2000

Attention, memory, and self-efficacy differences between ADHD and aging individuals

Douglas Lee Welsh

Attention, Memory, and Self-Efficacy Differences Between

ADHD and Aging Individuals

Douglas Lee Welsh

University of Richmond

Jane Marie Berry, Ph.D., Thesis Supervisor

An Abstract of the Thesis Presented in Partial Fulfillment of the Requirements for the Degree of Master of Arts (in Psychology).
August, 2000

Attention and memory abilities decline with age. Although a similar pattern of attentional and memory decrement has been observed in individuals with Attention Deficit Hyperactivity Disorder (ADHD), these two populations have never been directly compared. The present study examined performance on attention, self-efficacy (SE), and memory tasks by ADHD young adults and non-ADHD younger and older adults. ADHD adults displayed lower attentional SE than both non-ADHD younger and older adults, but performed comparably to older adults on an attention task on which non-ADHD younger adults outperformed both groups. ADHD adults and older adults had lower memory SE than non-ADHD younger adults, but ADHD and non-ADHD younger adults both performed better than older adults on a category cued-recall task. These results suggest that the attentional deficits that characterize both a clinical population and an aging population have similar features. Future directions for research comparing clinical and aging populations on tests of cognitive function are addressed.

I certify that I have read this thesis and find that, in scope and quality, it satisfies the requirements for the degree of Master of Arts.

Jane M Berry

Dr. Jane M. Berry, Committee Chair

Dr. Craig H. Kinsley, Committee Member

Dr. Andrew F. Newcomb, Committee Member

ATTENTION, MEMORY, AND SELF-EFFICACY DIFFERENCES BETWEEN

ADHD AND AGING INDIVIDUALS

By

Douglas Lee Welsh

B.S., Furman University, 1997

A Thesis

Submitted to the Graduate Faculty

of the University of Richmond

in Candidacy

for the degree of

MASTER OF ARTS

in

Psychology

August, 2000

Richmond, Virginia

To my parents, Luckey and Libby Welsh, whose love
and unflagging support inspired me, and whose wish
to see the completion of this project helped me persevere
during the last few difficult months. I want you to know
it's done and that it's for you.

Acknowledgments

I am very grateful to my mentor, Jane M. Berry, for her guidance with this project. Jane spent many hours with me discussing the data, providing statistical assistance, and challenging me to think deeply about the conceptual and measurement issues involved. Even more importantly, however, I am grateful to Jane for her friendship. She was a constant source of support and encouragement with regard to both professional and personal matters, and she helped me make many important decisions. Finally, Jane's honest feedback has helped to make me a better researcher and a better person.

I wish to thank the rest of my committee---Drs. Craig Kinsley and Andy Newcomb---for their helpful comments and quick feedback during the various stages of this project.

Finally, I could not have completed this thesis without the encouragement and support of my family. Thanks Mom and Dad for loving me unconditionally and unselfishly. I will be there for you, whenever needed, as you have always been there for me.

TABLE OF CONTENTS

LIST OF TABLES

List of Figures

List of Appendices

Attention, Memory, and Self-Efficacy Differences

Between ADHD and Aging Individuals

Attentional resources are important prerequisites for memory acquisition (Cowan, 1995; Mulligan, 1997). The information processing abilities of individuals with attentional deficits, such as clinical and aging populations, can provide clues to the attentional resources that are necessary for good memory functioning. Individual differences in attention among the general population (Madden & Plude, 1993; McDowd & Oseas-Greger, 1991) and the normative attentional declines in older adults are related to poorer memory performance (McDowd & Craik, 1988; Salthouse, Rogan, & Prill, 1984). Similar attentional impairments and effects have been reported in studies examining cognitive disabilities of children diagnosed with Attention Deficit Hyperactivity Disorder[1] (ADHD; Coldren & Corradetti, 1997). Prior investigations, however, have restricted their inquiry to memory performance differences found among young and older adults; the influence of aging and ADHD on individuals has not been compared concurrently. Furthermore, both of these populations (ADHD and older adults) report poor self-assessments of their cognitive abilities (Cavanaugh & Green, 1990; Licht, 1993). The aging literature has shown that self-efficacy beliefs (Bandura, 1989) contribute to poor performance on memory tasks. Could the same effect hold for individuals with attention deficits? To answer these questions, the present study was designed to examine attention and self-efficacy as possible mediators of memory and attention performance in adults with and without an attentional deficit.

<u>Attention and Age</u>.

Cognitive aging is frequently characterized by well-documented losses in memory (e.g., Salthouse, 1982) and attention (Hartley, 1992). Specifically, Hartley suggested that poor attentional processes are one of the most important contributors to age-related changes in cognition. Attention is a difficult construct to define and measure, and it is necessary to understand the construct first in order to investigate lifespan changes in attention.

The first obstacle encountered in studying attention is the apparent lack of a good definition for the word. James (1890) noted "everyone knows what attention is," (p. 404) yet a comprehensive and widely held definition of attention remains elusive even today. Attention is not a unitary construct, yet there appears to be consensus on the central concepts. One of the most comprehensive definitions of attention separates attentional processes into three dimensions: arousal, capacity, and selectivity (Madden & Plude, 1993; Enns & Burack, 1997).

Arousal describes the momentary level of excitation of the whole organism, a level that could be manipulated by varying such factors as general alertness and cognitive readiness. Maintaining attention in the sense of alertness is presumably involved in the ability to perform long, boring tasks (Posner & Boies, 1971), and constitutes the basis for the study of vigilance, or sustained attention. Capacity refers to the limited cognitive resources available to support information processing. The difficulty of simultaneously handling two tasks has been attributed to this limited capacity aspect of attention. Selectivity refers to the specificity with which resources are allocated in accordance to task demands, selecting certain stimuli for processing and excluding others (Plude &

Doussard-Roosevelt, 1990). This capability is referred to as selective attention. These three dimensions are not considered to be independent of one another: selective processing is controlled by a limited-capacity processing system lacking sufficient resources or arousal required for adequate processing of simultaneously presented stimuli. A major aspect of attentional function, then, is the ability to selectively allocate cognitive processing capacity among the myriad arrays of input presented by the senses at any given time or for any length of time.

The present study focused on age-related changes in sustained attention and capacity, and extrapolated from research on aging and attention to the ADHD population.

A sustained attention task requires the individual to attend continuously to a stream of events for an extended period of time and to react when a particular target event occurs. The targets can be sensory, for example detecting double jumps in a clock hand that moves once per second (the Mackworth Clock Task; Giambra & Quilter, 1988), or cognitive, for example monitoring a digit stream for occurrences of a previously specified digit sequence (Hartley, 1992). Target detection accuracy is commonly used as an indicator of performance. However, absolute level of performance, i.e., total number of targets detected, includes cognitive processes other than sustained attention (Giambra, 1993). For example, task performance is also dependent upon the ability to discriminate targets from nontargets within the time permitted. This ability would be reflected at the beginning of the sustained attention period by unequal detection accuracy in the young and old age groups. Therefore, sustained attention capabilities are best measured by the inclusion of both the overall level of detection accuracy and the change in performance over time. Typical results show a decline in the likelihood of correctly detecting a target as the time on task increases; this decline is commonly referred to as the vigilance decrement (Davies & Parasuraman, 1982).

Studies examining the effects of age on sustained attention tasks have produced conflicting results. Older adults have been found to perform more poorly on vigilance tasks than younger adults in some studies (Thackray & Touchstone, 1981; Parasuraman, Nester, & Greenwood, 1989) but not in others (Giambra & Quilter, 1988; Deaton, 1988). When significant age effects occurred, individuals 60 years old and older responded more slowly, had lower detection accuracy, or made more false positive responses on cognitive tasks (Giambra, 1993). Several explanations have been offered to account for the variation in older adults' performance on sustained attention tasks. For example, Parasuraman et al. (1989) and Deaton and Parasuraman (1993) suggest that the effects of adult aging on vigilance depend on the nature of the vigilance task performed. That is, overall levels of sustained attention are lower in older adults than in younger adults when the processing demands of vigilance tests are increased by varying the complexity of the task (e.g., event rate or stimulus quality).

In general, the target detection rate in low event rate vigilance tasks is similar for both age groups; however, as evidenced in Parasuraman & Giambra (1991), older adults tend to perform more poorly than younger adults in high event rate tasks. Parasuraman et al. (1989) presented younger and older subjects with a visual discrimination task in which stimuli were provided at a fast rate for three levels of degradation. Performance declined with only the highest level of degradation and was more severe in older adults, thereby illustrating the effect of stimulus quality. Increased demands during vigilance tasks may decreased performance on vigilance tasks to a greater extent in older adults than younger adults. The nature of age differences in sustained attention, then, clearly merits further investigation.

Capacity as a component of attention has been investigated in dual-task studies that require the division of attention between the two simultaneous tasks (Hartley, 1992). One of the most consistent findings in cognitive aging research is the poorer performance of older adults in situations that require division of attention (Craik, 1977). However, recent reviews of earlier dual-task studies questioned the accuracy of an age-related decrement in divided attention performance. Somberg and Salthouse (1982) reported no age differences in divided attention performance when single-task, baseline performance accuracy was equated across age groups. These results suggest previously observed age differences in divided attention performance were artifacts of single-task performance differences between young and older adults, not the actual allocation of attentional resources. More recent research on aging and divided attention performance is consistent with Somberg and Salthouse's findings. Specifically, Salthouse et al. (1984) failed to replicate the absence of an age-related decline in performance on dual tasks, despite statistical control for age differences in baseline single-task performance. Salthouse et al. argued that the added complexity of the tasks, i.e., requiring memory for simultaneously presented letter strings, is responsible for the poorer performance of older adults. Based on these and other discrepancies in the attention and aging literature, Plude and Hoyer (1985) have emphasized the need to take a closer look at the conditions under which dual tasks do and do not produce age differences in performance. The present study investigated the effects of divided attention on memory under several conditions of attentional load.

Attention and Attention Deficit Hyperactivity Disorder (ADHD).

ADHD is characterized by inattentiveness, impulsiveness and hyperactivity resulting in significant impairment of cognitive and behavioral functioning (see American Psychiatric Association [APA], 1994; Pennington, Groisser, & Welsh, 1993). Although investigators are able to agree upon the general characteristics associated with ADHD, there is little consensus about the precise nature of the cognitive processes that are at the core of the condition (Coldren & Corradetti, 1997). Studies examining the effects of ADHD on cognition report the presence of decrements in information processing abilities such as attention and working memory. ADHD individuals have a limited attentional capacity and are unable to attend consistently and selectively to relevant stimuli; the degree of deficiency, in turn, regulates and determines what they remember.

Specifically, ADHD individuals present a diminished ability to inhibit irrelevant stimuli which in turn produces less efficient cognitive processing (Barkley, 1997). This model predicts impaired task performance attributable to poor inhibition of task-irrelevant stimuli. Deficits in inhibition as an attentional problem is consistent with current theories that maintain that reduced availability of processing resources underlies the performance decrements typical of ADHD individuals (Parasursman, 1984). It is suggested that processing resources are inappropriately allocated to task-irrelevant information. Another related theory addresses attentional deficits using a process-energy model of information processing (Sergeant & van der Meere, 1990). This model focuses on the demands tasks impose on information processing as well as the energy resources needed to meet those demands; performance impairments in ADHD are attributed to deficits in effort resources required for maintaining or distributing attention.

Consistent with research on aging described earlier, sustained attention is impaired in persons with ADHD. ADHD individuals have more difficulty in maintaining attention over time than non-ADHD individuals. One well-known measure of sustained attention is the Continuous Performance Task (CPT; Sergeant & van der Meere, 1990). In this vigilance task, stimuli are flashed one at a time on the computer screen and the subject is instructed to respond when a particular stimulus or pattern of stimuli appears. Children with ADHD do more poorly on sustained attention tasks than control children, as demonstrated by an increase in omission and commission errors, and a faster rate of performance decrement over time (Sergeant & van der Meere). However, the hypothesis that ADHD children actually have a greater impairment in performance across time (i.e., vigilance decrement) than non-ADHD children has been met with some controversy. For example, Draeger, Prior, and Sanson (1986) failed to find evidence of a differential change in performance on the CPT over time, whereas other studies have found a greater sustained attention decrement in ADHD children (e.g., Dykman, Ackerman, & Oglesby, 1979; Sykes, Douglas, & Morgenstern, 1973). Possible reasons for discrepancies between studies include subject characteristics (e.g., ADHD inclusion criteria, group size, sex, intelligence), and task and testing parameters (e.g., task length, stimuli used, instructions given, presence of tester, performance feedback, CPT measures). Seidal and

Joschko (1990) provide a comprehensive discussion of the effects of these factors on CPT performance.

Currently, little research has been done examining divided attention deficits in ADHD children or adults. The few studies that have examined this component of the attention construct report different findings (e.g., Schnedler et al., 1982; van der Meere & Sergeant, 1987). Schachar and Logan (1990) found a dual task performance deficit in ADHD males; performance deteriorated more rapidly in ADHD subjects than in non-ADHD subjects with the introduction of a secondary task. It is proposed, then, that ADHD individuals have greater difficulty in shifting attentional capacity efficiently from primary to secondary task processes (Schachar & Logan). Carlson, Pelham, Swanson, and Wagner (1991) replicated Schachar and Logan's general findings; non-medicated ADHD children failed to allocate available attentional capacity resources to the primary task efficiently. By contrast, van der Meere and Sergeant did not find a divided attention deficit in ADHD children comparable to controls. Although ADHD individuals were less efficient at performing the task, performance was independent of memory load, i.e., the divided attention parameter. Considering the discrepancies in the ADHD literature, it is important to explore this dimension of attention (i.e, attentional capacity) further. The present study includes a divided attention memory task and a self-reported measure of divided attention ability, both of which have not been adequately examined to date in the ADHD population.

Memory and Attention in Older and ADHD Individuals.

The ability to store and retrieve new information declines with increasing age. Older adults generally perform more poorly than young adults on recall of newly acquired information. Age-related memory decline mainly affects explicit memory abilities which are revealed in tasks requiring conscious recollection of an earlier episode, as expressed on free recall or recognition tests (Light, 1991). Older adults may have a decreased attentional capacity that limits effortful processing in relation to younger adults (Salthouse et al, 1984), thereby accounting for age differences on explicit memory tasks.

The memory impairments observed in older adults are similar to the pattern of deficits presented in ADHD. Deficits in children with ADHD revealed poor performance on effortful tasks, i.e., tasks requiring conscious allocation of attentional resources (e.g., free recall; Borcherding, et al., 1988). However, the impact of dividing attention during encoding has not been investigated within this population. Mulligan (1997) examined the effects of dividing attention during presentation of target words on subsequent memory tests using a digit-letter-monitoring task in which the attentional requirement (from mild to strong divisions of attention) varied in accordance with the number of to-be-remembered letters and numbers (0-5). Results indicated the strength of the attention manipulation was an important determinant of memory performance on category-cued recall tasks, i.e., 5 letters and numbers led to poorer performance.

Aging and performance effects on divided attention memory tests reveal mixed results. Whereas several studies have demonstrated a greater effect of divided attention on memory performance of older adults compared to young adults (e.g., Isingrini et al., 1995), other studies have not (e.g., Rabinowitz, Craik, & Ackerman, 1982). Tun and

Wingfield (1995) proposed that the subjective experience of dividing attention between two activities changes with increased age, and how this experience varies across different task domains. This explanation is consistent with research that finds that metamemory (beliefs about memory) is related to memory ability (Dixon, Hultsch, & Hertzog, 1988).

Tun and Wingfield organized different types of divided-attention activities in relation to their relative familiarity or novelty, testing the hypothesis that less predictable (familiar) activities require more processing resources, and produce greater age differences when two tasks must be performed at once. Young and older adults were asked to rate the perceived difficulty of performing combinations of tasks, which together comprised a measure of self-perceived divided attention abilities. Older adults, compared to young adults, rated most combinations of activities as more difficult and as increasingly more difficult over time (i.e., as they've aged); however, self-perceptions of ability in the elderly varied with task domain, such that novel information became increasing difficult with increased age, while familiar situations showed little change. The findings of Tun and Wingfield suggest that self-perceptions of task difficulty under divided attention conditions may play an important role in explicit memory performance.

Self-Efficacy.

Behavioral-emotional deficits identified with ADHD include lowered self-esteem, learned helplessness, diminished effort, and negative self-perceptions (Milich & Okazaki, 1991). Such impairments suggest deficits in motivation and may be partially responsible for the poorer performance displayed in ADHD individuals. Typically, these individuals experience greater difficulty performing novel tasks or tasks that they consider puzzling or complex. It appears that ADHD individuals fail to exert the effort required in difficult task situations, exhibiting a helpless response style toward execution of the task (Hoza & Pelham, 1995). Low self-confidence is also suggested to be involved in the performance decrements, in which increased task demands produce feelings of inadequacy and self-doubt.

The importance of the role of motivational deficits in developing a clearer understanding of ADHD is emerging (see Hinshaw, 1994; Nadeau, 1995; Weiss & Hechtman, 1993 for recent review). The combined behavioral and cognitive symptomatologies characteristic of ADHD patients suggest the basis for an interesting course of investigation and is addressed in the present study within the context of self-efficacy theory related to cognition.

Self-efficacy refers to a set of beliefs about one's own ability to successfully perform a task (Bandura, 1977). Memory self-efficacy (MSE) refers to self-evaluative beliefs of competence and judgments of confidence regarding memory abilities. Researchers of memory functioning have explored the possible relationship between memory self-efficacy (MSE) and performance. Overall, research on MSE in adulthood finds that older adults have lower levels of MSE and perform more poorly on a recall task than younger adults (e.g., Berry, West, & Dennehy, 1989; Berry & West, 1993; Luszcz & Hinton, 1995). The relationship between MSE and memory performance suggests attentional self-efficacy (ASE) may be lower in ADHD and aging individuals and may be related to their poorer attentional abilities. Self-awareness of attentional deficits and how this knowledge might influence performance on test of attention and memory was explored in the present study.

Present Study.

The review of research on attention, memory, and self-efficacy in ADHD and aging individuals indicates additional research is needed to address, and attempt to resolve, some of the discrepancies in the literature. The present study was designed to address gaps in the existing literature concerning preciously neglected domains of cognitive functioning in specific populations and across populations, while also addressing real-world issues of public concern.

More specifically, the objectives of the present study were 1) to examine group differences in memory, attention, and self-efficacy, and 2) to explore possible causal relationships between these variables. The purpose of measuring attentional capabilities was to determine the mediating role of attention on memory performance. The purpose of measuring ASE was to determine whether ADHD and aging individuals were aware of their attentional deficits and to determine the mediating role of ASE on performance.

The proposed research is unique in that it combines several areas of recent interest in the fields of developmental, cognitive, and clinical psychology. Comparing data from non-ADHD older adults to ADHD young adults is intriguing as these two populations report similar problems in everyday cognitive functioning, e.g., anxiety, poor attention, and memory loss. The present study offers insight into the factors responsible for poorer performance among these individuals compared to individuals without an attentional deficit on memory and attention tasks, and provides information which may be useful in the development of strategies to coach and treat ADHD and aging individuals who are concerned over impaired or declining cognitive abilities.

Hypothesis 1: Attention differences by group. Non-ADHD young adults should perform better than ADHD young and non-ADHD older adults on measures of attention.

Hypothesis 2: Memory differences by group. Non-ADHD young adults should perform better than ADHD young adults, and non-ADHD older adults should perform more poorly than ADHD young adults on measures of memory.

Hypothesis 3: Attention as a mediator of group differences on memory. Attentional capabilities should partially mediate the relationship between group and memory performance.

Exploratory Hypotheses. If the basic relationship between group, attention, and memory can be established, the role of self-efficacy in attention and memory should be examined. It was hypothesized that non-ADHD young adults would endorse higher levels of attentional self-efficacy than ADHD and older adults. It was also hypothesized that non-ADHD young adults and ADHD young adults would endorse higher levels of memory self-efficacy than older adults. Attentional self-efficacy should partially mediate the relationship between group and attention performance, and memory self-efficacy should partially mediate the relationship between group and memory performance.

Method

Participants

The present study consisted of three groups of male[2] subjects ranging in age from 18-88: non-ADHD young adults (N = 33; M age = 22.45, SD = 3.19), older adults (N= 32; M age = 76.38, SD = 4.56), and ADHD young adults (N = 27; M age = 21.52, SD = 3.06). All subjects were recruited through ads in local newspapers or flyers posted throughout the greater-Richmond community; ADHD young adults were also referred by local university disability services (e.g., University of Richmond, and Virginia Commonwealth University).   All participants were paid $20.00.

Potential subjects who responded to advertisements for ADHD adults were interviewed over the telephone for initial screening; they were queried on age, date of psychological evaluation, name and address of the diagnosing clinician, specialty or training background of diagnosing clinician (i.e., credentials), drug therapy (past and present), other medical conditions (see Appendix A). In order to be considered for inclusion in the present study, ADHD young adults must have been previously diagnosed by a licensed clinician and must have scored above the clinical cutoff on one of two standardized ADHD rating scales. Self-reported ADHD diagnosis was verified against DSM-IV criteria using Barkley and Murphy's Childhood and Current Symptom Scales (CCSS; Barkley & Murphy, 1998) and Conners' Adult ADHD Rating Scale (CAARS; Conners, Erhardt, & Sparrow, 1999). To be classified in the ADHD group for this study, basic DSM-IV criteria must have been met. These criteria are: 1) at least 6 of 9 inattention symptoms or 6 of 9 impulsive-hyperactive symptoms are currently present; 2) symptoms are reported to have arisen in childhood; 3) some impairment from the symptoms is present in at least two settings; 4) pervasive impairment in social, academic, or occupational functioning. Of the 38 callers responding to advertisements, 27 met the inclusion requirements and represent the ADHD group in the present study.

The Barkley and Murphy's CCSS (see Appendix B) contain the 18 symptom items from the DSM-IV in the form of a self-reported rating scale. ANOVAs on the DSM-IV ADHD symptoms total subscale confirmed childhood and current ADHD symptomatology in the ADHD young adults included in the present study, Wilks' criterion $F(4,154) = 20.74$, Wilks' Lambda = .422, $p < .001$, $eta^2 = .350$. Univariate analyses and post hoc tests identified ADHD younger adults as significantly different from the non-ADHD younger and older adult groups on both childhood and current ADHD scales, $F(2,78) = 53.13$, $MSE = 87.89$, $p < .001$, $eta^2 = .572$ and $F(2,78) = 32.74$, $MSE = 49.16$, $p < .001$, $eta^2 = .456$, respectively. See Table 1 for means and standard deviations.

Insert Table 1 about here

The CAARS is a 66-item self-report scale on which adults rate the severity of current ADHD symptomatology using a 4-point Likert scale (see Appendix C). The three major domains of ADHD symptoms (inattention, hyperactivity, and impulsivity) are assessed by item subgroups on the scale. Its psychometric properties are satisfactory (see

Erhardt, Epstein, Conners, Parker, & Sitarenios, 1998). An ANOVA on the DSM-IV ADHD symptoms total subscale confirmed the presence of ADHD symptomatology in the ADHD young adults included in this study, $\underline{F}(2,78) = 36.00$. $\underline{MSE} = 115.49$, $\underline{p} < .001$, $eta^2 = 480$. Scheffé's test identified the ADHD young adults as significantly different from the non-ADHD young and older adult groups. See Table 2 for means and standard deviations.

Insert Table 2 about here

ADHD participants were asked to not take any medication on the day (Barkley; personal communication, 5/18/99) of their appointment, therefore making their last dose the afternoon before the day of their scheduled testing session. When they arrived for their appointment, they were queried as to when they last took their medication. If they failed to follow our instructions, then they were rescheduled for another day (Barkley).

Groups did not differ in years of education, $\underline{F}(2,89) = 2.08$, $\underline{MSE} = 5.18$, $\underline{p} > .05$. Self-rated health was reported on a 5-point Likert scale (1 = poor, 5 = excellent); groups did not differ on self-rated health, $\underline{F}(2,89) = 1.73$, $\underline{MSE} = 0.42$, $\underline{p} > .05$. Older adults scored significantly higher than younger adults and younger ADHD adults on an ETS vocabulary test (see Appendix D), a measure of crystallized intelligence, $\underline{F}\ (2,89) = 6.11$, $\underline{MSE} = 35.82$, $\underline{p} < .01$. Younger adults and younger ADHD adults, however, performed significantly better than older adults on the WAIS-R digit-symbol substitution test, a measure of fluid intelligence, $\underline{F}\ (2,89) = 77.17$, $\underline{MSE} = 107.32$, $\underline{p} < .001$. The results for age differences on crystallized and fluid intelligence measures are consistent with the cognitive aging literature and suggest that these samples are comparable to the general population. Participant characteristics are provided in Table 3.

Insert Table 3 about here

Participants completed a background information questionnaire, designed to collect demographic information (e.g., age, race, marital status), medical history (e.g., health, number of prescription medications), and use of drugs (e.g., nicotine, "recreational drugs") and alcohol. Subjects were screened for dementia using Kahn's Mental Status Questionnaire (MSQ; Kahn, Goldfarb, Pollack, & Peck, 1960). The MSQ (see Appendix E) contains 10 items assessing orientation to person, place, and time. Example items are, "What is the year?" and "Who is the president of the United States?" The recommended cutoff scores are: 0 to 2 incorrect (no or mild brain dysfunction), 3 to 8 (moderate dysfunction), 9 to 10 (severe dysfunction). If three or more items were missed on the MSQ, that participant was to be excluded from the study; no subject interviewed for inclusion in the present study scored above 2 on the MSQ.

<u>Materials</u>

The test battery covers two cognitive domains (attention and memory) and one metacognitive domain (self-efficacy). A description of each measure, grouped by domain, is given in the following paragraphs.

Attention. Attentional abilities were measured using a questionnaire and a computerized task. The Divided Attention Questionnaire (DAQ; Tun & Wingfield, 1995), a 16 item self-assessment scale, measures perceptions of divided attention ability across behavioral domains, i.e., under a variety of situations performing combinations of activities (see Appendix F). Participants were asked to rate, using Likert scales, the perceived difficulty (5-point scale ranging from "very easy" to "very hard"), degree of change over time (3-point scale ranging from "easier" to "no change" to "harder"), and frequency of performance (3-point scale ranging from "none" to "few [1-6]" to "often [>6]") for various combinations of activities. Tun and Wingfield (1995) report adequate psychometric properties for the DAQ. Internal consistency was estimated with standardized alpha coefficients; the Se coefficients for the three DAQ scales (perceived difficulty, degree of change, and frequency) were .88, .89, and .70, respectively. Test-retest reliability coefficients, averaged over items, for these rating scales were: $r = .63$ (perceived difficulty), $r = .44$ (degree of change), and $r = .52$ (frequency).

The Continuous Performance Test (CPT; Conners, 1995) is a computerized task designed to measure sustained attention. The CPT is presented in a game-like format and takes 14 minutes to complete. Letters are presented on the screen one at a time, at three different rates. Each letter is displayed for 250 milliseconds. The letters are approximately 1" in height and width, capitalized, and boldfaced. Participants are instructed to press the spacebar when a letter appears on the screen and to not press it if the letter "X" appears. The validity of the CPT as a measure of inattention in children with ADHD has been supported by correlations between CPT outcome measures and parent/teacher ratings of inattention (Barkley, 1991). Furthermore, studies have found adequate sensitivity and specificity using CPT tasks as diagnostic instrument for children with ADHD (Conners, 1996; Klee & Gartinkel, 1983). Recently, two adult ADHD studies (Barkley, 1996; Epstein, Conners, Sitarenois, & Erhardt, 1998) employing CPT methodology differentiated between non-ADHD and ADHD young adults. These findings complement the child-ADHD literature suggesting that the CPT is a valid and reliable measure of attention.

Memory. Episodic memory was assessed using a computerized category-cued recall task (Mulligan, 1997). Using the Battig and Montague (1969) norms, 6 common words, from 5 to 10 letters in length, were selected from each of 16 categories (a sport, a fruit, a piece of furniture, a bird, a color, a four-footed animal, an article of clothing, a tree, a musical instrument, a part of the human body, a vegetable, a dance, an insect, a substance for flavoring food, a fish, a part of a building). The items selected from each category were not among the 10 most frequently produced exemplars, having an average rank of 17.4.

Two study lists (see Appendix G) of 48 items each were generated by randomly dividing the 16 categories into two groups of eight. Thus, six words from each of the eight categories comprised a given study list for a total of 48 words per study list. The items in each list were randomly ordered, subject to the constraint that no two consecutive items were from the same category. Twelve additional items were chosen from nonselected Battig and Montague categories; four of these items will be presented before the list, as practice items, and four different items are placed at both the beginning and end of each list as primacy and recency buffers (Mulligan, 1997). Each of the 12 additional items came from a different category, and the average frequency rank of these items was similar to that of the study items. Each study list was presented an equal number of times across subjects.

An attentional load of 0, 1, 3, or 5 digits and letters was presented before each study item. Nonzero loads were created by randomly selecting items from a set of digits (1-9) and a set of numbers (B, C, D, F, G, H, J, K, L) according to the following rules: (1) digits and letters occupied alternating positions, with a digit in the first position (attentional loads of 1 consisted of a single digit); and (2) no repetition of digits or letters within a load. It is thought that the use of these materials and rules will help to minimize chunking strategies by subjects (Mulligan & Hartman, 1996).

Self-Efficacy. Domain-specific and task-specific self-efficacy was measured using three questionnaires, the Metamemory in Adulthood Questionnaire (MIA; Dixon et al., 1988), the Welsh Attention Questionnaire (WAQ), and the Attentional Self-Efficacy Questionnaire (ASEQ). Memory self-efficacy (MSE) was assessed using the Capacity (measuring perceived memory capabilities) and Change (measuring perceived change in memory capabilities) subscales of the MIA, a self-report instrument scored on 5-point Likert scales (ranging from "strongly agree," to "strongly disagree") that asks participants to rate statements describing their own memory functioning and knowledge of general memory processes. These two subscales serve as reliable indicators of MSE (Hertzog, Hultsch, & Dixon, 1989). Studies investigating the psychometric characteristics of the Capacity and Change subscales report significant age differences and satisfactory reliability (internal consistency alpha coefficients ranging from .81 to .93) and validity (for review, see Hertzog et al.).

Attentional self-efficacy was measured using the WAQ and ASEQ. The WAQ is a domain-specific self-efficacy questionnaire designed for this study and is comparable to the MIA in format. Higher scores on the WAQ mean a higher self-assessment of general attentional capabilities. The 35 items from the MIA subscales and the 34 items from the WAQ were presented together in one questionnaire consisting of 69 items (see Appendix H). The ASEQ is a task-specific assessment of perceived attentional abilities (confidence ratings for the CPT described earlier) developed for this study and based on the Memory Self-Efficacy Questionnaire (MSEQ; Berry, et al., 1989). A series of statements describing increasingly higher levels of performance on the CPT was administered after orienting participants to the nature and task demands of the computerized task (see Appendix I). Participants were asked to rate their confidence for performing the task at each level, indicating their response by circling a percentage ranging from 10% to 100% in 10-unit increments. Sixteen (BAR PRESS) and 8 (NO PRESS) ASE confidence ratings (0% to 100%) across different levels of CPT were summed and then averaged across levels for the measure of task-specific ASE.

Procedure

The BIQ, MIA (Capacity and Change subscales only), WAQ, DAQ, and Barkley and Murphy's CCSS, as well as the subject consent form, were presented in a questionnaire booklet, and mailed to participants to complete prior to testing. At testing, participants were tested individually in a laboratory setting at the University of

Richmond. Participants read and signed an informed consent form stating that they would perform several different tasks, some having to do with memory and some having to do with attention or problem solving, and were given an opportunity to ask any questions. Testing sessions required participants to complete a battery of tests comprised of two computerized (CPT, category-cued recall task) and six paper-and-pencil instruments (MSQ, ASEQ, ETS Vocabulary Test, WAIS-R digit symbol, CAARS, and BSI). Participants were randomly assigned to one of eight presentation orders (see Appendix J).

Tasks were administered in the following manner:

Attention and Self-Efficacy. A practice version of the CPT was administered in order to familiarize participants to the demands of the task. Instructions were displayed on the screen and example stimuli were presented. Participants were verbally informed of the varying rates at which letters may be presented, as some letters were presented faster or slower than other letters. Participants were not allowed to press keys on the keyboard during task orientation in order to avoid differential practice or task familiarity that could result in contaminated responses on the ASEQ. Once the participant fully understood the task, the ASEQ was presented. The actual CPT followed completion of the questionnaire. Participants were left unattended during testing in an attempt to minimize possible distractions.

Memory. The memory measure (category-cued recall task) consisted of two phases: a study task and a memory test. In the study task, target words were presented in trials. First, a ready prompt was displayed for 500 msec. Then, the attentional load of 1, 3, or 5 digits and letters (or a dash in the 0-load condition) was presented for 2.5 sec. For the non 0-load trials, participants were asked to read the digit-letter string aloud and retain it in memory until the recall signal is given. For the 0-load trials, participants were instructed to say "blank" in response to the dash. Next, the study word was presented for 3 sec; participants were instructed to read the word aloud. Finally, either the word RECALL (in the non-0-load condition) or the word BLANK (in the 0-load condition) appeared for 2.5 sec. The participants were instructed to either recall the digits and letters (in the non-0-load conditions) or to again say "blank" (in the 0-load condition). Participants were told that it was equally important to correctly recall the digit and letter strings as it was to remember the target words for later recall (Mulligan, 1997).

Following the study phase, participants were given a category-cued recall test where they were presented with eight category names one at a time. Participants were instructed to say six things that belong to each category, first trying to use as many words from the previous task as they can remember, then using other category members that come to mind until a total of six are given. The experimenter tracked the number of different exemplars recalled/produced and signaled the participant to proceed to the next category when six exemplars had been provided. No time limit on recall was imposed.

Statistical Analyses Procedures.

Multiple dependent variables were examined by MANOVAs. Next, univariate tests were conducted to examine group differences for significant dependent variables. Post hoc comparisons, using Scheffé's test with alpha level set to .05, were performed to examine the pairwise differences between groups. Finally, effect size was calculated using eta-squared (eta^2) statistic; eta^2 indexes the percent of total variance that is explained or accounted for by differences in the independent variable.

During preliminary analyses, unequal variances were found between groups on the performance measures of interest. The assumption of equal variances can be violated if the number of subjects in each group is the same (Hays, 1981). Therefore, in order to avoid compromising interpretational validity, subjects were screened using the BSI. The BSI is a self-report measure used in the assessment of psychological symptomatic distress (see Appendix H). It consists of 53 paper and pencil items and requires about 10 minutes to complete. The instructions are to determine how much a particular problem has caused distress for the test-taker in the past seven days, including the day the test is being completed. Each item lists a potential stressor and is responded to with a 1 (not at all) through 5 (extremely). The items within the inventory are based on the Symptom Check List-90 (Derogatis, 1986) and fall into nine scales: Somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. The measure also includes three global indices: global severity index, positive symptom index, and positive symptom total. The internal consistencies (alpha coefficients) of the scales range from .71 to .83. The test-retest reliabilities of the scales range from .68 to .91. The global indices have test-retest reliabilities above .80.

Non-ADHD young adults and older adults with extreme high and low scores on the BSI Global Severity Index were excluded from statistical analyses, resulting in equivalent numbers of subjects ($N = 27$) in all three experimental groups, (non-ADHD young adults: M age = 22.70, $SD = 3.26$, older adults: M age = 76.67, $SD = 4.38$, and

ADHD young adults: M age = 21.52, SD = 3.06). Following this procedure, the same pattern of results between groups on years of education, self-rated health, ETS vocabulary, and WAIS-R digit symbol substitution remained. See Table 4 for univariate tests, means, and standard deviations.

Insert Table 4 about here

It is also important to consider whether the presence of psychiatric symptoms influences performance on memory and attention tasks. The presence of comorbid symptomatology was assessed using scores from subscales of the BSI (Derogatis, 1993). Before analyses were conducted, correlations were computed between BSI subscales and performance measures. Significant correlations between BSI subscales and performance measures would warrant covarying those subscales from subsequent analyses of the performance measures (Barkley, personal communication, 5/34/99). Significant correlations were obtained between only one measure of attention (Monitoring/Adapting Skill factor from the CPT) and four BSI subscales (interpersonal sensitivity, depression, paranoid ideation, and psychoticism). The pattern of significant group differences on the Monitoring/Adapting Skill factor did not change when the effects of these subscales on this factor were covaried or removed, suggesting that group differences on psychiatric symptomatology did not change group differences on attention.[3] Table 5 presents the correlation matrix of BSI subscales and performance measures (i.e., memory and attention).

Results

Hypothesis 1: Group Differences on Attention Performance

The dependent measures for the CPT are Omission Errors (OMNS), Commission Errors (COMNS), Hit Reaction Time (HITRT), Hit Reaction Time Standard Error (HITRTSE), Variability of Standard Errors (SDs), Hit Reaction Time Block Change (HITRTBC), Hit Reaction Time Standard Error Block Change (HITSEBC), Hit Reaction Time Inter-stimulus Interval (ISI) Change (HRTISIC), and Hit Reaction Time Standard Error ISI Change (HSEISIC). See Table 6 for means and standard deviations.

Insert Table 6 about here

Two additional measures related to signal detection theory (SDT; Green & Swets, 1975) are also provided by Conners' CPT: Perceptual Sensitivity (*d'*) and Response Bias (ß). The measure of *d'* indicates ability to discriminate targets from non-targets. The measure of ß indicates a conservative response tendency. A MANOVA found between-group differences on these signal detection parameters, Wilks' criterion $F(4,156) = 4.21$, Wilks' Lamda = .813, $p < .01$, eta^2 = .099. Univariate analyses and post hoc tests showed that older adults ($M = 70.97$, $SD = 19.21$) were more conservative in their tendency to respond (i.e., ß) than either non-ADHD young ($M = 55.14$, $SD = 12.04$) or ADHD young adults ($M = 59.16$, $SD = 16.01$), $F(2,78) = 7.12$, $MSE = 256.79$, $p < .01$, eta^2 = .154. Groups did not differ on *d'*, $p > .05$.

Prior to testing formal hypotheses on attention, several data reduction procedures were conducted in order to reduce the nine CPT scales into fewer superordinate factors of attention. Scores from all subjects on each of the nine CPT measures were subjected to principal component analysis (varimax rotation with Kaiser normalization), which extracted an initial factor solution specified for four attentional factors. See Table 7 for factor loadings. Scales with factor loadings above .60 (indicated in bold in Table 7) were identified as loading uniquely on a given factor.

Insert Table 7 about here

The first factor to emerge involved attention problem indicators. The measures that loaded on this factor were OMNS, HITRTSE, and SDs. High OMNS (percentile values greater than 90) suggest inattentiveness to the task. Large HITRTSE and SDs scores (high T-scores of 60 or above on any CPT measure suggests attention problems) indicate inconsistent responding; SDs had its heaviest loading on this factor, closely followed by HITRTSE. Taken together, these measures suggest general attentiveness to the CPT task. Factor 1 was labeled <u>Inattention</u>. The second factor comprised measures of task response patterns across ISIs. HRTISIC and HSEISIC assess change in hit rate reaction time and variability, respectively, across ISIs; large scores indicate poor ability to adjust ones' responding across ISIs. This factor (Factor 2) was labeled <u>Monitoring/Adapting Skill</u>. The third factor comprised COMNS and HITRT, measures that indicate impulsivity. A high number of COMNS and a large HITRT score indicate impulsive responding resulting in response errors. COMNS had the heaviest loading on this factor, followed by HITRT. Factor 3 was labeled Impulsive-Error Prone. The fourth factor comprised HRTBC and HSEBC, measures of consistency of responding over blocks of stimuli. A high HRTBC score indicates atypical response speed slowing as the test progresses; high HSEBC scores indicate an erratic pattern of responding as the test progresses. This factor (Factor 4) was labeled Inconsistency.

A MANOVA yielded group differences on the four factors, Wilks' criterion $F(8,150) = 10.39$, Wilks' Lambda = .414, $p < .001$, $eta^2 = .357$. See Table 8 for CPT Factor means and standard deviations. Univariate tests revealed that only the first two factors, Inattention and Monitoring/Adapting Skill, were significantly different across groups, $F(2,78) = 18.26$, MSE = .70, $p < .001$, $eta^2 = .319$) and $F(2,78) = 15.92$, MSE = .73, $p < .001$, $eta^2 = .290$, respectively. Subsequent post hoc analyses of the Inattention factor showed that older adults demonstrated poorer attention than ADHD young and non-ADHD young adults; ADHD young adults also performed worse than non-ADHD young adults.

Older adults were generally slower to respond and more variable in their responses than were non-ADHD young and ADHD young adults. Non-ADHD young and ADHD young adults had significantly higher scores on the Monitoring/Adapting Skill factor than older adults; this suggests that older adults are better at adjusting to changing task demands (i.e. ISIs) than either of the young groups.

Insert Table 8 about here

As ISI increases, older adults become relatively faster at responding and more consistent; that is, when targets are presented after longer intervals, older adults respond faster and more stably to them than when the intervals between target stimuli are shorter. This response pattern indicates better monitoring of their task responding than non-ADHD young and ADHD young adults, indicating possibly that older adults are adjusting a conservative response bias (ß). An examination of ß (see section above on analyses of ß and d' on p. 26) indicated that older adults exhibited a more conservative tendency to respond. In order to examine the possibility that group differences on attention as measured by the four factors were contaminated by this differential response bias, ANCOVAs were performed on each of the factors, covarying ß. When groups were equated on ß, group differences on the Inattention factor remained, $F(2,77) = 10.34$, $MSE = 5.92$, $p < 001$, $eta^2 = .212$. Pair-wise comparisons (via Bonferroni's test) revealed significant differences between non-ADHD young adults and both ADHD young and older adults, but not between ADHD young and older adults (see Figure 1), as was found before groups were equated on ß. When ß was covaried out of the equation for the Monitoring/Adapting Skill factor (along with the correlated BSI subscales), group differences remained as well, $F(2,73) = 9.46$, $MSE = .67$, $p < .001$, $eta^2 = .242$; differences between groups did not change (see Figure 2). Table 9 provides CPT factor means, standard errors, univariate tests, and post-hocs after equating groups on ß.

Insert Table 9 about here

Divided Attention Questionnaire (DAQ). Three subscale scores from the DAQ were computed from the 15 DAQ items: "perceived difficulty," "degree of change over time," and the "frequency of performance." The items were rated on 1-5 (perceived difficulty) or 1-3 (change, frequency) Likert scales. Percentages of the maximum score were calculated in order to make the scales comparable. These scores (means and standard deviations) are given in Table 10. A MANOVA revealed significant group effects on the DAQ, Wilks' criterion $F(6,152) = 8.42$, Wilks' Lambda = .563, $p < .001$, $eta^2 = .249$. Univariate analyses revealed that these group differences were limited to the difficulty, $F(2,78) = 4.88$, $MSE = 168.79$, $p < .05$, $eta^2 = .111$, and change scales, $F(2,78) = 19.46$, $MSE = 64.54$, $p < .001$, $eta^2 = .333$. Post-hoc comparisons demonstrated that on the difficulty subscale, younger adults rated their ability to divide attentional resources successfully significantly higher than both younger ADHD and older adults. Older adults, however, rated the degree of change over the past 10 years significantly higher than the other two groups, indicating that with increased age, the perceived ability to divide attention decreases (see Figure 3)

Insert Table 10 about here

Hypothesis 2: Group Differences in Memory Performance

The hypothesis that non-ADHD young adults would perform better than ADHD young adults, and that older adults would perform more poorly than ADHD young adults on measures of memory was tested with a mixed ANOVA with group (non-ADHD young adults, ADHD young adults, and older adults) as a between- subjects factor and attentional load (0, 1, 3, 5) as a within-subjects factor. Word recall was the dependent variable. Between group differences on attentional load was significant at the multivariate level, Wilks' criterion $\underline{F}(3,76) = 11.08$, Wilks' Lambda = .696, $\underline{p} < .001$, $eta^2 = .304$. Univariate tests confirmed group differences on memory performance, $\underline{F}$ (2,78) = 31.12, $\underline{MSE} = 1.26$, $\underline{p} < .001$ (see Figure 4), $eta^2 = .444$, and attentional load, $\underline{F}$ (3,78) = 11.98, $\underline{MSE} = .02$, $\underline{p} < .001$, $eta^2 = .133$ (see Figure 5). Post- hoc comparisons, using Scheffé's test, indicated that non-ADHD young adults and ADHD young adults remembered more category members than older adults. Higher attentional load at encoding led to lower memory performance scores; performance was significantly lower in the 5-load condition than all other conditions but performance was not significantly different between any other load condition. The interaction between group and load was nonsignificant. See Table 11 for means and standard deviations.

Insert Table 11 about here

Two one-way ANOVAs, followed by Scheffé's test, were performed to examine differences between groups in the number of intrusions and late hits produced during recall. Older adults ($\underline{M} = 4.33$, $\underline{SD} = 1.94$) generated significantly more late hits than non-ADHD young ($\underline{M} = 1.59$, $\underline{SD} = 1.45$) and ADHD young adults ($\underline{M} = 1.48$, $\underline{SD} = 1.28$), $\underline{F}(2,78) = 28.16$, $\underline{MSE} = 2.50$, $\underline{p} < .001$, $eta^2 = .419$. Young ADHD adults, however, produced significantly more intrusions than non-ADHD and older adults,

$\underline{F}(2,78) = 11.70$, $\underline{MSE} = 8.86$, $\underline{p} < .001$, $eta^2 = .231$ ($\underline{M} = 4.93$, $\underline{SD} = 4.37$; $\underline{M} = 1.44$, $\underline{SD} = 1.99$; $\underline{M} = 1.63$, $\underline{SD} = 1.88$, respectively).

Hypothesis 3: Attention as a Mediator of Memory Performance

An ANCOVA was performed to examine attention as a possible mediator of memory performance. The dependent variable was memory, the independent variable was group, and the covariate was attention (CPT Inattention). Although group differences on memory remained significant, the F was reduced from $\underline{F}(2,78) = 31.12$ $\underline{MSE} = .01$, $\underline{p} < .001$, $eta^2 = .444$ to $\underline{F}(2,78) = 16.56$, $\underline{MSE} = .01$, $\underline{p} < .001$, $eta^2 = .304$. Initially, group membership accounted for 44% of the variance (eta^2) in memory performance. Once differences in attention were statistically controlled, strength of the group effect (eta^2) on memory performance was reduced to 30%. In psychological research, an eta^2 of .10 to .15 (Salthouse, 1993) is considered fairly strong. Therefore, a reduction in effect size of .14 lends support to the hypothesis that attention partially mediates memory performance.

Exploratory Hypotheses: The Role of Self-Efficacy

Group Differences in Attentional Self-Efficacy. In order to test the exploratory hypothesis that non-ADHD younger adults would endorse higher levels of ASE than both ADHD younger adults and older adults, group differences on the ASEQ (the measure of task-specific ASE) were examined. Sixteen (BAR PRESS, or HITS) and 8 (NO PRESS, or CR'S) ASE confidence ratings (0% to 100%) across different levels of CPT were summed and then averaged across levels for the measure of task-specific ASE strength, (SEST; PSEST & NPSEST). Single item predictions for both response types were also collected (PPRED & NPPRED). A MANOVA with PPRED, PSEST, NPPRED, and NPSEST as the dependent variables, revealed significant group differences on the ASEQ, Wilks' criterion $\underline{F}(8,150) = 3.22$, Wilks' Lambda = 728, $\underline{p} < .01$, $eta^2 = .147$. A univariate test found differences between groups on NPPRED (no bar press prediction), $\underline{F}(2,78) = 5.05$, $\underline{MSE} = 30.81$, $\underline{p} < .01$, $eta^2 = .115$. Scheffé's test indicated that non-ADHD young adults had significantly higher NPPREDs than ADHD young adults. Older adults did not differ from either group. A univariate test found differences between groups on PSEST (bar press self-efficacy strength), $\underline{F}(2,78) = 3.23$, $\underline{MSE} = 290.95$, $p < .05$, $eta^2 = .077$. Scheffé's test showed that non-ADHD younger adults had higher PSEST ratings than older adults (see Figure 6). ADHD young adults did not differ from either group. See Table 12 for means and standard deviations.

An ANOVA was performed on the summed responses from the WAQ and found significant group differences, $\underline{F}(2,78) = 22.68$, $\underline{MSE} = .22$, $\underline{p} < .001$, $eta^2 = .368$ (see Figure 7). Scheffé's test revealed that ADHD young adults had significantly lower attentional self-efficacy than non-ADHD young and older adults. See Table 12 for means and standard deviations.

Insert Table 12 about here

Attentional self-efficacy as a mediator of attention performance. See Table 13 for correlations between attention self-efficacy and memory recall.

Insert Table 13 about here

To test the hypothesis that ASE partially mediates attention performance, an ANCOVA was performed. Before proceeding with the analysis, however, a composite score for ASE strength was calculated in order to provide a more stable estimate of ASE strength; therefore, PSEST and NPSEST were combined to create TOTSEST[4] (see Footnote 4 for formula). The dependent variable was attention (CPT Inattention, after equating groups on ß), the independent variable was group, and the covariate was ASE strength (TOTSEST). Contrary to the hypothesis, group differences on attention performance remained significant, $F(2,76) = 8.49$, $MSE = .56$, $p < .001$, $eta^2 = .183$. The omnibus F was not substantially reduced ($F(2,77) = 10.34$, $MSE = 5.92$, $p < 001$, $eta^2 = .212$); likewise, the change in amount of variance explained by group membership was only 3%. See Table 14 for mediational analyses.

Insert Table 14 about here

Group Differences in Memory Self-Efficacy: In order to test the exploratory hypothesis that non-ADHD younger adults and ADHD younger adults would endorse higher levels of MSE than older adults, group differences on the MIA Capacity and Change subscales (the measures of MSE) were examined. Item responses for each subscale were summed; this sum was divided by the total number of items contained in each subscale. A MANOVA yielded significant group effects, Wilks' criterion $F(4,154)$

= 12.35, Wilks' Lambda = .573, $p < .001$, $eta^2 = .243$. Univariate tests yielded significant group effects on both Capacity, $F(2,78) = 10.60$, $MSE = .28$, $p < .001$, $eta^2 = .214$, and Change, $F(2,78) = 4.95$, $MSE = .22$, $p < .001$, $eta^2 = .372$ (see Figure 8). Scheffé's test found that older and ADHD young adults report significantly lower MIA Capacity than non-ADHD young adults; older adults report significantly higher MIA Change compared to the other groups. See Table 12 for means and standard deviations.

Memory self-efficacy as a mediator of memory performance. Table 13 presents the correlations between MIA Change, Capacity (memory self-efficacy) and memory recall. As can be seen, the intercorrelations among the relevant variables were high and significant. To test the hypothesis that MSE partially mediates group differences on memory performance, an ANCOVA was performed. The dependent variable was memory, the independent variable was group, and the covariate was MSE (MIA Change and Capacity). Although group differences on memory performance remained significant, controlling for MIA Change reduced the F from $F(2,78) = 31.12$ $MSE = .01$, $p < .001$, $eta^2 = .444$ to $F(3,77) = 16.68$, $MSE = .01$, $p < .001$, $eta^2 = .302$ and the effect size from .444 to .302, change in $eta^2 = .142$. Covarying out MIA capacity did not ($F(3,77) = 25.10$, $MSE = .01$, $p < .001$, $eta^2 = .395$). These findings lend some support to the hypothesis that memory self-efficacy partially mediates memory performance. See Table 15 for mediational analyses.

Insert Table 15 about here

Discussion

The primary purpose of this study was to examine the relationship between young ADHD adults and older adults performance on measures of attention and memory, and beliefs about their memory and attentional abilities. Other objectives were to examine the mediating role of attention and attentional self-efficacy on the relationship between group and memory performance, and group and attention performance. These goals were addressed by testing three formal hypotheses and four exploratory hypotheses. Young ADHD adults and older adults performed similarly on measures of attention and held similar beliefs about their attentional and memory abilities. However, ADHD young adults performed at a higher level than older adults on measures of memory. In addition, the relationship between group and attention and memory performance revealed the mediating role of attention and self-efficacy.

Group differences on Attention Performance

Consistent with Barkley, Murphy, and Kwasnik (1996), non-ADHD young adults outperformed ADHD young adults and older adults on CPT Inattention. This finding further validates the use of Conners' CPT as an adequate measure of sustained attention. Further, differences between ADHD young adults and non-ADHD young adults persisted even after equating for ß. Remarkably, group differences between ADHD young adults and older adults were not statistically different when ß was excluded from attention analyses. While age differences in sustained attention have been noted in older adults (Thackray & Touchstone, 1981; Parasuraman, Nester, & Greenwood, 1989), this finding demonstrates this deficit in not restricted to older adults and lends convergent support to existing findings in child ADHD populations and extends the ADHD literature on sustained attention deficits to adults with ADHD. ADHD young adults and older adults appear to lack the inherent sustained attention needed to process incoming stimuli under sustained conditions as well efficiently as non-ADHD adults. While ADHD young adults likely never developed the capacity, this quality in older adults likely declines throughout the aging process (McDowd & Shaw, 2000). In this way, it appears previously non-ADHD young adults become more like ADHD young adults as they approach advanced age. Additional studies identifying the timing and mechanism by which this ability begins to decline is needed to further understand this relationship. Furthermore, these questions would benefit from longitudinal approaches, whereby non-ADHD young adults and ADHD young adults are tested over time and in old age. In fact, perhaps ADHD young adults experience a steeper decline in their attentional capabilities with increased age compared to non-ADHD young adults.

Similarities noted between ADHD young adults and older adults in inattentiveness did not extend to each groups' ability to adapt to changing inter-stimulus-intervals (ISI). Overall, older adults responded better than both young groups at increased ISIs. This is not surprising considering that older adults are generally slower and therefore would benefit from slower presentation rates. That is, older adults' RT is slower than the younger groups, but not differentially slower at longer ISIs as seen in the younger groups. This finding is consistent with the aging literature where older adults perform better at tasks when given longer time to respond (e.g., Plude & Doussard-Roosevelt). Davies and Parasuraman (1982) suggust these age effects are the result of more cautious decision making in attending to and evaluating a stimulus for action. Under this assumption, older adults appeared to employ more cautious decision making than both young groups . Non-ADHD young and ADHD young adults had slower reaction times during larger ISIs than at shorter ISIs than at shorter ISIs, demonstrating their poor ability to effectively monitor changing event rates across task intervals. Unlike inattention, perhaps this impulsivity improves with increased age. Continuing along these lines, it is not surprising, then, for ADHD young adults and non-ADHD young adults to perform similarly on our measure of impulsivity, as impulsivity might be more of an age-related variable rather than a clinical manifestation.

Group Differences on Memory Performance

The results showed that both aging and divided attention produced large declines in memory performance. Non-ADHD young and ADHD young adults remembered more words than older adults on tests of memory (see Smith & Earles, 1996; Craik & Jennings, 1992) and attentional load had negative impact on subsequent recall (Mulligan, 1997). However, attentional load did not affect this relationship as shown by the nonsignificant Group X Attentional Load interaction. The effects of divided attention on memory recall observed in our study are consistent with other studies comparing performance of young and older adults (Isingrini, Vazou, & Leroy, 1995; Anderson, Craik, & Naveh-Benjamin, 1998; Salthouse, Rogan, &Prill; 1984); while older adults recalled less than younger adults, the degree of deficit did not increase differentially for older adults as attentional load increased. Further inspection of the effects of divided attention may help explain this discrepancy.

Although the interaction effect was nonsignificant, older adults' memory performance was at floor under the highest load, consistent with recent literature (Anderson et al., 1998). Therefore, in agreement with Salthouse et al. (1984), it is not surprising that older adults performed so poorly at recall. Several hypotheses have been proposed to account for older adult's poorer performance under divided attention conditions. Nyberg, Nilsson, Olofsson, and Backman (1996) postulate that age differences on dual tasks may be a reflection of the particular combination of memory task and secondary task. Similarly, Salthouse et al. suggest that the degree of task complexity affects the pattern of age differences obtained when dividing attention between two concurrent activities. It is important, then, to consider the nature of the divided attention memory task utilized in the present study. The use of various attentional loads to divide attention between presentation of each target word provides a rigorous division of attention during encoding. The Group X Attentional Load interaction might not have reached significance because of poor power. This explanation is supported by isolated group analyses of memory performance as a function of attentional load; ADHD young adults appear to be more sensitive to increased attentional load than either of the other groups (i.e., non-ADHD young and older adults). However, this trend did not reach significance because of poor power

Attention as a Mediator of Memory Performance

While some of the variability in memory performance scores was due to group differences (or variability) in attentional abilities, other factors also appear to account for this relationship. Memory performance differences between the groups decreased when the attentional capacity differences between the groups were accounted for statistically. This finding lends support to traditional (e.g., Broadbent, 1958; Norman, 1969) as well as more recent (Cowan, 1995; Craik, Govoni, Naveh-Benjamin, & Anderson, 1996) theories positing attention as a prerequisite to efficient memory encoding. Relatively few studies, however, have included an independent measure of attentional demands. Thus, for the most part, attribution of memory deficits to attention has been an assumption rather than statistical verification. Historically, limiting attentional capacity through dual-task methodology or increased task complexity and observing the effects of these manipulations on memory performance has been considered evidence for the centrality of attention in successful information processing. Our findings extend this line of inquiry by testing, and providing partial support for, a model of attention as a direct mediator of memory ability rather than an inferred effect.

The Role of Self Efficacy

Both ADHD young and older adults reported significantly lower MIA Capacity than non-ADHD young adults. ADHD and non-ADHD young adults both perceived less change in their memory than older adults. These findings support the aging literature regarding age-related decrements on perceived memory ability and ability maintenance (Hultsch, Hertzog, & Dixon, 1990; Hultsch, Hammer, & Small, 1993). Contrary to our hypothesis, however, ADHD young adults displayed levels of memory capacity similar to older adults and lower than non-ADHD young adults. This result, in hindsight, coincides with behavioral data characterizing ADHD children and adults as having low self-esteem, learned helplessness, diminished effort, and negative self-perceptions (Milich & Okazaki.

1991). Apparently, the ADHD individuals do not differentiate between their labeled deficit (attention) and other deficits (e.g., memory abilities, as demonstrated here). Whereas ADHD are aware of their attentional difficulties, they also appear to generalize awareness of difficulties to related cognitive domains.

Differences in memory performance among groups were substantially reduced after adjusting for differences in MSE Change. Similarly, previous studies cite age group as the best predictor of memory recall (Hultsch et al., 1993; West, Crook, & Barron, 1992), and MSE as a reliable partial mediator of memory performance. Cognitive variables (e.g., attention, speed) are better predictors of the age-related decline in episodic memory than noncognitive characteristics (Luszcz, Bryan, & Kent, 1996). Contrary to expectation, the mixed findings in the present study (i.e., different patterns of group differences on MSE and memory performance), render the MSE mediation hypothesis untenable, as presently tested.

Whereas non-ADHD young adults endorsed higher levels of ASE than either ADHD young or older adults, these differences were only significant for the no press prediction (NPPRED) and the press self-efficacy strength (PSEST) measures. ADHD young adults and older adults endorsed similar efficacy evaluations of their abilities to meet the task demands of the CPT, as no significant differences between them emerged. Young adults, however, demonstrated significantly higher levels of press SEST than older adults; additionally, ADHD young adults rated their ability to inhibit response towards non-targets significantly less than non-ADHD young adults. These findings, taken individually, are consistent with research identifying older adults as less likely to respond to targets, i.e., errors of omissions or response bias, and ADHD individuals as more likely to respond to non-targets, i.e., errors of commission. The difference in PSEST (a self-report measure), then, complements the older adult's performance on the behavioral measure of attention (i.e., the CPT) in this study. Similarly, ADHD young adults exhibited significantly lower efficacy at being able to not respond to nontargets; suggesting that poor performance in these individuals result from an inability to inhibit response to irrelevant stimuli (Barkley, 1998)

When groups were equated on ß (response bias), task-specific attentional self-efficacy did not further explain, or mediate, the relationship between group and attention performance. Thus no support was obtained for the test of this hypothesis applied to CPT task performance. Failure to obtain support for ASE's mediating role in CPT performance may be due in part to the measure used to examine attention ability. Bandura's (1986) self-efficacy theory posits that task-specific self-efficacy beliefs are influenced by past performance experiences. The CPT is a unique instrument; what the task demands is not encountered routinely in everyday life; i.e., it doesn't look like attention as we know it. Furthermore, the inherent characteristics of the task and the instructions on which performance is predicted make it difficult for subjects to fully understand what the task entails and thus unlikely able to foresee their performance accurately. Either ASE is irrelevant to attention performance or a better measure of attention (i.e., one optimal for examining attentional SE) and attentional SE should be developed. Future research can do this.

Conclusion

Attentional capability and capacity appear to influence information processing differently depending on group membership. Age, as well as attentional deficits, clearly affects this process. Conversely, the ability to monitor and adapt to stimuli confounds investigation of deficits in sustained attention. Older adults appear more consistent or, less erratic than either of the younger groups; this pattern of results, taken individually, suggests older adults are attending well to the task. Yet, this interpretation is deceiving; older adults benefit more from longer ISIs than the younger groups because of their cautious response style (ß) and cognitive slowing.

Divided attention also influences memory performance. Differences in attentional abilities and task demands relate to memory performance. related to memory encoding of complex tasks appear to explain this association. Interestingly, self-efficacy appears to play a role in memory and divided attention capacity, which may help explain some of the differences observed in performance. This possibility warrants further study in both ADHD and non-ADHD young adults as a potential strategy to improve information processing capabilities in ADHD young adults. Similarly, studies with older ADHD and non-ADHD adult populations will likely further enhance this understanding.

Limitations and Future Directions

The samples studied in this research were small ($\underline{n} = 27$, $\underline{N} = 81$). Given the small sample size, the findings of this study may not be generalizable to a larger population. Within group variance on several measures (e.g., CPT dependent measures, category cued-recall) was quite large for the ADHD sample. Large within group variance combined with small sample size may have obscured significant between group effects. However, large variability among ADHDs may be characteristic of this clinical population. To examine this possibility, future research should control for potential sources of confounding variance by matching groups on subject characteristics (e.g., intelligence, age, socio-economical background, etc.).

Another limitation of this study was that group differences on CPT Inattention hovered around the .05 level of significance, before and after co-varying ß. Participants with extreme BSI scores (i.e., the high and low ends of the Global Severity Index scale) were excluded from statistical analyses in order to bring the young and old sample sizes down to the same number of subjects as in the ADHD sample (i.e., $n = 27$). We adopted this strategy in order to address the possible violation of homogeneity of variance between groups (Hays, 1981). Specifically, this procedure of eliminating high and low scores would help to maintain mean levels within groups while attempting to achieve more comparable variance between groups. This sample reduction technique would balance the types of possible errors by throwing out highs (a conservative approach, thereby decreasing group differences) and lows (a liberal approach, thereby increasing group differences). Another approach would have been to randomly exclude cases; however, because of the small sample size, such a technique could have resulted in a very skewed sample. Instead, excluding cases based on high and low scores of self-reported psychopathology symptomotalogy, allowed for more conservative tests of our hypotheses. Future studies would benefit from a larger sample, where randomization would be an alternative and possibly better method of subject exclusion.

The potential link between attention and memory is particularly important because the complex encoding mechanisms necessary for long-term memory have been assumed to be attention demanding (e.g., Craik & Tulving, 1975). More studies with a larger subject pool and optimal measures of relevant variables are needed to further investigate attention's role in memory performance. Using a more sophisticated statistical approach (e.g., mediational analyses) to confirm prior assumptions regarding the importance of attention as well as self-efficacy (e.g., mediational analyses) will help to foster the development of models of information processing. Such findings will benefit both clinical and aging populations.

References

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: APA.

Anderson, N. D., Craik, F. I. M., & Naveh-Benjamin, M. (1998). The attentional demands of encoding and retrieval in younger and older adults: Evidence from divided attention costs. Psychology and Aging, 13, 405-423.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavior change. Psychological Review, 84, 191-215.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, New Jersey: Prentice-Hall.

Bandura, A. (1989). Regulations of cognitive processes through perceived self-efficacy. Developmental Psychology, 25, 729-735.

Barkley, R.A., (1991). The ecological validity of laboratory and analogue assesment methods of ADHD sumptoms. Journal of Abnormal Child Psychology, 19, 149-178.

Barkley, A. R. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. Psychological Bulletin, 121, 65-94.

Barkley, A. R., & Murphy, K. R. (1998). Attention-deficit hyperactivity disorder: a clinical workbook (2nd ed.). New York: The Guilford Press.

Barkley, A. R., Murphy, K. R., & Kwasnik, D. (1996). Psychological adjustment and adaptive impairments in young adults with ADHD. Journal of Attention Disorders, 1, 41-54.

Battig, W. F., & Montague, W. E. (1969). Category norms for verbal items in 56 categories: A replication and extension of the Connecticut category norms. Journal of Experimental Psychology Monographs, 80 (3, pt. 2).

Berry J. M. (1987, August). A self-efficacy model of memory performance. Paper presented at the 95th annual convention of the American Psychological Association, New York.

Berry, J. M., & West, R. L. (1993). Cognitive self-efficacy in relation to personal mastery and goal-setting across the life span. International Journal of Behavioral Development, 16 (2), 351-379.

Berry, J. M., West, R. L., & Dennehey, D. M. (1989). Reliability and validity of the memory self-efficacy questionnaire. Developmental Psychology, 25, 701-713.

Borcherding, B., Thompson, K., Krusei, M., Bartko, J., Rapoport, J. L., & Weingartner, H. (1988). Automatic and effortful processing in attention deficit hyperactivity disorder. Journal of Abnormal Child Psychology, 16, 333-345.

Broadbent, D. E. (1958). Perception and communication. London: Pergamon.

Carlson, C. L., Pelham, W. E., Swanson, J. M., & Wagner, J. L. (1991). A divided attention analysis of the effects of methylphenidate of the arithmetic performance of children with attention-deficit hyperactivity disorder. Journal of Child Psychology and Psychiatry, 32(3). 463-471.

Cavanaugh, J. C., & Green, E. E. (1990). I believe, therefore I can: Personal beliefs and memory aging. In E. A. Lovelace (Ed.), Aging and cognition: Mental processes, self-awareness, and interventions (pp. 189-230). Amsterdam: Elsevier.

Coldren, J. T., & Corradetti, K. (1997). Conceptual relations between attentional processes in infants and children with attention-deficit/hyperactivity disorder. In J. T. Enns & J. A. Burack (Eds.), Attention, Development, and Psychopathology (pp.147-167). New York: Guilford Press.

Conners, C. K. (1994). The Conners Continuous Performance Test. Toronto: Multi-Health Systems.

Conners, C. K. (1996, October). Clinical use of the Continuous Performance Test: Diagnostic utility and drug sensitivity. Paper presented at the 1996 Annual Meeting of the American College of Neuropsychopharmacology, Honolulu, HI.

Conners, C. K., Erhardt, D., & Sparrow, E. (1999). Conners' Adult ADHD Rating Scales (CAARS). Multi-Health Systems.

Cowan, N. (1995). Attention and memory: An integrated framework. Oxford: Oxford University Press.

Craik, F. I. M. (1977). Age differences in human memory. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology aging (1st ed.). New York: Van Nostrand Reinhold.

Craik, F. I. M., Govoni, R., Naveh-Benjamin, M., & Anderson, N. D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. Journal of Experimental Psychology: General, 125(2), 159-80.

Craik, F. I. M., & Jennings, J. M. (1992). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), The handbook of aging and cognition (pp.51-110). Hillsdale: Earlbaum.

Craik, F. I. M., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. Journal of Experimental Psychology: General, 104(3), 268-294.

Davies, D. R., & Parasuraman, R. (1982). The psychology of vigilance. London: Academic Press.

Deaton, J. E. (1988). Cognitive and sensory vigilance as a function of age. Unpublished doctoral dissertation. Washington, DC: Catholic University.

Deaton, J. E., & Parasuraman, R. (1993). Sensory and cognitive vigilance: Effects of age on performance and subjective workload. Human Performance, 6(1), 71-97.

Derogatis, L. R. (1986). Manual for the symptom checklist 90, revised (SCL-90). Baltimore: Author.

Derogatis, L. R. (1993). BSI: Brief symptom inventory. Minneapolis: National Computer Systems.

Dixon, R. A., Hultsch, D. F., & Hertzog, C. (1988). The Metamemory In Adulthood (MIA) questionnaire. Psychopharmacology Bulletin, 24, 671-688.

Draeger, S., Prior, M., & Sanson, A. (1986). Visual and auditory attention performance in hyperactive children: Competence or compliance. Journal of Abnormal Child Psychology, 14, 411-424.

Dykman, Ackerman, & Oglesby, (1979). Selective and sustainede attention in hyperactive, learning disabled, and normal boys. The Journal of Nervous and Mental Disease, 167, 288-297.

Enns, J. T., & Burack, J. A. (1997). Attention, development, and psychopathology. Bridging disciplines. In J. T. Enns & J. A. Burack (Eds.), Attention, development, and psychopathology (pp.3 - 28). New York: Guilford Press.

Epstein, J. N., Conners, C. K., Sitarenios, G., & Erhardt, D. (1998). Continuous Performance Test results of adults with attention deficit hyperactivity disorder. Clinical Neuropsychologist, 12(2), 155-168.

Ernst, M., Zametkin, A. J., Matochik, J. A., Liebenauer, L., Fitzgerald, G. A., Cohen, R. M. (1994). Effects of intravenous dextroamphetamine on brain metabolism in adults with attention-deficit hyperactivity disorder (ADHD): Preliminary findings. Psychopharmacology Bulletin, 30(2), 219-225.

Giambra, L. M. (1993). Sustained attention in older adults: Performance and processes. In J. Cerella, J. Rybash, W. Hoyer, & M. I. Commons (Eds.), Adult information processing: Limits on loss (pp.259-271). San Diego: Academic Press.

Giambra, L. M., & Quilter, R. E. (1988). Sustained attention in adulthood: A unique, large-sample, longitudinal and multi-cohort analysis using the Mackworth Clock-test. Psychology and Aging, 3, 75-83.

Green, D. M., & Swets, J. A. (1974). Signal detection theory and psychophysics. Huntington, New York: R. E. Krieger.

Hartley, A. A. (1992). Attention. In F. I. M. Craik & T. A. Salthouse (Eds.), The handbook of aging and cognition (pp. 3-49). Hillsdale: Erlbaum.

Hays, W. L. (1981). Statistics (3rd ed.). New York, NY: CBS College Publishing.

Hertzog, C., Hultsch, D. F. & Dixon, R. A. (1989). Evidence for the convergent validity of two self-report metamemory questionniares. Developmental Psychology, 25, 687-700.

Hinshaw, S. P. (1994). Attention deficits and hyperactivity in children. Thousand Oaks: Sage.

Hoza, B. & Pelham, W. E., (1995). Social-cognitive predictors of treatment response in children with ADHD. Journal of Social and Clinical Psychology, 14, 23-35.

Hultsch, D. F., Hammer, M., & Small, B. J. (1993). Age differences in cognitive performance in later life: Relationships to self-reported health and activity life style. Journal of Gerontology: Psychological Sciences, 48, 1-11.

Hultsch, D. F., Hertzog, C., & Dixon, R. A. (1990). Ability correlates of memory performance in adulthood and aging. Psychology and Aging, 5, 356-368.

Hultsch, D. F., Hertzog, C., Dixon, R. A., & Davidson, H. (1988). Memory self-knowledge and self-efficacy in the aged. In M. L. Howe & C. J. Brainerd (Eds.), Cognitive development in adulthood: Progress in cognitive development research (pp. 65-92). New York: Springer.

Isingrini, M., Vazou, F., & Leroy, P. (1995). Dissociation between implicit and explicit memory tests: Effects of age and divided attention on category exemplar generation and cued recall. Memory and Cognition, 23, 462-467.

James, W. (1890). Principles of psychology. New York: Holt.

Kahn, R. L., Goldfarb, A. I., Pollack, M., & Peck, A. (1960). Brief objective measures for the determination of mental status in the aged. American Journal of Psychiatry, 117, 326-328.

Klee, S. H., & Garfinkel, B. D. (1983). The computerized Continuous Performance Task: A new measure of inattention. Journal of Abnormal Child Psychology, 11, 487-496.

Licht, B. G. (1993). Achievement-related beliefs in children with learning disabilities: Impact on motivation and strategic learning. In L. Meltzer (Ed.), Strategy assessment and instruction for students with learning disabilities: From theory to practice (pp. 195-220). Austin: Pro-Ed.

Light, L. L. (1991). Memory and aging: Four hypotheses in search of data. Annual Review of Psychology, 42, 333-376.

Luszcz, M., & Hinton, M. (1995). Domain- and task-specific beliefs about memory in adulthood: A microgenetic approach. Australian Journal of Psychology, 47(1), 54-59.

Luszcz, M., Bryan, J., & Kent, P. (1996). Predicting episodic memory performance of very old men and women: Contributions from age, depression, activity, cognitive ability, and speed. Psychology & Aging, 12(2), 340-351.

Madden, D. J., & Plude, D. J. (1993). Selective preservation of selective attention. In J. Cerella, J. Rybash, W. Hoyer, & M. L. Commons (Eds.), Adult information processing: Limits on loss (pp. 273-301). San Diego: Academic Press.

McDowd, J. M., & Craik, F. I. M. (1988). Effects of aging and task difficulty on divided attention performance. Journal of Experimental Psychology: Human Perception and Performance, 14, 267-280.

McDowd, J. M., & Oseas-Kreger, D. M. (1991). Aging, inhibitory processes, and negative priming. Journal of Gerontology, 46, 340-345.

McDowd, J. M., & Shaw, R. J. (2000). Attention and aging: A functional perpective. In F. I. M. Craik and T. A. Salthouse (Eds.), The handbook of aging and Cognition (2nd ed.). New Jersey: Erlbaum.

Milich, R., & Okazaki, M. (1991). An examination of learned helplessness among attention deficit hyperactivity disordered boys. Journal of Abnormal Psychology, 19, 607-623

Mulligan, N. W., & Hartman, M. (1996). Divided attention and indirect memory tests. Memory and Cognition, 24(4), 453-465.

Mulligan, N. W. (1997). Attention and implicit memory tests: The effects of varying attentional load on conceptual priming. Memory and Cognition, 25, 11-17.

Nadeau, K. G. (1995). Life management skills for the adult with attention deficit disorder. In K. G. Nadeau (Ed.), A comprehensive guide to attention deficit disorder in adults: Research, diagnosis, and treatment (pp. 191-217). New York: Brunner-Mazel.

Norman, D. A. (1969). Memory and attention: An introduction to human information processing. New York: Wiley.

Nyberg, L., Nilsson, L. G., Olofsson, U., & Backman, L. (1997). Effects of divided attention during encoding and retrieval on age differences in episodic memory. Experimental Aging Research, 23, 137-147.

Parasuraman, R. (1984). Varieties of attention. New York: Academic Press.

Parasuraman, R., Giambra, L. M. (1991). Skill development in vigilance: Effects of event rate and age. Psychology and Aging, 6, 155-169.

Parasuraman, R., Nester, P., & Greenwood, P. (1989). Sustained-attention capacity in young and older adults. Psychology and Aging, 4, 339-345.

Pennington, B. F., Groisser, D., & Welsh, M. C. (1993). Contrasting cognitive deficits in attention deficit hyperactivity disorder versus reading disability. Developmental Psychology, 29(3), 511-523.

Plude, D. J., & Doussard-Roosevelt, J. A. (1990). Aging and attention: Selectivity, capacity, and arousal. In E. A. Lovelace (Ed.), Cognition and aging (pp. 97-133). Amsterdam: Elsevier.

Plude, D. J., Hoyer, W. J. (1985). Attention and performance: Identifying and localizing age deficits. In N. Charness (Ed.), Aging and human performance (pp.47-99). New York: Wiley.

Posner, M. I., & Boies, S. J. (1971). Components of attention. Psychological Review, 78(5), 391-408.

Rabinowitz, J. C., Craik, F. I. M., & Ackerman, B. P. (1982). A processing resource account of age differences in recall. Canadian Journal of Psychology, 36, 325-344.

Salthouse, T. A. (1982). Adult cognition: An experimental psychology of human aging. New York: Springer-Verlag.

Salthouse, T. A. (1991). Theoretical perspectives on cognitive aging. Hillsdale, NJ: Erlbaum.

Salthouse, T. A. (1993). Speed mediation of adult age differences in cognition. Developmental Psychology, 29, 722-738.

Salthouse, T. A., Rogan, J.D., & Prill, K. (1984). Division of attention: Age differences on a visually presented memory task. Memory and Cognition, 12, 613-620.

Schachar, R., & Logan, G. (1990). Are hyperactive children deficient in attentional capacity? Journal of Abnormal Child Psychology, 18(5), 493-513.

Schnedler, R. W., Pelhan, W. E., Bender, M. E., & Pass, J. E. (1982). Capacity limitations in attentional processes of hyperactive children. Paper presented at the annual meeting of the American Psychological Association, August 1982, Washington, D.C.

Seidal, W. T., & Joschko, M. (1990). Evidence of difficulties in sustained attention in children with ADHD. Journal of Abnormal Child Psychology, 18, 217-229.

Sergeant, J., & van der Meere, J. (1990). Convergence of approaches in localizing the hyperactivity deficit. In B. B. Lahey & A. E. Kazdin (Eds.), Advances in clinical child psychology (Vol. 13, pp. 207-246). New York: Plenum Press.

Smith, A. D., & Earles, J. L. K. (1996). Memory changes in normal aging. In F. Blanchard-Fields & T. Hess (Eds.), Perspectives on cognitive change in adulthood and aging (pp. 192-220). New York: McGraw-Hill.

Somberg, B. L., & Salthouse, T. A. (1982). Divided attention abilities in young and old adults. Journal of Experimental Psychology: Human Perception and Performance, 8, 651-663.

Spencer, T., Wilens, T., Biederman, J., Faraone, S. V., Ablon, J. S., Lapey, K. (1994). A double-blind, crossover comparison of methylphenidate and placebo in adults with childhood-onset attention-deficit hyperactivity disorder. Archives of General Psychiatry, 52(6), 434-443.

Sykes, D. H., Douglas, V. I., & Morgenstern, G. (1973). Sustained attention in hyperactive children. Journal of Child Psychology & Psychiatry & Allied Disciplines, 14(3), 213-220

Thackray, R. I., & Touchstone, R. M. (1981). Age-related differences in complex monitoring performance. Washington, D.C.: U.S. Government Printing Office.

Tun, P. A., & Wingfield, A. (1995). Does dividing attention become harder with age? Findings from the divided attention questionnaire. Aging and Cognition, 2(1), 39-66.

Van der Meere, J., & Sergeant, J. (1987). A divided attention experiment with pervasively hyperactive children. Journal of Abnormal Child Psychology, 15(3), 379-392.

Weiss, G., & Hechtman, L. (1993). Hyperactive children grown up. New York: Guilford Press.

West, R. L, Crook, T. H., & Barron, K. L. (1992). Everyday memory performance across the life span: Effects of age and noncognitive individual differences. Psychology and Aging, 7(1), 72-82.

Zametkin, A. J., Nordahl, T. E., Gross, M., King, A. C., et al. (1990). Cerebral glucose metabolism in adults with hyperactivity of childhood onset. New England Journal of Medicine, 323(20), 1361-1366.

Footnotes

[1]Although a substantial literature exists on examination of attention and memory processes in childhood ADHD samples, studies investigating these domains in adults with ADHD is extremely sparse. Therefore, unless otherwise indicated, the literature reviewed here refer to findings in the child-ADHD population. Hypotheses regarding adult-ADHD functioning based on childhood findings are supported by research that indicates that many of the same underlying dysfunctions present in childhood remain in adulthood (Conners, personal communication, 2/26/99). For example, adults with ADHD perform similarly to children on a continuous performance task of vigilance (Epstein, et al., 1998). Neuro-imaging studies with ADHD children (e.g., Ernst, et al., 1994) find the same right frontal processing deficits that were previously indicated in adults with ADHD (Zametkin et al., 1990). Moreover, response to medication is about the same in both ADHD adults and ADHD children (Spencer, et al., 1995).

[2]The sample was restricted to males in this study because of sex differences in the presentation and manifestation of ADHD symptomotology.

[3]Because the CPT Monitoring/Adapting Skill factor was correlated with BSI subscales of interpersonal sensitivity (.23, $p < .05$), depression (.40, $p < .001$), paranoid ideation (.32, $p <$ 01), and psychoticism (.29, $p < .05$), an ANCOVA was conducted to assess group differences on the CPT Monitoring/Adapting Skill factor when the effects of these BSI subscales are removed. Group differences did not change, $F(2,74) = 12.84$, $MSE = .66$, $p < .001$. Bonferroni's test yielded the same pattern of performance across groups.

[4]TOTSEST = [(((PSEST) / (# of items)) / 100) + (((NPSEST) / (# of items)) / 100) / 2].

Table 1

Barkley's CCSS means (standard deviations) by group

	Group		
	Younger	ADHD	Older
Current Symptoms:			
Inattention	5.52 (3.48)	12.33 (4.44)	5.41 (5.09)
Hyperactivity/Impulsivity	7.19 (3.55)	12.19 (5.86)	4.59 (3.34)
Total	12.71 (5.13)	24.52 (8.97)	10.00 (6.38)
Childhood Symptoms:			
Inattention	7.30 (4.92)	19.26 (6.09)	5.74 (3.83)
Hyperactivity/Impulsivity	7.22 (5.20)	15.07 (7.30)	4.04 (3.52)
Total	14.52 (8.66)	34.33 (11.94)	9.78 (6.80)

Table 2

Conners' Adult ADHD Rating Scales (CAARS) means (standard deviations) by group

	Group		
	Younger	ADHD	Older
Inattention/Memory Problems	45.52 (9.19)	57.37 (9.22)	49.59 (6.58)
Hyperactivity/Restlessness	46.11 (8.04)	55.52 (9.15)	47.41 (7.29)
Impulsivity/Emotional Lability	44.81 (6.43)	47.89 (10.07)	47.04 (8.44)
Problems with Self-Concept	46.15 (7.15)	49.07 (9.14)	48.00 (8.14)
DSM-IV Inattention	54.85 (11.00)	73.30 (10.17)	46.48 (11.26
DSM-IV Hyperactive – Impulsive	49.22 (9.73)	58.81 (14.89)	45.30 (9.37)
DSM-IV ADHD Symptoms Total	53.56 (9.65)	70.22 (11.32)	45.96 (11.20)
ADHD Index	46.30 (5.78)	54.59 (8.16)	47.04 (8.55)

Table 3

Characteristics of the original sample (N = 92); means (standard deviations), ANOVAs, and post-hocs

	Group				
	Younger	ADHD	Older	F (2,89)	Scheffé
Education	15.67 (2.43)	14.70 (1.66)	15.84 (2.54)	2.08	
Self-rated health	4.48 (.62)	4.37 (.69)	4.19 (.64)	1.73	
ETS vocabulary	21.77 (4.92)	21.74 (5.51)	26.34 (7.24)	6.11**	1 < 3, 2 < 3
WAIS-R digit-symbol	70.30 (10.56)	67.33 (16.94)	40.91 (9.96)	77.17***	1 > 3, 2 > 3

Note. For Scheffé post-hoc differences, 1 = Young, 2 = ADHD, 3 = Older.

*p < .01. **p < .001.

Table 4

Characteristics of the analyzed sample (N = 81); means (standard deviations), ANOVAs, and post-hocs

	Group				
	Younger	ADHD	Older	$F(2, 79)$	Scheffé
Education	15.85 (2.40)	14.70 (1.66)	15.93 (2.06)	2.99	
Self-rated health	4.52 (.58)	4.37 (.69)	4.15 (.66)	2.26	
ETS vocabulary	22.12 (5.24)	21.74 (5.51)	26.70 (6.32)	6.06**	1 < 3, 2 < 3
WAIS-R digit-symbol	70.56 (10.90)	67.33 (10.58)	39.15 (17.26)	74.06***	1 > 3, 2 > 3

Note. For Scheffé post-hoc differences, 1=Young, 2=ADHD, 3=Older.

**$p < .01$. ***$p < .001$.

Table 5

Correlations between BSI Subscales and Performance measures (CPT Inattention and Monitoring/Adapting Skill; Memory Recall)

	Somatization	OC	IS	DEP	ANX	HOS	PHOB	PAR	PSY	Inattention	Monitoring/ Adapting Skill
Obsessive-Compulsive	-.040										
Interpersonal Sensitivity	.459**	-.029									
Depression	.430**	.029	.766**								
Anxiety	.662**	.008	.654**	.598**							
Hostility	.436**	.035	.633**	.596**	.542**						
Phobia	.603**	-.024	.444**	.315**	.568**	.318**					
Paranoid Ideation	.324**	-.052	.675**	.734**	.487**	.680**	.325**				
Psychotic	.541**	.002	.641**	.733**	.580**	.634**	.538**	.679**			
Inattention	.012	-.090	-.003	.099	-.018	.012	.067	.060	.028		
Monitoring/Adapting Skill	-.015	.090	.225*	.395**	.193	.185	.049	.315**	.285**	.000	
Memory Recall	.026	.105	.127	.055	.084	.133	.038	.123	.027	-.515**	.345**

*$p < .05$. **$p < .01$.

Table 6

Performance means (standard deviations) on CPT subscales by group

	Group		
	Younger	ADHD	Older
Omissions	60.93 (14.18)	65.29 (17.91)	79.56 (18.40)
Commissions	46.75 (10.54)	46.29 (11.42)	46.81 (9.28)
Hit Reaction Time	53.38 (10.68)	51.10 (13.19)	44.66 (7.83)
HRT Standard Error	47.45 (11.09)	53.62 (14.31)	58.46 (8.31)
Standard Error Variability	43.42 (8.49)	50.63 (10.58)	57.27 (8.27)
HRT Block Change	49.22 (11.67)	52.33 (10.98)	50.35 (17.27)
HRTSE Block Change	49.35 (7.56)	48.88 (8.54)	46.26 (9.37)
HRT ISI Change	59.27 (10.41)	66.06 (15.28)	47.85 (10.50)
HRT ISI SE Change	50.57 (5.50)	54.25 (9.47)	44.90 (10.86)

Table 7

CPT performance means (standard deviations) and factor loadings

		Factors			
	Performance	Inattention	Monitoring/ Adapting Skill	Impulsivity	Consistency
OMNS	68.59 (18.54)	**.638**	-.371	.402	.002
COMNS	46.62 (10.32)	.038	-.215	**.908**	-.002
HITRT	50.38 (11.54)	-.526	-.083	**.800**	-.004
HITRTSE	53.18 (12.22)	**.847**	.244	-.375	.112
SDs	50.44 (10.69)	**.895**	.148	-.086	-.027
HITRTBC	50.63 (13.49)	.072	-.148	-.118	**.873**
HITSEBC	48.16 (8.52)	-.043	.380	.146	**.708**
HRTISIC	57.72 (14.29)	.065	**.819**	-.187	.048
HSEISIC	49.91 (9.61)	.120	**.880**	-.118	.042

Note. OMNS = omission errors; COMNS = commission errors; HITRT = hit reaction time; HITRTSE = hit reaction time standard error; SDs = variability of standard errors; HITRTBC = hit reaction time block change; HITSEBC = hit reaction time standard error block change; HRTISIC = hit reaction time inter-stimulus interval (ISI) change; HSEISIC = hit reaction time standard error ISI change.

Table 8

Group means (standard deviations), ANOVAs, and post-hocs on CPT Factors before equating ß

	Group				
	Younger	ADHD	Older	F(2,78)	Scheffé
Inattention	-.66 (.65)	-.05 (.95)	.71 (.88)	18.26***	1 < 2, 1 < 3, 2 < 3
Monitoring/ Adapting Skill	.20 (-.66)	54 (1.03)	-.73 (.90)	15.92***	1 > 3, 2 > 3
Impulsivity	.10 (1.00)	.06 (1.22)	-.17 (.74)	.572	
Consistency	.01 (.94)	.08 (.90)	-.09 (1.17)	.187	

Note. For Scheffé post-hoc differences, 1=Young, 2=ADHD, 3=Older.

***$p < .001$.

Table 9

Group means (standard errors), ANOVAs, and post-hocs on CPT Factors after equating ß

	Group				
	Younger	ADHD	Older	$\underline{F}^a$	Scheffé
Inattention	-.51 (.15)	.00 (.15)	.50 (.15)	10.34***	1 < 2, 1 < 3
Monitoring/ Adapting Skill	.15 (.17)	.52 (.16)	-.67 (.17)	9.46***	1 > 3, 2 > 3
Impulsivity	.14 (.20)	.08 (.19)	-.22 (.20)	.854	
Consistency	.01 (.20)	.07 (.20)	-.06 (.21)	.109	

Note. For Scheffé post-hoc differences, 1 = Young, 2 = ADHD, 3 = Older.

[a]After equating groups on ß.

***$p < .001$.

Table 10

DAQ subscale means (standard deviations), ANOVAs and post-hocs by group

	Group				
	Younger	ADHD	Older	F(2,78)	Scheffé
Subscale:					
Difficulty	45.43 (7.93)	54.72 (12.67)	55.26 (16.82)	4.88*	1 < 2, 1 < 3
Change	62.06 (8.43)	60.91 (8.39)	73.25 (7.23)	19.46***	1 < 3, 2 < 3
Frequency	80.49 (8.83)	82.14 (16.24)	74.40 (12.24)	2.74	

Note. For Scheffé post-hoc differences, 1 = Young, 2 = ADHD, 3 = Older.

*$p < .01$. ***$p < .001$.

Table 11

Performance means (standard deviations) on the category cued-recall task by group

	Group		
	Younger	ADHD	Older
Attentional Load:			
O digits	.34 (.15)	.34 (.20)	.16 (.13)
1 digits	.33 (.16)	.33 (.17)	.11 (.12)
3 digits	.28 (.17)	.30 (.14)	.10 (.10)
5 digits	.24 (.17)	.20 (.14)	.06 (.10)

Table 12

Self-efficacy measure means (standard deviations), ANOVAs, and post-hocs by group

	Group				
	Younger	ADHD	Older	F(2,78)	Scheffé
ASEQ:					
PPRED	307.30 (16.56)	289.85 (39.09)	286.26 (43.75)		
NPPRED	28.70 (4.91)	24.19 (6.48)	27.85 (5.13)	5.05**	1 > 2
PSEST	73.14 (17.49)	66.05 (17.47)	61.36 (16.18)	3.23*	1 > 3
NPSEST	78.15 (14.58)	72.69 (13.72)	68.47 (17.21)		
WAQ	3.28 (.39)	2.49 (.41)	3.17 (.58)	22.68***	1 > 2, 2 < 3
MIA:					
Capacity	3.53 (.48)	3.04 (.42)	2.91 (.65)	10.60***	1 > 2, 1 > 3
Change	3.47 (.34)	3.20 (.43)	2.63 (.59)	4.95***	1 > 3, 2 > 3

Note. For Scheffé post-hoc differences, 1 = Young, 2 = ADHD, 3 = Older.

*p < .05. **p < .01. ***p < .001.

Table 13

Correlations of attentional self-efficacy measures with memory performance

	MIA Change	MIA Capacity	DAQ Difficulty	DAQ Change	WAQ	Total Recall	Inattention
ASE TOTSEST	.24*	.17	-.12	-.29**	.64	.20	-.34**
MIA Change		.55***	-.51***	-.62***	.23*	.47***	-.43***
MIA Capacity			-.52***	-.31**	.49***	.35**	-.39***
DAQ Difficulty				.31**	-.38***	-.29**	.25*
DAQ Change					.02	-.47***	.42***
WAQ						-.12	-.18
Total Recall							-.52***

*p < .05. ** p < .01. *** p < .001.

Table 14

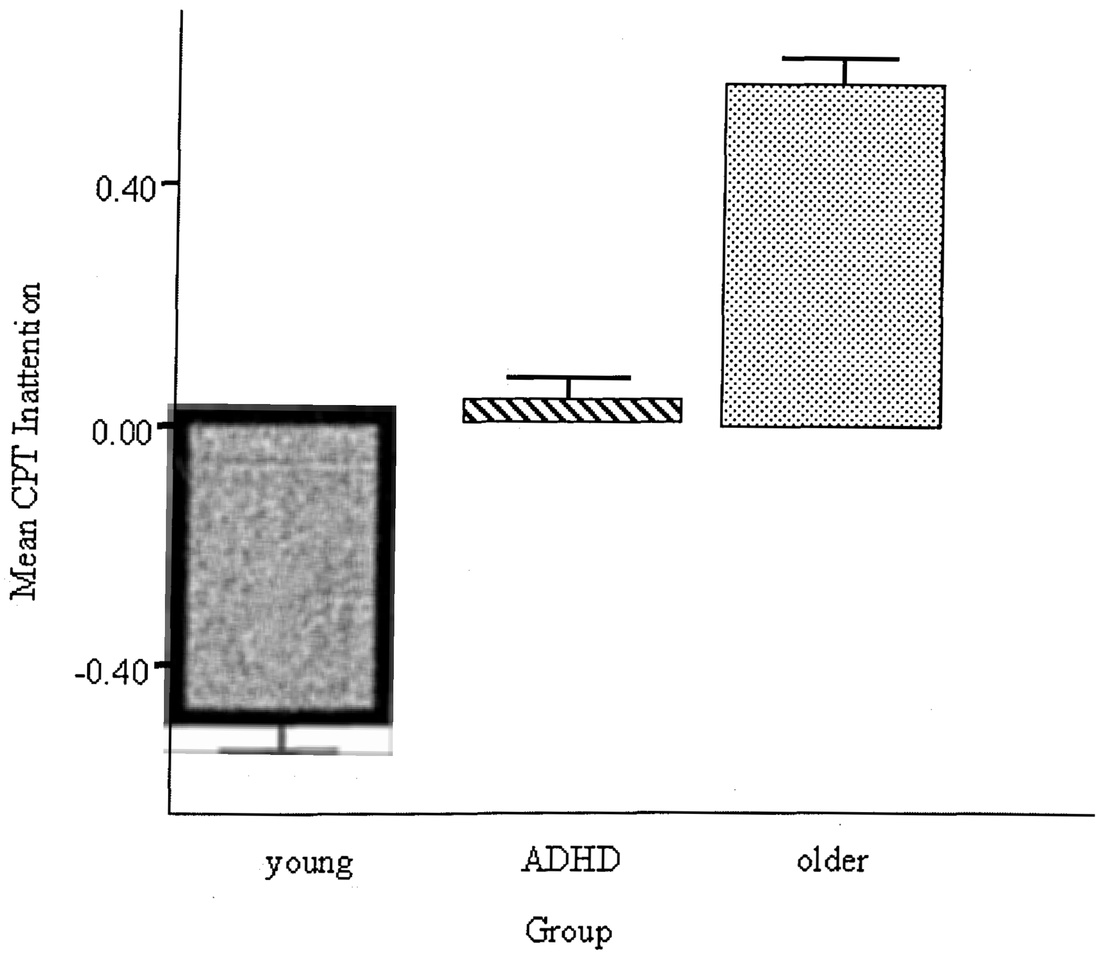
Attentional self-efficacy as a mediator of attentional performance

Variables	df	Mean Square	F	Sig.
CPTBETA	1	10.35	18.07	.000
GROUP	2	5.92	10.34	.000
CPTBETA	1	8.96	15.96	.000
TOTSEST	1	.99	2.21	.141
GROUP	2	4.51	8.49	.000

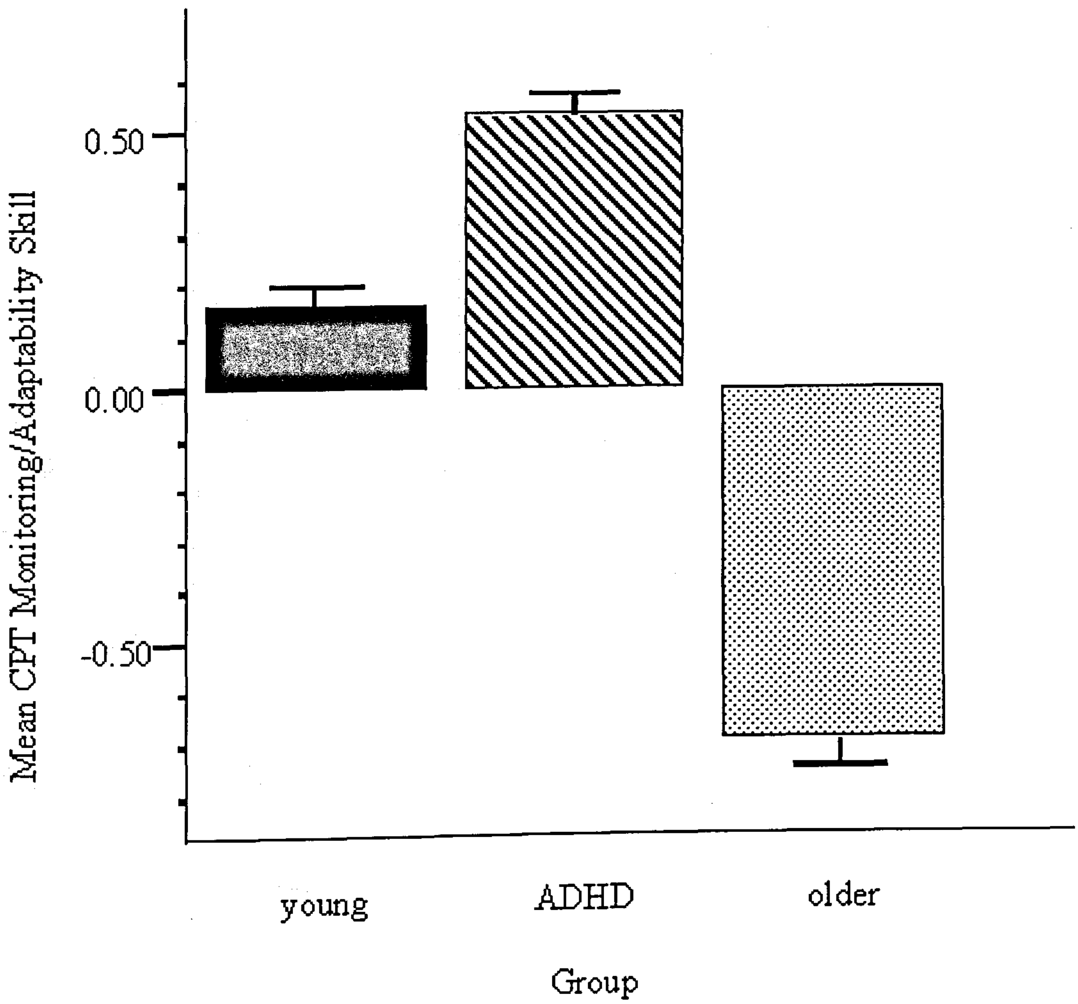
Table 15

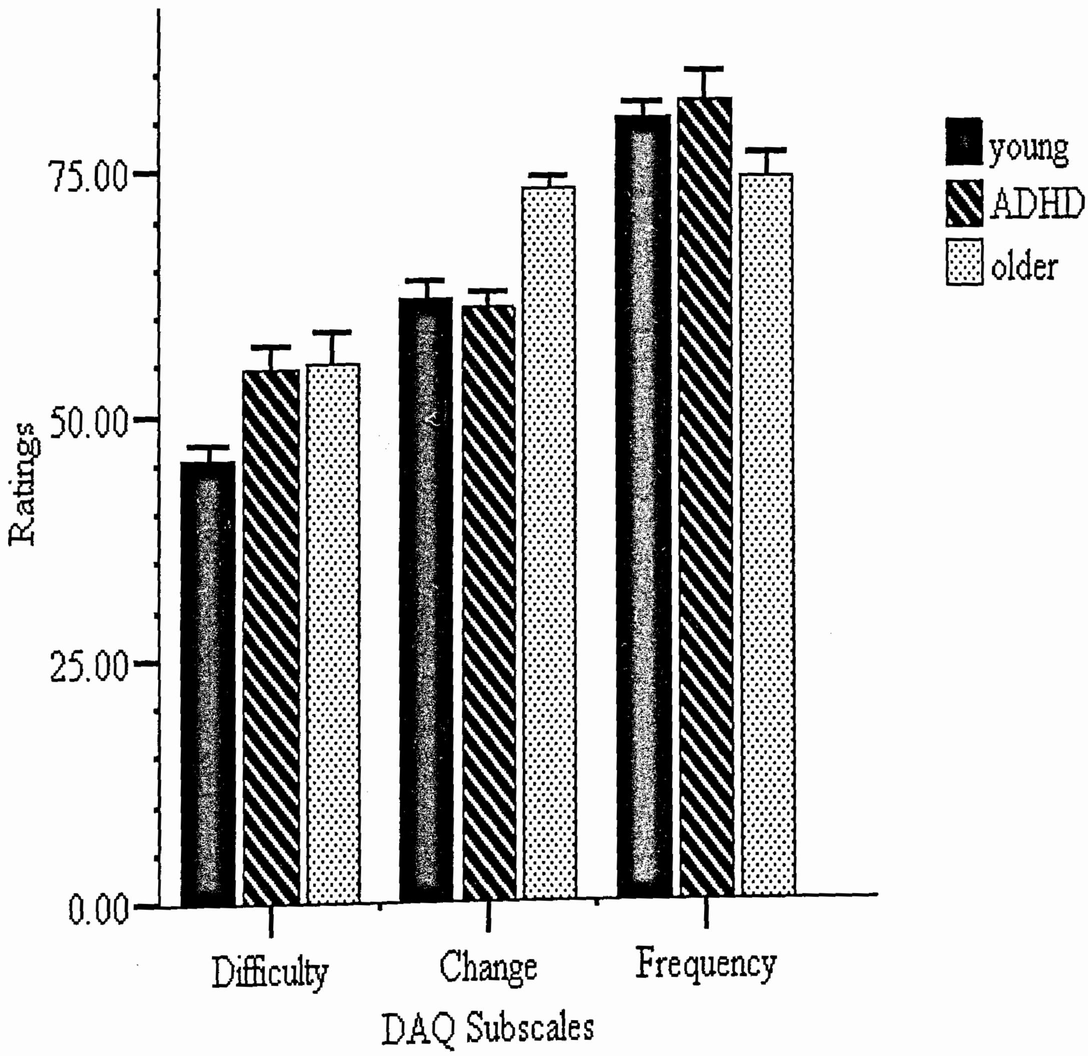
Memory self-efficacy as a mediator of memory performance

Variables	df	Mean Square	F	Sig.
GROUP	2		31.12	.000
MIACAP	1	.03	2.63	.11
MIACHA	1	.01	.10	.76
GROUP	2	.17	17.38	.000

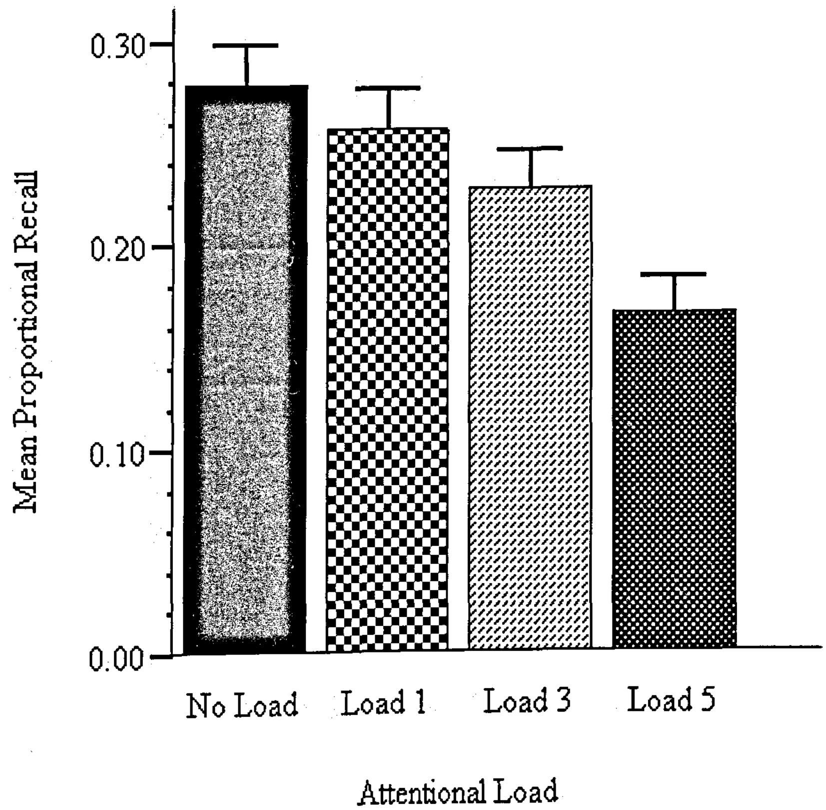


0.40
0.00
-0.40
Mean CPT Inattention
young
ADHD
older
Group

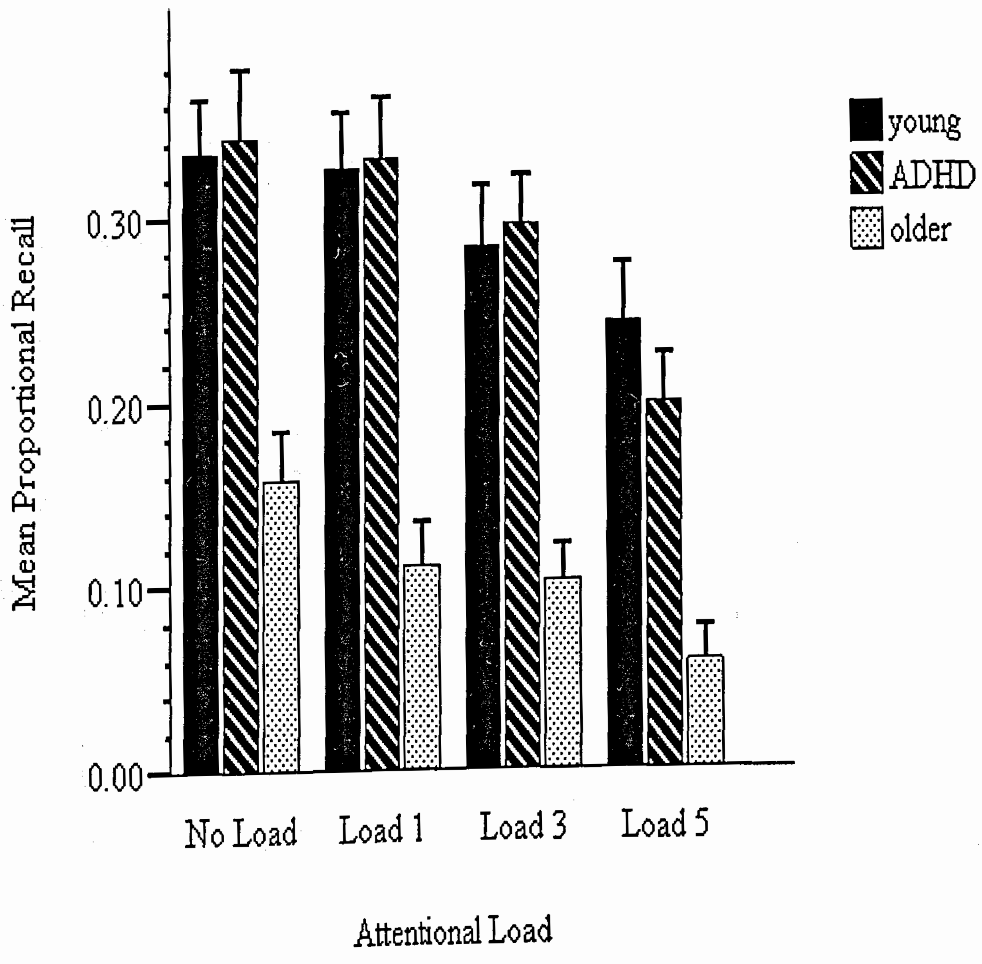

Mean CPT Monitoring/Adaptability Skill
0.50
0.00
-0.50
young
ADHD
older
Group

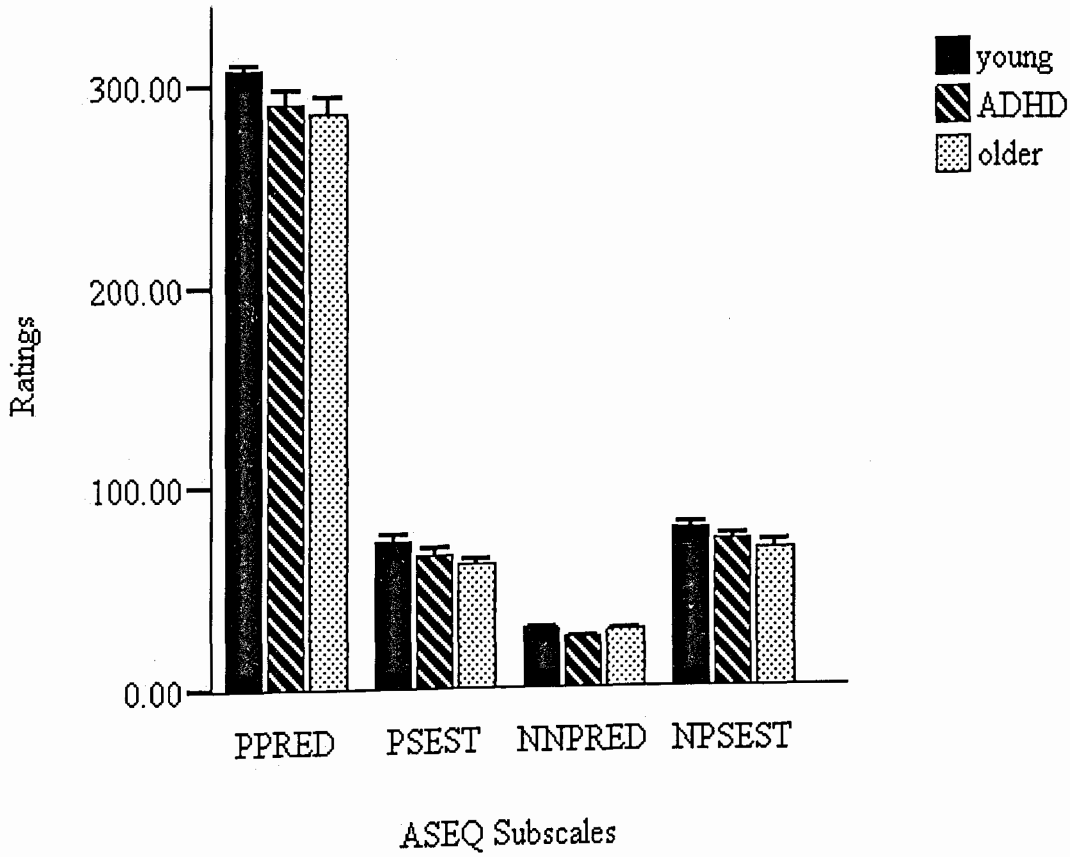


75.00
50.00
25.00
0.00
Ratings
Difficulty
Change
Frequency
DAQ Subscales
young
ADHD
older

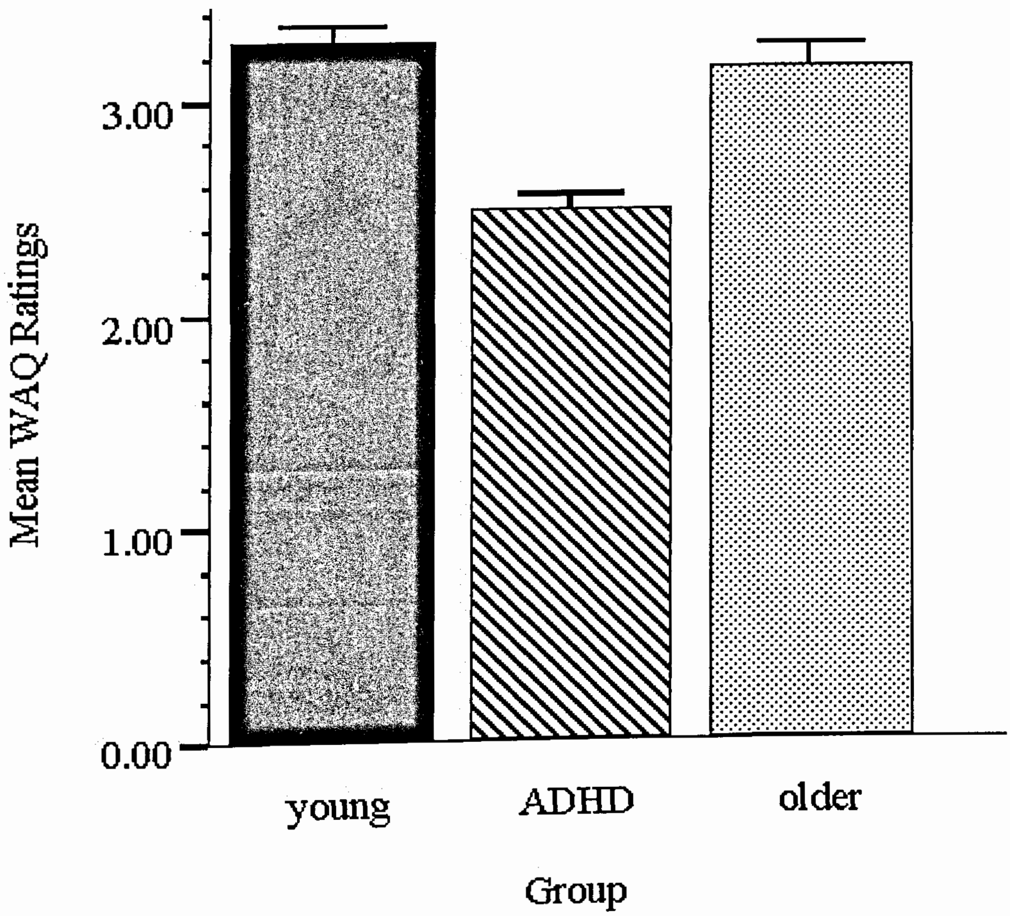


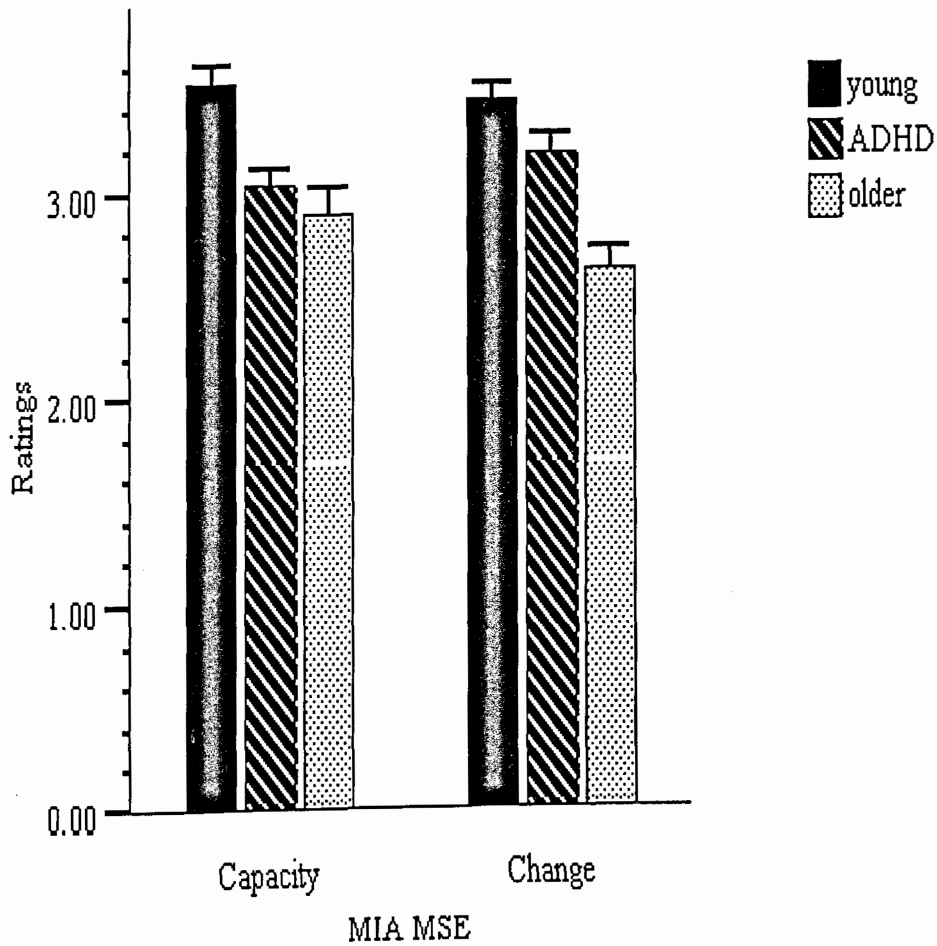
0.30
0.20
0.10
0.00
Mean Proportional Recall
No Load
Load 1
Load 3
Load 5
Attentional Load


young
ADHD
older
Mean Proportional Recall
0.30
0.20
0.10
0.00
No Load
Load 1
Load 3
Load 5
Attentional Load



300.00
200.00
100.00
0.00
Ratings
PPRED
PSEST
NNPRED
NPSEST
ASEQ Subscales
young
ADHD
older


Mean WAQ Ratings
3.00
2.00
1.00
0.00
young
ADHD
older
Group


Ratings
3.00
2.00
1.00
0.00
Capacity
Change
MIA MSE
young
ADHD
older

Appendix A

Telephone Interview

Name: ______________________ Date: ______________________

Subject #: ______________________ Time: ______________________

Date of Birth: ______________________ Interviewer: ______________________

Age: ______________________ Occupation: ______________________

1. Have you been diagnosed with ADD or ADHD?

   a. NO
   b. YES

   If yes, ask 2 - 11
   If no, go to 9 - 11

2. When were you diagnosed with ADD/ADHD?

3. Who diagnosed you with ADD/ADHD?

   Clinician's Name: ______________________

   Address: ______________________

   ____

4. What are or were his/her training credentials (i.e., specialty or training background of diagnosing clinician, e.g., PhD in clinical psychology, or, MD in psychiatry, etc.)?

5. Are you currently seeing a therapist or psychiatrist?

   a. NO
   b. YES
   If yes, details:

   Clinician's Name: ______________________

   Address: ______________________

Appendix A

Telephone Interview

1. What sort of treatment have you received in the past for ADD/ADHD?

2. What sort of treatment do you receive now?

3. What medications have you taken in the past to treat ADHD and what, if any, do you take now?

<u>Past</u>

Drug: ____________________

Dosage: __________________ mg.

Drug: ____________________

Dosage: __________________ mg.

<u>Current</u>

Drug: ____________________

Dosage: __________________ m

4. Have you ever been diagnosed with bipolar disorder?

   a. NO
   b. YES

   If yes, details:

5. Have you ever been diagnosed with any other psychological disorder?

   c. NO
   d. YES

   If yes, details:

6. Do you currently have any medical problems? [<u>Interviewer</u>: This question has to do with the body, i.e. physical health (not the mind, or mental health)]

   a. NO
   b. YES

   If yes, details (including medications):

INTERVIEWER'S COMMENTS:

Appendix B

Barkley and Murphy's Current and Childhood Symptom Scales

Permission to reproduce this measure could not be obtained by the copyright holder. A copy of this measure can be obtained from:

The Guilford Press

72 Spring Street

New York, NY 10012

Appendix C

Conners' Adult ADHD Rating Scale

Permission to reproduce this measure could not be obtained by the copyright holder. A copy of this measure can be obtained from:

Multi-Health Systems Inc.

908 Niagara Falls Blvd.

North Tonawanda, New York 14120-2060

Appendix D

ETS Vocabulary Test

Permission to reproduce this measure could not be obtained by the copyright holder. A copy of this measure can be obtained from:

Educational Testing Service

Princeton, New Jersey

Appendix E

Mental Status Questionnaire

IV. Information and Orientation Questionnaire

1. What is the name of this place?
2. Where is it located? (address)
3. What is today's date?
4. What is the month now?
5. What is the year?
6. How old are you?
7. When were you born? (month)
8. When were you born? (year)
9. Who is the president of the United States?
10. Who was the president before him?

Appendix F

Divided Attention Questionnaire (DAQ)

We are interested in how difficult it is to combine two activities at once, for example, to carry on a conversation while driving a ca Please consider this combination: driving while talking with someone. Decide **how difficult** you find this situation to be, from very easy" to "medium" to "very difficult," and place a check on the slot under that answer. Next consider **how much the difficulty of this situation has changed** for you over the last 10 years. Has it become "easier," was there "no change," or has become "harder"? Now indicate in the last **column how frequently you encounter that situation**. How many times in an average month do you find yourself driving and talking to someone at the same time: "none," a "few" times (1 to 6 times a month), C "often" (more than 6 times a month). Put a check under the best answer. Please answer these questions for each item. Thank you.

	How difficult is this?					***Change in the last 10 years***			***Times per month***		
	very easy	easy	medium	hard	very hard	easier	no change	harder	none	few (1-6)	often (>6)
1) Driving while talking with someone.	___	___	___	___	___	___	___	___	___	___	___
2) Driving while reading road signs to exit from a highway.	___	___	___	___	___	___	___	___	___	___	___
3) Driving while listening to music on the radio.	___	___	___	___	___	___	___	___	___	___	___
4) Driving while planing a schedule or a shopping list.	___	___	___	___	___	___	___	___	___	___	___
5) Watching TV while reading a book or newspaper.	___	___	___	___	___	___	___	___	___	___	___
6) Talking with someone while a television show is on in the room.	___	___	___	___	___	___	___	___	___	___	___
7) Talking while playing cards.	___	___	___	___	___	___	___	___	___	___	___

Appendix F

Divided Attention Questionnaire (DAQ)

	How difficult is this?					***Change in the last 10 years***			***Times per month***		
	very easy	easy	medium	hard	very hard	easier	no change	harder	none	few (1-6)	often (>6)
8) Talking to someone in the midst of a crowd of people talking.	___	___	___	___	___	___	___	___	___	___	___
9) Talking to someone while preparing a meal or doing chores.	___	___	___	___	___	___	___	___	___	___	___
10) Walking while having a conversation with someone.	___	___	___	___	___	___	___	___	___	___	___
11)Talking on the phone while checking a calendar or appointment book.	___	___	___	___	___	___	___	___	___	___	___
12)Talking on the phone while someone in the room is talking to you.	___	___	___	___	___	___	___	___	___	___	___
13)Listening to music on the radio while reading or doing paperwork.	___	___	___	___	___	___	___	___	___	___	___
14)Listening to someone talk while planning your reply.	___	___	___	___	___	___	___	___	___	___	___
15)Trying to remember a person name while you are being introduced.	___	___	___	___	___	___	___	___	___	___	___
16)Doing household chores while thinking about other things.	___	___	___	___	___	___	___	___	___	___	___

Appendix G

Memory Task Word Lists

Word List A		Word List B	
watermelon	shoulder	softball	walnut
strawberry	mouth	bowling	chestnut
apricot	heart	skiing	willow
cantaloupe	tooth	badminton	sycamore
pineapple	stomach	volleyball	evergreen
blueberry	elbow	wrestling	hickory
stereo	mustard	vulture	cucumber
cabinet	thyme	pigeon	radish
bureau	chocolate	oriole	turnip
bookcase	nutmeg	parrot	celery
footstool	ketchup	woodpecker	squash
radio	vinegar	blackbird	cabbage
leopard	barracuda	lavender	tango
squirrel	minnow	silver	mambo
donkey	bluefish	maroon	polka
giraffe	flounder	turquoise	limbo
rabbit	marlin	violet	modern
buffalo	shrimp	indigo	ballet
harmonica	closet	trousers	butterfly
viola	bathroom	jacket	hornet
cello	foundation	stockings	cricket
banjo	stairway	undershirt	cockroach
piccolo	chimney	scarf	centipede
bassoon	elevator	gloves	termite

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

INSTRUCTIONS

Different people use their memory in different ways in their everyday lives. For example, some people make shopping lists, whereas others do not. Some people are good at remembering names, whereas others are not.

Different people also use their attention in different ways. For example, some people work better in a quiet environment, whereas others do not. Some people are good at paying attention to the things they need to, whereas others do not.

In this questionnaire, we would like you to tell us about your memory and attention abilities. There are no right or wrong answers to these questions because people are different. Please take your time and answer *each* of these questions to the best of your ability.

Each question is followed by five choices. Draw a circle around the letter corresponding to your choice. Mark *only* one letter for each statement.

Some of the questions ask your opinion about memory-related statements; for example:

My memory will get worse as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

In this example you could, of course, choose any *one* of the answers.
If you agree strongly with the statement you would circle a. If you disagree strongly you would circle letter e. The b and d answers indicate less strong agreement or disagreement. The letter c answer gives you a middle choice, but don't use the c unless you really can't decide on any of the other responses.

Some of the questions ask your opinion about attention-related statements; for example:

I am good at attending to details.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Again, you could choose any *one* of the answers.

Keep these points in mind.
(a) Answer *every* question, even if it doesn't seem to apply to you very well.
(b) Answer as honestly as you can what is true for *you*. Please do not mark something because it seems like the "right thing to say."

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*	
1. I have difficulty taking notes during a lecture or seminar.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
2. I am good at remembering names.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
3. I find my mind wandering from tasks that are uninteresting or difficult.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
4. I know of someone in my family whose memory improved significantly in old age.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
5. I am forgetful in daily activities.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
6. I frequently have trouble focusing my attention.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
7. I am good at remembering titles of books, films, or plays.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
8. I find it harder to sufficiently prepare for class when there are other interesting things to do.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*		
9.	I am good at remembering birthdates.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
10.	I can remember things as well as always.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
11.	It is easy for me to concentrate on what I am doing while the TV/radio are on.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
12.	After I have read a book I have no difficulty remembering factual information from it.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
13.	I find it difficult to read written materials unless it is very interesting or very easy.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
14.	I'm less efficient at remembering things now than I used to be.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
15.	I am good at attending to details.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
16.	The older I get the harder it is to remember clearly.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

17.	I am always able to listen carefully to what others are saying.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
18.	I am just as good at remembering as I ever was.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
19.	I have no trouble keeping track of my appointments.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
20.	I consider myself to have a relatively short attention span.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
21.	I have no trouble remembering lyrics of songs.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
22.	I have a tendency to tune out or drift away in the middle of a page or conversation.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
23.	My memory has improved greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
24.	Especially in groups, I find it hard to stay focused on what is being said in conversations.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

25.	I find it difficult to direct my attention to important sounds in my immediate environment while ignoring others.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
26.	I am good at remembering things like recipes.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
27.	I am poor at remembering trivia.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
28.	I am much worse now at remembering the content of news articles and broadcasts than I was 10 years ago.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
29.	I've always been known as a "quick" learner.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
30.	Compared to 10 years ago, I am much worse at remembering titles of books, films or plays.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
31.	It is easy for me to maintain my attention during a speech/presentation.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
32.	I remember my dreams much less now than 10 years ago.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

33.	I can always complete a task correctly without needing to hear the instructions repeated.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
34.	I often miss key elements of a conversation or lecture.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
35.	My memory has declined greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
36.	I have no trouble following a conversation.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
37.	I am good at remembering the content of news articles and broadcasts.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
38.	I misplace things more frequently now than when I was younger.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
39.	As people get older they tend to forget where they put things more frequently.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
40.	I have difficulty reading without losing my place.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

41.	Compared to 10 years ago, I now forget many more appointments.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
42.	I often need to reread a paragraph to understand it.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
43.	I always write grammatically correct letters without omitting necessary words or adding/repeating unnecessary words.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
44.	I am usually able to remember exactly where I read or heard a specific thing.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
45.	My memory for important events has improved over the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
46.	I can never sustain my attention during tasks or fun activities without difficulty.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
47.	Remembering the plots of stories and novels is easy for me.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
48.	I have difficulty reading without leaving out words.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

49.	I am good at remembering the order that events occurred.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
50.	I can always balance my checkbook without making careless errors.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
51.	I am good at following through on instructions.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
52.	I am good at remembering conversations I have had.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
53.	It is hard for me to shift my attention back and forth from one complicated task to another.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
54.	My memory for phone numbers will decline as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
55.	I always work steadily without difficulty.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
56.	My memory for dates has greatly declined in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

57.	I never lose things necessary for tasks or activities.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
58.	My memory for names has declined greatly in the last 10 years.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
59.	I often forget who was with me at events I have attended.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
60.	My memory will get better as I get older.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
61.	I can always attend solely to a lecturer and disregard other activities going on in the room.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
62.	I am good at remembering the places I have been.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
63.	I consider myself to have a relatively short attention span.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
64.	I am good at organizing tasks and activities.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

Appendix H

MIA Memory-Self-Efficacy and WAQ Attentional Self-Efficacy Questionnaire

Memory & Attention Questionnaire *(continued)*

65.	I have difficulty persisting at work that requires sustained mental effort.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
66.	I tend to daydream a lot.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
67.	I have no trouble remembering where I have put things.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
68.	I am good at remembering names of musical selections.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly
69.	It is hard for me to pay attention to things I need to.	a. agree strongly b. agree c. undecided d. disagree e. disagree strongly

CPT Questionnaire

The Continuous Performance Test (CPT) is a vigilance, or attention test. It takes 14 minutes to complete. The letters are presented at a varied rate, that is, some are presented faster or slower than others. Therefore, you never know when the next letter will appear, or whether or not you will need to respond.

There are two ways to make a correct response:

(1) bar press immediately after the appearance of any letter A through Z, excluding X

(2) no bar press immediately after appearance of letter X only.

Before performing the actual task, I'd like you to answer some questions.

Appendix I

Attentional Self-Efficacy Questionnaire (ASEQ)

One way to make a correct response is to bar press immediately after the appearance of any letter A through Z, excluding X.

I will make _____ out of 324 total possible correct responses (bar pressing immediately after the appearance of any letter A through Z, excluding X)

Now estimate how certain you are that you will make correct responses to the number of letters indicated in the ranges below. Circle a percentage for each range to indicate how certain you are that you can make that number of correct responses. 0% means "completely uncertain" that you will respond correctly to that number of letters and 100% means "completely certain" that you will respond correctly to that number of letters.

	Completely uncertain	....	....	....	....	....	....	....	....	....	**Completely certain**
I can make 0 to 49 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 50 to 99 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 100 to 149 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 150 to 199 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 200 to 249 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 250 to 299 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 300 to 302 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 303 to 305 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 306 to 308 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 309 to 311 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 312 to 314 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 315 to 317 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 318 to 320 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 321 to 323 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make all 324 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix I

Attentional Self-Efficacy Questionnaire (ASEQ)

NO BAR PRESS

The second way to make a correct response is to not bar press immediately after the appearance of letter X only.

I will make _____ out of 36 total possible correct responses (no bar press immediately after appearance of letter X only)

Now estimate how certain you are that you will make correct responses to the number of letters indicated in the ranges below. Circle a percentage for each range to indicate how certain you are that you can make that number of correct responses. 0% means "completely uncertain" that you will respond correctly to that number of letters and 100% means "completely certain" that you will respond correctly to that number of letters.

	Completely uncertain…									…**Completely certain**
I can make 0 to 5 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 6 to 10 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 11 to 15 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 16 to 20 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 21 to 25 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 26 to 30 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make 31 to 35 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I can make all 36 correct responses.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix J

Counterbalanced Task Orders

	Task Order
1	RECALL-CPT-DS-ETS-CAARS-BSI
2	CPT-RECALL-DS-ETS-CAARS-BSI
3	RECALL-CPT-DS-ETS-BSI-CAARS
4	CPT-RECALL -DS-ETS-BSI-CAARS
5	RECALL-CPT-ETS-DS-CAARS-BSI
6	CPT-RECALL -ETS-DS-CAARS-BSI
7	RECALL-CPT-ETS-DS-BSI-CAARS
8	CPT-RECALL -ETS-DS-BSI-CAARS

RECALL → Memory Task
CPT → Attention Task
DS → WAIS-R Digit Symbol
ETS → Vocabulary Test
BSI → Brief Symptom Inventory
CAARS → Conners' Adult ADHD Rating Scale