a diuretic to lower their blood pressure to normal levels for the testing session. In later studies, Light (1978, 1980a,b) included older subjects (18-77 years) and subjects with known cerebrovascular and cardiovascular disorders again and found response slowing for medicated but not nonmedicated hypertensives. In addition, subjects with cerebrovascular disorders (strokes and transient ischemic attacks) were significantly slower than both normotensive controls and subjects with cardiovascular disorders.

An important methodological issue in these studies is the selection of subjects. From Light's studies (1975, 1978, 1980a,b) it seems clear that including hypertensive subjects with cerebrovascular complications will partially determine the results obtained, at least for response speed. Recent studies have been careful to include only subjects with essential hypertension and screen out subjects with possible confounding conditions (i.e. diabetes and kidney disease). Other variables which have been demonstrated to affect the results of neuropsychological tests (e.g., age, sex, education) have also not been carefully controlled in many previous studies comparing

hypertensives and normotensives. In addition, methodological differences (e.g., removing subjects from medication prior to testing) help to explain the inconsistent results previously obtained.

An interesting study by Miller, Shapiro, King, Gincherreau and Hosutt (1984) found that hypertensive subjects placed on antihypertensive medications improved significantly in response speed compared with hypertensive controls who were not placed on medication. Although earlier studies did not control for age, sex, race, and education, Shapiro, King, Gincherreau and Fitzgibbons (1982) controlled for these variables and included only subjects diagnosed with essential hypertension. Subjects with hypertension secondary to other disease processes were screened out. Shapiro et al., (1982) found significant slowing of reaction time in unmedicated hypertensive subjects, but medicated hypertensive subjects were not significantly slower than normotensive subjects.

King and Miller (1990) concluded from a review of the literature that slight psychomotor slowing not attributable to age or medication had been demonstrated in essential hypertensives for tasks involving simple psychomotor speed, but results were mixed for tasks that added a perceptual or cognitive component (e.g., Trail Making, Digit Symbol Substitution).

Intelligence. Another area of active research has been on the relations between hypertension and intellectual ability and memory. In the area of aging, researchers have attempted to

differentiate normal from pathological cognitive changes. Wilkie and Eisdorfer (1971), in a ten-year longitudinal study of hypertensive subjects, found changes in WAIS scores in subjects first tested in their sixties, although many of their subjects had end-organ changes and cardiovascular disease. Goldman, Kleinman, Snow, Bidus, and Koral (1974) found the frequency of errors on the Category Test was related to diastolic blood pressure even after age and IQ were partialled out. Pentz, Wood, Elias, Schultz, and Dineen (1980) found that while there were no differences between hypertensives and normotensives on Trail Making A or B, hypertensives made more errors on the Category Test. Schultz and Elias (1980) found decreased WAIS verbal scores for younger (21-39) but not older (45-64) hypertensives compared to normotensive controls. Tunick and Franzen (1990) found no differences in response speed (Trails A and B, Reaction Time), but found differences between elderly hypertensives and normotensives in verbal and visual memory in subjects matched for age, sex, education, and race. In addition, hypertensive subjects scored higher on trait anxiety, depression, and total number of self-reported physical illnesses and medications.

On the other hand, Boller et al. (1977) found no significant differences on six subtests of the WAIS, the Wisconsin Card Sort Task, Wechsler Memory Scale and Rey-Osterreith Complex Figure between young, male, untreated hypertensives and normotensive controls matched for age, sex, education, and occupational status. In addition, Thompson, Eisdorfer, and Estes (1970)

found no relationship between WAIS performance and cardiovascular disorders after socioeconomic status and race were taken into account.

Shapiro et al. (1982) tested male and female subjects on Block Design, Digit Symbol Subtest, BVRT, and Time Judgment and found declines in performance only for hypertensive females on Digit Symbol and Time Judgment. It is difficult to state definite conclusions about the effect of hypertension on cognitive performance due to differences in samples and methodology employed in the previous studies. Elias (1980) concluded that the differences in cognitive performance found between hypertensive and normotensive subjects in most studies do not seem to be large enough to affect performance on everyday tasks and that individual differences are large for both normotensive and hypertensive subjects. Pentz, et al. (1980) suggested that conclusions about cognitive impairment in hypertensives are premature because the influence of age, education, health, anxiety and psychopathology on neuropsychological tests has not been controlled.

More recent studies have attempted to control for age, education, and socioeconomic status and screen out subjects with non-essential hypertension, cardiovascular and cerebrovascular complications (e.g., Elias, Robins, Schultz, Streeten & Elias, 1987). Studies which carefully control for medical complications and demographic variables are necessary to distinguish the effects of essential hypertension from medical complications and

demographic differences.

Beyond matching hypertensive and normotensive samples on demographic characteristics, researchers must be careful to include descriptions of their samples as to sex, race, overall health status, education, and socioeconomic status so that differences in results obtained among studies may be related to the demographic characteristics of the sample used. Elias et al, (1987), for example, found no differences between well-educated hypertensive and normotensive subjects on the Average Impairment Rating from the Halstead-Reitan neuropsychological battery, while in the less well educated group hypertensive subjects performed more poorly than did normotensive subjects.

Working memory. Measures of memory seem to be particularly sensitive in differentiating between hypertensive and normotensive subjects (Elias, Elias, & Elias, 1990; Tunick & Franzen, 1990; Wilkie et al., 1976). Elias et al. (1990) suggested that studies which attempt to identify specific memory processes affected by hypertension would be the most useful for understanding cognitive changes related to health status.

Working memory differs from short term memory in that information is manipulated as well as stored (Baddeley, 1981). In working memory there is a necessary trade off between processing resources needed for maintaining material in an active state and those needed for manipulating material (Morris, Gick, & Craik, 1988). Age decrements have been found in working memory tasks (Craik, 1977; Craik & Rabinowitz, 1984; Light & Anderson,

1985). These findings are often explained by claiming that elderly individuals have diminished resources available. According to Salthouse (1991) the reduced processing resources explanation for age-related cognitive deficits attempts to attribute the many age differences in cognitive performance to a few general mechanisms such as speed of processing or attention. This explanation may also relate to hypertensive individuals, especially elderly hypertensives where resources may be especially limited. Working memory limitations are often used to explain age-related cognitive declines due to the crucial role working memory plays in problem solving, learning, and comprehension; working memory limitations could also explain health-related cognitive declines (Craik, Morris, & Gick, 1989; Welford, 1958).

Self-assessed memory. Many researchers have attempted to link everyday memory to memory performance on standard laboratory measures. Everyday memory has usually been measured by self-report. Several different questionnaires have been developed which ask individuals to indicate the frequency with which they have difficulty with everyday memory items such as remembering names and remembering where they put something. Some researchers have been successful at demonstrating a relationship between self-reported everyday memory and actual memory performance (Blau, 1986; Carroll, 1986; Dixon & Hultsch, 1983; Hermann, 1982; Martin, 1986) while others have not (O'Hara, Hendricks, Kohout, Wallace, & Lemke, 1986; Scogin, Storandt, & Lott, 1985; West et

al., 1984; Zarit, Cole, & Guider, 1981).

These inconsistent results may be due to the different measures used and poor scale-to-task isomorphism (Hermann, 1982). Scale-to-task isomorphism refers to whether the everyday memory item (scale) and lab task are similar and have memory processes in common. Many of the lab tasks used in prior investigations (e.g. Broadbent, Cooper, Fitzgerald, & Parkes, 1982; Wilkins & Baddeley, 1978) tapped different processes than those tapped by the everyday memory questionnaires. In studies that attempted to use lab tasks related to self-report items, a moderate relationship has been found (e.g. Martin, 1986; Tunick & Puckett, 1990).

In addition, some researchers have suggested that other variables mediate responses on self-report inventories. One of these variables is health status. Health status seems to be a strong predictor of everyday memory problems as measured by self-report questionnaires (Cutler & Grams, 1988; Tunick & Puckett, 1990; Prescott, 1990). Although there have been many studies which compare actual memory performance of hypertensive and normotensive individuals, few studies have assessed the relation between memory self-assessments and hypertension. One study of elderly hypertensive and normotensive adults which found some differences in memory performance, found no differences on the Cognitive Failures Questionnaire (Tunick & Franzen, 1990).

The Memory Failures Questionnaire (MFQ) was used to measure self-assessed memory in the present investigation. It was

developed to assess the self-appraisal of everyday memory functioning in adults (Gilewski, Zelinski, & Schaie, 1990). In Zelinski, Gilewski, and Anthony-Burgstone's (1990) study, MFQ scores accounted for a significant amount of variance in memory performance even after the effects of depression, health, and education were partialled out (R^2 ranged from .05 - .12). One dimension of the MFQ is frequency of forgetting. When filling out questionnaires which ask subjects to rate how frequently they forget appointments, people's names, etc., it has been assumed that occasions of forgetting are retrieved from memory and rated at the time the questionnaire is filled out. However, Hultsch and Dixon (1990) have suggested that individuals turn to self-efficacy beliefs when filling out frequency of forgetting questionnaires and convert these beliefs into responses appropriate for the questionnaire. Thus, one might expect a strong relationship between self-reported frequency of forgetting and self-efficacy. In addition, since individuals use actual incidents of forgetting to determine their current self-efficacy beliefs, one might expect the relationship between actual frequency of forgetting and self-efficacy to be strong (Hultsch & Dixon, 1990).

Another variable related to self-reported memory questionnaires is affective status (Gilewski & Zelinski, 1986; Larrabee & Levin, 1986); depressed elderly individuals tend to report more memory problems than non-depressed elderly individuals.

Self-Evaluation In Hypertensive Individuals

An individual differences perspective, focusing on subject characteristics, allows for some explanation of the wide variability in cognitive performance found within the elderly population and suggests the possibility that the relative contribution of these variables may change with age (Hultsch & Dixon, 1990). The inclusion of non-cognitive characteristics in the study of cognition assumes a difference between cognitive competence and performance. Cognitive competence is the theoretical upper limit of an individual's cognitive capacity and refers to an individual's innate ability to process information. Since cognitive competence is impossible to measure with current technology, cognitive researchers must rely on test performance to demonstrate competence. The difficulty with using performance on a test to reflect competence results from the many factors which influence performance (e.g., health, anxiety, negative expectations). In measuring the competence of elderly individuals a further difficulty arises from the disproportionately negative effect that these factors have on the performance of elderly subjects (LaRue & D'Elia, 1985).

The issue of competence versus performance has been an important one in the study of cognition and aging and has frequently been used to explain apparent age differences in cognitive performance. According to Kausler (1990), although elderly adults may be as competent as young adults, they perform more poorly if they are not as motivated or if they are more

anxious. These factors may affect the performance of individuals with chronic health problems as well.

Increased incidence of anxiety and depression have long been implicated as factors leading to the poorer performance of elderly adults and individuals with health problems. In addition, metacognition, more specifically self-efficacy or self-evaluation, has also received much attention as an explanation for cognitive declines in the elderly, especially those in poor health.

Anxiety. There has been much evidence, both theoretical and empirical, linking anxiety to performance on several cognitive measures in both young and old subjects. Anxiety has been shown to be negatively related to speed of performance (Fozard & Costa, 1977) and to performance on other laboratory tasks (Costa et al., 1976; Eisdorfer, 1968; Hodges & Durhan, 1972; Hodges & Spielberger, 1969; Spielberger, 1977).

Theoretically, it has been suggested that anxiety inhibits performance through excessive self-focusing and worrying (Paulman & Kennelly, 1984; Strack, Blaney, Ganellen, & Coyne, 1985). An individual's level of state anxiety is influenced by his/her perception of the situation as being threatening. By affecting an individual's ability to concentrate on the task at hand, anxiety could affect both the encoding and retrieval of information.

Findings have been mixed on whether state anxiety increases with age, but several studies have shown that elderly subjects

are more anxious than young subjects in a variety of test taking situations (Eisdorfer, 1968; Powell, Eisdorfer, & Bogdonoff, 1964; Whitbourne, 1976). Although most of the research has used self-assessed anxiety, Eisdorfer, Nowlin, & Wilkie (1970) reported increased levels of autonomic arousal in older adults in lab settings.

In addition, Yesavage & Jacobs (1984) found decreased memory deficits following anxiety reduction in older adults using subjects screened for clinical depression and dementia. The authors used a measure of anxiety which had two scales, "emotionality" (uneasiness, tension, and nervousness) and "worry" (concern about one's level of performance, negative task expectations, and negative self-evaluations). They interpreted "worry" as representing the cognitive component of anxiety. Their results indicated that "emotionality" was not correlated with cognitive performance but "worry" and self-assessed cognitive interference scores were related to cognitive performance. Subjects with the greatest reduction in the cognitive component of anxiety and cognitive interference, in addition to improved performance on a divided attention task, showed the greatest increase in performance on a face-name recall task. The authors concluded that anxiety in the elderly has a cognitive component and it is this component (negative task expectations and negative self-evaluations) which interferes with memory performance. The results of this study indicate that at least part of the poor memory performance in some older adults

can be attributed to performance factors like anxiety. Additionally, these findings suggest that memory deficits in the elderly may not be irreversible but may be attenuated through a combination of affective and cognitive interventions.

Findings of no age differences in some studies of anxiety may obscure the relationship between anxiety and cognitive performance in elderly individuals with health problems. According to LaRue and D'Elia (1985), individuals with health problems have been excluded from many studies relating anxiety and age. Or, the authors of these studies have either failed to report objective health information or described their samples as healthy giving no supporting evidence. LaRue and D'Elia's investigation indicated that health status, not age, was the only significant predictor of trait anxiety in multiple regression analysis. In addition, the authors analyzed subjects in the highest and lowest quartile of trait anxiety for the presence of hypertension and cardiovascular disease. Forty-seven per cent of subjects in the high anxiety group had at least one cardiovascular condition compared to 11% in the low anxiety group.

Elias (1980) indicated that an important direction for future studies involving hypertensive subjects would be to identify the non-cognitive factors which might influence performance. Wilkie et al. (1976), in attempting to explain why hypertensives did more poorly than normotensives on several specific sub-task items on the Wechsler Memory Scale and not on

other items, indicated that performance factors such as understanding of test instructions and anxiety might be the reason. Subjects in their study were screened for cerebrovascular disease but all subjects with high blood pressure (diastolic <105 mm Hg) had end organ changes. Several studies have associated hypertension with increased anxiety (Friedman & Bennett, 1977; Wilkie et al., 1976). Pilowski, Spalding, Shaw, and Korner (1973) reported a significant association between anxiety, several personality scores, and measures of cardiovascular functioning.

Although much of the research on non-cognitive factors in hypertensives has been directed at emotional reactivity as a cause of hypertension, other studies have focused on the possibility that hypertension leads to affective differences perhaps due to abnormal brain physiology (King & Miller, 1990). King and Miller (1990) concluded that differences in the emotional or interpersonal behaviors of hypertensives has been consistently observed in spite of the differences in samples and instruments used across studies. Although most studies used only subjects with essential hypertension, Wennerholm and Zarle (1976) also included a group with hypertension secondary to a known physical cause. The results indicated that both hypertensive groups were more likely than healthy subjects to use denial and repression with secondary hypertensives being more distressed and anxious than the essential hypertensives.

Shapiro et al. (1982) included the Tulane Test-Behavior

Scale to examine subjects' approaches to taking a series of demanding tests. Subjects were newly diagnosed, untreated hypertensives. Hypertensives scored lower on seven of twelve individual scale items. The items which loaded on the Social/Interpersonal factor of the scale differentiated between hypertensive and normotensive subjects. Many of the original subjects were retested fifteen months later after some were put on antihypertensive medication and pre-treatment to post-treatment comparisons were made. Performance of those subjects on medication was more like normotensive controls than unmedicated hypertensives for test taking behaviors as well as cognitive performance.

Shapiro et al.'s (1982) study is important because it implies that the mechanism relating hypertension and behavior is physiological in nature and that lowering a subject's blood pressure could lead to improved performance and social/interpersonal behaviors. Conversely, Robbins, Elias, & Schultz (1990) found in hierarchal multiple regression analyses that blood pressure was a significant predictor of state anxiety only, not trait anxiety or depression. Knowledge of hypertensive diagnosis however, added significantly to the prediction of state anxiety, trait anxiety, and depression in multiple regression analyses even after age, education, sex, and blood pressure were entered in the equation. Unfortunately the authors did not administer any cognitive assessments and thus no conclusion can be reached of the possible effect of knowledge of hypertensive

diagnosis on cognitive performance. Although the mechanisms for explaining the relationship between hypertension and affect and hypertension and cognitive performance are not yet known, it seems clear that such a relationship does exist.

Depression. Many studies have documented the relationship between depression and either self-assessed memory or actual memory performance (Gibson, 1981; O'Hara et al., 1986; West et al., 1984; Cavanaugh & Murphy, 1986; Strack, et al., 1985; Stromgen, 1977; Thompson, 1980; Whitehead, 1974). Kendrick and Post (1967), for example, found impairment in verbal memory in their sample of depressed elderly and Gibson (1981) found that both depressed and demented elderly performed more poorly on a free recall task compared to normal controls. Other studies have indicated that memory performance increases and memory complaints decrease following treatments aimed at ameliorating depression (Popkin, Gallagher, Thompson, & Moore, 1982; Zarit, Gallagher, & Kramer, 1981).

In order to determine which memory tasks depressed elderly individuals have most difficulty with, Kennelly et al. (1985) picked tasks that varied in their demands on memory. Subjects in this study were given the Beck Depression Inventory and classified as depressed ($\underline{X}$ = 11.6) or non-depressed ($\underline{X}$ = 4.0). The authors found that working memory and fluid intelligence were more affected by depression than short term memory or crystallized intelligence. These results may help to explain why some researchers have not been able to demonstrate a relationship

between depression and actual memory performance. It may be that depression differentially affects tasks that are more effortful. In addition, memory performance may be related to severity of depression. Perhaps the samples of healthy elderly adults used in most cognitive studies do not have a large enough subsample of severely depressed subjects. Although some studies attempting to relate depression to memory attempted to select subjects with a diagnosis of major depression (e.g. O'Hara et al., 1986), other studies divided their subjects into depressed and non-depressed groups by scores on symptom checklists such as the Beck Depression Inventory (e.g. Kennelly et al., 1985).

The definition of depression is an important factor in both evaluating the results of studies attempting to relate affect and cognition and in determining the prevalence of depression in elderly adults. Although depressive disorders tend to decline with age, depressive symptoms seem to increase with age (Murrell & Meeks, 1991). Blazer (1983) found that more elderly adults have depressive symptomology compared to actual cases of depressive disorder. In addition, depression scales or checklists may be tapping Adjustment Disorders (minor reactions to stress) which may result from stressful life events such as bereavement or health related events rather than clinical depression (Klerman, 1983). Jarvik (1983) believes that depressive affect is related to disease rather than age and Lieberman (1983) found that life events related to health were the most common precursor of depression. Although Lieberman

found that the total number of life events declined with age, some events which seem to be linked to depression (e.g. poor health) increased in frequency with age. Murrell and Norris (1984), for example, found that approximately 24% of their subjects over 55 had experienced a new illness or accident in the previous year. Since many elderly adults may have periods of depressed affect related to life events, study of the relationship between depressive symptoms and cognitive performance would seem to be appropriate.

Several studies have found a relationship between hypertension and depressive symptoms (e.g., Heine, et al, 1969; Tunick & Franzen, 1990). Wood, Elias, Shultz, and Pentz (1979) reported higher Zung depression scores for young hypertensives, but not for older hypertensives, although the mean age of their older hypertensives was only 54 years. There has not been a systematic study of depression in elderly hypertensives, although depression has been shown to affect both self-assessed and actual memory performance (O'Hara, et al., 1986; West et al., 1984).

Wilkie and Eisdorfer (1971) suggested that anxiety and depression might affect performance in hypertensives by influencing their allocation of attention. This notion is supported by Perlmutter, Adams, Berry, Kaplan, Person, and Verdonik (1987), who suggested that depression influences behavior through the development of negative expectancies and decreased attention. Perlmutter et al. (1987) and others have suggested that negative attributions disadvantage many elderly

individuals in test taking situations.

The acceptance of aging stereotypes and negative expectancies, although present in many healthy elderly individuals, has been found to be most prevalent in individuals with poor health (Milligan, Powell, Harley, & Furchtgott, 1985). In addition, worrying about the effect of health status and medications on one's cognitive ability might make an individual with a chronic illness, such as hypertension, more susceptible to cognitive deficits related to anxiety and depression. Several researchers believe that the effect of depression as well as anxiety on cognitive performance is indirect and mediated by performance expectations such as self-efficacy (Berry et al., 1989; Camp, 1986; Cavanaugh & Murphy, 1986; Goodstein, 1985; Strack et al., 1985). Using this mediational model the effect of hypertension would be to increase negative affect either by physiological mechanisms or through knowledge of hypertensive diagnosis. While anxiety and depression are mood states (short term dispositions), locus of control and self-efficacy could be considered personality traits that are associated with moods (Lefcourt, Miller, Ware & Sherk, 1981; Thayer, 1989). Johnson and Magaro (1987) have theorized that cognitive deficits related to mood disorders could be produced in part by low effort in addition to problems with encoding and retrieval of information congruent to the current mood. Thayer (1989) also discussed effort as an important factor in performance. In his model, individuals evaluate whether they have the energy or resources to

accomplish a task, with depressed individuals having low energy. Thayer's model is similar to Bandura's (1986) concept of self-efficacy although Bandura's notion is that individuals are evaluating whether they have the skill rather than energy to accomplish a task. Bandura sees low effort as the end result of low self-efficacy, however the result is the same with the individual not expending much effort on the task.

Another model of the mechanism for the effect of anxiety and depression on behavior involves neurotransmitters. Different levels of catecholamine metabolites have been found in the urine and cerebrospinal fluid of persons with affective disorders (Thayer, 1989). Depressed individuals, for example, have decreased levels of catecholamines, particularly norepinephrine. Serotonin levels have also been found to be important as well as the interactions among amine systems. Since the norepinephrine system and acetylcholine system act in balance to control autonomic functions, depression could be linked to high acetylcholine and low norepinephrine. Evidence from drug studies support this hypothesis (see Davis, Single & Spring, 1983; Thayer, 1989) although cause and effect are difficult to establish.

Cloninger (1987) as well as Gray (1988) have proposed models of anxiety based on anxiety as a central state. Both personality and neurotransmitters form the basis of Cloninger's (1987) model. The three personality dimensions described by Cloninger are novelty seeking, harm avoidance, and reward dependence.

Individuals with a novelty seeking personality are characterized by having intense excitement in response to novel stimuli and this personality trait may be associated with low basal dopaminergic activity (Orsillo & McCaffrey, 1992). Individuals with harm avoidance personality respond intensely to aversive stimuli and learn to avoid punishment, novelty, and non-rewarding situations. These individuals have frequent anticipatory worries and this thought is thought to be associated with increased serotonergic activity. This trait might be similar to what Yesavage and Jacobs (1984) identified as worry, or the cognitive component of anxiety. The final personality trait is reward dependence characterized by learning to maintain rewarded behavior and is correlated with low basal noradrenergic activity. Information on Generalized Anxiety Disorder (GAD), defined as excessive anxiety and worry for several months, lends support to these models (Orsillo & McCaffrey, 1992). Findings from EEG and brain imaging studies support the hypothesis that individuals with GAD many have decreased attention to environmental stimuli and information processing deficits (Orsillo & McCaffrey, 1992). Similar mechanisms may also be in effect for individuals with less severe anxiety problems, although this hypothesis has not been directly tested. Even normal aging has been associated with declines in neurotransmitters. Woodruff-Pak, Coffin and Sasse (1991) have suggested that declines in cognitive ability with age may be associated with declines in the amount of norepinephrine synthesized by the brain. These authors also suggest that the

balance between serotonergic and cholinergic systems night be affected by age through the selective loss of neurons in neurotransmitter bearing cells. This evidence suggests that there may be physiological as well as psychological mechanisms involved in the relationships among anxiety, depression, cognitive performance and hypertension in elderly adults.

Self-efficacy. Many researchers have attempted to link metamemory with actual memory performance. Metamemory refers to knowledge about memory processes and strategies in general and knowledge about one's own memory functioning. Studies attempting to link metamemory and memory performance have had mixed findings (e.g. Chaffin & Hermann, 1983; Gilewski & Zelinski, 1986). One explanation for these mixed findings could be due to the use of instruments which tap different dimensions of metamemory. Hertzog, Hultsch and Dixon (1989) have made the distinction between knowledge about one's memory and belief's about one's memory. This distinction is an important one as an individual can have accurate knowledge about what strategies to use for a given task but still believe that he/she will not be able to perform well on this task.

Hertzog et al. (1989) relate beliefs about one's memory to Bandura's (1986) self-efficacy construct. Self-efficacy can be defined as, "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p.391). Many researchers believe that memory beliefs influence memory performance (e.g.

Bandura, 1986; Dweck, 1986; Berry, 1986) and that the relationship between memory beliefs and performance changes with age (Berry et al., 1989).

The results of studies on memory predictions are mixed. One reason for the differing results could be the type of measure used, for example single versus multiple predictions. Studies involving single predictions about expected performance have found that older adults tend to overestimate their abilities while younger adults are either accurate or tend to underestimate their abilities (Balcerak & Rebok, 1986; Bruce, Coyne, & Botwinick, 1982; Murphy, Sanders, Gabriesheski, & Schmitt, 1981).

Different results have been found in studies using multiple memory predictors. Self-efficacy measures using multiple memory predictors match each prediction to a specific task, thus making it more likely that predictions will correspond to actual performance. Self-efficacy theory predicts that individuals low in self-efficacy will expend less effort and persist less in performing a task (Bandura, 1986), thus performing more poorly. It has been assumed that older adults are more likely to have low self-efficacy due to beliefs about aging stereotypes and increased anxiety over frequency of forgetting. Evidence has been found to support the notion that older adults are more upset by and attach more importance to memory failures than young adults (e.g., Cavanaugh & Murphy, 1986). Older adults also believe they perform more poorly on tests compared to young adults (Cornelius & Caspi, 1986) and older adults tend to have

lower expectancies for success (Prohaska, Parham & Teitelman, 1984).

While only a few studies have been done with measures using multiple task predictors, the results seem to indicate that older adults have lower self-efficacy than young adults. Berry et al. (1989), for example, found that younger adults predicted they could perform at significantly higher levels of difficulty than older adults.

Rebok and Balcerak (1989) found that older adults were more likely than young adults to attribute performance to task difficulty (an external factor) while young adults were more likely to attribute performance to effort. In multiple regression analyses the authors found that attributions of ability and effort predicted self-efficacy strength. These results support Bandura's (1986) hypothesis that attributions or causal explanations can influence self-efficacy. Studies of self-efficacy, like most studies in the area of cognitive aging tend to use samples described as health, community dwelling adults thus yielding little information on the relationship between health and self-efficacy.

Individuals with health problems in general, and hypertension in particular, seem to report more depressive symptoms (e.g., Heine et al., 1969). In addition, older adults with health problems tend to see themselves more like the typical stereotyped "old person" than healthy older adults (Milligan, et al., 1985) which could influence their self-evaluations. In a

study examining the relationships among self-efficacy, social support and depression, Holahan and Holahan (1987) used path analysis to demonstrate that self-efficacy was negatively related to depression a year later and also functioned indirectly through its effect on social support. Self-efficacy was conceptualized to be an important factor in initiating and maintaining social support which in turn was important in maintaining the psychological well-being of older adults.

Lachman and Leff (1989) found self-efficacy was related to memory and speed of processing performance. In addition, they found a negative relation between number of health problems and competence and a positive relationship between self-efficacy and competence. A surprising finding in this study was the positive relationship between number of health problems and self-efficacy. The authors concluded that perhaps successfully coping with a number of illnesses contributed to the subjects' high self-efficacy.

Locus of control. The findings of age-differences in self-efficacy also lend support to the hypothesis that older adults are more external in personal control beliefs. There is a large body of literature which supports this view (e.g.Banziger & Drevenstedt, 1982, Lachman & Leff, 1989; Prohaska et al., 1984). In addition, external control beliefs have also been associated with poorer health (e.g. Luczcz, 1990; Ciricelli, 1987; Felton & Kahana, 1974). Rodin (1982) has focused on the importance of control in understanding health/aging/stress relationships.

Rodin suggested that perceptions of control can decrease the negative effects of stress that are related to being in poor health.

In a five-year longitudinal study, Lachman and Leff (1989) found no significant change in average intellectual function, but found that beliefs in powerful others (external locus of control) did increase significantly. Sense of internal control remained stable. This change in external control was specific to intelligence, as there was no change on a general measure of control beliefs. External locus of control over health also significantly increased. In this study subjects' self-ratings of health decreased significantly over time. In addition, Lachman and Leff found that number of medical problems and fluid intelligence predicted later changes in perceived intellectual control. Individuals who were less healthy and had lower fluid intelligence were more likely to show a loss in perceived control over intelligence over the five year period. The authors concluded that an increase in perceived external control may be an effective coping strategy for these individuals.

Other studies relating perceptions of control to health status have found that higher levels of external control are related to better adjustment in elderly nursing home residents (Felton & Kahana, 1974) and elderly hospital patients (Ciricelli, 1987). Ciricelli concluded that it may be more adaptive for an elderly individual in poor health to give control to others. In the long run, this elderly individual may achieve better control

over his/her situation in this way. Schultz (1986) has called aligning with powerful others who act in one's best interests "secondary control" and believes it may ultimately lead to greater control over events.

In support of this view, Blanchard-Fields and Irion (1988) found that the relationship between locus of control and coping was moderated by age. In older adults, a belief in powerful others was positively related to problem solving and self-control coping strategies, while in young adults these variables were negatively related. Woodward and Wallston (1987) found that older individuals desired less health related control and also had lower self-efficacy. The authors suggested that when older adults perceive themselves as being less competent, they desire less control. Additionally, the authors concluded that both an increased incidence of disease in the elderly and increased dependence on the medical system may contribute to decreased desire for control. However, in contrast to Shultz (1986), these authors believe that giving up control may be detrimental to effective coping.

Few studies have related hypertension to locus of control. A study by Wennerhold and Zarle (1976) used a general measure of locus of control and found no differences between hypertensives and normotensives. Lachman (1986) has stressed the importance of using domain specific control measures and demonstrated that age affected measures of health and intellectual locus of control, but not a general measure of control. Therefore no conclusions

about whether hypertension is related to either intellectual or health related desire for control can be reached from Wennerholm and Zarle's study.

In summary, hypertension has been associated with deficits in cognitive performance such as speed of processing and working memory in addition to being associated with several non-cognitive variables such as anxiety and depression. Although there have not been any studies investigating the relationship between hypertension and intellectual self-efficacy or between hypertension and intellectual locus of control, based on both the aging and health-related literatures, one might expect hypertensives to have lower self-efficacy and more external locus of control scores compared to normotensive individuals of the same age. Since both self-efficacy and locus of control are associated with cognitive performance, the relationship between hypertension and cognitive performance may be mediated by self-efficacy and locus of control which may also mediate the relationship between anxiety and depression and performance.

Statement of Problem

The primary purpose of the present study was to examine the effect of hypertension on both self-assessed and laboratory measures of memory and on non-cognitive factors such as anxiety, depression, self-efficacy, and locus of control. Previous studies have examined the effect of hypertension on cognitive performance or on non-cognitive variables, but there has not been an examination of the relationship between cognitive and non-

cognitive or self-evaluative variables in elderly hypertensive individuals even though several researchers have noted the need for this kind of study (e.g., Elias, 1980). It is important to study the cognitive and non-cognitive characteristics of elderly hypertensive individuals in order to differentiate normal from pathological aging changes. Past research on age-related cognitive changes focused on describing universal trends, such as declines in memory with age (e.g., Poon, 1985). However, it became apparent to researchers in the field that large individual differences in cognitive performance were present among elderly individuals (e.g. Baltes & Willis, 1981) and researchers have begun to focus on attempting to explain the variability in performance that occurs within the elderly population (e.g. Berry, 1986; Lachman & Leff, 1989; West et al., 1984). Hypertension is one important source of interindividual variability in the elderly which has been related to declines in cognitive performance (e.g. Hertzog et al., 1978).

There is reason to believe that working memory and speed of processing are the cognitive abilities most affected by age and health status (Elias et al, 1990; Morris, Gick, & Craik, 1988; Salthouse, 1991). The present study assessed speed of processing, spatial and verbal measures of working memory and spatial and verbal measures of short term memory. Vocabulary as well as incidental memory were also examined.

It has been suggested that non-cognitive factors (e.g., anxiety, depression, self-efficacy) might explain the poor

performance of hypertensives on some cognitive tasks (Elias, 1980; Wilkie, Eisdorfer, & Nowlin, 1976). Many studies have found hypertensives to have increased anxiety and depression. Both of these variables have been found to be negatively related to memory performance (e.g., Eisdorfer, 1968). Also, although few studies have attempted to relate self-efficacy or locus of control to memory performance in hypertensives, there is evidence that both low self-efficacy and external locus of control are related to poor memory performance (e.g., Bandura, 1986; Lachman & Leff, 1989) and are associated with health problems (Ciricelli, 1987; Felton & Kahana, 1974; Lachman & Leff, 1989; Woodward & Wallston, 1987).

In addition, several researchers have hypothesized that self-efficacy and locus of control mediate the relationship between affect and cognitive performance (e.g., Bandura, 1989; Lachman et al., 1987). Depressed individuals, for example, tend to have negative self-evaluations and expectancies which could be related to their poorer memory performance. The following hypotheses were examined in the present study.

Hypotheses

1. a) Based on the literature reporting poorer memory performance for hypertensive subjects (e.g., Elias, 1980; King & Miller, 1990), hypertensive subjects were expected to perform more poorly than normotensive subjects on working memory measures (backward digit span, visual memory span tapping backward and reading span) and rate of information processing measure (digit

symbol substitution).

b) No differences between hypertensive and normotensive subjects were expected for crystallized intelligence (vocabulary), incidental memory (digit symbol substitution recall), or short term memory measures (forward digit and visual memory span tapping forward).

2. Based on previous findings that hypertensives have higher trait anxiety scores and higher scores on depression checklists (e.g., Tunick & Franzen, 1990; Wennerhold & Zarle, 1976), hypertensives were expected to have higher scores on trait, but not state, anxiety, and Beck Depression Inventory scores compared to normotensives.

3. Although no studies have examined self-efficacy or locus of intellectual control in hypertensive subjects, based on the literature relating these variables to health status, it was hypothesized that hypertensives would have lower self-efficacy and higher external locus of control scores compared to normotensives. In addition, since metacognition or more specifically metamemory has been related to memory self-efficacy (e.g. Hertzog et al., 1990) and to health status (Cutler & Grams, 1988; Tun et al., 1987; Tunick & Puckett, 1990), it was hypothesized that hypertensives would report more memory problems on the Memory Function Questionnaire compared to normotensives.

4. Hypertensives were expected to report a higher number of physical and psychological symptoms on the Cornell Medical Index compared to normotensives.

5. It was hypothesized that significant negative relationships would be found between anxiety and self-efficacy, depression and self-efficacy and between self-efficacy and external locus of control. In addition, anxiety, depression, and external locus of control were expected to be related negatively to both self-assessed and laboratory measures of working memory, while self-efficacy and internal locus of control were expected to be related positively to self-assessed and laboratory measures of memory.

6. Based on West et al.'s (1984) mediation model (Figure 1), it was hypothesized that anxiety and depression would have *significant direct effects on self-efficacy but not on cognitive* performance. Also in support of the mediational effect of self-efficacy, it was hypothesized that self-efficacy would have a significant direct effect on cognitive performance.

Method

Subjects

Eight male and twelve female normotensive adults aged 62 to 77 years ($\underline{X}$ = 71.8, $\underline{SD}$ = 3.67) and 8 male and 12 female hypertensive adults aged 62 to 78 years ($\underline{X}$ = 72.5, $\underline{SD}$ =4.70) participated in the study. All subjects were Caucasian, except for 1 black female hypertensive subject.

Subjects were recruited through contact at senior centers, physicians' offices, and a pre-existing subject pool which included West Virginia University alumni. All subjects were paid $10.00 for participating. Subjects were community dwelling adults

with vision and hearing corrected to normal levels. Subjects rated their overall health as "good", although hypertensive subjects reported more physical symptoms overall than did normotensive subjects (see Table 1). Mean educational level was approximately 15 years for both hypertensive and normotensive subjects indicating that many subjects had some years of college. Ninety-five per cent of subjects in each group were retired (19/20). Criteria for inclusion in the hypertensive group was diagnosis by a physician of essential hypertension based on a systolic blood pressure of greater than 140 mm of mercury and a diastolic blood pressure of greater than 90 mm of mercury at the time of diagnosis. Essential hypertension is the most common form of high blood pressure accounting for approximately 90% of all cases (King & Miller, 1990). In addition, essential hypertension has a well-established identity from an epidemiologic view and avoids confounding hypertension with complications of other illnesses (King & Miller, 1990). Hypertensives on anti-hypertensive medication were not excluded from the study. Seventy per cent of hypertensives were on anti-hypertensive medication (10% on beta blockers, 10% on calcium channel blockers, 10% on enzyme inhibitors, 5% on blood thinners, and 55% on diuretics). Duration of high blood pressure was 12.7 years (SD = 8.66). Normotensive subjects had no history of hypertension and blood pressure less than 140/90 mm of mercury at the time of testing.

Subjects were screened by phone when initially contacted.

Table 1

Means, Standard deviations & F-tests for Health and Demographic Variables

Variables	Normotensives (n=20)	Hypertensives (n=20)	F	eta^2
no. physical symt.	X = 3.95 SD = 3.89	X = 8.70 SD = 7.03	7.00[a]	.22
phys. symt. with CV scale removed	X = 3.95 SD = 3.89	X = 5.95 SD = 6.19	1.50	.06
self-rep. health composite	X = 5.15 SD = 1.23	X = 6.11 SD = 1.85	3.64	.09
self-rep. health	X = 1.80 SD = .52	X = 2.11 SD = .74	2.24	.06
daily act. limited by health	X = 1.55 SD = .69	X = 2.05 SD = .85	4.16[a]	.10
concern about health	X = 1.80 SD = .95	X = 1.95 SD = .97	.23	.01
systolic BP before tasks	X = 134.30 SD = 8.41	X = 148.65 SD = 9.40	25.89[b]	.41
systolic BP after tasks	X = 138.25 SD = 8.42	X = 157.00 SD = 10.00	40.91[b]	.52
systolic change	X = 3.95 SD = 3.56	X = 8.35 SD = 5.08	10.06[b]	.21
diastolic BP before tasks	X = 71.70 SD = 11.23	X = 81.30 SD = 10.45	7.83[b]	.17
diastolic BP after tasks	X = 75.00 SD = 7.78	X = 84.00 SD = 7.88	13.21[b]	.26

Table 1 continued

Means, Standard deviations & F-tests for Health and Demographic Variables

Variables	Normotensives (n=20)	Hypertensives (n=20)	F	eta^2
diastolic change	X = 3.30 SD = 5.70	X = 2.70 SD = 5.40	.12	.00
education	X = 15.40 SD = 3.17	X = 15.32 SD = 3.20	.01	.00

[a] $p < .05$

[b] $p < .01$

Subjects with past neurological history (e.g., head injury, stroke), past history of diabetes, kidney disease, heart failure or currently under treatment for depression, anxiety, psychosis or drug or alcohol addiction were excluded from the study. In addition, none of the subjects participating in the study had experienced a serious loss (e.g., death of a spouse) in the last six months.

At the time of testing subjects filled out the Cornell Medical Index and the Neurological and Past History Survey. Subjects reporting any of the above mentioned problems were excluded from data analysis. Two subjects reporting congestive heart failure were screened out prior to data analysis; 2 more subjects were tested to bring the total number of subjects back to 40.

Materials

Personality In Intellectual Contexts (PIC). (Lachman et al., 1982). This instrument (see Appendix A) was constructed to examine the attributions and evaluations of older adults related to their intellectual aging (Lachman, 1981). It was constructed to be specific for the domain of intelligence and appropriate for older adults. The PIC short form consists of three scales, each with 12 items, measuring locus of control (Internal, Chance, and Powerful Others). Chance and Powerful Others are considered separate aspects of external locus of control. A score for each scale was obtained with a possible range of 12 to 72 for each scale. Locus of control has been shown to be age sensitive

(Lachman, 1981) and related to memory performance and to depression (e.g., West et al., 1984). It has satisfactory interindividual stability over time (2-6 years; Lachman, 1983). Internal consistency reliability ranged from .51 to .64 in one study and 3 month test-retest reliabilities were .66 (Lachman, 1986b).

Self-efficacy Questionnaire (SEQ). (Berry, West, & Dennehey, 1989). The self-efficacy questionnaire (see Appendix B) uses multiple indices to obtain direct predictions of performance (Berry et al., 1989). It is based on Bandura's (1986; 1989) construct of self-efficacy which refers to people's judgments about their own ability in a given situation. Stressful situations, such as testing, prompt self-efficacy evaluations which then influence thoughts, feelings, and behaviors. The questionnaire was designed to be appropriate for older adults and specific to the domain of memory.

The questionnaire describes 10 memory tasks for which subjects assess their memory abilities. The questionnaire was modified to reflect the tasks used in the present study as suggested by Berry et al. (1989). Four of the tasks were everyday versions of memory tasks that subjects did not actually perform. The everyday questions assessed self-efficacy in memory for a grocery list, phone numbers, location of items placed in a room, and directions to a friend's house. The remaining 6 questions assessed self-efficacy for digit recall forward and backward, visual memory span forward and backward, reading span,

and number correct on the digit symbol substitution subtest.

For each task there were five levels of task difficulty. Subjects indicated whether they could perform the task at each level (yes/no). Subjects then indicated their confidence in their response by circling a confidence rating ranging from 10% to 100% Self-efficacy level (SEL) for each task was calculated by summing the number of yes responses made at the 20% confidence level or higher with a possible range of 0 to 5. Self-efficacy strength (SES) scores were calculated by averaging confidence ratings across tasks separately for yes and no responses. Thus individuals received both positive (for yes responses) and negative (for no responses) SES scores. A total SEL score was calculated by summing SEL scores for the 10 tasks (possible range 0 to 50). In addition, SEL was calculated separately for everyday tasks (Q1-Q4) and laboratory tasks (Q5-Q10). This instrument has been shown to be sensitive to age differences and to be positively related to actual memory performance (Berry et al., 1989). Cronbach's alpha was .88 in one study and test-retest reliability was reported at .89 (Berry, West & Dennehey, 1989).

Memory Function Questionnaire (MFQ). (Gilewski, Zelinski, & Schaie, 1990). This questionnaire consists of 92 items assessing various aspects of everyday remembering and forgetting (see Appendix C). Subjects responded using a seven-point Likert type scale. The instrument consists of four scales: General Frequency of Forgetting (possible range of scores 33 - 231), Seriousness of Forgetting (possible range 19 - 133),

Retrospective Function (possible range 5 - 35), and Mnemonics Usage (possible range 8 - 56). A score for each scale was obtained. In addition, a total MFQ score was obtained by summing scale scores (possible range 65 - 455). The MFQ has shown convergent validity with the Metamemory in Adulthood Questionnaire (Dixon & Hultsch, 1983) and concurrent validity with performance on lab tests and clinical memory tests (Blau, 1986; Williams, Little, Scates, & Blackman, 1987; Zelinski, Gilewski, & Anthony-Burgstone, 1990). The MFQ has been found to be related to depression (Blau, 1986; O'Hara et al., 1986; Popkin et al., 1982) and it or similar instruments have been found to be sensitive to health status (Cutler & Grams, 1988; Tun et al., 1987; Tunick & Puckett, 1990). It is hypothesized to reflect self-awareness of memory and thus be related to self-efficacy (Berry, 1986). Internal consistency of factor scores has been reported as ranging from .83 to .94 (Zelinski, et al., 1990).

Short term memory. Forward digit span from the Wechsler Adult Intelligence Scale Revised (Wechsler, 1981) was used to measure short term memory (see Appendix D). This measure reflects storage capacity and does not appear to be sensitive to either age or health status (Poon, 1985). Subjects were read number sequences of increasing length and were asked to repeat each sequence from memory. Subjects were given 2 trials at each length beginning with 3 digits and continuing until they failed both trials or were able to repeat back a sequence of 8 digits. Subjects received 2 points if they passed both trials, 1 point if

they passed only 1 trial, and 0 points if they failed both trials. Possible range of scores was 0 to 12.

Visual memory span tapping forward from the WAIS-R was the spatial short term memory analog to forward digit span (Wechsler, 1981). Subjects watched the examiner touch red squares on a card in sequences of increasing length ranging from 2 to 7 squares with 2 trials at each length. After each sequence subjects were asked to repeat the performance from memory. Subjects received 2 points if they passed both trials, 1 point if they passed only 1 and 0 points if they failed both trials. The task was stopped when a subject failed both trials of any item. Possible range of scores was 0 to 14.

Working memory. Backward digit span from the WAIS-R (Wechsler, 1981) is a measure of working memory (Hayslip & Kennelly, 1982; Wingield et al., 1988) and involves simultaneous storage and processing or manipulating of material in memory (see Appendix D). Backward digit span has been found to be sensitive to age and health status (Belbin and Belbin, 1968; Botwinick, 1977; Craik et al., 1989). Subjects were read number sequences of increasing length ranging from 3 to 8 numbers with 2 trials at each length. Subjects were then asked to repeat the sequence backwards from memory. Subjects received 2 points if they passed both trials, 1 point if they passed 1 trial, and 0 points if they failed both trials of any item. The task was stopped when a subject failed both trials of any item. Possible range of scores was 0 to 12.

Visual memory span tapping backwards from the WAIS-R was the spatial working memory analog to backward digit span (Kennelly et al., 1985). Subjects watched the examiner touch the green squares on a card in sequences of increasing length ranging from 2 to 8 squares with 2 trials at each length. Subjects were then asked to repeat the performance in reverse. Subjects received 2 points if they passed both trials, 1 point if they passed only 1, and 0 points if they failed both trials. The test was discontinued when both trials of any item were failed. Possible range of scores was 0 to 12.

There is evidence that working memory encompasses several subsystems (e.g. verbal versus visuospatial; Baddeley, 1981; Wingfield, Stine, Lahar, & Aberdeen, 1988). Based on the literature indicating that visuospatial abilities decline more than verbal abilities with age (Albert & Kaplan, 1980; Benton, 1974; Reitan, 1967) and may be sensitive to health status (Spieth, 1965; Wilkie & Eisdorfer, 1971) these measures may be differentially sensitive to the effects of age or the presence of hypertension.

Reading Span (adapted from Daneman & Carpenter, 1980) is a more complex measure of working memory (see Appendix D). It may be more sensitive to age or hypertensive status due to the complexity hypothesis which indicates that age differences increase when the complexity of the task is increased (Cerella, Poon, & Williams, 1980; Salthouse, 1982). Subjects read sentences aloud ranging from 2 to 7 sentences with 2 trials at

each length. The subjects were instructed to put the card face down after the sentences were read and try to recall the final words of all the sentences (2-7 words). The test was discontinued when the subject failed both trials of any item. A subject received 2 points for passing both trials, 1 point if only 1 trial was passed, and 0 points if both trials were failed. Possible range of scores was 0 to 12.

Vocabulary. Vocabulary is a measure of crystallized intelligence considered to be learned information which accumulates with experience (Woodruff-Pak, 1988). Vocabulary has not been found to be sensitive to either age or health status (Botwinick, 1977). In the present study vocabulary was measured by the Word Familiarity Survey (Gardner & Grange, 1977; see Appendix E). This assessment is a multiple choice measure which has been used in cognitive research (e.g. Shaw & Craik, 1989).

Rate of information processing. The Digit Symbol subtest of the WAIS-R (Wechsler, 1981) was used to measure rate of information processing (see Appendix F). Administration was modified according to Hart, Kwentis, Wade, and Hamer (1987) so that nonverbal, incidental memory was also measured. Subjects were instructed to fill in the boxes as quickly as possible with the symbols that correspond to each number until all the boxes were filled in. Both speed and accuracy were stressed. All subjects completed the entire 93 digit symbol substitutions. To assess incidental memory, subjects were given the 9 digits and 9 empty boxes and instructed to recall the symbols and match them

to the respective digits. Incidental recall was scored by summing the total number of symbols recalled and the total number of symbols correctly paired with digits. In addition, the number of correct substitutions completed in 90s and the time taken to complete the entire instrument was measured.

Beck Depression Inventory (BDI). (Beck, Steer, & Garlin, 1988). The BDI is a self-report inventory designed to include all symptoms integral to depression (see Appendix G). Each symptom category includes a series of statements reflecting varying degrees of severity. The total score represents a combination of symptom category and severity. Subjects were instructed to circle the statement which best described the way they felt during the previous week. The highest numbered statements for each item were summed across the 21 items. The BDI is correlated with both clinical ratings and the Hamilton Psychiatric Rating Scale for Depression. Possible range of scores was 0 - 63.

State-Trait Anxiety Inventory (STAI). (Spielberger, Gorusch, & Lushene, 1970). The STAI consists of two separate self-report scales for measuring state and trait anxiety (see Appendix H). The Trait scale asks subjects to indicate how they generally feel (e.g., I am calm, cool, and collected") while the State scale asks subjects to indicate how they feel at the present moment (e.g., "I am tense"). This instrument correlates with other measures of state and trait anxiety and has been found to be sensitive to age (LaRue & D'Elia, 1985) and health status (e.g.

Tunick & Franzen, 1990). It has been found to be negatively correlated with performance on lab measures of memory and self-assessed memory (LaRue & D'Elia, 1985; West et al., 1984). Possible range of scores was 20 - 80 for each scale.

Health and Demographic Questionnaire. Demographic questions included age, gender, years of education, whether working or retired, and previous occupation (see Appendix I). In addition, subjects completed three health status items (e.g. Siegler, Nowlin, & Blumenthal, 1980). For the first item subjects rated their overall health using a four-point scale (where 1="excellent" to 4="poor"). For the second item, subjects described the extent to which their daily activities were limited by health, using a four-point scale (where 1="not at all limited to 4="very much limited"). For the final item, subjects indicated how concerned they were about their health using a four-point scale (where 1="not at all concerned" to 4="very concerned"). The 3 health questions were summed to provide an overall rating of self-reported health status. Self-reported health status has been found to relate to physician's health ratings (Siegler et al., 1980). Possible range of scores was 3 to 12.

Cornell Medical Index (CMI). (Brodman, Erdmann, & Wolff, 1956). This questionnaire consists of 195 dichotomous items assessing past illnesses, family history, health behaviors, and symptoms (see Appendix J). It assesses both physical and psychological symptoms and so is useful for disentangling changes

in physical and mental health (Aldwin, Spiro, Levenson, & Bosse, 1989). Physical symptoms are divided into 12 scales (e.g. cardiovascular, frequency of illness) and psychological symptoms are divided into 6 scales (e.g. depression, anger). Subjects responded by circling either yes or no for each item. Scores for physical and psychological symptoms were summed separately. The CMI has been found to have both high levels of specificity and sensitivity as a general measure of physical and mental health and it compares well with physicians' rating of overall mental and physical health (Abramson, Terepolsky, Brook, & Kark, 1965; Aldwin et al., 1989). Possible range of scores was 144 for physical symptoms and 51 for psychological symptoms.

Procedure

After signing the consent form, the subject's blood pressure was taken three times, 3 minutes apart in the right arm. To compute blood pressure, the first measure was discarded and the second and third measures were averaged to get pre-testing blood pressure. Blood pressures were taken by either the investigator or a research assistant. The investigator was professionally trained to take blood pressures and trained the research assistants over a 2 month period so that blood pressures taken were consistent across individuals within 2 mm Hg. Subjects were seated at a desk with the right arm supported while blood pressure was measured with a standard aneroid sphygmomanometer. Restrictive clothing was removed from the arm which was slightly flexed, abducted, and relaxed. The forearm was supported at

heart level with the hand supinated as recommended by the Committee of the American Heart Association. The deflated bag and cuff were applied snugly around the arm with the lower edge about one inch over the antecubital space and with the rubber bag over the inner aspect of the arm directly over the brachial artery. A Sprague Rappaport type stethoscope was applied snugly over the artery in the antecubital space. The first sound heard with each heart beat was taken as the systolic measure. The cuff was deflated at a rate of 2 to 3 mm. Hg. per heart beat and the point of complete cessation of sound was taken as the diastolic pressure.

The subject then filled out questionnaires in the following order: Personality in Intellectual Contexts (PIC), the Self-Efficacy Questionnaire (SEQ)and the Memory Failures Questionnaire (MFQ). After filling out the questionnaires a short break (approximately 5 minutes) could be taken.

Berry et al. (1989) found that when the SEQ was given first it was more likely to reflect an individual's beliefs about memory performance. When given after actual memory tasks, subjects were able to use feedback to alter their self-efficacy beliefs. Since the purpose of the present study was to examine how an individual's beliefs and expectations influence memory performance, questionnaires involving memory beliefs (MFQ, SEQ, and PIC) were given before the actual memory tasks.

After the break, the following cognitive measures were given in this order: forward digit span, visual memory tapping

forward, backward digit span, visual memory tapping backward, reading span, vocabulary, and digit symbol substitution. After the cognitive tasks were administered, a post-testing blood pressure was obtained using the procedure described for arriving at a pre-testing blood pressure. Another 5 minute break was allowed before completing the last questionnaires.

Following the break, the remaining questionnaires were administered in the following order: Beck Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI), Health and Demographic Questionnaire, and Cornell Medical Index (CMI). The entire testing session ranged from 45 minutes to 1 1/2 hours.

Variables and Data Analysis

The variables defined in the present study are presented in Table 2. To test the previously stated hypotheses, the following data analyses were performed:

(1) Based on Hypothesis 1 (a) that hypertensive subjects would perform more poorly than normotensive subjects on working memory measures and rate of information processing measure, a multivariate analysis of variance was performed with hypertensive status as the independent variable and backward digit span, visual memory span tapping backward, reading span and digit symbol substitution (number of correct responses and time to complete the whole task) as the dependent variables.

(2) Based on Hypothesis 1 (b) that there would be no significant differences between hypertensive and normotensive subjects for crystallized intelligence, incidental memory and

Table 2

Measures Used, Variables Derived, and Range of Scores

Measure	Variable	Actual Ranges
Constructed for this study	Age	62-78
	Gender	1 or 2
	Years of education	9-20
	Work Status	1 or 2
	Blood pressure group	1 or 2
	Duration of high B.P.	1-35
	Self-Reported Health	3-12
	Systolic B.P. before tasks	119-160
	Systolic B.P. after tasks	116-175
	Diastolic B.P. before	40-99
	Diastolic B.P. after	60-95
Cornell Medical Index (Brodman, Erdmann & Wolff, 1956)	Total number reported physical symptoms	0-27
	Total number reported psychological symptoms	0-15
State-Trait Anxiety Inventory (Spielberger, Gorusch & Lushene, 1970)	State anxiety	20-49
	Trait anxiety	20-60
Beck Depression Inventory (Beck, Steer & Garlin, 1988)	Depression	0-17

Table 2 continued

Measure	Variables	Ranges
Memory Function Questionnaire (Gilewski, Zelinski & Schaie, 1990)	Factor 1 (Frequency of forgetting)	112-221
	Factor 2 (Seriousness of forgetting)	25-124
	Factor 3 (Retrospective function)	6-33
	Factor 4 (Mnemonics usage)	8-44
	Total score	161-397
Personality In Intellectual Contexts (Lachman, Baltes, Nesselroade & Willis, 1982)	Internal locus of control	41-72
	Chance locus of control	12-48
	Powerful others locus of control	13-57
Self-Efficacy Questionnaire (Berry, West & Dennehey, 1989)	Positive self-efficacy strength	55-100
	Negative self-efficacy strength	0-100
	Total self-efficacy level	13-50
Wechsler Adult Intelligence Scale (Wechsler, 1981)	Forward digit span	3-11
	Backward digit span	2-11
	Visual memory span tapping forward	5-11
	Visual memory span tapping backward	3-11

Table 2 continued

Measure	Variables	Ranges
	Digit Symbol Substitution Total number correct	21-57
	Time to finish all	150-460
	Number of digits recalled	0-9
	Number of digits and symbols correctly paired	0-9
Reading Span (adapted from Daneman & Carpenter, 1980)	Reading span-number of words recalled	1-7
	Vocabulary	5-27

Note. Gender: 1 is male, 2 is female; Work Status: 1 is working, 2 is retired; Blood Pressure Group: 1 is normotensive, 2 is hypertensive.

short term memory, an multivariate analysis of variance wasperformed with hypertensive status as the independent variable. The dependent variables were vocabulary, digit symbol substitution recall, forward digit span, and visual memory span tapping forward.

(3) Based on Hypothesis 2 that hypertensive subjects would have higher scores than normotensive subjects on depression scores and on trait, but not state, anxiety scores, an analysis of variance was performed on each measure with a Bonferroni-type adjustment of Type I error. The independent variable for the analyses was hypertensive status. The dependent variables for the analyses were state anxiety, trait anxiety, and Beck Depression Inventory scores.

(4) Based on Hypothesis 3 that hypertensive subjects would have lower self-efficacy and higher external locus of control scores compared to normotensive subjects, two separate analyses were performed. The first analysis performed was a MANOVA with internal locus of control, chance locus of control and powerful others locus of control as the dependent variables and hypertensive status as the independent variable. A second MANOVA with self-efficacy level and self-efficacy strength (positive and negative) as the dependent variables and hypertensive status as the independent variable was also performed.

(5) Based on the hypothesis that hypertensives would report more memory problems overall than normotensives an ANOVA was performed on the total Memory Function Questionnaire score with

hypertensive status as the independent variable. In addition, when significant group differences were found in the total MFQ score, follow-up ANOVA's with Bonferroni-type adjustment of Type I error were performed, with individual MFQ scale scores as the dependent variables and hypertensive status as the independent variable.

(6) Based on Hypothesis 4 that hypertensive subjects would report a higher number of physical and psychological symptoms on the Cornell Medical Index compared to normotensive subjects, a MANOVA was performed with hypertensive status as the independent variable. The dependent variables were number of physical symptoms reported, number of psychological symptoms reported, and self-reported health status.

(7) Based on Hypothesis 5 that significant relationships would be demonstrated between anxiety and self-efficacy, depression and self-efficacy, and between self-efficacy and locus of control, Pearson product-moment correlation coefficients were computed for these variables.

In addition, since it was expected that anxiety, depression, and external locus of control would be negatively related to both self-assessed and laboratory measures of working memory and that self-efficacy would be positively related to self-assessed and laboratory measures of memory, Pearson product-moment correlations were computed for these variables. Significance levels were set at .01 for all correlations.

(8) Based on Hypothesis 6 that anxiety and depression would

have significant direct effects on self-efficacy and that self-efficacy would have a significant direct effect on cognitive performance path analysis was performed (see Figure 1).

(9) Hierarchal multiple regression analyses were performed to determine the unique variance contributed by hypertensive status after controlling for (a) affect (combined anxiety and depression z scores); (b) number of psychological symptoms reported; and (c) personal efficacy (combined internal locus of control and self-efficacy z scores) in three separate analyses. The criterion variables for all three analyses were number correct on the digit symbol substitution task, visual memory span tapping backward, reading span, visual memory span tapping forward, backward digit span, and total score on the Memory Function Questionnaire.

Results

Multivariate analysis of variance with cognitive performance and self-evaluation variables as the dependent variables and gender as the independent variable was performed. The results were not reported as no significant gender effects were found.

Cognitive Performance and Hypertension

As expected, hypertensive subjects performed more poorly on rate of information processing and on some measures of working memory. No significant group differences were found on measures of short term memory, vocabulary and incidental memory measures.

Rate of information processing and working memory. Two rate of information processing scores were derived from the digit symbol substitution subtest: number of correct responses and time to complete the whole task. Other dependent variables in this analysis were backward digit span, visual memory span tapping backward, and reading span. Results indicated a significant effect of hypertension, multivariate $F(5,34) = 3.21$, $p < .02$. Follow up analyses with alpha adjusted to .01 (see Table 3 for means, standard deviations, and F's.), indicated that there was a significant effect of hypertension for number of correct responses, time to complete digit symbol substitution subtest, visual memory span tapping backward, and reading span. No group differences were found for backward digit span. Examination of group means showed that hypertensive subjects made fewer correct responses and took more time to complete the digit symbol substitution subtest. This result indicates hypertensive subjects tended to process information more slowly than normotensive subjects. In addition, hypertensive subjects scored significantly lower on visual memory span tapping backward and reading span tasks than did normotensive subjects indicating that on the more complex working memory tasks hypertensives had poorer working memory than normotensive subjects.

Incidental memory, short term memory, and vocabulary. Two incidental memory scores were derived from the digit symbol substitution subtest: number of symbols recalled and number of digits and symbols correctly paired. The other dependent

Table 3

Means, Standard deviations & F-tests for Cognitive Performance

Variables	Normotensives (n=20)	Hypertensives (n=20)	F	eta^2
digit symb. number correct	X = 44.25 SD = 8.30	X = 34.95 SD = 11.34	8.76[b]	.19
digit symb. time	X = 198.20 SD = 37.60	X = 256.55 SD = 90.97	7.03[b]	.16
back. digit span	X = 5.45 SD = 2.19	X = 5.20 SD = 2.04	.14	.00
visual mem. span backward	X = 7.50 SD = 2.14	X = 5.90 SD = 2.04	7.80[b]	.17
reading span	X = 4.85 SD = 1.39	X = 3.60 SD = 1.73	6.36[a]	.14
forward digit	X = 7.80 SD = 1.99	X = 6.75 SD = 1.97	*	
visual mem. span forward	X = 8.45 SD = 1.99	X = 8.05 SD = 1.36	*	
vocabulary	X = 15.53 SD = 5.55	X = 15.72 SD = 6.62	*	
digit symbol recall	X = 6.90 SD = 2.13	X = 6.15 SD = 2.32	*	
digit symbol correctly paired	X = 5.75 SD = 2.34	X = 5.05 SD = 2.46	*	

[a]p<.05
[b]p<.01
* no follow-up analyses were performed due to the non-significant multivariate analysis

variables in this analysis were vocabulary score, forward digit span, and visual memory span tapping forward. As expected there as no significant group effect, multivariate $F(5,34) = .67$, $p < .65$.

Self-Evaluation and Hypertension

As expected, hypertensive subjects reported having significantly more psychological symptoms, having significantly lower internal locus of control and significantly higher chance locus of control than normotensive subjects. In addition, hypertensive subjects reported more memory problems overall and rated their memory problems as being more serious than normotensive subjects. An unexpected finding was the non-significant group effects for trait anxiety, self-efficacy, and powerful others locus of control.

Self-assessed memory and hypertension. Since a significant effect of hypertension on Memory Function Questionnaire (MFQ) total score was found, $F(1,37) = 4.15$, $p < .05$ (see Table 4 for means, standard deviations, and F tests), follow up analyses of the individual scales were performed. Unexpectedly, no significant effects of hypertension were found for Scale 1 (Frequency of Forgetting), Scale 3 (Retrospective Function), and Scale 4 (Mnemonics Usage). On Scale 2 (Seriousness of Forgetting), there was a significant effect of hypertension with hypertensive subjects reporting that when they do forget names, appointments, etc., they consider these failures to be somewhat serious.

Table 4

Means, Standard deviations & F-tests for Self-Evaluation

Variables	Normotensives (n=20)	Hypertensives (n=20)	F	eta^2
state anxiety	X = 26.42 SD = 5.78	X = 26.79 SD = 7.61	.03	.00
trait anxiety	X = 32.25 SD = 8.50	X = 34.16 SD = 12.20	.32	.01
depression	X = 3.60 SD = 2.70	X = 6.15 SD = 4.66	4.48[b]	.11
psych.symptoms	X = .55 SD = .83	X = 3.05 SD = 4.15	6.99[a]	.19
self-eff.total	X = 37.45 SD = 9.41	X = 33.55 SD = 10.98	*	
s.e.strength-negative	X = 50.63 SD = 32.22	X = 56.50 SD = 36.16	*	
s.e. strength-positive	X = 80.40 SD = 10.80	X = 84.25 SD = 11.27	*	
l.o.c.-internal	X = 65.15 SD = 6.12	X = 55.70 SD = 10.38	12.29[a]	.24
l.o.c.-chance	X = 22.50 SD = 5.50	X = 32.75 SD = 11.34	13.23[a]	.26
l.o.c.-powerful others	X = 30.25 SD = 8.61	X = 35.05 SD = 12.06	2.10	.05
MFQ Scale 1	X = 168.26 SD = 21.35	X = 161.84 SD = 32.24	.52	.01
MFQ Scale 2	X = 93.32 SD = 15.30	X = 72.30 SD = 32.22	6.65[b]	.15

Table 4 continued

Means, Standard deviations and F-tests for Self-Evaluation

Variables	Normotensives (n=20)	Hypertensives (n=20)	F	eta^2
MFQ Scale 3	X = 19.79 SD = 5.09	X = 18.45 SD = 7.72	.41	.01
MFQ Scale 4	X = 25.21 SD = 9.56	X = 23.35 SD = 10.88	.32	.01
MFQ total score	X = 306.58 SD = 34.62	X = 274.53 SD = 59.25	4.15[a]	.10

Note. MFQ Scale 1-Frequency of Forgetting
MFQ Scale 2-Seriousness of Forgetting
MFQ Scale 3-Retrospective Function
MFQ Scale 4-Mnemonics Usage

[a] p< .05
[b] p< .01
* no follow-up analyses were performed due to the non-significant multivariate analysis

Affective status and hypertension. ANOVA's of state anxiety, trait anxiety, and depression scores with a Bonferronitype adjustment of alpha to .02 (Tabachnick & Fidell, 1989) indicated no significant group effects for state and trait anxiety. Although mean scores indicated that hypertensives tended to have higher depression scores, this finding was also not significant (Table 4).

Self-efficacy and hypertension. No significant group effects were found for self-efficacy level summed across tasks and positive and negative self-efficacy strength each averaged across tasks, multivariate $F(3.35) = 1.22$, $p < .32$ (see Table 4 for means and standard deviations). Although no differences in self-efficacy strength were predicted, hypertensives had been predicted to have lower self-efficacy levels. Mean scores indicated that hypertensives did tend to have lower self-efficacy levels, though these differences did not reach significance.

Since Berry, West, & Dennehey (1988) found differences in the relationship between self-efficacy measures and performance for everyday and laboratory tasks, self-efficacy level was computed separately for everyday tasks (questions 1 - 4) and laboratory tasks (questions 5-10). Analyses of laboratory self-efficacy and everyday self-efficacy levels indicated no significant effects of hypertension, $F(1,38) = 1.36$, $p < .25$ and $F(1,38) = 1.58$, $p < .22$, respectively.

Locus of control and hypertension. Results of multivariate analysis showed a significant effect of hypertension on internal,

chance, and powerful others locus of control, multivariate $F(3,36) = 5.62$, $p < .003$. Follow up analyses indicated that hypertensive subjects scored significantly lower on internal locus of control and significantly higher on chance locus of control than normotensive subjects. Means, standard deviations and F tests for locus of control measures are presented in Table 4. The effect of hypertension on powerful others locus of control was not significant, although mean differences were in the predicted direction.

Health status and hypertension. Two scores were derived from the Cornell Medical Index (Brodman, Erdmann, & Wolff, 1956): number of physical symptoms and number of psychological symptoms reported . A composite self-reported health status score was derived by summing the 3 individual ratings of self-reported health. As expected there was a significant effect of hypertension on overall health status, multivariate $F(3.35) = 3.51$, $p < .03$. Follow-up analyses indicated no significant effect of hypertension on self-reported health while there was a significant group effect for number of physical symptoms reported and number of psychological symptoms reported. Means, standard deviations and F tests are presented in Tables 1 and 4. Hypertensive subjects reported a larger number of physical and psychological symptoms than normotensive subjects.

Correlations Among Self-Efficacy, Affect, and Health

The zero-order correlations between self-efficacy measures, trait anxiety scores, state anxiety scores, depression scores,

number of psychological symptoms reported, self-reported health status, and number of physical symptoms reported were calculated. The results are presented in Table 5. Alpha levels were set at .01 to reduce Type I error. Surprisingly, self-efficacy level was not found to be significantly related to trait anxiety, depression, or number of psychological symptoms. While self-efficacy level was not significantly related to self-reported health, it was found to be significantly inversely related to number of physical symptoms reported. These results show that individuals who reported a larger number of physical symptoms tended to have lower self-efficacy levels.

Correlations Among Locus of Control, Affect, and Health

The zero-order correlations between internal, chance, and powerful others locus of control, number of psychological symptoms, state anxiety, trait anxiety, depression, self-reported health, and number of physical symptoms were calculated. The results are presented in Table 5.

Internal locus of control was significantly negatively related to depression and number of psychological symptoms indicating that individuals with higher depression scores and individuals reporting more psychological symptoms tended to have lower internal locus of control scores. In addition, internal locus of control was significantly negatively related to number of physical symptoms but not to self-reported health indicating that individuals who reported more physical symptoms tended to have lower internal locus of control.

Table 5

Correlations Of Self-Efficacy And Locus of Control With Self-Evaluations

Variables (n=40)	Int.loc	chance loc.	po loc	self-eff.
state anxiety	-.30	.01	-.02	-.20
trait anxiety	-.32	-.32	.11	-.28
depression	-.57[b]	.44[a]	.36	-.36
psych.Symptoms	-.44[a]	.40	.34	-.36
physical Symp.	-.41[a]	.14	.03	-.42[a]
self-reported health	-.24	.34	.27	-.22
self-efficacy level	.54[b]	-.42[a]	-.18	1.00

[a] $p < .01$

[b] $p < .001$

Chance locus of control was significantly positively related to depression indicating that individuals reporting higher levelsof depression tended to have higher chance locus of control scores. Powerful others locus of control was not significantly related to any of the affective measures and neither chance nor powerful others locus of control was related to either measure of health status.

Correlations Between Self-Efficacy and Locus of Control

The zero-order correlations between self-efficacy level and locus of control measures were calculated. The results are presented in Table 5. Locus of control has 3 factors: internal, chance, and powerful others. Both chance and powerful others are particular aspects of external locus of control.

As expected, self-efficacy level was significantly positively related to internal locus of control and negatively related to chance locus of control. These results indicate that individuals with a higher self-efficacy level tended to also have higher internal locus of control and lower chance locus of control. Surprisingly, powerful others locus of control was not significantly related to self-efficacy level.

Correlations Between Self-Assessed Memory and Self-Evaluations

The zero-order correlations between self-assessed memory, trait anxiety, state anxiety, depression, number of psychological symptoms reported, self-efficacy, internal locus of control,chance locus of control, and powerful others locus of control were calculated. The results are presented in Table 6.

Table 6

Correlations Among Self-Assessed Memory and Measures of Self-Evaluation

Variables (n=40)	MFQT	MFQF1	MFQF2	MFQF3	MFQF4
state anxiety	-.22	-.04	-.24	-.33	-.16
trait anxiety	-.34	.32	-.23	-.32	.02
depression	-.36	-.20	-.33	-.15	.26
psych.symptoms	-.14	-.04	-.13	-.14	.18
internal locus of control	.46[a]	.37	.39	.28	.04
chance locus of control	-.44[a]	-.53[b]	-.25	-.11	-.04
powerful others locus of control	-.24	-.39	-.02	-.09	-.02
physical symptoms	-.26	-.06	-.28	-.21	-.25
self-reported health	-.03	.06	.01	.05	-.05
self-efficacy total	.36	.21	.33	.30	.16

Note. MFQT = Memory Function Questionnaire total score
MFQF1 = MFQ-Frequency of Forgetting Scale
MFQF2 = MFQ-Seriousness of Forgetting Scale
MFQF3 = MFQ-Retrospective Function Scale
MFQF4 = MFQ-Mnemonics Usage Scale

[a] $p < .01$
[b] $p < .001$

Self-assessed memory was measured by the Memory Function Questionnaire (MFQ) which has a total score and 4 Scale scores.The MFQ is scored such that lower scores indicate more memory problems. The MFQ total score was significantly negatively related to chance locus of control and positively related to internal locus of control. These results indicate that individuals who reported having more memory problems overall tended to have higher chance locus of control and lower internal locus of control. An unexpected result was that MFQ total score was not significantly related to self-efficacy, depression, or health status.

While MFQ Scale 2 (Seriousness of Forgetting), Scale 3 (Retrospective Function) and Scale 4 (Mnemonics Usage) were not significantly related to any measures of affect, locus of control, self-efficacy or health, Scale 1 (Frequency of Forgetting) was significantly negatively related to chance locus of control. This result indicates that individuals who reported forgetting names, appointments, and what they have read, more frequently tended to have higher chance locus of control scores.

Correlations Between Self-Assessed Memory and Cognitive Performance

The zero-order correlations between the 4 scale scores and total score of the Memory Function Questionnaire (MFQ) and cognitive performance measures were calculated. The results are presented in Table 7. The results show that MFQ total score, Scale 1 (Frequency of Forgetting), Scale 2 (Seriousness of

Table 7

Correlations Among Measures of Memory Performance and Self-Assessed Memory

Variables (n=40)	MFQT	MFQF1	MFQF2	MFQF3	MFQF4
forward digit span	.14	.05	.16	-.10	.20
backward digit span	.17	.12	.10	.06	.21
visual memory tapping forward	.17	.05	.12	.23	.26
visual memory tapping backward	.38	.21	.38	.21	.16
reading span	.20	.15	.13	.02	.24
vocabulary	.20	.28	.09	-.02	.01
digit symbol number correct	.11	.21	.02	-.07	-.01
digit symbol time to complete	-.17	-.21	-.06	.10	-.01
digit symbol-no. of digits recalled	.28	.27	.17	.17	.11
digit symbol-no. correctly paired	.33	.34	.15	.16	.21

Note. MFQT = Memory Function Questionnaire (MFQ) total score
MFQF1 = MFQ Frequency of Forgetting Scale
MFQF2 = MFQ Seriousness of Forgetting Scale
MFQF3 = MFQ Retrospective Function Scale
MFQF4 = MFQ Mnemonics Usage Scale

Forgetting), Scale 3 (Retrospective Function), and Scale 4 (Mnemonics Usage) were not significantly associated with any ofthe cognitive performance measures.

Correlations Between Cognitive Performance and Self-Evaluations

The zero-order correlations between cognitive performance measures and state anxiety, trait anxiety, depression, number of psychological symptoms reported, self-efficacy, and locus of control (internal, chance, and powerful others) were calculated. The results are presented in Table 8. An unexpected finding was that none of the laboratory measures of cognitive performance were related to state anxiety, trait anxiety or depression. Another measure of affective status, number of psychological symptoms reported, was significantly negatively related to forward digit span and positively related to vocabulary indicating that individuals who reported more psychological symptoms tended to have poorer performance on a measure of short term memory and better vocabulary scores.

In comparison to the affective measures, locus of control scores were significantly associated with many of the cognitive performance measures. Internal locus of control was significantly related to forward digit span, number correct on the digit symbol substitution subtest and time to complete the digit symbol substitution subtest. These results indicate that individuals with higher internal locus of control scores tended to score higher on forward digit span, and get more correct and take less time to complete the digit symbol substitution subtest,

Table 8

Correlations Among Measures of Memory Performance and Measures Of Self-Evaluation

Variables (n=40)	1	2	3	4	5	6	7	8	9	10
state anxiety	-.31	-.14	-.33	-.26	-.16	-.03	-.04	.11	.03	.05
trait anxiety	-.12	-.17	-.17	-.33	-.23	.23	-.16	-.27	-.30	.32
beck depress.	-.30	-.17	.16	.26	-.12	.30	-.27	-.37	-.23	.32
psych. symptoms	-.42[a]	-.08	-.31	-.33	-.32	.49[a]	-.39	-.25	-.20	.36
int. l.o.c.	.47[a]	.38	.10	.37	.20	.02	.42[a]	.17	.08	-.44[a]
chance l.o.c.	-.39	-.38	-.17	-.30	-.50[b]	.13	-.66[b]	-.47[a]	-.47[a]	.74[b]
p.o. l.o.c.	-.41	-.29	-.25	-.23	-.36	.21	-.52[b]	-.19	-.32	.56[b]
phys. symptoms	-.19	.07	-.20	-.38	-.14	.23	-.21	.04	.04	.05
health	-.29	-.12	-.23	-.14	.06	.10	-.31	-.02	.07	.18
self efficacy	.25	.30	.47[a]	.36	.08	.11	.37	.08	.07	-.27

Note. 1. forward digit span; 2. backward digit span; 3. visual memory span tapping forward; 4. visual memory span tapping backward; 5. reading span; 6. vocabulary; 7. digit symbol number correct; 8. digit symbol number recalled; 9. digit symbol number correctly paired; 10. digit symbol time to complete.

[a] $p < .01$
[b] $p < .001$

indicating they tend to process information more quickly and have better short term memory. Chance locus of control wassignificantly negatively associated with reading span (a measure of working memory), digit symbol number correct (an information processing measure), and both measures of incidental memory (number of digits recalled and digits and symbols correctly paired) and positively related to time to complete digit symbol.chance locus of control tended to perform more poorly on a complex working memory task, an incidental memory task and tended to process information more slowly.

Powerful others locus of control was significantly negatively associated with forward digit span and number correct on the digit symbol substitution subtest and positively associated with time to complete the digit symbol subtest. These results indicate that individuals with high powerful others locus of control tended to perform more poorly on a short term memory task and process information more slowly.

To determine whether self-efficacy level of individual tasks predicted performance of those tasks, multiple regression analyses were performed with the self-efficacy level of each item as the independent variable and each memory task as the dependent variable. The first six questions on the Self-Efficacy Questionnaire asked subjects to predict their performance on forward digit span, backward digit span, visual memory span tapping forward, visual memory span tapping backward, reading span and digit symbol substitution number correct. The results

showed that memory performance was significantly predicted by self-efficacy level for only visual memory tapping forward (R^2 = .16, p <.01) and number correct on the digit symbol substitution subtest (R^2 = .10, p <.05). The last 4 questions of the SEQ asked subjects to predict performance on everyday versions of the lab tasks. The results showed that self-efficacy level of 2 everyday tasks (finding the location of objects placed in a room and remembering directions to a friend's house) predicted performance on visual memory span tapping forward (R^2 = .10, p <.05; and R^2 = .11, p <.03. respectively).

A "laboratory" self-efficacy level was derived by summing individual self-efficacy level scores for questions 1-6. These questions were ones which related to actual memory tasks performed in the present study. When regression analyses were performed with "laboratory" self-efficacy level as the independent variable, and the 6 corresponding memory tasks as the dependent variables, results were significant for forward digit span, visual memory tapping forward, visual memory tapping backward and number correct on the digit symbol substitution subtest (with R^2 ranging from .10 to .22).

Predictors of Cognitive Performance Hypertension with anxiety and depression controlled. The following analyses were performed to determine the unique variance contributed by hypertensive status after controlling for depression and anxiety. Hierarchichal multiple regression analyses were performed in which various cognitive measures were examined with respect to hypertensive

status before and after the effects of anxiety and depression were partialled out.

In Model 1, hypertensive status (a categorical variable) was entered as the predictor. (See Table 9 for adjusted R^2, F, and Beta for each equation.) Hypertensive status was a significant predictor of digit symbol number correct, visual memory span tapping backward, reading span and total MFQ score, but not visual memory span tapping forward, backward digit span or working memory composite. In Model 2, a composite affect score (trait anxiety and depression z scores combined) was entered first into the hierarchichal regression model, followed by hypertensive status. This model was designed to estimate the unique contribution of hypertensive status after partialling out the effects of anxiety and depression. The results indicate that for digit symbol number correct, visual memory span tapping backward and MFQ total, although affect (trait anxiety and depression) measures accounted for a significant proportion of the variance when entered first, hypertensive status remained significant for all the above variables except for MFQ total. When reading span was the dependent variable affect did not account for a significant amount of variance when entered first and hypertensive status remained significant. Thus it appears that controlling for anxiety and depression did not eliminate differences in cognitive performance between hypertensive and normotensive individuals on memory tasks but did attenuate group differences on self-assessed memory.

Table 9

Cognitive Performance Regressed on Hypertension With Anxiety & Depression Controlled

Dependent Var. (n=40)	Effect (Model 1) HT status			Effect (Model 2) Affect			HT Status		
	B	R^2	F	B	R^2	F	B	$R^2\Delta$	FΔ
Digit Symb No. Correct	-.34	.19	8.75[b]	-.27	.11	4.55[a]	-.37[b]	.13	6.18[b]
Vis.Mem. Tap.Back.	-.37	.13	5.26[a]	-.33[a]	.16	6.81[b]	-.36[b]	.13	6.44[a]
Read.Span	-.34	.12	4.56[a]	-.13	.04	1.52	-.39[b]	.15	6.72[b]
MFQ total	-.33	.11	4.08[a]	-.42[b]	.21	9.34[b]	-.25	.06	2.92
Vis.Mem. Tap.Forw.	-.07	.01	.16	-.21	.05	1.92	-.09	.01	.28
Back.Digit Span	.01	.00	.00	-.26	.07	2.64	.00	.00	.00
Work.Mem. Composite	-.29	.09	3.16	-.32[a]	.14	6.06[b]	-.31[a]	.09	4.43[a]

[a] $p < .05$
[b] $p < .01$

Hypertension with psychological symptoms controlled. A second series of hierarchichal multiple regression analyses were performed to determine the unique contribution of hypertensive status after controlling for affect, using number of psychological symptoms reported. As reported previously, in Model 1, hypertensive status was entered as the predictor (See Table 10). In Model 3, number of psychological symptoms was entered first into the regression model followed by hypertensive status. The results indicate that for digit symbol number correct and visual memory span tapping backward psychological symptoms accounted for a significant proportion of the variance, and hypertensive status no longer contributed significantly. For total MFQ score and reading span, although psychological symptoms did not account for a significant proportion of the variance, hypertension no longer contributed significantly after the effect of psychological symptoms was partialled out.

Based on the two analyses reported above, it appears that number of psychological symptoms is a better predictor of performance on memory tasks than the more frequently used self-report inventories for anxiety and depression. In addition, for all measures included in this analysis, hypertensive status was no longer a significant predictor of memory performance after controlling for number of psychological symptoms.

Hypertension with locus of control and self-efficacy controlled. A third set of hierarchichal multiple regression analyses was performed (see Table 11) controlling for personal

Table 10

Cognitive Performance Regressed on Hypertension with Psychological Symptoms Controlled

Dependent Var.	Effect (Model 1) HT Status			Effect (Model 3) Psych Sympt			HT Status		
(n=40)	B	R^2	F	B	R^2	F	B	$R^2\Delta$	FΔ
Digit Symb No. Correct	-.34	.19	8.75[b]	-.39	.22	9.44[b]	-.17	.02	.99
Vis.Mem. Tap.Back.	-.37	.13	5.26[a]	-.27	.14	5.55[a]	-.25	.05	2.08
Read.Span	-.34	.12	4.56[a]	-.17	.08	3.14	-.26	.06	2.25
MFQ total	-.33	.11	4.08[a]	-.01	.02	.83	-.32	.08	3.09
Vis.Mem. Tap.Forw.	-.07	.01	.16	-.35	.10	3.84	.08	.01	.23
Back.Digit Span	.01	.00	.00	-.17	.02	.60	.09	.01	.21
Work.Mem. Composite	-.29	.09	3.16	-.27	.12	4.74[a]	-.17	.02	.93

[a] $p < .05$
[b] $p < .01$

Table 11

Cognitive Performance Regressed on Hypertension With Personal Efficacy Controlled

Dependent Var. (n=40)	Effect (Model 1) HT Status			Effect (Model 4) Efficacy			HT Status		
	B	R^2	F	B	R^2	F	B	$R^2\Delta$	FΔ
Digit Symb No. Correct	-.43	.19	8.75[b]	.32[a]	.20	9.46[b]	-.31[a]	.08	4.06[a]
Vis.Mem. Tap.Back.	-.37	.13	5.26[a]	.30[a]	.18	8.14[b]	-.29	.07	3.61
Read.Span	-.34	.12	4.56[a]	.00	.02	.92	-.38[a]	.12	5.17[a]
MFQ total	-.33	.11	4.08[a]	.38[b]	.21	9.71[b]	-.18	.03	1.34
Vis.Mem. Tap.Forw.	-.07	.01	.16	.34[a]	.11	4.77[b]	.00	.00	.00
Back.Digit Span	.01	.00	.00	.43[b]	.15	6.61[b]	.11	.01	.41
Work.Mem. Composite	-.29	.09	3.16	.35[a]	.10	8.71[b]	-.23	.04	2.07

[a] p <.05
[b] p <.01

efficacy (internal locus of control and total self-efficacy z scores combined). The results indicate that for digit symbol number correct, visual memory tapping backward, visual memory tapping forward, backward digit span and total MFQ score, personal efficacy accounted for a significant proportion of the variance when entered first, and hypertensive status was no longer a significant predictor of the dependent variables except for digit symbol number correct after the effects of personal efficacy were partialled out (Model 4). For digit symbol number correct hypertensive status remained significant even after partialling out the effects of personal efficacy. When reading span was the dependent variable personal efficacy did not account for a significant amount of the variance when entered first and hypertensive status remained significant. Thus it appears from these analyses that the effects of hypertension on cognitive performance can be attenuated and even eliminated by controlling for self-evaluation measures such as psychological symptoms, locus of control and self-efficacy.

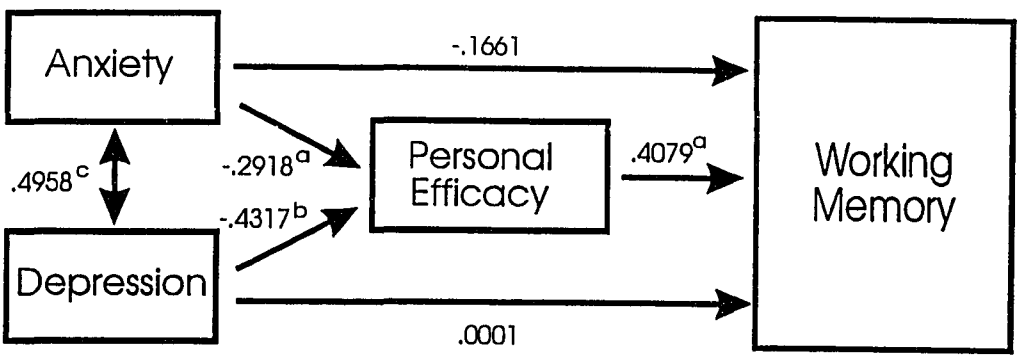
Path Analysis

To explore the possible process-oriented nature of various measures of self-evaluation on memory performance path analyses were conducted using multiple regression techniques. Several psychologists have hypothesized that the relationships between anxiety and cognitive performance and between depression and cognitive performance are mediated by self-evaluative variables such as personal self-efficacy. West et al. (1984), for example,

believe that affect influences an individual's self-perceptions or expectations and that these expectations then mediate both cognitive self-assessments and actual performance. Therefore an integrated model was constructed to evaluate both the direct and indirect effects of anxiety and depression on cognitive performance and self-assessed memory through their association with personal efficacy (see Figures 2-4). The model was constructed to reflect this process with arrows going only in one direction, although actual memory performance also has an effect on self-evaluations. As individuals monitor their performance they most likely change their expectations and self-evaluations based on their recent memory performance (Bandura, 1989). Due to the procedure followed in the present investigation in which the self-evaluation questionnaires were administered prior to any of the performance measures, the expectation is that although self-evaluations may have been based on previous memory performance, they could not have been affected by memory performance as measured in the present investigation. For Model 1, first trait anxiety, depression, a composite personal efficacy measure (self-efficacy total and internal locus of control z scores) were entered as predictors and a composite of working memory and rate of information processing measures (backward digit span, visual memory span tapping backward, reading span, and digit symbol number correct) was the criterion measure. Empirical justification for the composites of variables derived from the high intercorrelations between these variables which were

Figure 2

Path Model of Working Memory



Note. Values shown are standardized path coefficients with significant predictors indicated.

ap <.05 bp <.01 cp <.001

Path Model of Short Term Memory

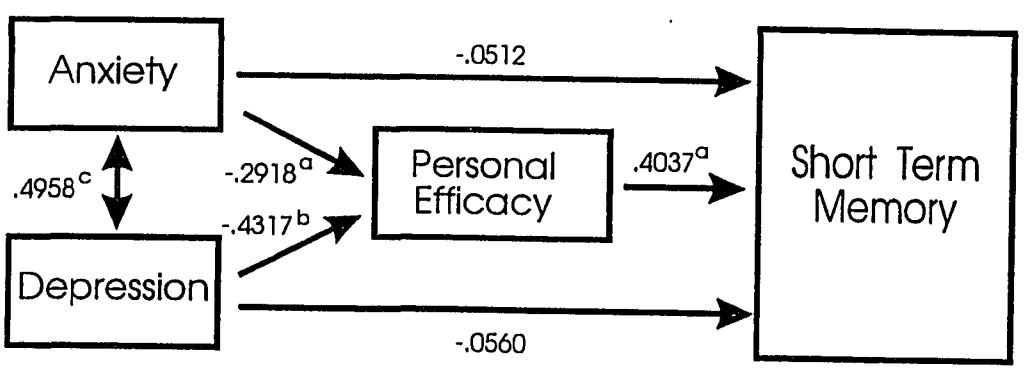
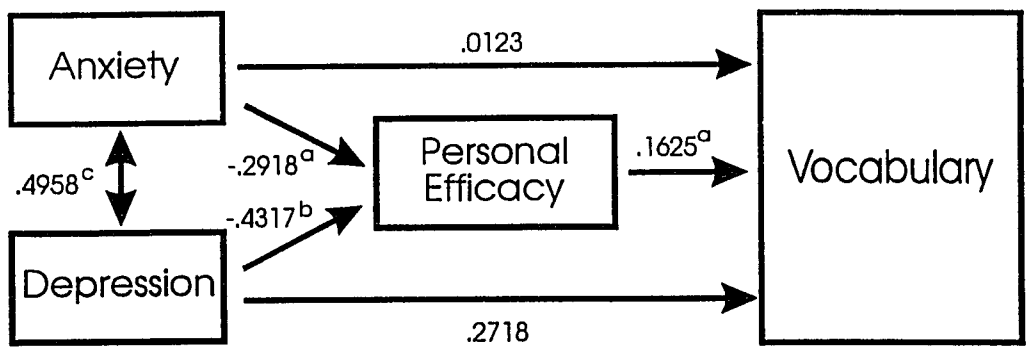


Figure 3

Path Model of Vocabulary



Note. Values shown are standardized path coefficients with significant predictors indicated.

[a]p <.05 [b]p <.01 [c]p <.001

Path Model of MFQ Score

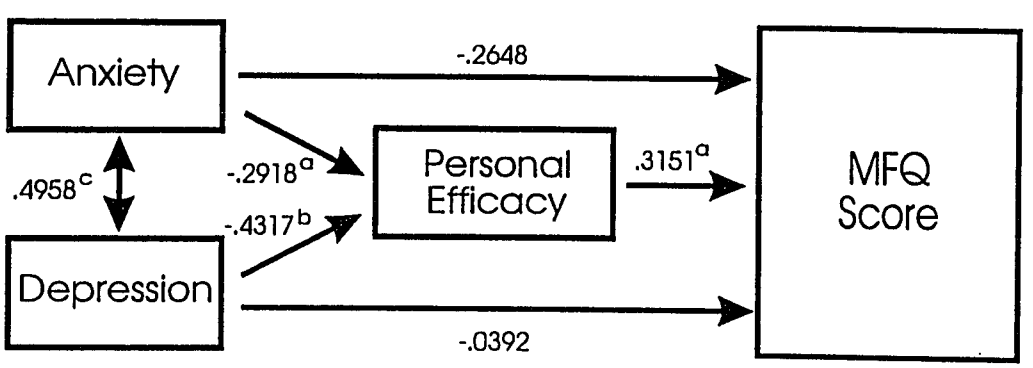
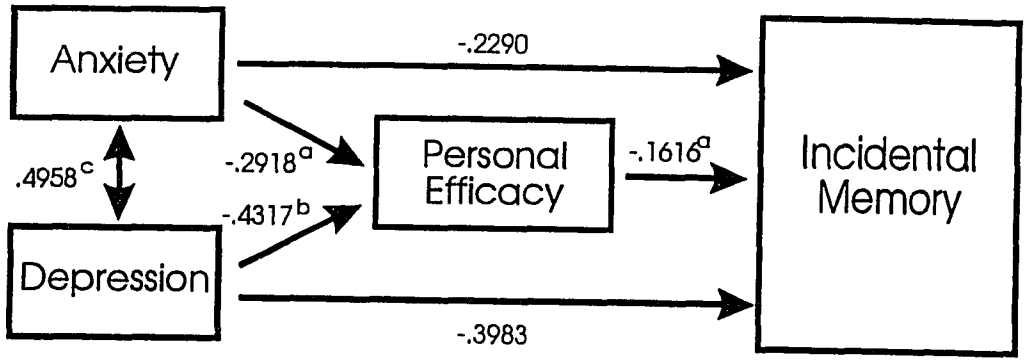


Figure 4

Path Model of Incidental Memory



Values shown are standardized path coefficients with significant predictors indicated.

[a]p <.05 [b]p <.01 [c]p <.001

conceptually related. A second multiple regression equation was constructed with trait anxiety and depression as the predictors and the composite personal efficacy score as the criterion measure.

The same procedure was followed with a composite short term memory score (forward digit span and visual memory span tapping forward z scores) as the criterion measure (Model 2), with vocabulary as the criterion measure (Model 3), with self-assessed memory (Memory Function Questionnaire Total) as the criterion measure (Model 4) and with incidental memory (number of digits recalled, and number of digits and symbols correctly paired z scores) as the criterion measure (Model 5). The path models estimated by these regression analyses are shown in Figure 2.

Summaries of direct, indirect, and spurious effects on working memory, short term memory, vocabulary, MFQ scores, and incidental memory are presented in Tables 12 - 16. In path analysis, direct effects are the standardized regression coefficients (standardized path coefficients) obtained from least squares regression; indirect effects were obtained by multiplying successive path coefficients and summing the products when two variables were separated by an intervening variable (Cohen & Cohen, 1983; Nie, Hull, Jenkins, Steinbrenner & Bent; 1975). Direct and indirect effects were added together to obtain total effects. In addition, there are spurious relationships that each variable has with the dependent variable which are due to common causes. Spurious relations were computed by finding the

Table 12

Summary of Direct, Indirect, & Spurious Effects on Working Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=working memory				
Trait Anxiety	-.3397	-.1666	-.1190	-.2856	-.0541
Depression	-.2638	.0001	-.1761	-.1760	-.0878
Efficacy	.4786	.4079[a]	0	.4079	.0707
Equation 2	Dependent variable=personal efficacy				
Trait Anxiety	-.4244	-.2918[a]	0	-.2918	-.1326
Depression	-.5214	-.4317[b]	0	-.4317	-.0897

[a] $p < .05$
[b] $p < .01$

Table 13

Summary of Direct, Indirect, & Spurious Effects on Short Term Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=short term memory				
Trait Anxiety	-.2397	-.0512	-.1178	-.1690	-.0707
Depression	-.2822	-.0560	-.1743	-.2303	-.0519
Efficacy	.4546	.4037[a]	0	.4037	.0509
Equation 2	Dependent variable=personal efficacy				
Trait Anxiety	-.4244	-.2918[a]	0	-.2918	-.1326
Depression	-.5214	-.4317[b]	0	-.4317	-.0897

[a] $p < .05$
[b] $p < .01$

Table 14

Summary of Direct, Indirect, & Spurious Effects on Vocabulary

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=vocabulary				
Trait Anxiety	.0414	.0123	-.0474	-.0351	-.0211
Depression	.1931	.2718	-.0702	.2016	-.0085
Efficacy	.0196	.1625	0	.1625	-.1429
Equation 2	Dependent variable=personal efficacy				
Trait Anxiety	-.4244	-.2918[a]	0	-.2918	-.1326
Depression	-.5214	-.4317[b]	0	-.4317	-.0897

[a] p <.05
[b] p <.01

Table 15

Summary of Direct, Indirect, & Spurious Effects on Memory Function Questionnaire total score

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=MFT total				
Trait Anxiety	-.4320	-.2698	-.0920	-.3618	-.0702
Depression	-.3506	-.0392	-.1360	-.1752	-.1754
Efficacy	.4594	.3151	0	.3151	.1443
Equation 2	Dependent variable=personal efficacy				
Trait Anxiety	-.4244	-.2918[a]	0	-.2918	-.1326
Depression	-.5214	-.4317[b]	0	-.4317	-.0897

[a] $p < .05$
[b] $p < .01$

Table 16

Summary of Direct, Indirect, & Spurious Effects on Incidental Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=incidental memory				
Trait Anxiety	-.2827	-.2290	-.0472	-.2762	-.0065
Depression	-.3843	-.3983	-.0698	.4681	.0835
Efficacy	.1432	-.1616	0	-.1616	-.0184
Equation 2	Dependent variable=personal efficacy				
Trait Anxiety	-.4244	-.2918[a]	0	-.2918	-.1326
Depression	-.5214	-.4317[b]	0	-.4317	-.0897

[a] $p < .05$
[b] $p < .01$

difference between the zero-order standardized Beta for that variable and the total effect (indirect plus direct) of that variable.

Based on the above analyses, trait anxiety and depression each have significant direct effects on personal efficacy, as expected. In Model 1, when anxiety, depression, and personal efficacy are regressed on working memory, only personal efficacy has a significant direct effect on working memory. In fact, the indirect effect of depression is larger than the direct effect and the indirect effect of anxiety is approximately as large as the direct effect. For Model 2, again only personal efficacy has a significant direct effect on short term memory and anxiety and depression have larger indirect than direct effects.

Different results were found when vocabulary was the criterion measure. The direct effect of personal efficacy was not significant, and the direct effect of depression, while not significant, was the largest direct effect. Similarly when incidental memory was the criterion measure the direct effect of personal efficacy was not significant and the direct effects of anxiety and depression, while not significant, were larger than the effect of personal efficacy. The direct effect of personal efficacy on MFQ total score was the largest effect, but also not significant. While trait anxiety had a moderately large direct effect, the indirect effect of depression was larger than its direct effect.

Based on the above analyses, while anxiety and depression

had significant direct effects on personal efficacy and accounted for 35% of the variance in personal efficacy, anxiety and depression did not have significant direct effects on the measures of cognitive performance used in the present investigation. The strongest relations between depression and performance were for incidental memory and vocabulary. Personal efficacy, on the other hand, had a significant direct effect on working memory, short term memory and had the largest direct effect on self-assessed memory.

Discussion

The present study investigated two sources of inter-individual variability related to cognitive performance in older adults and determined if age differences in cognitive performance might be attributed to these characteristics rather than to age. The first characteristic studied was health status, specifically the presence or absence of hypertension. The second set of characteristics examined were self-evaluations of affect, self-efficacy, and locus of control. In addition, the relationships between health status, self-evaluations and cognitive performance were examined.

Hypertension and Cognitive Performance

Unlike previous studies which examined the effects of hypertension on cognitive performance without controlling for other relevant variables, the present study was designed to control for the effects of these variables by eliminating subjects with kidney disease, cardiovascular disease, diabetes,

past neurological history and treatment for psychiatric illness and drug or alcohol addiction. In addition, the groups were equivalent for education, race, age, and gender. The present study also extends the findings of several previous studies which did not include subjects over 60.

Explanation of Group Differences in Working Memory

As expected, there were no differences between hypertensive and normotensive subjects in vocabulary, short term memory or incidental memory. Also expected, hypertensive subjects performed more poorly on working memory measures. More specifically, hypertensive subjects performed more poorly than normotensive subjects on a complex working memory task and a spatial analog of backward digit span but there were no differences in performance in a simple measure of working memory, backward digit span.

Complexity hypothesis.

Although it was not expected that hypertensive subjects would perform more poorly on short term or incidental memory tasks, group differences were expected in all of the working memory tasks. Short term and working memory are not considered two distinct memory systems but are considered to be on a continuum of processing complexity (Craik & Rabinowitz, 1984). Short term memory is considered to reflect storage capacity only thus requiring less effort than working memory which requires both storage and active manipulation of material (Hultsch & Dixon, 1990). Short term memory does not appear to be sensitive

to age or health (Poon, 1985).

Of the three working memory tasks, backward digit span is the least complex. Both reading span and visual memory tapping backward were chosen because they were expected to be especially sensitive to both age and health status. Reading span is a complex working memory task (Daneman & Carpenter, 1980) and visual memory tapping backward was chosen because it should require more effort than backward digit span based on the literature indicating that visuospatial abilities decline more than verbal abilities with age (Albert & Kaplan, 1980; Benton, 1974; Reitan, 1967) and may be sensitive to health status (Spieth, 1965; Wilkie & Eisdorfer, 1971).

Age and health differences in working memory are related to the complexity of the component operations (Craik et al., 1989) due to the "complexity hypothesis", which states that the performance of older adults suffers disproportionately relative to young adults as tasks become more complex (Cerella et al., 1980; McDowd & Craik, 1988).

Processing resources. Several researchers (e.g. Craik & Byrd, 1982) have suggested that older adults have a smaller pool of processing resources for mental operations. According to this view, as the complexity of the task increases and the number of mental operations increase, there is increasing competition for this limited resource pool. Findings of age differences in working memory are often explained by claiming that older adults have diminished resources in a basic process such as speed or

attention. Salthouse (1991), for example, has attempted to explain age-related differences in many cognitive tasks by partialling out age differences in speed of processing. Present findings that hypertensive older adults are slower than normotensive older adults along with evidence of slowing of reaction time in hypertensives (Light, 1980a, 1980b; Spieth, 1965; Wilkie & Eisdorfer, 1972) indicate that the processing resources of hypertensive older adults may be limited more than those of healthy older adults. Although differences in speed do account for a large amount of variance in complex cognitive tasks, the use of a simple processing resource model is currently thought to be too simplistic to account for all age and health related differences in cognitive performance (Light, 1991).

Relying on cognitive speed as the explanation for age and health-related differences in cognitive performance does not seem sufficient to explain the selective nature of cognitive differences found in hypertensive older adults and ignores the health-related and age-related differences in non-cognitive variables which have also been found.

Effortful versus automatic. Another explanation of the mechanisms by which age and health status could affect complex or effortful tasks is offered by Kennelly, Hayslip & Richardson (1985) who hypothesized that self-evaluation variables affect performance on tasks which would be considered more effortful. According to Bandura's (1986, 1989) theory that self-efficacy affects performance through decreased effort and persistence, it

is reasonable to expect that if self-efficacy mediates the relationship between hypertension and cognitive performance, performance will be affected most on tasks that require the most effort, attention, and persistence.

Primary Versus Secondary Aging

Taken together, the findings of group differences in working memory and speed of processing tend to support the contention that age-related differences in cognitive performance could be due to the effects of disease (i.e. hypertension) rather than to age alone. The robust findings of age related slowing and declines in performance on complex tasks and tasks involving visuospatial abilities could be attributed to the poorer health status of older adults compared to young adults. According to LaRue and D'Elia (1985), authors of many studies have failed to report objective health information or have described their sample as healthy, community dwelling adults giving no supporting evidence. When LaRue and D'Elia (1985) included subjects with health problems in their investigation of anxiety and age, they found that health status, not age, was the only significant predictor of trait anxiety.

Siegler and Costa (1985), discussed the methodological difficulties involved in aging research related to health status and suggested several ways researchers could attempt to disentangle the effects of disease (secondary aging) from the effects of age (primary aging). One of the methods discussed involved studying the impact of a particular condition, such as

hypertension, by comparing the performance of healthy individuals of the same age to hypertensive individuals, screening for other health problems as was done in the present study.

The Relation Between Cognitive Performance and Self-Evaluation

To determine whether the poorer cognitive performance of hypertensives relative to normotensives was due to differences in self-evaluations, three hierarchal multiple regression analyses were performed controlling for (1) anxiety and depression, (2) number of psychological symptoms reported, and (3) self-efficacy and locus of control. The results of these analyses showed that the effects of hypertension on cognitive performance could be attenuated and even eliminated by controlling for affective status and personal efficacy (a composite of self-efficacy and internal locus of control). Hypertensive status was no longer a significant predictor of memory performance after number of psychological symptoms and personal efficacy were each partialled out. Controlling for anxiety and depression did not eliminate group differences in cognitive performance but did attenuate differences in self-assessed memory. These results indicate that performance differences between the groups may not be due solely to declines in the cognitive competence of hypertensive subjects, but may also be associated with negative self-evaluations and expectations which reduce the effort and persistence of hypertensive individuals.

Hypertension And Self-Evaluation

The second set of characteristics examined in the present

investigation were self-evaluations of self-assessed memory, affect, self-efficacy, and locus of control and the relationship of these self-evaluations to both cognitive performance and hypertension in older adults.

Self-assessed Memory

Self-assessed memory and hypertension. Although hypertensive subjects reported having more memory problems overall on the MFQ, there were surprisingly no group differences in frequency of forgetting, retrospective function (comparing their present memory ability to past ability), or mnemonics usage. The only significant difference found was on the seriousness of forgetting scale. Hypertensive adults reported that when they do forget names, appointments, or something they've read, they consider these memory failures to be more serious relative to normotensive adults. Since group means were in the expected direction it may be that the present study did not have sufficient power to find significant differences in the other scales.

There is evidence in the literature that age-based memory stereotypes of decline play a critical role in the self-perceptions of older adults (Cavanaugh, Morton, & Tilse, 1989; Perlmutter et al., 1987). These stereotypes of declines in cognitive ability with age may be even more salient for older adults with chronic health problems such as hypertension (Milligan et al., 1985). Age-based memory beliefs may sensitize older individuals so that they become more aware of the same kind

of everyday memory failures they have always experienced. In analyzing individual items on everyday memory questionnaires, rather than overall scores, it becomes apparent that young individuals may actually experience more memory failures than older adults on some items (e.g. Tunick, Pollina, Greene, & Puckett, 1990). An important point made by Ryan (1992) is that these beliefs in the inevitable decline of cognitive ability with age can influence an individual's memory self-efficacy regardless of their veridicality.

Self-assessed memory and other self-evaluations. Somewhat surprising was the result that MFQ scores were not significantly related to any measures of self-efficacy, anxiety, depression, or health status. MFQ scores were significantly related to locus of control. Individuals who reported more memory problems overall tended to have higher chance locus of control and lower internal locus of control scores.

There is much evidence in the literature that depressed individuals tend to report more memory problems (e.g. Gilewski & Zelinski, 1986; Larrabee & Levin, 1986) contrary to the findings of the present study. A plausible explanation for this result is that there was little variance in depression scores in the present study. The levels of depression in the present sample were not high enough to consider these individuals severely depressed.

A more difficult result to explain was the finding of no significant association between self-assessed memory and self-

efficacy. According to Hultsch and Dixon (1990), individuals turn to their self-efficacy beliefs when filling out everyday memory questionnaires both for frequency of forgetting scales and for comparing their present memory abilities to past memory abilities (retrospective function). Hultsch et al. (1988) have theorized that there are 4 dimensions of metamemory: memory knowledge, memory monitoring, memory related affect, and memory self-efficacy. They define memory self-efficacy as one's beliefs about one's memory capacity, how much one's memory has changed and the degree to which one's memory performance is under personal control. They define memory monitoring as consisting of evaluations of the accuracy of one's performance. It seems clear that Berry's (1989) definition of self-efficacy as measured by predictions of performance and used in the present study is more like Hultsch et al.'s (1988) construct of memory monitoring than their construct of self-efficacy, which more closely resembles locus of control used in the present study. In the present study, locus of control was significantly related to MFQ scores. It is not as surprising a finding that self-assessed memory as measured by the MFQ is not highly correlated with memory prediction as measured by the Memory Self-Efficacy Questionnaire as these questionnaires measure two distinct dimensions of metamemory.

Self-assessed memory and cognitive performance. The findings for associations between self-assessed memory and laboratory tasks have been mixed, with many studies finding no

relationship between self-assessed memory and cognitive performance as did the present study (O'Hara et al., 1986; Scogin et al., 1985; West et al., 1984; Zarit et al., 1981). These findings may be due to the lack of similarity between the self-assessed item and laboratory task and the lack of common memory processes between them (Hermann, 1982).

In the present study, as in many previous studies, the laboratory tasks included would appear to tap different processes than the MFQ which is basically a measure of memory failures in everyday life. Frequency of forgetting is an important component of the MFQ. Laboratory tasks, in the present study, were measures of working memory and processing speed (retrospective memory) while the frequency of forgetting scale has subjects evaluate their prospective memory (remembering appointments, birthdays). Prospective memory and retrospective memory involve different processes (Jurden, 1992). Frequency of forgetting also includes a section related to forgetting what one has read (discourse memory) and a section asking subjects how well they remember things that happened 1 month to 6 years ago (autobiographical memory). In addition, many other MFQ items ask about highly routinized behaviors, such as forgetting where you've put something, which are done automatically without much awareness by the individual (Perlmutter, Monty, & Chan, 1986). These everyday memory items ask subjects to evaluate their performance on tasks which clearly involve different processes than the laboratory tasks used in the present study and in many

other studies.

Anxiety, Depression, and Psychological Symptoms

Although hypertensive subjects were not significantly more depressed or anxious than normotensive subjects, they did report significantly more psychological symptoms on the Cornell Medical Index. Although the mean number of psychological symptoms reported by hypertensives seems quite small, there was more variability in the responses of the hypertensive group. While the normotensive group reported 0-2 symptoms, the hypertensive group reported 0-15 symptoms. Similarly for anxiety and depression, the hypertensive group had more variance with 7 out of 20 hypertensive subjects reporting depression scores higher than 8 compared to 1 normotensive subject. Five out of 20 hypertensive subjects reported trait anxiety scores of 48 or higher while none of the normotensive subjects scored this high.

Although mean differences indicated that hypertensive subjects tended to have higher trait anxiety and depression scores with mean differences for depression approaching significance, an important point raised by several researchers concerns the validity of self-report evaluations compared to more objective measures. In the present investigation it would appear that the more objective measures (psychological symptoms) was more sensitive to group differences than the self-report measure and was significantly associated with other self-evaluations and cognitive performance. These findings could explain some previous results of no differences in anxiety and depression due

to age or health status and no relationship between affect and cognitive performance. Perhaps including more objective measures of affect, such as number of symptoms reported on the CMI, would assist in clarifying relationships between affect, age, health status and cognitive performance.

Self-Efficacy As A Mediator

Several psychologists have hypothesized that anxiety and depression are not directly related to cognitive performance but are mediated by personal efficacy (e.g. West et al., 1984). In this model it is the individual's expectation of success or failure that affects performance. Anxiety and depression are thought to affect the individual's expectations such that a depressed individual, for example, would be more likely to expect to fail and would remember past incidences of failure when faced with a cognitive task. The individual would then exert less effort and show less persistence than an individual with expectations of success.

In order to further examine the role of personal efficacy in mediating the relationship between affect and cognitive performance, path analyses was performed. The results showed that both anxiety and depression have significant direct effects on personal efficacy and account for a moderate to large amount of the variance in personal efficacy, but do not have significant direct effects on working memory or short term memory. Personal efficacy, on the other hand, has a significant direct effect on both working memory and short term memory. These findings lend

support to the model that efficacy mediates the relationship between affect and memory. Further evidence is shown by the differential effects of affect and personal efficacy in models where vocabulary and incidental memory were the criterion measures. In these models personal efficacy did not have a significant direct effect. For incidental memory, anxiety and depression had larger direct effects than efficacy. These findings also lend support to the idea that the effects of efficacy will be larger for more effortful tasks.

Self-Efficacy as a Construct

While the findings of the present study support the hypothesis that hypertensive individuals have lower internal and higher external locus of control, no support was found for hypertensives having lower self-efficacy. A possible explanation for the lack of group differences in self-efficacy lies in the scale itself. Berry et al. (1989) devised the SEQ to be a measure of Bandura's (1986, 1989) construct of self-efficacy which refers to an individual's judgement of his or her ability in a given situation. Individuals high in self-efficacy should expend more effort and persist longer on a task. The SEQ uses multiple indices to obtain direct predictions of performance. Although prediction of task performance is one way to measure efficacy or confidence in one's ability to do that task, it seems reasonable to expect that to be accurate in predicting task performance an individual needs to be familiar enough with the task to know the specific strategies involved. Only after

individuals have determined the necessary strategies can they judge whether or not they have the ability to execute these strategies. Most tasks on the SEQ are laboratory type tasks that individuals would not be familiar with. Supporting the importance of familiarity, Berry et al. (1989) found that there was a significant relation between prediction and performance only for "everyday" type tasks on the SEQ. In the present study only laboratory type tasks were used and the findings indicated that performance on only 2 tasks was predicted by self-efficacy level for that task. A composite self-efficacy level for all the laboratory tasks was a better predictor of performance, significantly predicting performance on 4 of the 6 tasks.

Another difficulty with the SEQ relates to differences in definitions of self-efficacy, some definitions are more related to personal control over the outcome of a situation than to memory monitoring or predictions of task performance. Locus of control may actually be more useful than self-efficacy, as measured by predictions of task performance, for determining whether an individual will persist in a difficult, effortful task. The Personality in Intellectual Contexts Scale (PIC) which was used to measure locus of control in the present study assesses whether individuals feel they have some control over their memory abilities or whether declines with age are inevitable (e.g. "If I want to work at it, I'm able to figure out quite a few puzzles and similar problems." for internal locus of control; versus "There's nothing I can do to preserve my mental

clarity and there's no doubt it will become harder and harder for me to add and subtract numbers." for chance external locus of control).

Locus Of Control

The findings of the present study support the importance of including locus of control in studies of age-related and health-related changes in cognitive performance. The present results indicate that individuals high in internal locus of control perform better on measures of short term memory, working memory, and cognitive speed, report they have fewer memory problems, are less depressed, have higher self-efficacy, and report fewer physical and psychological symptoms than individuals low in internal control. Although the constructs are related, locus of control is somewhat different from self-efficacy.

The issue over control is fundamental to efficacy. If individuals do not believe they have control over the outcome of a task then it is doubtful that they would exert much effort or persist in the face of difficulties. These two variables, effort and persistence rather than performance, are at the heart of Bandura's (1986, 1989) theories of self-efficacy. In addition, individuals who don't expect to succeed through their own efforts would be more likely to give up when effortful thinking and strategy use become necessary (Wood & Bandura, 1989). Especially when studying relations between laboratory type tasks and self-evaluations, locus of control would seem to be a more useful measure than self-efficacy as measured by task predictions

because individuals would be more likely to fall back on general memory beliefs in unfamiliar or novel situations with which they have no experience (Phares, 1976).

Individuals might have a better point of reference for predicting unfamiliar tasks if they were told how the "average" person their age would score. A prediction of higher than the average would indicate that individuals had high self-efficacy regarding that particular task. Future studies might examine self-efficacy in relation to tasks older individuals are familiar with and actually have to perform (e.g. balancing their checkbook, preparing income tax or solving everyday problems). In addition to predicting their performance on such tasks, subjects could be asked what strategies they would use, giving researchers information about subjects' knowledge in addition to their beliefs and the accuracy of those beliefs.

Future research also needs to clarify the construct of internal control which seems to be multidimensional in nature (see Baltes & Baltes, 1986 for a review). Originally, external control was considered a unified construct but has since been divided into chance and powerful others. According to Anastasi (1984), locus of control and controllability are often confounded. Locus of control characterizes the cause of an outcome as internal (dealing with aptitude, effort, health) or external (dealing with task difficulty, luck, help from others) while controllability concerns the degree to which the situation is under the person's control. Weiner (1985) discusses the same

idea but distinguishes between locus and control rather than locus of control and controllability. Judgements about what is responsible for an outcome (locus) are different from whether the outcome can be changed (control). For example, an individual can feel responsible for not doing well on a task due to internal causes (e.g. lack of ability) and still feel he/she cannot change the outcome (control). In much of the literature internal locus is confounded with control and external locus with lack of control (Cavanaugh & Green, 1990). Bandura (1986) also believes that an individual makes two judgements, whether or not they can do what is required (self-efficacy) and whether their efforts will produce the desired results. Another related construct in the literature concerns attributions of success and failure. It would seem that before further research can determine the relationship between self-evaluations and cognitive performance the associations between self-efficacy, attributions, locus of control, and controllability would need to be clarified.

Is External Control Adaptive For Hypertensives?

In the present investigation hypertensive subjects were found to have higher external locus of control relative to normotensive subjects. Although most studies have found higher external locus of control for older adults and adults with health problems there is some controversy about whether having an external locus of control is adaptive for these individuals. Lachman and Leff (1989), for example, believe that it is adaptive for older individuals in poor health with declining abilities to

have higher external locus of control. Woodward and Wallston (1987) suggested that when older adults perceive themselves as being less competent, they desire less control. In support of this view, Rodin (1982) has suggested that perceptions of external control can decrease the negative effects of stress that are related to being in poor health. Ciricelli (1987) concluded that giving control to others when one is in poor health might lead to having better actual control over the situation. Shultz (1986) has called aligning with powerful others who act in one's best interest "secondary control" and also believed it could ultimately lead to more control over events.

Woodward and Wallston (1987), however, concluded that giving up control to powerful others may not be an effective coping strategy even though it may reduce the stress associated with memory or health problems. Rodin (1986) believes that interventions which enhance perceived control and develop coping strategies are beneficial to older adults and may even lessen the development of disease. In the present study hypertensive subjects did not score higher on the powerful others scale but the chance external scale. This finding indicates that subjects in the present investigation did not feel that they needed the assistance of powerful others, but that a decline in their abilities was inevitable and not under their control. Having a higher level of chance locus of control would not appear to be an effective coping strategy and would not give individuals "secondary control", only some relief from feeling personally

responsible for their declines. Although Lazarus and Folkman (1984) believe that emotion-focused coping strategies can be adaptive, especially in situations that are not under one's control, this strategy could be problematic.

According to Bandura (1990), individuals who don't believe they can succeed will tend to avoid situations where they may be challenged. By avoiding activities with any cognitive or memory component individuals are assuring further decline in these abilities due to disuse. Individuals with low internal locus of control and high external locus of control would either not attempt a difficult task or not expend enough effort to succeed at the task insuring more negative instances that would keep their self-efficacy low. Individuals high in internal locus of control would expend enough effort and persist long enough to succeed at the task thus enhancing the potential for positive instances that would keep self-efficacy high. For older adults, declines in self- efficacy could have far-ranging effects such as social isolation through withdrawal from both activities and interactions with friends. Holahan and Holahan (1987), for example, found that self-efficacy functioned both directly and indirectly through its effect on social support to prevent depression.

Although the present investigation did not specifically measure health related locus of control, several studies have found that older adults in poor health also have higher health related external locus of control (e.g. Ciricelli, 1987; Shultz,

1986). Believing that the course of one's disease is not under one's control could lead to lack of compliance in medication usage and diet and exercise regimens, a common problem in the medical field and one which may lead to preventable complications.

Implications for Intervention

The findings of the present study lend support to the literature concerning the important influence that memory perceptions and beliefs have on memory performance in older adults (e.g. Bandura, 1990). Although much work clarifying the constructs of self-efficacy, attributions, locus of control, and controllability remains, individuals have already demonstrated the practical significance of applying information about self-evaluations to cognitive interventions.

Willis (1990) discussed the importance of including training in both cognitive strategies and performance factors which include speed, affect, motivation, self-efficacy, and locus of control. After reviewing several studies which trained cognitive strategies alone, performance factors alone, or a combination of cognitive and performance factors, Willis concluded that combined training yields the maximum improvement in cognitive functioning.

Several studies have attempted to decrease either anxiety or depression as part of a memory training program, but decreases in depression have not necessarily been associated with improved performance (e.g. Zarit et al., 1981b). Researchers attempting to improve memory performance by decreasing anxiety have fared

better. Yesavage and Jacobs (1984), for example, have demonstrated that subjects with the greatest reduction in anxiety after relaxation training also showed the greatest increase in recall performance.

Researchers have also attempted to influence subjects' perceptions of control. Perlmuter, Monty and Chan (1986), for example, have shown that when subjects are able to choose words to be learned rather than being assigned words, performance improved. The authors concluded that choice increased subjects' perception of control and thus enhanced motivation.

However, studies have shown that the same approaches will not work for every individual. Yesavage, Sheikh, Tanke, and Hill (1988) found that individual differences need to be taken into account when designing memory interventions. Prior to mnemonic training subjects were given both the WAIS vocabulary and State-Trait Anxiety Inventory. The authors found that subjects with high vocabulary scores benefited more from a combination of verbal elaboration training and mnemonic training, while subjects with high state anxiety benefited more from a combination of relaxation training and mnemonic training.

Finally, it is necessary to use some caution in adding a cognitive restructuring component to memory training programs. Cavanaugh and Green (1990) discussed the possible problems involved in manipulating an individual's self-perceptions and attributions. Having participants attribute memory failures to their own lack of effort may encourage them to expend more

effort, but task performance may still not improve if individuals are performing at their highest level already or if there are neurologic limits to their abilities. Individuals may be left blaming their lack of effort for memory problems that are not necessarily under their control.

Limitations of study

(1) Due to the selection procedure, subjects in the present study may not be representative of the general population of older adults. Many subjects chosen were alumni of West Virginia University and thus the mean education level of both groups was higher than average. In addition, subjects were screened for any health-related variables that could be confounded with essential hypertension such as kidney disease and diabetes, and subjects were screened for psychiatric illness, addiction and having any major losses in the previous six months. Subjects were volunteers recruited from churches, senior centers, and other organizations and were generally Caucasian and middle class individuals who rated their health as good. These selection procedures may have decreased the generalizability of the results.

(2) A possible confounded difference between the hypertensive and normotensive groups was the finding that hypertensive subjects reported a larger number of physical symptoms on the Cornell Medical Index and may have been in poorer health overall. Since subjects were initially screened to eliminate individuals with diabetes, past neurological history,

kidney disease, heart failure and psychiatric history, and the mean number of symptoms reported by hypertensives was small, it does not seem likely that the symptoms reported were of a nature to effect the results. In addition, both groups rated their health as "good", and no differences were found in concern about health or whether daily activities were limited by health. A more likely explanation for the larger number of physical symptoms reported by hypertensive subjects was the inclusion of a scale (13 questions) assessing cardiovascular health which included questions related to hypertension. A separate analysis was performed with the cardiovascular scale removed from the total score. Differences between the groups were no longer significant (see Table 1).

(3) Although the mediational model used in this study implies that the relationship between self-efficacy and cognitive performance is unidirectional, there is evidence that self-efficacy evaluations are based, in part, on previous cognitive performance (e.g. Bandura, 1986, 1990). The present study was designed so that the self-efficacy measure would be administered before the cognitive performance measures to insure that current cognitive performance would not affect current self-efficacy, but only a longitudinal design with time-lagged analyses or an experimental design where affect and self-efficacy could be manipulated would allow for an explicit analysis of the causal nature of the relations between self-evaluations, health, and cognitive performance. A study with a larger number of subjects

would be beneficial in that structural equation modeling could be used to test the fit of various models.

(4) In addition, a logical test of the mediational model of personal efficacy would measure anxiety, depression, self-efficacy, and locus of control prior to cognitive performance. In the present study, due to time constraints, although both self-efficacy and locus of control were measured before cognitive performance, anxiety and depression were measured after tests of cognitive performance were completed. Thus the procedure may have altered the relations among cognitive performance, self-efficacy, and affect. Several studies have indicated that depression may result from a self-perceived inability to attain one's goals (Bandura, 1990; Holahan & Holahan, 1987). Thus a second model was constructed with direction changed so that cognitive performance had both a direct effect on anxiety and depression and an indirect effect through self-efficacy (see Appendix M). Although this model represents a plausible explanation of the relations among personal efficacy, cognitive performance and affect it does not appear to be as useful as Model 1. In addition it is hoped that due to the high reliability of Beck Depression Inventory and Trait Anxiety scores, subjects' scores would not be significantly different if these assessments had been administered prior to testing of cognitive performance.

(5) Although MANOVA offers protection against inflated Type I error compared to a series of ANOVA's, a limitation of MANOVA

is that it is often less powerful than ANOVA (Tabachnick & Fidell, 1989). The relatively small number of subjects in the present investigation and the moderately large variability in scores may have lead to an increased possibility of Type II error in some analyses. Strength of association measures (eta^2) may help to clarify the relationship between hypertensive status and each dependent variable.

In addition, there may also have been insufficient power in the multiple regression analyses computed in the present study. In multiple regression analysis the rule of thumb has been to have a minimum of 5 cases for each independent variable (Tabachnick & Fidell, 1989). In the present study the maximum number of independent variables used was 2 thus meeting this criterion. Green (1991), however, has indicated that effect size needs to be taken into account when judging whether sample size is sufficient. For 1 predictor 23-53 subjects (2 predictors: 27-63 subjects) are needed to adequately test a hypothesis. The smaller number of subjects listed above are needed for analyses with large effect sizes (R^2=.26) and the larger number of subjects listed above are needed for analyses with medium effect sizes (R^2=.13). Since sample size in the present study was 40 and most effect sizes were in the medium range, there may have been insufficient power in some analyses with 2 independent variables.

(6) According to Bandura (1988; 1990), the variables that would be most affected by self-efficacy would be persistence and

effort. The present study did not include direct measures of persistence and effort, only of performance. Future studies should include measures of effort, persistence in the face of difficulties, strategies chosen, and strategies executed for a truer test of Bandura's hypothesis.

(7) In order to disentangle the effects of hypertension from the effects of aging on cognitive performance, it would be necessary to add two more groups to the present study, a group of healthy young adults and a group of young adults with hypertension.

(8) A possible limitation of the present study was the confounding of hypertensive status with antihypertensive drug use. Seventy per cent of hypertensive subjects in the present investigation were on anti-hypertensive medication at the time of testing. Since the effects of antihypertensive medications on performance are not yet fully known and vary with the type of medication used, dosage taken, and the response of the individual (King & Miller, 1990), it is not clear how the use of antihypertensive medications by some subjects may have affected the results. Although it has been found that some medications may actually improve performance in younger hypertensives (e.g. Miller et al. 1984), the performance of elderly hypertensives may be negatively affected (e.g. Larsson, Kukull, Buchner, & Reifler, 1987).

In summary, the results of the present study lend support to mounting evidence (e.g. Jennings, Waldstein, Muldoon, Poliferone,

Shapiro, & Manuck, 1992) that health status in general, and hypertension in particular affect basic cognitive processes such as speed of processing and working memory in older adults independent of the effects of age. A significant finding in the present study was the attenuation and even elimination of the effects of hypertension on cognitive performance by controlling for the effect of self-evaluations such as locus of control and self-efficacy. In addition, path analyses tended to confirm the role of personal efficacy as a mediator of the effects of anxiety and depression on memory. These results have important implications for the design of memory training programs which should include cognitive restructuring of subjects' memory beliefs as well as training of specific strategies.

In addition, the present study adds to the understanding of the relationships between non-cognitive factors and cognitive performance in older adults with hypertension. Although much research has been done suggesting that certain personality traits may lead to hypertension, recent research has suggested that knowledge of a hypertensive diagnosis in itself may lead to increased anxiety and depression and may be more important than actual blood pressure values with respect to anxiety and depression (e.g. Robbins, Elias, & Shultz, 1990; Wood et al., 1979). The results of the present study support Robbins et al.'s conclusions that programs following the diagnosis of hypertension should focus on individuals' concerns about hypertension and should alleviate individuals worries and fears rather than

emphasize dangers related to non-compliance. Decreasing individuals' anxieties and fears and attempting to enhance feelings of personal control might alleviate some of the negative perceptions and beliefs associated with hypertension, thus, perhaps, attenuating memory problems.

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APPENDIX A

Code Number_____
(02)

ADEPT PIC INVENTORY SHORT FORM

Instructions:

The following statements concern how you feel or think about certain situations. Below each statement there is a scale representing a range of responses from strongly agree to strongly disagree. Read each statement and select an answer which best represents the extent to which you agree or disagree with the statement. Make a circle around the number which corresponds to your answer choice. Try to choose the number 1 or the number 6, the extremes, whenever possible. There are no *right* or *wrong* answers–we want to know which answer best describes *you*. Be sure to answer every question.

Here is an example:

A. I like to read mysteries.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Circle the number of the answer choice that best describes you. If you especially enjoy reading mystery stories, you would circle number **1**. If you dislike mystery stories and never read such books you would circle number **6**.

Here is another example:

B. I'll never be able to learn to type well.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

If you already know how to type well you would circle number **6**. However, if you can type but think you could improve you might circle number **5**. You would circle number **1** if you believe you never would be able to type well.

Please continue with the actual questionniare items in the same manner as shown in the examples.

Adept PIC developed byLachman, M., Baltes, P., Nesselroade,J. & Willis, S. (1982)

As you answer the items on the next pages, please keep these points in mind:

1. When you feel you can, please choose either number 1 or 6. That is to say, try to avoid choosing the middle answers all the time, unless that is the best answer.
2. Do not spend too much time thinking about your answer. Give the first natural answer as it comes to you, describing yourself in the given situation.
3. Answer every question, even if it doesn't seem to apply to you very well.
4. Be as honest as possible about what is true of **you.**
5. **Circle the number** in the right column that corresponds to your answer.

DO NOT TURN THE PAGE UNTIL ASKED TO DO SO.

Q-1 When paying in a restaurant for meals or in a store for clothes, I am able to understand the bill.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-2 If I studied a map carefully I could figure out how to get around in a strange place.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-3 My problem solving ability depends on how healthy I am.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-4 I would have to ask a salesperson to figure out how much I'd save with a 20% discount.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-5 I'd call the T.V. network for the program schedule rather than try to read it on my own.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-6 My crossword puzzle skills will go downhill even if I keep doing puzzles.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-7 It's up to me to keep my mental faculties from deteriorating.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-8 I'd prefer an instructor to show me how to solve problems that involve numbers rather than work them out myself.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-9 I know if I keep using my memory I will never lose it.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-10 As long as I exercise my mind I will always be on top of things.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-11 After studying the answers to sample word puzzles or alphabet letter problems such as scrambled words (anagrams),/ I could solve similar ones on my own.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-12 What I can learn now is determined by what I was taught when I was younger.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-13 I can only understand instructions after someone explains them to me.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-14 There would be ways for me to learn how to fill out a tax form if I really wanted to.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-15 When it comes to reimbursements from or claims to an insurance company, I need an expert's advice.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-16 There's no doubt it will become harder and harder for me to add and subtract numbers.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-17 If at first glance I couldn't make sense of a train timetable, I'd be able to figure it out by studying it carefully.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-18 In order for me to have a nutritional diet a specialist would have to plan my meals.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-19 I have little control over my mental state.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-20 I need someone to help me when it comes to solving difficult puzzles or games.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-21 It's inevitable that my letter writing ability will deteriorate.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-22 I can't expect to be good at remembering zip codes at my age.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-23 If I want to and work at it, I'm able to figure out quite a few puzzles and similar problems.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-24 If I had a postal scale and instructions from the post office, I could not figure out postal rates for a package *without* the postman's help.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–25 I can't figure out sale prices of items unless someone helps me.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–26 There's nothing I can do to preserve my mental clarity.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–27 I couldn't learn to solve word puzzles or alphabet letter problems such as scrambled words (anagrams) without a teacher's help.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–28 I could remember important telephone numbers if I practiced them.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–29 I couldn't fill out my own tax forms without an accountant's assistance.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-30 If I forget my friend's zip code I'd be able to learn it again.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-31 I'd be able to keep an accurate record of my expenses so as to avoid financial problems.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-32 My mental acuity (sharpness) is bound to decline.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-33 How much I can remember these days is related to the memory training I had in school.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q-34 It's inevitable that my intellectual functioning will decline as I get older.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–35 I have no chance to improve my thinking abilities at my age.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Q–36 The public authorities would have to help me make sense of a bus schedule.

1. STRONGLY AGREE
2. AGREE
3. SLIGHTLY AGREE
4. SLIGHTLY DISAGREE
5. DISAGREE
6. STRONGLY DISAGREE

Check for any questions that you may have skipped.

APPENDIX B

Self-Efficacy Questionnaire

READ EACH STATEMENT

SAMPLE STATEMENT: "IF I DROVE TO A NEW LOCATION IN MY CITY ON WEDNESDAY, I COULD FIND THIS NEW PLACE AGAIN A WEEK LATER WITHOUT MAKING ANY INCORRECT TURNS."

NO YES 10 20 30 40 50 60 70 80 90 100%

IF YOU THINK THAT YOU COULD NOT DO THE TASK DESCRIBED IN THE STATMENT, CIRCLE NO.

IF YOU THINK THAT YOU COULD DO THE TASK DESCRIBED IN THE STATEMENT, CIRCLE YES.

IN ADDITION, ALSO MARK HOW SURE YOU ARE THAT YOU COULD OR COULD NOT DO THE TASK DESCRIBED IN THE STATEMENT.

YOU MAY BE 100% SURE THAT YOU COULD DO THE TASK DESCRIBED IN THE STATEMENT, OR YOU MAY BE ONLY 50% SURE THAT YOU COULD DO THE TASK, OR YOU MAY THINK THAT YOU MIGHT BE ABLE TO DO THE TASK, BUT ONLY BE 20% SURE. SIMILARLY, YOU MIGHT BE 100% SURE THAT YOU COULD NOT DO THE TASK DESCRIBED, OR THINK THAT YOU COULD NOT DO THE TASK DESCRIBED IN THE STATEMENT, BUT BE ONLY 50% SURE THAT YOU COULD NOT DO IT.

COMPLETE ONE PAGE AT A TIME. DO NOT TURN BACK TO EARLIER PAGES ONCE YOU HAVE FINISHED THEM.

1. If someone read me a grocery list with 8 items and asked me to repeat the grocerly list from memory, I could remember 8 of the items correctly a few minutes after hearing them.

   NO YES 10 20 30 40 50 60 70 80 90 100%

2. If someone read me a grocery list with 8 items and asked me to repeat the grocerly list from memory, I could remember 7 of the items correctly a few minutes after hearing them.

   NO YES 10 20 30 40 50 60 70 80 90 100%

3. If someone read me a grocery list with 8 items and asked me to repeat the grocerly list from memory, I could remember 6 of the items correctly a few minutes after hearing them.

   NO YES 10 20 30 40 50 60 70 80 90 100%

4. If someone read me a grocery list with 8 items and asked me to repeat the grocerly list from memory, I could remember 5 of the items correctly a few minutes after hearing them.

   NO YES 10 20 30 40 50 60 70 80 90 100%

5. If someone read me a grocery list with 8 items and asked me to repeat the grocerly list from memory, I could remember 3 of the items correctly a few minutes after hearing them.

   NO YES 10 20 30 40 50 60 70 80 90 100%

Example: cereal, bread, margerine, milk, celery

6. If I got 7 phone numbers from the operator and I dialed right after I got each number, I could correctly dial all 7 numbers.

NO YES 10 20 30 40 50 60 70 80 90 100%

7. If I got 7 phone numbers from the operator and I dialed right after I got each number, I could correctly dial 5 numbers.

NO YES 10 20 30 40 50 60 70 80 90 100%

8. If I got 7 phone numbers from the operator and I dialed right after I got each number, I could correctly dial 3 numbers.

NO YES 10 20 30 40 50 60 70 80 90 100%

9. If I got 7 phone numbers from the operator and I dialed right after I got each number, I could correctly dial 2 numbers.

NO YES 10 20 30 40 50 60 70 80 90 100%

10. If I got 7 phone numbers from the operator and I dialed right after I got each number, I could correctly dial 1 numbers.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example: 272-0059, 352-1748

11. If I had just placed 10 items in different locations in a room, I could remember where I put all 10 of the items.

NO YES 10 20 30 40 50 60 70 80 90 100%

12. If I had just placed 10 items in different locations in a room, I could remember where I put 8 of the items.

NO YES 10 20 30 40 50 60 70 80 90 100%

13. If I had just placed 10 items in different locations in a room, I could remember where I put 6 of the items.

NO YES 10 20 30 40 50 60 70 80 90 100%

14. If I had just placed 10 items in different locations in a room, I could remember where I put 4 of the items.

NO YES 10 20 30 40 50 60 70 80 90 100%

15. If I had just placed 10 items in different locations in a room, I could remember where I put 2 of the items.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example: glasses on the counter, pillow on the table, toy under the chair, bowl beside the sink.

16. If a friend gave me the directions to his/her new house and the directions involved 10 steps, a few minutes later I could remember all 10 steps either verbally or by drawing a map.

NO YES 10 20 30 40 50 60 70 80 90 100%

17. If a friend gave me the directions to his/her new house and the directions involved 10 steps, a few minutes later I could remember 8 steps either verbally or by drawing a map.

NO YES 10 20 30 40 50 60 70 80 90 100%

18. If a friend gave me the directions to his/her new house and the directions involved 10 steps, a few minutes later I could remember 6 steps either verbally or by drawing a map.

NO YES 10 20 30 40 50 60 70 80 90 100%

19. If a friend gave me the directions to his/her new house and the directions involved 10 steps, a few minutes later I could remember 4 steps either verbally or by drawing a map.

NO YES 10 20 30 40 50 60 70 80 90 100%

20. If a friend gave me the directions to his/her new house and the directions involved 10 steps, a few minutes later I could remember 2 steps either verbally or by drawing a map.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example: (1) turn left at Willy's supermarket
(2) go till you come to bright yellow house across from Exxon station
(3) go 6 blocks
(4) turn right at corner

21. If someone read me number sequences of increasing length and asked me to repeat the sequence from memory, I could remember a sequence of 8 numbers correctly right after hearing it.

NO YES 10 20 30 40 50 60 70 80 80 100%

22. If someone read me number sequences of increasing length and asked me to repeat the sequence from memory, I could remember a sequence of 7 numbers correctly right after hearing it.

NO YES 10 20 30 40 50 60 70 80 90 100%

23. If someone read me number sequences of increasing length and asked me to repeat the sequence from memory, I could remember a sequence of 6 numbers correctly right after hearing it.

NO YES 10 20 30 40 50 60 70 80 90 100%

24. If someone read me number sequences of increasing length and asked me to repeat the sequence from memory, I could remember a sequence of 5 numbers correctly right after hearing it.

NO YES 10 20 30 40 50 60 70 80 90 100%

25. If someone read me number sequences of increasing length and asked me to repeat the sequence from memory, I could remember a sequence of 3 numbers correctly right after hearing it.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example: 7 - 1 - 0 - 2 - 8

26. If someone read me number sequences of increasing length and asked me to repeat the sequences backward from memory, I could remember a sequence of 7 numbers correctly right after hearing it.

    NO YES 10 20 30 40 50 60 70 80 90 100%

27. If someone read me number sequences of increasing length and asked me to repeat the sequences backward from memory, I could remember a sequence of 6 numbers correctly right after hearing it.

    NO YES 10 20 30 40 50 60 70 80 90 100%

28. If someone read me number sequences of increasing length and asked me to repeat the sequences backward from memory, I could remember a sequence of 5 numbers correctly right after hearing it.

    NO YES 10 20 30 40 50 60 70 80 90 100%

29. If someone read me number sequences of increasing length and asked me to repeat the sequences backward from memory, I could remember a sequence of 3 numbers correctly right after hearing it.

    NO YES 10 20 30 40 50 60 70 80 90 100%

30. If someone read me number sequences of increasing length and asked me to repeat the sequences backward from memory, I could remember a sequence of 2 numbers correctly right after hearing it.

    NO YES 10 20 30 40 50 60 70 80 90 100%

Example: 7 - 4 - 1 You say: 1 - 4 - 7

31. If someone touched a series of squares on a card and asked me to touch the same squares from memory, I could touch a series of 8 squares correctly right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

32. If someone touched a series of squares on a card and asked me to touch the same squares from memory, I could touch a series of 7 squares correctly right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

33. If someone touched a series of squares on a card and asked me to touch the same squares from memory, I could touch a series of 5 squares correctly right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

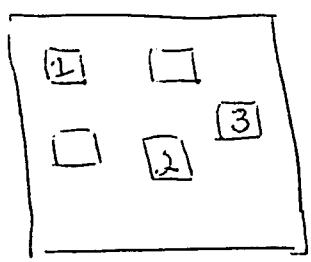
34. If someone touched a series of squares on a card and asked me to touch the same squares from memory, I could touch a series of 3 squares correctly right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

35. If someone touched a series of squares on a card and asked me to touch the same squares from memory, I could touch a series of 2 squares correctly right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example:



36. If someone touched a series of squares on a card and asked me to touch the squares in reverse order, I could touch a series of 7 squares correctly in reverse order right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

37. If someone touched a series of squares on a card and asked me to touch the squares in reverse order, I could touch a series of 6 squares correctly in reverse order right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

38. If someone touched a series of squares on a card and asked me to touch the squares in reverse order, I could touch a series of 5 squares correctly in reverse order right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

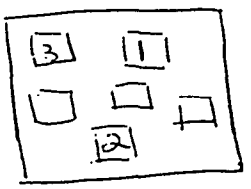
39. If someone touched a series of squares on a card and asked me to touch the squares in reverse order, I could touch a series of 3 squares correctly in reverse order right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

40. If someone touched a series of squares on a card and asked me to touch the squares in reverse order, I could touch a series of 2 squares correctly in reverse order right after seeing them touched.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example:



Experimenter touches 1-2-3

You touch 3-2-1

41. If someone gave me a list of sentences to read aloud and asked me to remember the last word of all the sentences, I could remember 5 words correctly right after reading the sentences.

NO YES 10 20 30 40 50 60 70 80 90 100%

42. If someone gave me a list of sentences to read aloud and asked me to remember the last word of all the sentences, I could remember 4 words correctly right after reading the sentences.

NO YES 10 20 30 40 50 60 70 80 90 100%

43. If someone gave me a list of sentences to read aloud and asked me to remember the last word of all the sentences, I could remember 3 words correctly right after reading the sentences.

NO YES 10 20 30 40 50 60 70 80 90 100%

44. If someone gave me a list of sentences to read aloud and asked me to remember the last word of all the sentences, I could remember 2 words correctly right after reading the sentences.

NO YES 10 20 30 40 50 60 70 80 90 100%

45. If someone gave me a list of sentences to read aloud and asked me to remember the last word of all the sentences, I could remember 1 word correctly right after reading the sentences.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example: sentence 1: The man went to the store and bought sugar.
sentence 2: The blizzard covered all the houses in the sleepy little town.
You would say: sugar, town.

46. If someone gave me symbols for the numbers 1 through 9 and asked me to fill in the boxes under a page full of numbers with the correct symbol, I could fill in 70 or more squares correctly in 90 seconds.

NO YES 10 20 30 40 50 60 70 80 90 100%

47. If someone gave me symbols for the numbers 1 through 9 and asked me to fill in the boxes under a page full of numbers with the correct symbol, I could fill in 60 squares correctly in 90 seconds.

NO YES 10 20 30 40 50 60 70 80 90 100%

48. If someone gave me symbols for the numbers 1 through 9 and asked me to fill in the boxes under a page full of numbers with the correct symbol, I could fill in 50 squares correctly in 90 seconds.

NO YES 10 20 30 40 50 60 70 80 90 100%

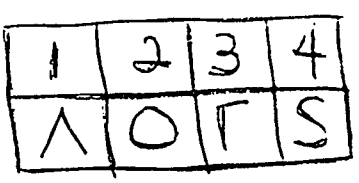
49. If someone gave me symbols for the numbers 1 through 9 and asked me to fill in the boxes under a page full of numbers with the correct symbol, I could fill in 40 squares correctly in 90 seconds.

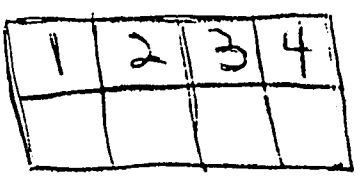
NO YES 10 20 30 40 50 60 70 80 90 100%

50. If someone gave me symbols for the numbers 1 through 9 and asked me to fill in the boxes under a page full of numbers with the correct symbol, I could fill in 30 or less squares correctly in 90 seconds.

NO YES 10 20 30 40 50 60 70 80 90 100%

Example:





APPENDIX

MEMORY FUNCTIONING QUESTIONNAIRE

This is a questionnaire about how you remember information. There are no right or wrong answers. Circle a number between 1 and 7 that best reflects your judgement about your memory. Think carefully about your responses, and try to be as realistic as possible when you make them. Please answer all questions.

GENERAL RATING SCALE (General Frequency of Forgetting)

How would you rate your memory in terms of the kinds of problems that you have?

major problems some minor problems no problems

1 2 3 4 5 6 7

FREQUENCY OF FORGETTING SCALE (General Frequency of Forgetting)

How often do these present a problem for you?

	always			sometimes			never
a. names.....	1	2	3	4	5	6	7
b. faces.....	1	2	3	4	5	6	7
c. appointments.....	1	2	3	4	5	6	7
d. where you put things(e.g. keys).....	1	2	3	4	5	6	7
e. performing household chores.....	1	2	3	4	5	6	7
f. directions to places.....	1	2	3	4	5	6	7
g. phone numbers you've just checked....	1	2	3	4	5	6	7
h. phone numbers you use frequently.....	1	2	3	4	5	6	7
i. things people tell you.....	1	2	3	4	5	6	7
j. keeping up correspondence.....	1	2	3	4	5	6	7
k. personal dates (e.g. birthdays).....	1	2	3	4	5	6	7

l. words.....	1	2	3	4	5	6	7
m. going to the store and forgetting what you wanted to buy.....	1	2	3	4	5	6	7
n. taking a test.....	1	2	3	4	5	6	7
o. beginning to do something and forgetting what you were doing.....	1	2	3	4	5	6	7
p. losing the thread of thought in conversation.....	1	2	3	4	5	6	7
q. losing the thread of thought in public speaking.....	1	2	3	4	5	6	7
r. knowing whether you've already told someone something.....	1	2	3	4	5	6	7

FREQUENCY OF FORGETTING DURING READING SCALE (General Frequency of Forgetting)

As you are reading a novel, how often do you have trouble remembering what you have read...

	always				sometimes		never
a. in the opening chapters, once you have finished the book.....	1	2	3	4	5	6	7
b. three or four chapters before the one you are currently reading.....	1	2	3	4	5	6	7
c. the chapter before the one you are currently reading.....	1	2	3	4	5	6	7
d. the paragraph just before the one you are currently reading.....	1	2	3	4	5	6	7
e. the sentence before the one you are currently reading.....	1	2	3	4	5	6	7

When you are reading a newspaper or magazine article, how often do you have trouble remembering what you have read...

	always			sometimes			never
a. in the opening paragraphs, once you have finished the article.....	1	2	3	4	5	6	7
b. three or four paragraphs before the one you are currently reading....	1	2	3	4	5	6	7
c. the paragraph before the one you are currently reading.....	1	2	3	4	5	6	7
d. three or four sentences before the one you are currently reading.....	1	2	3	4	5	6	7
e. the sentence before the one you are currently reading.....	1	2	3	4	5	6	7

REMEMBERING PAST EVENTS SCALE (General Frequency of Forgetting)

How well you remember things which occurred...

	very bad			fair			very good
a. last month is.....	1	2	3	4	5	6	7
b. between six months and one year ago is.....	1	2	3	4	5	6	7
c. between one and five years ago is.....	1	2	3	4	5	6	7
d. between six and ten years ago is.....	1	2	3	4	5	6	7

SERIOUSNESS SCALE (Seriousness of Forgetting)

When you actually forget in these situations, how serious of a problem do you consider the memory failure to be?...

	very serious					somewhat serious	not serious
a. names	1	2	3	4	5	6	7
b. faces	1	2	3	4	5	6	7
c. appointments	1	2	3	4	5	6	7
d. where you put things(e.g. keys)	1	2	3	4	5	6	7
e. performing household chores	1	2	3	4	5	6	7
f. directions to places	1	2	3	4	5	6	7
g. phone numbers you've just checked	1	2	3	4	5	6	7
h. phone numbers used frequently	1	2	3	4	5	6	7
i. things people tell you	1	2	3	4	5	6	7
j. keeping up correspondence	1	2	3	4	5	6	7
k. personal dates(e.g. birthdays)	1	2	3	4	5	6	7
l. words	1	2	3	4	5	6	7
m. going to the store and forgetting what you wanted to buy	1	2	3	4	5	6	7
n. taking a test	1	2	3	4	5	6	7
o. beginning to do something and forgetting what you were doing	1	2	3	4	5	6	7
p. losing the thread of thought in conversation	1	2	3	4	5	6	7
q. losing the thread of thought in public speaking	1	2	3	4	5	6	7
r. knowing whether you've already							

Procedure

1. Give subject consent form. Have them sign it.

2. Take blood pressure 3 times with 3 minute intervals. Record on subject log.

3. Order of Tasks:
   PIC
   SEQ
   MFQ
   subject can take a break if needed
   forward digit span
   backward digit span
   forward spatial (tapping) span
   backward "
   sentence verification
   vocabulary

   digit symbol

4. Take blood pressure again - subject should get up and stretch, get a drink of water, etc.

5. Give Beck, State-Trait, Health and Demographic Questionnaire, and Cornell Medical Index.

6. Pay subject, get signed receit.

Digits Forward

1. Say, "I am going to say some numbers. Listen carefully, and when I am through, say them right after me."
2. Discontinue after failure of both trials of any item.

Item	Trial 1	Trial 2
1	6-2-9	3-7-5
2	5-4-1-7	8-3-9-6
3	3-6-9-2-5	6-9-4-7-1
4	9-1-8-4-2-7	6-3-5-4-8-2
5	1-2-8-5-3-4-6	2-8-1-4-9-7-5
6	3-8-2-9-5-1-7-4	5-9-1-8-2-6-4-7

Digits Backward

1. Say, "Now I am going to say some more numbers, but this time when I stop I want you to say them backwards. For example, if I say 2-8-3, what would you say?"
2. "That's right. Now listen to these numbers and remember to say them backwards."

OR

3. If subject fails example, say, "No, I said 2-8-3, so to say them backwards you need to say 3-8-2. Now try these numbers. Remember you are to say them backwards. Ready? 1-5-8. Explain again if you have to, then go on to real trials whether subject gets this correct or not.
4. Discontinue after failure of both trials of an item.

Item	Trial 1	Trial 2
1	5-1	3-8
2	4-9-3	5-2-6
3	3-8-1-4	1-7-9-5
4	6-2-9-7-2	4-8-5-2-7
5	7-1-5-2-8-6	8-3-1-9-6-4
6	4-7-3-9-1-2-8	8-1-2-9-3-6-5

Tapping Forward

1. Say, "On the other side of this card are a number of red squares. When I turn them face up, I will touch some of the squares, one after another. Watch carefully as I do it, because as soon as I am through I will ask you to touch the same squares in the same order."

2. (Turn over card). Say, "Watch me." (do trial 1 of item 1). "Now you do it. Touch the same squares I did in the same order."

3. Go on to Trial 2, say,"Now we'll do another one. First watch me, then you touch the same squares I do in the same order. Stop if subject fails both trials of an item.

Item	Trial 1	Trial 2
1	2-6	8-4
2	2-7-5	8-1-6
3	3-2-8-4	2-6-1-5
4	5-3-4-6-1	3-5-1-7-2
5	1-7-2-8-5-4	7-3-6-1-4-8
6	8-2-5-3-4-1-6	4-2-6-8-3-7-5
7	7-5-6-3-8-7-4-2	1-6-7-4-2-8-5-3

Tapping Backward

1. Say, "This card contains a number of squares like those on the card we just used, except that the squares are green. In this test I'm going to touch the squares one at atime as I did before, but this time when I'm through I want you to touch the squares in reverse order."
2. (turn card over). Touch 7-2, say, "Now you do it. Touch the same squares that I did, but in reverse order."
3. If subject is incorrect say, "No, I touched this square first (tap square 7), then this square (tap square 2). You are to touch them backwards like this (tap 2, then 7). Now you do it."

OR

4. If subject is correct, go on to trial 1 of item 1. Say, "Remember, on this part of the test you have to touch the squares in reverse order from the way I touch them."
5. Discontinue when subject fails both trials of an item.

Item	Trial 1	Trial2
1	3-6	7-4
2	6-8-5	3-1-8
3	8-4-1-6	5-2-4-1
4	4-6-8-5-2	8-1-6-3-7
5	7-1-8-3-6-2	3-8-1-7-5-4
6	1-5-2-7-4-3-8	6-7-4-3-1-5-2

Sentence Verification

1. Say, "I am going to give you some cards with sentences on them. Read the sentences and when you are through, put the card face down. Then you will tell me the last word of each sentence."

2. Say, "Here is an example". (give first card with 2 sentences). Say, "Now read these sentences aloud. When you are done put the card face down. Now tell me the last word of each sentence".

3. If correct say "Right." and give trial 1 of item 1.

OR

4. If subject is incorrect, point to the last word of each sentence and say, "The last word of this sentence is campfire, and the last word of this sentence is ground. You would say, campfire, ground to me after turning the card face down." Go on to trial 1 of item 1.

5. Discontinue when subject fails both trials of an item.

Item	Trial 1	Trial 2
1	2 sentences	2 sentences
2	3 "	3 "
3	4 "	4 "
4	5 "	5 "
5	6 "	6 "
6	7 "	7 "

1. He saw a fat Indian sitting beside a campfire.
2. The lieutenant sat beside the man on the ground.

1. The taxi turned up Michigan avenue, where they had a clear view of the lake.

2. I will not shock my readers with the description of the crime.

1. Sometimes I get tired of trying to convince him that I love him.
2. At last his eyes opened and he saw the light.

1. Filled with foreboding, I fearfully opened the heavy, wooden door.
2. I turned my memories over at random like pictures in a photograph album.
3. The girl hesitated for a moment to taste the onions.

1. It was your belief in my suffering that kept me going.
2. When in trouble, children hope for miraculuous intervention.
3. Marian looked at the pictures with shocked amazement.

1. We boys wanted to warn them, but we backed down.
2. What would come after this day would be real life.
3. John became annoyed with Karen's bad habit of biting her nails.
4. His position as director was terminated abruptly.

1. It is possible, of course, that life did not arise on earth.
2. He had not gone far, after all.
3. The poor lady was thoroughly persuaded she had not long to live.
4. The reader may suppose that I had another motive.

1. The announcement of it would resound throughout the world.
2. He laughed sarcastically and looked as if he could have poisoned us.
3. On the desk where she wrote her letters was a clutter of objects.
4. He stuffed his denim shirt into his pants
5. He sliced the fruit carefully with his knife.

1. He covered his heart with both hands.
2. The stories all deal with a middle-aged heroe.
3. Without tension there could not be balance.
4. The silences grew progressively longer.
5. I wish I could tell someone how very sorry I was.
6. Two or three large pieces of wood smoldered on the hearth.

1. They called his name twice before he answered.
2. The basic characteristic of the heroes is their sensitivity.
3. He listened carefully to the voices.
4. John teased her because she acted like a schoolgirl.
5. The rain and wind kept beating against the window panes.

---

1. Sometimes the scapegoat is an outsider.
2. 3. The sound of an approaching train woke him.
3. The sound of an approaching train woke him.
4. The laughter of the children was disturbing.
5. The musician had developed a unique style.
6. The entire construction crew decided to lengthen their work day.
7. The smokers were asked to refrain from smoking.

1. All students who passed the test were exempt from class.
2. The campers continued their canoe trip.
3. Despite the unusually cold weather, they kept on hiking.
4. The young executive was determined to develop his business.
5. He cancelled his engagements for the week.
6. The child was punished for his lack of respect for his elders.
7. The effects of the flood were not fully realized till months later.

---

1. I imagine that he had been thinking things over.
2. There was still more than an hour before breakfast.
3. The house was silent and asleep.
4. By the end of the morning I had reached the big tobacco field.
5. Electronics will play an important role in your future.
6. There appears to be no defense against cheating.

Digit Symbol Task

1. Give worksheet and pencil to subject

2. Point to key and say:
"Look at these boxes. Notice that each has a number in the upper part and a special mark in the lower part. Each number has its own mark.
You are to put in each of the empty squares the mark that should go there."

3. Ask subject to fill out sample spaces. If subect has difficulty with this, explain again.

4. When the subject is ready, say:
" When I tell you to start you do the rest of them. Begin here and fill in all the squares, one after the other without skipping any. Keep working until you finish. Work as quickly as you can without making mistakes. Speed is important as well as accuracy.

5. Mark where subject is at 90s.

6. Record time it takes subject to complete all squares.

7. Take away sheet. Give subject second sheet with empty boxes and ask subject to recall the symbols and match them to the respective digits.
say: " Now try to remember the symbol that goes with each number. Put that symbol in the box directly under the number. This test is not timed."

S# _____

Psychology -- Memory Project

Vocabulary Test

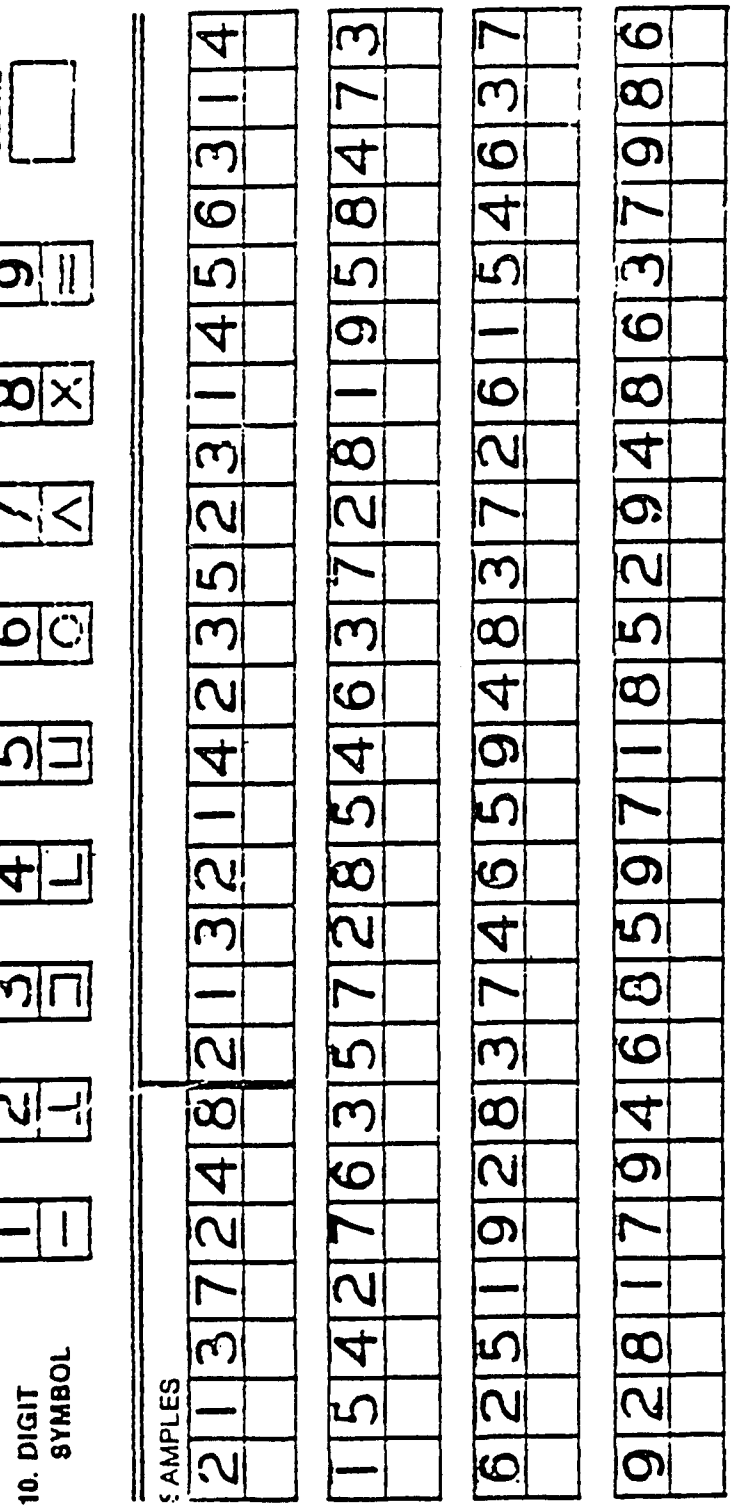
Directions: For each of the items below, select the numbered word or phrase that most nearly corresponds in meaning to the word in CAPITAL LETTERS and circle it.

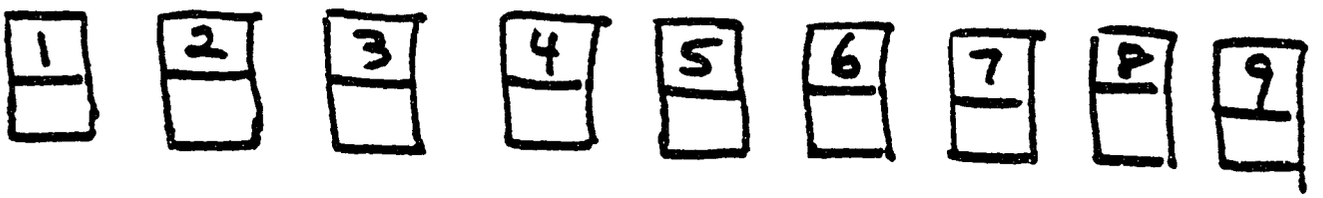
CAPSIZE	1) leak 2) race 3) grow 4) overturn 5) measure	WEIGHTY	1) sly 2) serious 3) shabby 4) spry 5) innocent
PROLONG	1) prompt 2) decrease 3) difficult 4) extend 5) waste	FANATIC	1) follower 2) strange 3) untrustworthy 4) sly 5) zealous
SUCCULENT	1) juicy 2) raw 3) cooked 4) spoiled 5) spicy	BUSTLE	1) tree 2) ornament 3) bureau 4) movement 5) cluster
AGITATED	1) hungry 2) excited 3) agile 4) tired 5) sick	LASCIVIOUS	1) lustful 2) liberal 3) final 4) loser 5) inclined
FRUGAL	1) sparing 2) huge 3) tasty 4) fashionable 5) musical	RECAPITULATE	1) surrender 2) brief 3) rebuild 4) relay 5) restate
MOLEST	1) purchase 2) muffle 3) lowest 4) annoy 5) groom	REMUNERATE	1) check 2) count 3) replete 4) compensate 5) satisfy
APATHY	1) understanding 2) leniency 3) rage 4) indifference 5) danger	EFFECTUATE	1) praise 2) accomplish 3) dissimulate 4) nullify 5) pretend

PLEASE TURN OVER →

S# _____

BRAVADO	1) celebrity 2) outlaw 3) boasting 4) turmoil 5) salutation	DIAPHANOUS	1) nocturnal 2) quarrelsome 3) morbid 4) logical 5) ethereal
CURSORY	1) hasty 2) dilatory 3) intrinsic 4) profane 5) dire	SPLEEN	1) grudge 2) caprice 3) impetuosity 4) melancholy 5) malice
INDIGENT	1) obnoxious 2) moody 3) sleep 4) nasty 5) poor	HORDE	1) greed 2) bully 3) harvest 4) crowd 5) content
LOQUACIOUS	1) garrulous 2) ostentatious 3) frivolous 4) limpid 5) dowdy	HIRSUTE	1) woman 2) shaggy 3) chamber 4) quaint 5) sorrowful
HIATUS	1) break 2) swamp 3) fence 4) disgust 5) flower	CAUDAL	1) brutal 2) careful 3) posterior 4) nervy 5) recent
BANAL	1) evil 2) trite 3) prohibitory 4) jovial 5) decaying	GUIDON	1) miniature 2) hat 3) hero 4) flag 5) achiever
TEDIUM	1) dilatory 2) anxiety 3) exhaustion 4) weakening 5) dull	VICISSITUDE	1) direction 2) generosity 3) hardship 4) ceremony 5) ferocity
LASSITUDE	1) contempt 2) convenience 3) permissiveness 4) lethargy 5) levity	SEVERALLY	1) unkindly 2) respectively 3) continuously 4) abruptly 5) harshly





BECK INVENTORY

Name _____ Date _____

On this questionnaire are groups of statements. Please read each group of statements carefully. Then pick out the one statement in each group which best describes the way you have been feeling the PAST WEEK, INCLUDING TODAY! Circle the number beside the statement you picked. If several statements in the group seem to apply equally well, circle each one. Be sure to read all the statements in each group before making your choice.

1 0 I do not feel sad.
1 I feel sad.
2 I am sad all the time and I can't snap out of it.
3 I am so sad or unhappy that I can't stand it.

2 0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel that the future is hopeless and that things cannot improve.

3 0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

4 0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

5 0 I don't feel particularly guilty.
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6 0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7 0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8 0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9 0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10 0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11 0 I am no more irritated now than I ever am.
1 I get annoyed or irritated more easily than I used to.
2 I feel irritated all the time now.
3 I don't get irritated at all by the things that used to irritate me.

12 0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13 0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions than before.
3 I can't make decisions at all anymore.

14 0 I don't feel I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel that there are permanent changes in my appearance that make me look unattractive.
3 I believe that I look ugly.

15 0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16 0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17 0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18 0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19 0 I haven't lost much weight, if any, lately.
1 I have lost more than 5 pounds. I am purposely trying to lose we
2 I have lost more than 10 pounds. by eating less. Yes_____ No__
3 I have lost more than 15 pounds.

20 0 I am no more worried about my health than usual.
1 I am worried about physical problems such as aches and pains; or upset stomach; or constipation.
2 I am very worried about physical problems and it's hard to think of much else.
3 I am so worried about my physical problems that I cannot think about anything else.

21 0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

SELF-EVALUATION QUESTIONNAIRE

Developed by C. D. Spielberger, R. L. Gorsuch and R. Lushene

STAI FORM X-1

NAME _____ DATE _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I am regretful	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel rested	①	②	③	④
9. I feel anxious	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel "high strung"	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel over-excited and "rattled"	①	②	③	④
19. I feel joyful	①	②	③	④
20. I feel pleasant	①	②	③	④

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This first questionnaire requests background information that will allow us to describe the people participating in our study. Please answer each question as carefull and as completely as you can.

1. What is your sex (Circle one)
   Male.....1
   Female.....2

2. How old are you? _____years

3. What is your current occupation? If you've retired, what was your former occupation?

   _____

4. Have your retired? (Please circle one)
   No.....1
   Yes.....2

5. What is the highest educational level that you reached (Please circle one)
   Some elementary school..... 1
   Finished elementary school..... 2
   Some junior high school..... 3
   Finished junior high school..... 4
   Some high school..... 5
   High school diploma..... 6
   Vocational school..... 7
   some college..... 8
   College degree..... 9
   Master's degree..... 10
   Graduate/professional degree..... 11

6. How would you rate your health? (please circle one).
   Poor.....1 4
   Fair.....2 3
   Good.....3 2
   Excellent.....4 1

7. How much are your daily activites limited by your health?
   Not at all limited.....1
   A little limited.....2
   Somewhat limited.....3
   Very much limited.....4

8. How concerned are you about your health?
   Not at all concerned.....1
   A little concerned.....2
   Somewhat concerned.....3
   Very much concerned.....4

Neurological and Past History Survey

Please read the following questions and answer each one.

1. Have you ever been diagnosed as having epilepsy or some seizure disorder? YES NO

2. Have you ever been diagnosed as having meningitis? YES NO

3. Have you ever been diagnosed as having multiple sclerosis? YES NO

4. Have you ever been diagnosed as having encephalitis? YES NO

5. Have you ever been dianosed as having a learning disability? YES NO

6. Have you ever been diagnosed as having color blindness? YES NO

7. Have you ever sustained an open-head injury (object penetrated skull)? YES NO

8. Have you ever sustained a closed-head injury(such as a serious blow to the head causing concussion or loss of consciousness)? YES NO

9. Have you ever been dianosed as having had a stroke? YES NO

10. Have you ever had brain surgery? YES NO

11. Do you have a histoy of diabetes? YES NO

12. Do you have a history of kidney disease? YES NO

13. Do you have congestive heart failure? YES NO

14. Are you currently being treated for depression, anxiety psychosis, or drug or alcohol addiction? (circle) YES NO

THIS IS A SPECIMEN COPY

History Number_____

...AEN)

CORNELL MEDICAL INDEX

HEALTH QUESTIONNAIRE

Date_____

Print Your Name_____ Your Home Address_____

How Old Are You?_____ Circle If You Are . . Single, Married, Widowed, Separated, Divorced.

Circle the Highest Year You Reached In School | 1 2 3 4 5 6 7 8 | Elementary School | 1 2 3 4 | High | 1 2 3 4 | College

What Is Your Occupation?_____

Directions: This questionnaire is for ***MEN ONLY.***
If you can answer **YES** to the question asked, put a circle around the (Yes)
If you have to answer **NO** to the question asked, put a circle around the (No)
Answer all questions. If you are not sure, guess.

A

Do you need glasses to read?	Yes	No	001
Do you need glasses to see things at a distance?	Yes	No	002
Has your eyesight often blacked out completely?	Yes	No	003
Do your eyes continually blink or water?	Yes	No	004
Do you often have bad pains in your eyes?	Yes	No	005
Are your eyes often red or inflamed?	Yes	No	006
Are you hard of hearing?	Yes	No	007
Have you ever had a bad running ear?	Yes	No	008
Do you have constant noises in your ears?	Yes	No	009

B

Do you have to clear your throat frequently?	Yes	No	010
Do you often feel a choking lump in your throat?	Yes	No	011
Are you often troubled with bad spells of sneezing?	Yes	No	012
Is your nose continually stuffed up?	Yes	No	013
Do you suffer from a constantly running nose?	Yes	No	014
Have you at times had bad nose bleeds?	Yes	No	015
Do you often catch severe colds?	Yes	No	016
Do you frequently suffer from heavy chest colds?	Yes	No	017
When you catch a cold, do you always have to go to bed?	Yes	No	018
Do frequent colds keep you miserable all winter?	Yes	No	019
Do you get hay fever?	Yes	No	020
Do you suffer from asthma?	Yes	No	021
Are you troubled by constant coughing?	Yes	No	022
Have you ever coughed up blood?	Yes	No	023
Do you sometimes have severe soaking sweats at night?	Yes	No	024
Have you ever had a chronic chest condition?	Yes	No	025
Have you ever had T.B. (Tuberculosis)?	Yes	No	026
Did you ever live with anyone who had T.B.?	Yes	No	027

C

Has a doctor ever said your blood pressure was too *high?*	Yes	No	028
Has a doctor ever said your blood pressure was too *low?*	Yes	No	029
Do you have pains in the heart or chest?	Yes	No	030
Are you often bothered by thumping of the heart?	Yes	No	031
Does your heart often race like mad?	Yes	No	032
Do you often have difficulty in breathing?	Yes	No	033
Do you get out of breath long before anyone else?	Yes	No	034
Do you sometimes get out of breath just sitting still?	Yes	No	035
Are your ankles often badly swollen?	Yes	No	036
Do cold hands or feet trouble you even in hot weather?	Yes	No	037
Do you suffer from frequent cramps in your legs?	Yes	No	038
Has a doctor ever said you had heart trouble?	Yes	No	039
Does heart trouble run in your family?	Yes	No	040

OPEN TO NEXT PAGE

Cornell University Medical College
1300 York Avenue, New York, N.Y. 10021

D

Have you lost more than half your teeth?	Yes	No	041
Are you troubled by bleeding gums?	Yes	No	042
Have you often had severe toothaches?	Yes	No	043
Is your tongue usually badly coated?	Yes	No	044
Is your appetite always poor?	Yes	No	045
Do you usually eat sweets or other food between meals?	Yes	No	046
Do you always gulp your food in a hurry?	Yes	No	047
Do you often suffer from an upset stomach?	Yes	No	048
Do you usually feel bloated after eating?	Yes	No	049
Do you usually belch a lot after eating?	Yes	No	050
Are you often sick to your stomach?	Yes	No	051
Do you suffer from indigestion?	Yes	No	052
Do severe pains in the stomach often double you up?	Yes	No	053
Do you suffer from constant stomach trouble?	Yes	No	054
Does stomach trouble run in your family?	Yes	No	055
Has a doctor ever said you had stomach ulcers?	Yes	No	056
Do you suffer from frequent loose bowel movements?	Yes	No	057
Have you ever had severe bloody diarrhea?	Yes	No	058
Were you ever troubled with intestinal worms?	Yes	No	059
Do you constantly suffer from bad constipation?	Yes	No	060
Have you ever had piles (rectal hemorrhoids)?	Yes	No	061
Have you ever had jaundice (yellow eyes and skin)?	Yes	No	062
Have you ever had serious liver or gall bladder trouble?	Yes	No	063

S

Are your joints often painfully swollen?	Yes	No	064
Do your muscles and joints constantly feel stiff?	Yes	No	065
Do you usually have severe pains in the arms or legs?	Yes	No	066
Are you crippled with severe rheumatism (arthritis)?	Yes	No	067
Does rheumatism (arthritis) run in your family?	Yes	No	068
Do weak or painful feet make your life miserable?	Yes	No	069
Do pains in the back make it hard for you to keep up with your work?	Yes	No	070
Are you troubled with a serious bodily disability or deformity?	Yes	No	071

F

Is your skin very sensitive or tender?	Yes	No	072
Do cuts in your skin usually stay open a long time?	Yes	No	073
Does your face often get badly flushed?	Yes	No	074
Do you sweat a great deal even in cold weather?	Yes	No	075
Are you often bothered by severe itching?	Yes	No	076
Does your skin often break out in a rash?	Yes	No	077
Are you often troubled with boils?	Yes	No	078

G

Do you suffer badly from frequent severe headaches?	Yes	No	079
Does pressure or pain in the head often make life miserable?	Yes	No	080
Are headaches common in your family?	Yes	No	081
Do you have hot or cold spells?	Yes	No	082
Do you often have spells of severe dizziness?	Yes	No	083
Do you frequently feel faint?	Yes	No	084
Have you fainted more than twice in your life?	Yes	No	085
Do you have constant numbness or tingling in any part of your body?	Yes	No	086
Was any part of your body ever paralyzed?	Yes	No	087
Were you ever knocked unconscious?	Yes	No	088
Have you at times had a twitching of the face, head or shoulders?	Yes	No	089
Did you ever have a fit or convulsion (epilepsy)?	Yes	No	090
Has anyone in your family ever had fits or convulsions (epilepsy)?	Yes	No	091
Do you bite your nails badly?	Yes	No	092
Are you troubled by stuttering or stammering?	Yes	No	093
Are you a sleep walker?	Yes	No	094
Are you a bed wetter?	Yes	No	095
Were you a bed wetter between the ages of 8 and 14?	Yes	No	096

GO TO NEXT PAGE

Have you ever had anything seriously wrong with your genitals (privates)?	Yes	No	097
Are your genitals often painful or sore?	Yes	No	098
Have you ever had treatment for your genitals?	Yes	No	099
Has a doctor ever said you had a hernia (rupture)?	Yes	No	100
Have you ever passed blood while urinating (passing water)?	Yes	No	101
Do you have trouble starting your stream when urinating?	Yes	No	102
Do you have to get up every night and urinate?	Yes	No	103
During the day, do you usually have to urinate frequently?	Yes	No	104
Do you often have severe burning pain when you urinate?	Yes	No	105
Do you sometimes lose control of your bladder?	Yes	No	106
Has a doctor ever said you had kidney or bladder disease?	Yes	No	107

I

Do you often get spells of complete exhaustion or fatigue?	Yes	No	108
Does working tire you out completely?	Yes	No	109
Do you usually get up tired and exhausted in the morning?	Yes	No	110
Does every little effort wear you out?	Yes	No	111
Are you constantly too tired and exhausted even to eat?	Yes	No	112
Do you suffer from severe nervous exhaustion?	Yes	No	113
Does nervous exhaustion run in your family?	Yes	No	114

J

Are you frequently ill?	Yes	No	115
Are you frequently confined to bed by illness?	Yes	No	116
Are you always in poor health?	Yes	No	117
Are you considered a sickly person?	Yes	No	118
Do you come from a sickly family?	Yes	No	119
Do severe pains and aches make it impossible for you to do your work?	Yes	No	120
Do you wear yourself out worrying about your health?	Yes	No	121
Are you always ill and unhappy?	Yes	No	122
Are you constantly made miserable by poor health?	Yes	No	123

K

Did you ever have scarlet fever?	Yes	No	124
As a child, did you have rheumatic fever, growing pains or twitching of the limbs?	Yes	No	125
Did you ever have malaria?	Yes	No	126
Were you ever treated for severe anemia (thin blood)?	Yes	No	127
Were you ever treated for "bad blood" (venereal disease)?	Yes	No	128
Do you have diabetes (sugar disease)?	Yes	No	129
Did a doctor ever say you had a goiter (in your neck)?	Yes	No	130
Did a doctor ever treat you for tumor or cancer?	Yes	No	131
Do you suffer from any chronic disease?	Yes	No	132
Are you definitely *under* weight?	Yes	No	133
Are you definitely *over* weight?	Yes	No	134
Did a doctor ever say you had varicose veins (swollen veins) in your legs?	Yes	No	135
Did you ever have a serious operation?	Yes	No	136
Did you ever have a serious injury?	Yes	No	137
Do you often have small accidents or injuries?	Yes	No	138

L

Do you usually have great difficulty in falling asleep or staying asleep?	Yes	No	139
Do you find it impossible to take a regular rest period each day?	Yes	No	140
Do you find it impossible to take regular daily exercise?	Yes	No	141
Do you smoke more than 20 cigarettes a day?	Yes	No	142
Do you drink more than six cups of coffee or tea a day?	Yes	No	143
Do you usually take two or more alcoholic drinks a day?	Yes	No	144

TURN TO NEXT PAGE

(M)			197
Do you sweat or tremble a lot during examinations or questioning?	Yes	No	145
Do you get nervous and shaky when approached by a superior?	Yes	No	146
Does your work fall to pieces when the boss or a superior is watching you?	Yes	No	147
Does your thinking get completely mixed up when you have to do things quickly?	Yes	No	148
Must you do things very slowly in order to do them without mistakes?	Yes	No	149
Do you always get directions and orders wrong?	Yes	No	150
Do strange people or places make you afraid?	Yes	No	151
Are you scared to be alone when there are no friends near you?	Yes	No	152
Is it always hard for you to make up your mind?	Yes	No	153
Do you wish you always had someone at your side to advise you?	Yes	No	154
Are you considered a clumsy person?	Yes	No	155
Does it bother you to eat anywhere except in your own home?	Yes	No	156
N			
Do you feel alone and sad at a party?	Yes	No	157
Do you usually feel unhappy and depressed?	Yes	No	158
Do you often cry?	Yes	No	159
Are you always miserable and blue?	Yes	No	160
Does life look entirely hopeless?	Yes	No	161
Do you often wish you were dead and away from it all?	Yes	No	162
O			
Does worrying continually get you down?	Yes	No	163
Does worrying run in your family?	Yes	No	164
Does every little thing get on your nerves and wear you out?	Yes	No	165
Are you considered a nervous person?	Yes	No	166
Does nervousness run in your family?	Yes	No	167
Did you ever have a nervous breakdown?	Yes	No	168
Did anyone in your family ever have a nervous breakdown?	Yes	No	169
(for your nerves)?	Yes		
Was anyone in your family ever a patient in a *mental* hospital (for their nerves)?	Yes	No	171
P			
Are you extremely shy or sensitive?	Yes	No	172
Do you come from a shy or sensitive family?	Yes	No	173
Are your feelings easily hurt?	Yes	No	174
Does criticism always upset you?	Yes	No	175
Are you considered a touchy person?	Yes	No	176
Do people usually misunderstand you?	Yes	No	177
Q			
Do you have to be on your guard even with friends?	Yes	No	178
Do you always do things on sudden impulse?	Yes	No	179
Are you easily upset or irritated?	Yes	No	180
Do you go to pieces if you don't constantly control yourself?	Yes	No	181
Do little annoyances get on your nerves and make you angry?	Yes	No	182
Does it make you angry to have anyone tell you what to do?	Yes	No	183
Do people often annoy and irritate you?	Yes	No	184
Do you flare up in anger if you can't have what you want right away?	Yes	No	185
Do you often get into a violent rage?	Yes	No	186
R			
Do you often shake or tremble?	Yes	No	187
Are you constantly keyed up and jittery?	Yes	No	188
Do sudden noises make you jump or shake badly?	Yes	No	189
Do you tremble or feel weak whenever someone shouts at you?	Yes	No	190
Do you become scared at sudden movements or noises at night?	Yes	No	191
Are you often awakened out of your sleep by frightening dreams?	Yes	No	192
Do frightening thoughts keep coming back in your mind?	Yes	No	193
Do you often become suddenly scared for no good reason?	Yes	No	194
Do you often break out in a cold sweat?	Yes	No	195

Gerontology Center
West Virginia University

Cover Letter for Participation in Research

Thank you for agreeing to participate in our study. This research project is being conducted by Ruth Tunick, a graduate student at West Virginia University, and is being supervised by Dr. Stan Cohen of the Psychology Department at W.V.U. We are interested in finding out if hypertension affects certain cognitive or thinking abilities.

We are not interested in your individual scores in our experiment. We are only interested in how your group performs as a whole when compared to other groups. In any case, your responses will remain anonymous and confidential and you will be coded on our records by a number. Please do not get distressed if you cannot complete all the tasks because these tasks are constructed so that no individual can get them all correct.

We appreciate your participation in our study and hope that you will gain something from this experience. If for any reason you decide to end your participation, you can do so without any penalty. Please feel free to ask the investigator any questions you might have.

304 293-2081 ◻ Suite 12, Chestnut Ridge Professional Building ◻ Morgantown, WV 26506

Behavioral Medicine
West Virginia University

CONSENT FORM

Title of Study: Effects of Hypertension on Cognitive tasks.

Principal Investigators: Ruth Tunick, 293-2001 or 599-9060.
Stan Cohen, Ph.D. 293-2580.

This research study involves the measurement of certain cognitive abilities. The purpose is to determine if high blood pressure affects certain cognitive or thinking processes.

I understand that I will be asked to fill out two questionnaires and do some paper and pencil tests which will take approximately two hours including breaks. My participation in this study is completely voluntary. I may refuse to participate, and I may withdraw at any time without any penalty.

I understand that this research is being conducted for research purposes only. Although there is no direct benefit to me, this research should increase understanding of thinking processes. I understand that any information about me obtained as a result of this study will be kept as confidentional as legally possible. The investigators, Ms. Tunick and Dr. Cohen, will be the only individuals with access to the data.

If I am in the group with hypertension, I understand that my physician may be contacted for information about my blood pressure, such as how long I have had high blood pressure, what medications I am on, and what other illnesses I may have. If any problems (such as hypertension) are found as a result of my participation in this study I will be informed of them so that I

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can seek appropriate medical care.

This experiment is safe and should not cause any discomfort, although some individuals may feel uncomfortable if they cannot complete all the tasks. I understand that these tasks are constructed so that most individuals will not be able to get them all correct. I have had an opportunity to ask questions. All of my questions have been answered satisfactorily. If I have further questions I will contact Ruth Tunick or Stan Cohen for information. If I have questions about my rights as a subject I may contact the Institutional Review Board (293-7073). I have read, understood, and received a copy of this consent form.

I agree I do not agree

(circle one)

Name_____ Signature_____

Date_____Sex_____Birthdate_____

Signature of person obtaining consent_____

Signature of principal investigator_____

304 293-2081 ▫ Suite 12, Chestnut Ridge Professional Building ▫ Morgantown, WV 26506

APPENDIX L

Subject Log

Subject code_____Age_____Sex_____

blood pressure at start_____ at end_____

duration of HBP_____ medications for BP _____

_____

Date_____Experimenter initials_____

Comments_____

_____

_____

MFQ (F1) _____(F2)_____(F3)_____(F4)_____

letter sets_____digit span forward_____

digit span backward_____spatial span forward_____

spatial span backward_____sentence verif_____

digit symbol (total number recalled_____

(number correctly paired)_____(90s)_____

(time)_____CMI physical_____psychological_____

scale 1_____scale 2_____scale 3_____scale 4 _____

scale 5_____scale 6_____BDI_____State_____Trait_____

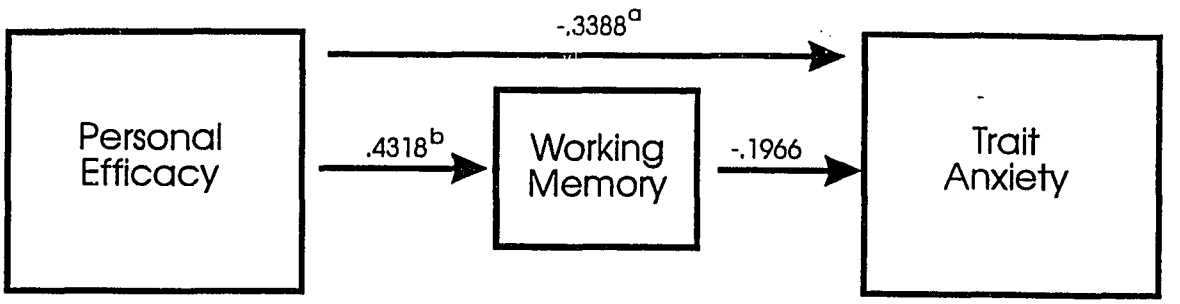
PIC(int)_____(chance)_____(PO)_____(Ach)_____

(Anx)_____(Morale)_____SEQ(SEL)_____(SES-N)_____

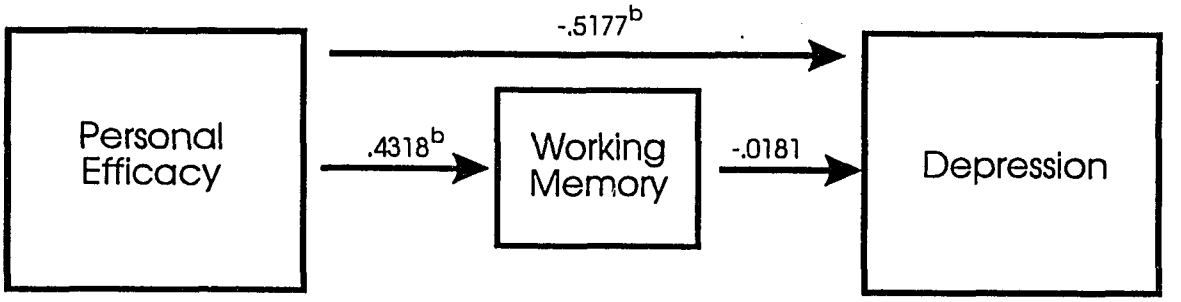
(SES-P)_____yrs. of educ_____

Appendix M

Path Model of Trait Anxiety with Working Memory



Path Model of Depression with Working Memory



[a]$p < .05$ [b]$p < .01$

Summary of Direct, Indirect, & Spurious Effects on Trait Anxiety with Working Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = trait anxiety					
Working Memory	-.3442	-.1966	0	-.1966	-.1476
Efficacy	-.4244	-.3388[a]	-.0849	-.4237	-.0007

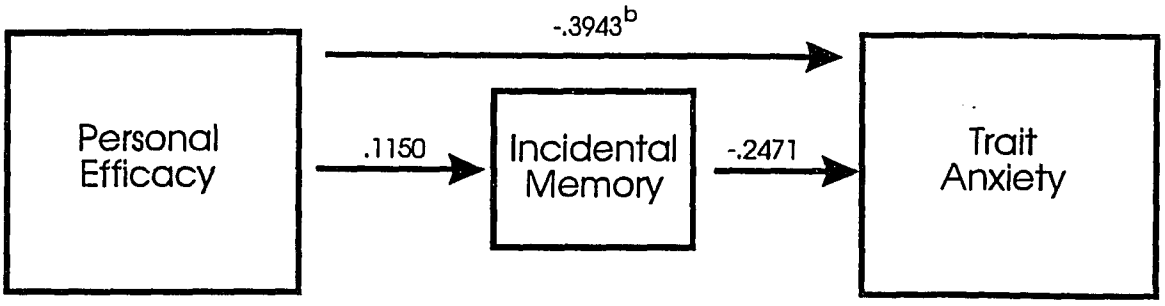
[a] $p < .05$

Summary of Direct, Indirect, & Spurious Effects on Depression with Working Memory

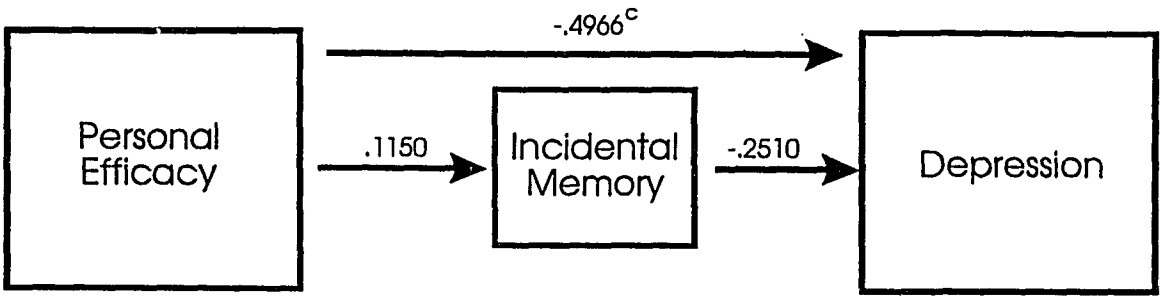
Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = depression					
Working Memory	-.2416	-.0181	0	-.0181	-.2235
Efficacy	-.5255	-.5177[b]	-.0078	-.5255	0

[b] $p < .01$

Path Model of Trait Anxiety with Incidental Memory



Path Model of Depression with Incidental Memory



[a]p < .05 [b]p < .01 [c]p < .001

Summary of Direct, Indirect, & Spurious Effects on Trait Anxiety with Incidental Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = trait anxiety					
Incidental Mem.	-.2827	-.2471	0	-.2471	-.0356
Efficacy	-.4244	-.3943[b]	-.0284	-.4227	-.0017

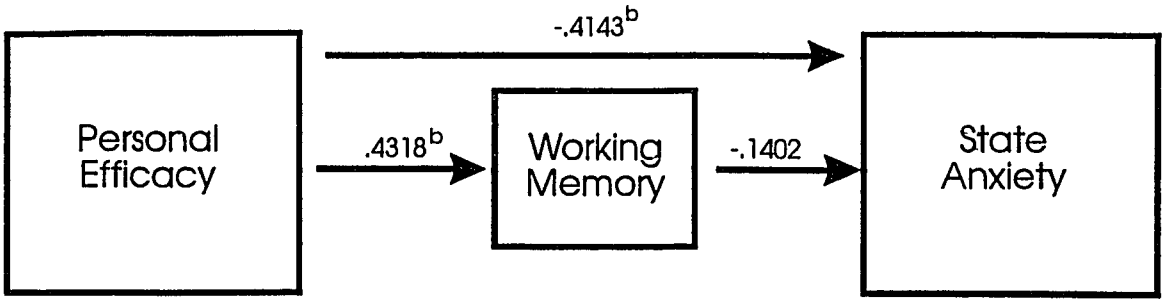
[b] $p < .01$

Summary of Direct, Indirect, & Spurious Effects on Depression with Incidental Memory

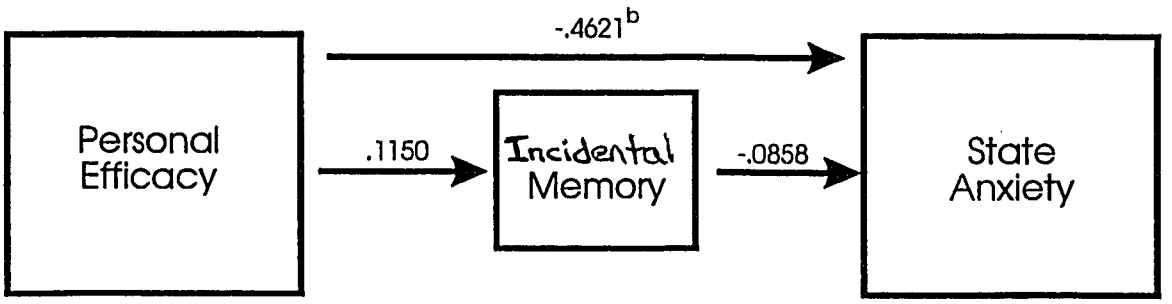
Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = depression					
Incidental Mem.	-.3080	-.2510	0	-.2510	-.0570
Efficacy	-.5255	-.4966[c]	-.0289	-.5255	0

[c] $p < .001$

Path Model of State Anxiety with Working Memory



Path Model of State Anxiety with Incidental Memory



[b]$p < .01$

Summary of Direct, Indirect, & Spurious Effects on State Anxiety with Working Memory

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = state anxiety					
Working Memory	-.3211	-.1402	0	-.1402	-.1809
Efficacy	-.4755	-.4143[b]	-.0605	-.4748	-.0007

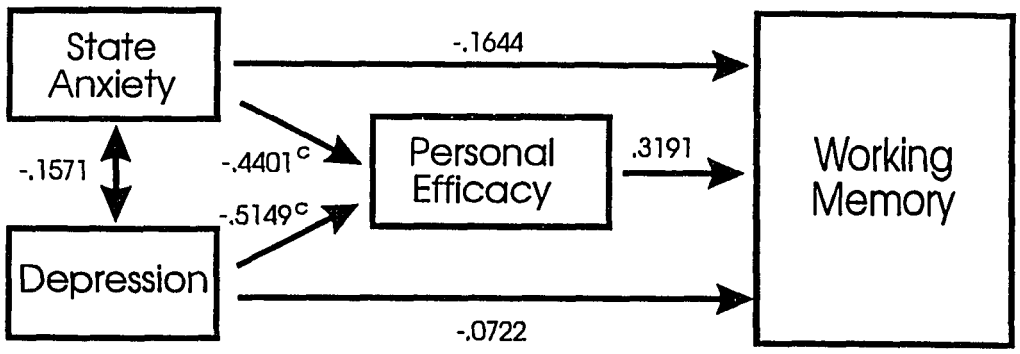
[b] $p<.01$

Summary of Direct, Indirect, & Spurious Effects on State Anxiety with Incidental Memory

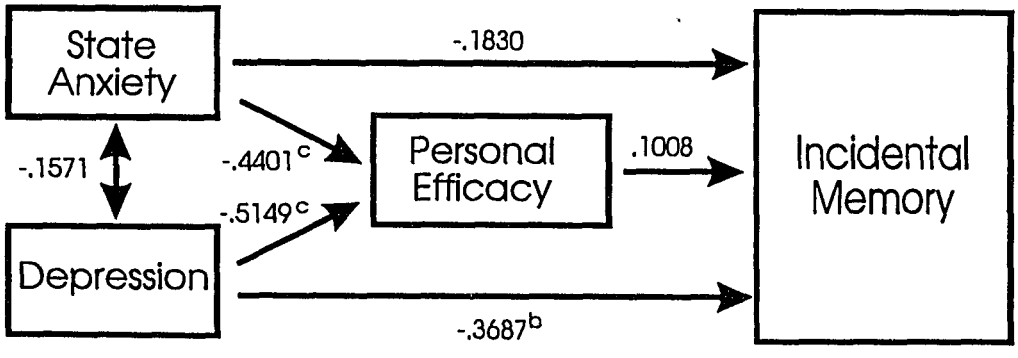
Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
dependent variable = state anxiety					
Incidental Mem.	-.1584	-.0858	0	-.0858	-.0726
Efficacy	-.4755	-.4621[b]	-.0099	-.4720	-.0035

[b] $p<.01$

Path Model Working Memory with State Anxiety



Path Model Incidental Memory with State Anxiety



ap < .05 bp < .01 cp< .001

Summary of Direct, Indirect, & Spurious Effects on Working Memory with State Anxiety

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=working memory				
State Anxiety	-.3211	-.1644	-.1404	-.3048	-.0163
Depression	-.2575	-.0722	-.1643	-.2365	-.0210
Efficacy	.4366	.3191	0	.3191	.1175
Equation 2	Dependent variable=personal efficacy				
State Anxiety	-.4755	-.4401[c]	0	-.4401	-.0354
Depression	-.5451	-.5149[c]	0	-.5149	-.0302

[c] p<.001

Summary of Direct, Indirect, & Spurious Effects on Incidental Memory with State Anxiety

Variables in Equation (n=40)	Zero Order Beta	Direct Effect	Indirect Effect	Total Effect	Spurious Effect
Equation 1	Dependent variable=incidental memory				
State Anxiety	-.1604	-.1830	-.0444	-.2274	0
Depression	-.3263	-.3687	-.0519	-.4206	0
Efficacy	.1872	-.1008	0	-.1008	.0864
Equation 2	Dependent variable=personal efficacy				
State Anxiety	-.4755	-.4401[c]	0	-.4401	-.0354
Depression	-.5451	-.5149[c]	0	-.5149	-.0302

[c] $p<.001$

Correlations Among Blood Pressure Variables and Measures of Performance

Variables (n=40)	SBPB	SBPA	DBPB	DBPA	Group
self-rep. health	.3933[b]	.2953[a]	.1407	.0958	.3194[a]
phys.sym.	.2630	.2680	.3270[a]	.3969[b]	.4853[c]
psych.sym.	.3432[a]	.3389[a]	.3647[b]	.3728[b]	.4347[b]
depression	.3442[a]	.2287	.3488[a]	.3334[a]	.3493[a]
tr.anxiety	.1443	.1115	.2646	.3080[a]	.0931
int.loc	-.3886[b]	-.2696	-.4298[b]	-.4180[b]	-.4442[b]
chance loc	.2340	.2455	.2538	.2727	.4459[b]
forw.digit span	-.1401	-.1052	-.3673[b]	-.3613[b]	-.2286
vis.mem. tap.back.	-.4277[b]	-.3990[b]	-.3571[b]	-.4126[b]	-.3659[b]
read.span	-.2139	-.2368	-.1513	-.2704	-.3440
vis.mem. tap.forw.	-.3053[a]	-.3163[a]	-.0407	-.0529	-.1232
back.digit span	-.1308	-.0502	-.3017[a]	-.3128[a]	-.0449

Note. SBPB = systolic blood pressure before cognitive testing
SBPA = systolic blood pressure after cognitive testing
DBPB = diastolic blood pressure before cognitive testing
DBPA = diastolic blood pressure after cognitive testing
Group = normotensive = 1; hypertensive = 2

[a] $p < .05$
[b] $p < .01$

Abstract

The primary purpose of the present study was to examine the effect of hypertension on both self-assessed and laboratory measures of memory and on non-cognitive factors such as anxiety, depression, self-efficacy, and locus of control. Eight male and twelve female normotensive adults aged 62 to 77 years (M = 71.8) and 8 male and 12 female hypertensive adults aged 62 to 78 years (M = 72.5) completed questionnaires measuring state and trait anxiety, depression, self-efficacy, locus of control, and health in addition to performing speed of processing, spatial and verbal working memory and short term memory tasks and measures of vocabulary and incidental memory.

As expected, hypertensive subjects performed more poorly on rate of processing and 2 of 3 working memory tasks. No differences were found in short term memory, vocabulary, or incidental memory. In addition, hypertensives reported having more memory problems overall and rated their memory problems as being more serious than normotensives. Hypertensives also reported more psychological symptoms, having lower internal and higher chance locus of control, and being more depressed compared to normotensives. No differences in self-efficacy, state anxiety, trait anxiety or powerful others locus of control were found.

Based on the results of hierarchal regression analyses, it was found that the effects of hypertension on cognitive performance could be attenuated and even eliminated by controlling for self-evaluations such as psychological symptoms,

locus of control, and self-efficacy. Exploratory path analyses were employed to explore the relationships among anxiety, depression, efficacy, and cognitive performance. The primary finding of these analyses was that while anxiety and depression had significant direct effects on efficacy, these variables did not have significant direct effects on the effortful measures of memory. The strongest relationships between depression and performance were for incidental memory and vocabulary. Efficacy, on the other hand, had significant direct effects on working memory and short term memory and a large direct effect on self-assessed memory. These results support the model described by Berry (1989) and others which shows self-efficacy mediating the relationship between affect and cognitive performance.

APPROVAL OF EXAMINING COMMITTEE

Kevin Larkin, Ph. D.

Irving Goodman, Ph. D.

Eric Rankin, Ph. D.

Michael Franzen, Ph. D.

Stanley Cohen, Ph. D., Chair

July 5, 1994
Date