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Comparison of Memory in College Students with and without Attention Deficit Hyperactivity Disorder: A Study of Argument Recall Accuracy

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COMPARISON OF MEMORY IN COLLEGE STUDENTS WITH AND WITHOUT ATTENTION DEFICIT HYPERACTIVITY DISORDER: A STUDY OF ARGUMENT RECALL ACCURACY

BY

Jordan Poll

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING THIS PART OF THE GRADUATE DEGREE CITED ABOVE

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Comparison of Memory in College Students with and without Attention Deficit Hyperactivity Disorder: A study of argument recall accuracy

Abstract

The memory abilities of college-aged adolescents (18-24) with ADHD were investigated using arguments. Previous ADHD research provides insight into ADHD's association with a decreased capability to recall important parts of statements. Students read a booklet containing 24 arguments to assess their ability to recall each argument. Participants read one statement, then, immediately after reading it, attempted to accurately recall it by writing it using paper and pencil. This process was repeated 24 times (total of 24 arguments). The researcher examined, specifically, the percent of correctly recalled predicates from those read arguments. Predicates were examined because it has been shown that students who can more accurately recall predicates of arguments, can more accurately evaluate that argument. The researchers accounted for the effect that reading skill has on recall ability by treating it as a co-variate. Results showed that participants with ADHD did not significantly differ in their average verbatim or gist memory for predicates of arguments after accounting for reading skill. However, a significant relation was found between ADHD and reading skill (i.e., ADHD status is associated with lower reading skill), and between reading skill and accurate recall (i.e., higher reading skill is associated with higher recall accuracy). ADHD was not directly associated with recall accuracy. However, it appears that ADHD may have had an indirect effect on recall accuracy. The implication of the study is discussed.

Comparison of Memory in College Students with and without Attention Deficit Hyperactivity Disorder: A study of argument recall accuracy

Introduction

The purpose of this thesis was to assess memory issues associated with Attention Deficit Hyperactivity Disorder (ADHD), specifically during late adolescence, 18 to about 24 years old. In the current research, an important time of development and a transition from high school to college, was investigated. This transition comes with challenges, such as balancing between freedom and responsibility, adjusting to higher level reading and writing, amassing content knowledge on a variety of topics, and recalling that knowledge. These challenges may be more problematic for adolescents with ADHD. A brief review of ADHD and the difficulties associated with the disorder are presented below.

ADHD is defined as a "persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development" by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013, p. 59). This pattern of behavior must be characterized by at least six symptoms of inattention including failure to give attention to details, difficulty sustaining attention, a lack of listening when spoken to, a lack of follow through on instructions, a failure to finish schoolwork, difficulty with organization of tasks, avoidance of tasks that include sustained mental effort, and easily distracted behavior. The behavior may also be associated with hyperactivity and impulsivity characterized by at least six symptoms including fidgeting, leaving their seat, running and climbing during inappropriate times, inability to engage in activities quietly, excessive talking, blurting out answers, difficulty

waiting their turn, and interruption of others. Some of these symptoms must be present before age 12 and in at least two settings. The symptoms also must interfere with social, academic, or occupational functioning. ADHD is often associated with delays in language development, impaired academic performance, or cognitive problems, such as attention, executive function, or memory. ADHD occurs in 5% of children and 2.5% of adults and has been shown to be associated with reduced performance in school and academics. This is manifested later in life as troubles with occupational performance, attendance, and attainment. The inattentive symptoms seem to be linked to deficits in academics and school, and peer neglect (DSM-5; American Psychiatric Association, 2013).

ADHD affects many aspects of children's lives, but it especially interferes with performance in school. Problems in attention, working memory, planning, organization, and disruptive and aggressive behaviors influence academic success for these individuals. Subjects such as reading, writing, math, science, and social studies may become too difficult to succeed in. Of the problems listed above, a main issue is that these children lack the ability to hold information in their mind, and therefore, may not be able to perform at the same level as their peers. This phenomenon is related to problems in memory.

The current study examined an area associated with school performance called argumentation. Research on arguments suggests that precision is key to accurate evaluation of arguments. Specifically, research shows those who remember the precise nature of the elements of arguments, also evaluate the same arguments (Dandotkar, Magliano, & Britt, 2015) or a different set of arguments (Britt, Kurby, Dandotkar, & Wolfe, 2008) well. In

other words, accurately evaluating arguments seems to rely on how well one retains the argument elements. Memory for arguments was assessed in students with ADHD and without symptoms of ADHD. The significance of argument memory in academic success is described below.

An argument consists of a claim and a reason (Toulmin, 1958). Claims make a statement (i.e., "The death penalty is ineffective"), and are supported by a reason (i.e., "because criminals are not scared of it"). The claims of arguments are further broken down into themes and predicates (Britt et al., 2008). The theme in the above example is "death penalty," making the predicate, "is ineffective." The predicate of an argument is essentially the central idea of the statement that determines whether a reason does or does not support the claim, making it the most crucial element to remember. By precisely knowing the predicate of an argument, one is much more likely to successfully evaluate the argument. This key detail makes the recall of argument predicates vastly critical in the academic setting. High memory for predicates matter for better evaluation of arguments (Britt et al., 2008; Dandotkar, Magliano, & Britt, 2015), making predicate recall a valuable tool for college students. The current study hypothesized that students with ADHD symptoms may also show poor memory for predicates similar to their poor memory for central ideas in a story. The following describes why ADHD may be associated with poor predicate recall.

Previous research suggests that individuals with ADHD have difficulties in several areas of academic literacy, particularly in memory and reading skills. For example, ADHD was shown to be associated with the strategic recall of words that were assigned values based on importance (Castel et al., 2011). In this study, participants with

ADHD could not recall the more important words as well as their non-ADHD peers. Low reading skills were found to be associated with ADHD as well (Miller et al., 2013). When examining the skills of participants to recall the central ideas of stories, Miller and colleagues found that ADHD was connected to markedly lower scores than typically developing peers. This information in the context of arguments is central, because in essence the predicate of an argument is the central idea of the argument.

The goal in the current study was to examine whether college students with ADHD would be different in their memory for predicates of arguments than those without ADHD. To accomplish this goal, the following paragraphs outline previous research on ADHD's relationship to memory and to reading, and then the connection between memory and reading.

Relationship between ADHD and memory

Children with ADHD are found to have issues with several aspects of memory. For instance, Miller, Keenen, Betjemann, Willcutt, Pennington, and Olsen (2013) found that the ability to identify and recall central ideas of stories was negatively affected by ADHD. In this study participants were asked to read stories and recall the important parts of what they just read. The participants' recall responses were scored on their ability to selectively recall the important parts of the story. "Important" story parts were identified by calculating the ideas that had the most connections to other ideas in the story. It was found that the verbal recall of central information was lower for ADHD than non-ADHD groups. Those with ADHD were less able to identify and recall the central ideas of stories.

Similarly, Ahmadi et al. (2013) found that memory was lower in an ADHD group when compared to typically developing peers. Participants in this study completed a recall task based on the construct called iconic memory. Essentially, iconic memory is the picture or representation of an image that is produced in a person's brain. It consists of two components, visible persistence and informational persistence. The overall weakness in iconic memory associated with ADHD presented by Ahmadi et al. shows that the disorder is associated with lower visual and auditory memory abilities.

Further evidence showed poor memory in individuals with ADHD by examining the ability to selectively memorize words. Words were given values of importance and participants were to put an emphasis on memorizing high value words. By comparing ADHD to non-ADHD participants, Castell et al. (2011) found that the ADHD group was less selective than controls in recalling high-value items.

A study by Dovis et al. (2015) compared the working memory and short-term memory ability of participants with ADHD-Combined Type, ADHD- Inattentive Type, and typically developing peers. The researchers used rating scales, parent and teacher interviews, and a battery of memory tasks including subtests from the WISC-III. Results showed that 58.1% of the ADHD-Combined Type, 33.3% of the ADHD-Inattentive Type, and 9.7% of the typically developing group were impaired on working memory. The differences between all groups were significant. The researchers also compared the three groups' short-term memory. It was found that 40.7% of the ADHD-Combined Type, 18.5% of the ADHD-Inattentive Type group, and 9.7% of the typically developing group were impaired in short-term memory. The differences between the ADHD-Combined Type and the typically developing group were significant. These results show

the lower than expected working memory and short-term memory abilities for individuals with ADHD, especially for those with the combined type.

Relationship between ADHD and reading skills

ADHD is found to have a connection with a number of features of low reading abilities. For example, Willcutt et al. (2005) found that reading and language abilities were lower for those with ADHD. Participants in this study completed a battery of neuropsychological measures assessing decoding including phoneme awareness, phonological decoding, and orthographic coding (all lower level reading measures). Tasks requiring reading and language skills were shown to be significantly more difficult for individuals with ADHD.

Likewise, semantic language deficits, reading underachievement, and verbal working memory were examined by Gremillion and Martel (2012). ADHD was found to be linked to lower levels on all of these factors. This was determined through the use of IQ assessments, achievement tests, and parent and teacher ADHD rating scales.

A study conducted by Greven et al. (2012) similarly found that reading skills were lower for individuals with ADHD. This research compared parent ratings of their child's ADHD symptoms with the teacher's rating of the child's reading skills. ADHD symptoms were found to be significantly correlated with reading problems.

Reading skills and ADHD symptoms were assessed by having children read aloud from age-appropriate passages and by administering the Conners' parent and teacher rating scales (Luoni et al., 2015). First, participants with ADHD had significantly slower reading speed. Further, the researchers found that the odds of encountering reading disorders was 18.13 times greater in children identified as having ADHD like behaviors

than their counterparts. Finally, the odds of encountering attention problems or signs of hyperactivity were 17.97 times greater in the poor readers group. These findings illustrate the strong relationship between ADHD and reading issues.

Relationship between memory and reading skills

As discussed in the sections above, it appears that students with ADHD in academic settings have issues both with memory and with reading. This section presents the relationship between one's reading skills and memory for information. It seems reasonable to expect a positive correlation between reading skills and one's memory. After all, a better memory for information requires one to read well first. As an example, Nithart et al. (2011) used measures of phonological processing to evaluate memory abilities. It was found that those with high phonological memory had higher reading scores. This is not surprising because strong phonological memory is required to maintain an accurate sequence of letter sounds (phonemes).

Additionally, scores on a reading test called the National Adult Reading Test compared with memory and attention scales showed that poor memory, attention, and working memory abilities were associated with increased errors in reading. Even when controlling for age, level of education, and socioeconomic status, the same result was found. Poor reading test scores were correlated with deficits in episodic and working memory (Frick et al., 2011).

Further, Floyd et al. (2012) found that low memory is related to low reading skills. These researchers, based on several achievement test subtests and reading measures, found that increased processing speed and short-term memory were associated

with higher reading comprehension. More importantly, participants' memory-related skills were directly linked to their decoding skills when reading.

Argument Literature

Research on arguments suggests that readers who read well also tend to remember the precise nature of predicates well when compared to their low-skilled counterparts (Britt et al., 2008). In this study, participants read simple two-clause (claim-reason) arguments one at a time, evaluated the arguments, after which participants were asked to recall the argument in as close to the exact words as possible. Participants' recall responses were coded for the theme (topic) and predicate (main verb) of the claim. Additionally, participants took a timed reading comprehension test, and the scores were utilized to group participants into skilled and less-skilled readers. Finally, participants were given a packet with a new set of arguments and were asked to evaluate (Flawed Judgment Task) whether each argument was structurally acceptable or flawed based only on the structure of the argument and not based on their beliefs about it. The authors found that skilled readers' memory for argument elements was better than less-skilled readers'. More importantly, there was no difference in skilled and less-skilled readers' memory for themes, but these readers differed in their memory for the predicates. In other words, although less-skilled readers remembered the topic of the claim as well as their skilled counterparts, what they could not do as well was remember the exact nature of the claim, the predicate.

Furthermore, Britt et al. (2008) found that memory for a critical element of arguments is a strong predictor of one's ability to evaluate arguments. Participants, based on their predicate-recall score, were classified as skilled and less-skilled predicate

recallers by a median-split. Participants' score on the flawed judgment task was examined between skilled and less-skilled recallers by using their reading skill as a covariate. Results showed that the participants with higher predicate recall abilities were more effective at correctly evaluating arguments than those whose memory for predicates was poor. In other words, while remembering the predicates well seem to help one evaluate arguments well, one's reading skill seems to help, at least, to some extent how well one remembered the predicates. A complete glossary of argument, reading, and memory terms is presented in Appendix 6 and Appendix 7.

Working Memory Literature

It is thought that individuals with ADHD have poor memory because of a working memory deficit. This phenomenon was documented in Fried et al.'s (2016) research on working memory and related educational outcomes of children with ADHD, which showed that significantly more youth with ADHD had working memory deficits than controls (31.9% vs 13.7%, $p < .05$). Additionally, the working memory deficits in children with ADHD were found to be significantly ($p < .01$) associated with an increased risk for grade retention and placement in special education classes as well as lower scores on reading and math achievement tests than for ADHD children without working memory deficits. Identifying students with ADHD with working memory deficits may help identify those at higher risk for academic problems.

Another study on the relationship between working memory and ADHD was conducted by Kasper, Alderson, and Hudec (2012). Results revealed large between-group (ADHD vs. non-ADHD) effect sizes on verbal and nonverbal working memory tasks.

These findings suggest that children with ADHD have significant working memory deficits compared to their non-ADHD peers.

ADHD and associated working memory deficits may be caused by several factors, including the prefrontal cortex (PFC), which is considered to play a large role by encoding, updating, and maintaining internal representations in working memory (D'Ardenne et al., 2011). In this study, D'Ardenne and colleagues used functional Magnetic Resonance Imaging (fMRI) techniques to identify activity in regions of the PFC during a working memory task. They also used single-pulse transcranial magnetic stimulation (TMS) to disrupt PFC activity while participants completed the same working memory task. They found increased activity in the PFC and that TMS pulses to the PFC impacted the ability to encode information during the memory task. It appears PFC has an impact on working memory, and that a compromised PFC is less effective at memory tasks.

In summary, ADHD, reading skills, and memory skills seem to be interrelated. Individuals with ADHD tend to have lower reading skills and deficits in memory, including working memory. Memory and reading skill are highly correlated as well, making it difficult at times to differentiate between memory deficits and reading deficits. These interrelationships are summarized below.

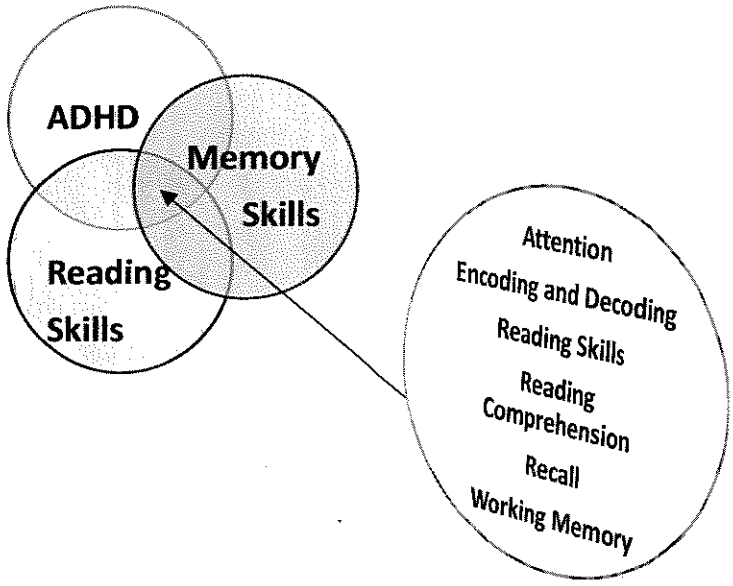

Figure 1. Interrelationship among ADHD, Reading Skills, and Memory Skills (For more detailed interrelationships, refer to Appendix 7)

Overview of the Current Study

The present study extends previous research in two ways. First, the vast majority of the research literature on ADHD is focused on children's behavior symptoms (i.e., attention, focus, flexibility, and inhibition) that affect learning. The current study targets college age individuals (18-24), who are typically better suited to regulate their behavior. Since the impact of behavior on academic performance has already been well established, this study aimed to examine other factors associated with academic success. Additionally, an attempt was made to examine, likely for the first time, the ability of individuals with ADHD to recall predicates of arguments.

Hypotheses and Predictions

It was hypothesized that adolescents with ADHD would have poorer memory for predicates when compared to those without ADHD. This hypothesis predicted an interaction between ADHD status and claim element (themes vs. predicates). Particularly, it was predicted that the difference in the recall scores between themes and predicates of

argument-claims, after equating participants on their reading skill, would be greater for students with ADHD when compared to their counterparts. In other words, individuals with ADHD would recall the arguments less accurately in general, recall themes more accurately than predicates to a greater degree than non-ADHD participants, and would have lower memory for predicates.

Support for Hypotheses and Predictions

This hypothesis was based on previous research on individuals with ADHD showing an inability to identify central ideas of stories (Miller et al., 2013). For example, in the argument; "The death penalty is ineffective because criminals are not scared of it", the predicate is, "is ineffective." The hypothesis in the present study essentially stated that those with ADHD would not recall predicates of claims (i.e., "is ineffective") as well as those without ADHD and in turn would not get a clear representation of arguments. In a claim, the predicate (or verb) is the most central part to understanding the argument and ADHD is associated with difficulties capturing the central idea of text.

ADHD is linked to a lack of ability to identify central ideas of stories compared to those without ADHD. This relates to the current study because predicates are the central idea of arguments. When a passage is comprehended, a mental representation of what is read is built and connections are formed between ideas of the passage that are related to one another (Miller et al., 2013). The ideas with the highest number of connections emerge as central, or important, to the overall message of the passage. This lack of ability to identify central ideas of stories could be associated with lower capabilities of recalling central portions of arguments (i.e., predicates).

Further evidence for this hypothesis came from support for a deficit in memory associated with ADHD. ADHD was shown to negatively impact iconic memory (Ahmadi et al., 2013). Memory abilities are vital when examining predicate recall accuracy. Since ADHD status has been shown to affect memory, it was assumed that adolescents with

ADHD would have less accurate recall of predicates due to memory deficits.

Having the ability to select what is important, attending to that information, and then recalling the high-value items is how memory is efficiently used (Castel et al., 2011). It has been shown that ADHD is associated with lower abilities in efficiently recalling important items. In predicate recall, the accurate recall of the important piece of the argument is assessed. The knowledge that ADHD affects recall of high-value items suggests that recall of predicates could be poor.

In Bolden et al.'s 2012 study, Short-term memory (i.e., the capacity for holding information in a readily available state for a short period of time) and articulatory rehearsal (i.e., verbally repeating information) were examined in boys with ADHD compared to controls. Phonological short-term storage capacity and articulatory rehearsal were shown to be impaired for participants with ADHD, meaning they were less able to retrieve and express information. These results lead to the hypothesis that the memory of individuals with ADHD and their ability to recall what they have just read are impaired. This information lead to the assumption that individuals with ADHD would be less able to recall predicates of arguments compared to those without ADHD.

Additional evidence for the hypothesis came from support for a deficiency in reading and language skills associated with ADHD (Willcutt et al., 2005). ADHD is shown to negatively impact reading and language skills compared to those without ADHD. This suggests that participants may be less able to precisely recall predicates due to a lack of reading and language abilities.

Jacobson et al. (2011) found that reading fluency was lower for individuals with ADHD compared to those without ADHD. Reading fluency's association with reading achievement scores in school make it an important factor when examining reading abilities in adolescents. Gremillion and Martel (2012) found that high numbers of ADHD symptoms are shown to be linked with lower semantic language ability, verbal working

memory, and reading underachievement. This relationship between ADHD and low language, memory, and reading ability suggest a clear deficit in individuals with ADHD. This supported the decision to control for reading skill in the current study. Thus, showing, specifically, the effect of ADHD on recall.

Memory, attention, and working memory have been shown to affect reading ability (Frick et al., 2011). Since the current study examined memory of texts that have been read while controlling for reading skill, strictly the memory abilities of individuals with ADHD were addressed. This provided information on recall abilities of adolescents with ADHD regardless of reading ability.

Britt et al. (2008) found that less skilled readers have a lower ability to recall predicates of arguments. This research provided support for the effect of reading ability on recall of written texts and that reading skill directly affects predicate recall. The conclusion that ADHD status predicts reading abilities signals that ADHD status could affect predicate recall. Thus, reading skills was controlled for in this study.

Often, when reading, students only create a gist representation of the text. This means that readers are not creating a verbatim memory of what they read, instead they are creating a less precise, gist, representation (Britt et al., 2008). The idea of not creating precise representations of texts can be examined through research on arguments (See Appendix 6. Argument Terms). The ability to detect flaws and generate ideas that counter arguments requires knowing the precise use of words and their meaning. This is a skill that depends on knowing the exact wording of the text read. "An argument is an attempt to persuade a reader or listener to accept an assertion (referred to as the claim) by providing one or more supporting reasons" (p. 53). Essentially, arguments test the ability to clearly understand a statement. Arguments involve a claim with support using a set of reasons. The reason should provide the required support of the claim. By examining the predicates of claims of arguments in the present study, the logical relationship between

argument elements are seen and text coherence is observed. The argument becomes coherent because of the predicate. Claims are the part of the argument that guide the activation of relevant knowledge and beliefs. In the present study, specifically, the predicate of the claim was examined. "The predicate is the main verb or predicate adjective in the claim" (p. 54). A reader imprecisely recalling a claim predicate has been shown to relate to problems in comprehension and evaluation of arguments (Appendix 5 presents a complete list of arguments).

Although it is known that there is an impairment in memory and reading ability of those with ADHD, this phenomenon has not been examined through arguments. The current research is beneficial to the ADHD literature because it addresses the crucial ability for creating a clear representation of nonfiction text. The study presents support for the importance of argument recall abilities in ADHD, reading, and memory research. The following research question was addressed in the current study; after accounting for reading skill, are adolescents with ADHD less able than non-ADHD peers to precisely recall argument claim predicates?

Method

Participants

One hundred and four undergraduate students from the Introductory Psychology courses at Eastern Illinois University participated in the study for course credit. Among the participants, twenty-eight (26.9%) were male and seventy-six (73.1%) were female. The average age for participants was 19.8, average GPA was 2.94, and average ACT score was 21.33. Twenty (19.2%) participants were identified as having symptoms consistent with ADHD and eighty-four (80.8%) were not. Seven of the twenty participants identified with the ADHD screener were currently taking ADHD medication. Participants were recruited from the SONA system, a research participation pool in the Psychology Department. Participants were assigned to the ADHD group if they were identified as showing ADHD symptoms using the screening measure, the Adult ADHD Self-Report Scale (ASRS-V1.1) Symptom Checklist, or if they indicated they had a current diagnosis of ADHD. The checklist was completed individually using pen and paper during data collection sessions. Informed consent was required to participate in this study. The participants were grouped using ADHD status as "ADHD" and "non-ADHD" groups.

Measures

Argument Booklet. The argumentation task was used to assess for proportion of accurately recalled elements (themes and predicates). Students read a booklet containing 24 arguments from Britt et al.'s (2008) article and were assessed on their ability to recall each argument. Students began by reading one argument and answering an agreement question about the argument (i.e., Do you agree with this argument? Y/N) in order to

determine how well the participants evaluated the arguments (Appendix 5). Participants were instructed to decide (i.e., circle one) if the argument is "logically flawed" or "logically OK," regardless of whether they agree with it or not. In addition, on a 6-point Likert Scale (1, Definitely Flawed to 6, Definitely Not Flawed), participants rated how confident they were about whether or not the argument was flawed.

Then, immediately after reading it, participants turned the page and attempted to accurately recall the statement using paper and pencil. This process was repeated 24 times (total of 24 arguments). The items were presented in order and included a claim (separated into theme and predicate) and a reason (included in Appendix 5). For example: "People should drive SUVs because they are safer in an accident." In this example, the claim is, "People should drive SUVs," including the theme, "SUVs," and the predicate, "should drive." The reason is, "because they are safer in an accident." This list of arguments was used to assess for predicate recall accuracy. In this study, recall of the "reason" portion of the argument, and the agreement question were not considered.

Recall accuracy was scored using two separate methods. In the first method, participants received credit for recalling the predicate of the argument and credit was also given for synonyms of words in the predicate. In the second scoring method, participants only received credit for responses that recalled the predicate verbatim. Scoring was completed by the principal investigator.

This measure was selected due to its use in previous research in Britt et al.'s (2008) study. It was shown to be a useful measure for assessing participants' ability to evaluate and recall arguments.

Reading Assessment: The Woodcock-Johnson-III Tests of Achievement (Woodcock, McGrew, & Mather, 2001) was used to measure reading comprehension. This test was administered in a "fill in the blank" format and included twenty questions. Questions increased in difficulty as they progressed. The initial question read, "Reptile eggs look a lot like bird eggs. Some are almost perfectly _____ like ping-pong balls; others are oblong." The correct answers that received credit were, "round(ed)," "circular," or "shaped." The final most difficult question read, "In the 19th century, politicians were rewarded for having booming oratorical voices or an imposing physical presence. Successful political leaders have always been those who _____ best to the dominant communications medium of the day." The credited responses were, "adapt," "conform," "play," or "respond." All questions either received a 1 for a correct response or a 0 for an incorrect response. It was administered in paper and pencil format. All twenty questions were administered to each participant and were scored based on number of items answered correctly out of twenty. The scores on this measure were used as the co-variate when analyses were conducted. According to the Woodcock-Johnson-III (Woodcock, McGrew, & Mather, 2001) Examiner's Manual, the comprehension measure "require[s] the person to read a short passage and identify a missing key word that makes sense in the context of that passage. The items become increasingly difficult by removing pictorial stimuli and by increasing passage length, level of vocabulary, and complexity of syntactic and semantic cues." The test, when administered in the way outlined by the Woodcock-Johnson-III administration guidelines has a median reliability of .83 in the age 5 to 19 range and .88 median reliability in the adult range. These reliability statistics were calculated for administration where the questions are read aloud one at a time. This

measure was selected due to its adaptability for administration to a large group of participants and high reliability.

Attention Deficit Hyperactivity Disorder Scale. The Adult ADHD Self-Report Scale (ASRS-V1.1) Symptom Checklist was the ADHD screening measure used (Appendix 4). The Symptom Checklist was developed in conjunction with the World Health Organization (WHO), and the Workgroup on Adult ADHD that included a team of psychiatrists and researchers consisting of Lenard Adler, MD (New York University Medical School), Ronald C. Kessler, PhD (Harvard Medical School), and Thomas Spencer, MD (Harvard Medical School). The Symptom Checklist consists of the eighteen DSM-IV-TR criteria and participants indicated if they "Never," "Rarely," "Sometimes," "Often," or "Very Often" exhibited the listed behavior over the past 6 months. The participants were classified into the ADHD group if they answered four of the first six symptoms as "Often," or "Very Often." Items on the measure included questions about how often the individual has trouble wrapping up details of projects, has difficulty getting things in order when doing tasks that require organization, has problems remembering obligations, delays starting tasks, fidgets and squirms, and has feelings of being overly active. The authors of the scale (Adler, Kessler, & Spencer) indicated that if the individual answers in that fashion then "the patient has symptoms highly consistent with ADHD in adults and further investigation is warranted." The first six questions were reported to be the most predictive of symptoms consistent with ADHD. This measure was selected due to its utility as a screening measure. For the purposes of this study, participants were separated into ADHD and non-ADHD groups based upon results from this measure. This tool was not, however, intended to diagnose students with ADHD.

Procedure

Approval to conduct this study on human subjects was received from Eastern Illinois University's Institutional Review Board (IRB). Participants were recruited through the Psychology Department research pool. Students enrolled in Introductory Psychology courses were required to participate in research. This study was posted on the department's research participation online system, SONA, for students to sign up to participate. A schedule was posted for the study that included multiple days and times, and participants reported to the designated classroom of their choice. Data were collected by the primary researcher in a group setting in classrooms, and took about one hour. Participants were allowed to leave upon completing all materials, or if they wished to terminate participation.

To ensure confidentiality, all measures were number coded, and participants were identified by the code on their respective packet. No identifying information, such as name was required, and only aggregate data were reported. Data were saved in a password secured file and computer, and the paper and pencil task was stored in a locked filing cabinet in the thesis supervisor's office, where only the primary researcher and his supervisor could access it. Records (including those who formally withdrew) will be permanently deleted or shredded after three years.

Upon entering the classrooms, participants were first given the Consent to Participate form (Appendix 1), which informed them of their rights, including confidentiality and the voluntary nature of the study, the procedure for the study, and whether or not risk was involved. A signed consent was required for participation.

Once consent was signed, participants were given a packet that included, in order, demographic questions, the Woodcock-Johnson-III (Woodcock, McGrew, & Mather, 2001) reading comprehension test, and the Adult ADHD Self-Report Scale (ASRS-V1.1) Symptom Checklist. However, the measures in the packet were handed out one by one, as participants turned in each completed measure to the examiner, in order to avoid going back and forth between measures. At the end, participant received a debriefing statement in writing explaining the purpose of the study and providing community resources in case ADHD is an issue for some participants.

As indicated before, participants read arguments one at a time out of a packet. After reading each argument, participants responded on whether they agreed or disagreed with the argument to assess for evaluation accuracy. The agreement question was not analyzed in the current study. Participants then turned the page of the packet and were prompted to recall the argument by writing their memory of the argument. Arguments were presented one at a time using a paper packet of arguments (Appendix 5). Participants individually read through the packet. The first page presented the argument and agreement question and the second page was blank and participants attempted to recall the argument from memory and write it on the blank page. After participants attempted to recall, they turned the page and read the next argument. All materials were administered in person and one-hour of course credit was given to those who participated.

Results

Differences in reading comprehension scores between the ADHD and non-ADHD groups were first examined. Students in the ADHD group had significantly lower average reading comprehension scores ($M = 8.14$, $SD = 2.66$) than the students in the non-ADHD group ($M = 9.44$, $SD = 2.77$), $t(103) = -1.94$, $p = .03$ (one-tailed), $d = .47$.

A 2 x 2 mixed factorial ANCOVA with claim element (theme vs. predicate) as the within-subjects factor, ADHD status as the between-subject factor, and reading skill as a covariate was conducted using participants' scores from the recall task. The proportion of accurately recalled themes/predicates is the dependent variable (the number of correctly recalled themes/predicates out of the number of total themes/predicates). It was predicted that adolescents with ADHD would recall predicates of claims with less accuracy than those without ADHD after accounting for reading skill.

The analysis of recall accuracy for the first scoring method (only the number of synonyms of themes and predicates accurately recalled) did not yield a significant interaction of ADHD status and claim element, $F(1, 101) = .32$, $p = .58$. Likewise, there was no significant main effect of ADHD status, $F(1, 101) = 2.19$, $p = .14$. However, there was a significant main effect of claim element, $F(1, 101) = 60.29$, $p < .001$. Themes (i.e., "uniforms") were recalled significantly more accurately ($M = .95$, $SD = .12$) than predicates (i.e., "should be required") ($M = .86$, $SD = .21$) regardless of ADHD status and after accounting for reading skills. There was also a significant interaction of reading skill and claim element, $F(1, 101) = 31.2$, $p < .001$. Higher reading skill (the covariate) was associated with higher recall accuracy, $F(1, 101) = 60.29$, $p < .001$.

The analysis of recall accuracy of themes/predicates of only verbatim responses also did not yield a significant interaction of ADHD status and claim element, $F(1, 101) = .46$, $p = .50$. There was also no significant main effect of ADHD status, $F(1, 101) = .74$, $p = .39$. However, there was a significant main effect of claim element, $F(1, 101) = 85.44$, $p < .001$. Themes were recalled significantly more accurately ($M = .93$, $SD = .13$) than predicates ($M = .79$, $SD = .22$) regardless of ADHD status and after accounting for reading skills. There was also a significant interaction between reading skill and claim element $F(1, 101) = 27.07$, $p < .001$. Higher reading skill (the covariate) was associated with higher recall accuracy, $F(1, 101) = 85.44$, $p < .001$.

Discussion

The purpose of this thesis was to assess memory issues associated with Attention Deficit Hyperactivity Disorder (ADHD), specifically during late adolescence, 18 to about 24 years old. The study focused on an important time of development and a transition from high school to college. Many challenges occur during this age range, such as balancing between freedom and responsibility, adjusting to higher level reading and forming opinions on that reading, writing that is associated with academic literature, amassing content knowledge on a variety of topics, and recalling that knowledge. These challenges were predicted to be more problematic for adolescents with ADHD.

The hypothesis that adolescents with ADHD would recall predicates of claims with less accuracy than those without ADHD over and above reading skills was not fully supported in this study. Although, ADHD was found to have an indirect association with memory (i.e., ADHD is associated with reading skill, which is associated with recall accuracy). Both groups recalled themes (i.e., "uniforms") more accurately than predicates (i.e., "should be required") and higher reading skill was associated with higher recall accuracy. The ADHD and non-ADHD groups did not differ in verbatim recall or thematic recall by giving credit to synonyms either. This result showed that the groups did not differ in their gist or their precise recall of arguments and ADHD status did not have a direct effect on recall. However, consistent with Britt et al.'s (2008) study, both groups had significantly higher memory for themes over predicates and higher reading skill was associated with higher recall accuracy. The result of not accurately recalling the predicate is not recalling the most central part for understanding the argument (Britt et al., 2008). Miller et al. (2013) has demonstrated weaknesses in individuals with ADHD in

identifying central ideas of stories. This study showed a similar phenomenon in individuals without ADHD.

Three factors were examined in this study; reading skill, recall accuracy, and ADHD status. This study revealed a significant relation between ADHD and reading skill (i.e., ADHD status is associated with lower reading skill), and a significant relation between reading skill and accurate recall (i.e., higher reading skill is associated with higher recall accuracy). ADHD was not directly associated with recall accuracy. However, as depicted in Figure 2 below, it appears that ADHD may have had an indirect effect on recall accuracy.

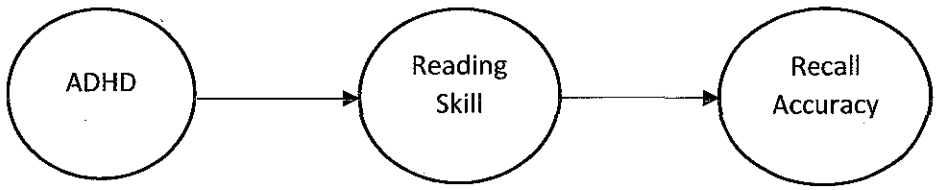

Figure 2. Associations among ADHD, Reading Skill, and Recall Accuracy

It appears there are multiple explanations why participants recalled themes more than predicates, for example, prior knowledge. "Themes" may be understood in the context of background knowledge (Britt et al., 2008). Thus, it is possible that participants can access background knowledge for understanding the gist of a theme for recall more than a predicate. Furthermore, according to Boonthum-Denecke, McCarthy, and Lamking (2012), reasoning skills play a role in recalling predicates. They said, "We found that both skilled and less-skilled reasoners were equally accurate at recognizing the predicate and the theme immediately after the claim. The problem comes in maintaining the representation. After reading the reason, less-skilled reasoners were less accurate at recognizing the predicate than the theme" (p. 145).

Nonetheless, both groups (ADHD and non-ADHD) could benefit from strategic reading comprehension instruction and modeling where students are trained to focus their attention on the verb or predicate of a statement when reading nonfiction or argumentative text. When predicates of arguments are precisely recalled, comprehension and evaluation of arguments is higher (Britt et al., 2008). By giving additional attention to predicates or verbs of statements, readers can learn to more efficiently comprehend text. If readers do not intentionally attend to verbs, it may result in reading and re-reading more often than necessary resulting in frustration and fatigue. The result of not accurately recalling the predicate is not recalling the most central part to understanding the argument. Readers must create a mental representation of what is read by building connections between ideas of the passage that are related to one another (Miller et al., 2013). By building the correct connections (i.e., connections centered on the predicate), the ideas with the highest number of connections emerge as central, or important, to the overall message of the passage. In other words, individuals who do not have a clear representation of argument predicates cannot effectively distinguish what point the argument was making. This phenomenon is evident when breaking down the elements of an argument. The argument, "Uniforms should be required in all public schools," includes a theme ("uniforms") and a predicate ("should be required"). Participants are able to more accurately recall that the argument was about uniforms (the theme). What they are lacking is the most important part, the predicate. The predicate outlines the argument the author is trying to make. In this case, "should be required" (predicate) is the stance the author makes. If readers cannot recall what the predicate was, then they cannot effectively determine if they agree or disagree with the author. The reader may not recall

if the author wrote "should be required," "should not be required," or "should be banished" They may not recall how strong the author's stance was (i.e., "should be required," or "should be encouraged."). The predicate of an argument presents a wealth of information on the intended message.

Although results showed similar argument recall between the two groups, the groups' reading level differed. The ADHD group's average reading skill was significantly lower than the non-ADHD group. This finding was consistent with previous research that showed lower reading skills for individuals with ADHD (Gremillion & Martell, 2012; Greven et al., 2012; Willcutt et al., 2005).

The reading difficulties of individuals with ADHD has been documented. For example, many experts suspect that reading problems observed in children with ADHD may be centered around cognitive impairments related to executive function, such as the ability to efficiently shift from one mind-set to another, separate emotion from thought, execute goal-oriented behavior, and to process, store and retrieve information in an efficient manner. Without these skills, even in the absence of basic reading difficulties, reading comprehension performance is often compromised (Cutting et al., 2003; McGrath et al., 2010; & Sesam et al., 2009).

The findings of the current study were, however, contrary to previous research showing deficits in memory skills of individuals with ADHD (Ahmadi et al., 2013; Castel et al., 2011; Miller et al., 2013). The direct effect of ADHD was shown in these studies, and general recall was examined (i.e., recall of information in general, as opposed to recall of specific words). In the current study, ADHD was found to have an indirect effect on memory. The indirect nature of the association could have been due to

the very specific nature of this study and the way memory was analyzed. In other words, argument predicate recall is looking at a very precise portion of the argument that may not be considered central to the typical reader. It is also possible that the ADHD group's reading level was good enough to recall the information they read suggesting that a certain reading skill threshold may be required for recall. Identifying this threshold would make for an interesting but challenging research project. In addition, there is a high comorbidity between ADHD and reading problems (Willcutt et al., 2005) including slow processing speed (Shanahan et al., 2006). However, the fact participants in this study are in college, late adolescence, they may have learned sufficient reading skills to memorize themes despite their low reading score on the reading measure, the Woodcock-Johnson-III Test of Achievement. For example, in Castel et al.'s (2011) study, 6 to 9 years old participants showed memory deficits, while in Miller et al.'s (2013), girls who were followed from childhood to adulthood showed improved symptoms of ADHD over time on measures of sustained attention and global executive functions. This suggests that individuals with ADHD can learn skills to improve memory skills, which could account for the findings of the current study as well. This study utilized a very specific predicate recall task, which may explain the finding of the lack of a direct connection between ADHD and memory. Most of the current research is focused on general recall on broad topics. Future studies could examine memory directly or look at specific recall compared to general recall.

Furthermore, the group assignment may partially explain the results of the memory task. The groups were separated using an ADHD "screener," meaning the tool was not created to differentiate individuals with ADHD from those without ADHD (non-

ADHD group). Instead, the tool is intended to identify individuals in need of "further investigation" into their ADHD symptoms. For instance, although the DSM-V (APA, 2013) indicates that the prevalence of ADHD is about 2.5% for adults in the United States, in this study, 19.2% of participants showed symptoms of ADHD, or they reported that they were diagnosed with ADHD. In future studies, researchers may want to establish the threshold for reading skills for argumentation tasks, and also use diagnostic tools to identify participants with ADHD.

Limitations and Future Direction

Limitations of the current study include the population, the nature of data collection, the ADHD screening tool used, and interrater reliability. The vast majority of participants (80.8%) were identified as non-ADHD, and only 19.2% were diagnosed with ADHD or suspected of experiencing ADHD symptoms on the screening measure used in this study (Adult ADHD Self-Report Scale (ASRS-V1.1) Symptom Checklist). It is possible that participants were more alike than expected. Conducting power analyses would have been helpful in determining the number of participants with ADHD needed. The study would have benefited from using relatively the same number of participants in each group. In addition, the sample was made up of students who were required to participate in research for course credit. Because participants received credit for simply completing the study, they might not have had vested interest in the research, and it is likely that they did not put forth full effort in completing the tasks. Future studies may consider to provide incentives in order to encourage participants to do their best. A convenience sample was used, students from a Midwest public university. A participant pool that includes ethnic and geographic diversity would make results more

generalizable. Finally, only one researcher scored all tasks, contributing to the lack of interrater reliability. In the future, it would be ideal for two people to blindly score the measures.

The study also required sustained attention; data collection lasted one hour and included high levels of writing by hand, which college students may not be accustomed to anymore because of technology and computer use. It may aid accuracy if participants type their responses instead of hand writing them. Data collection can also be spread over two days, half-hour each day, to avoid fatigue. It may be beneficial to present arguments on a computer screen for the same amount of time for each participant, or track the time it takes for a participant to respond to each item. This may control for the time factor that might have contributed to similar results in recall for both the ADHD and non-ADHD groups. It is possible that the ADHD group that scored lower on reading skills took more time than the non-ADHD group.

An ADHD screener was used in this study to separate participants into two groups, ADHD and non-ADHD. A more accurate diagnosis of ADHD requires additional tools that may include rating scales, interviews, observations, and in some cases executive functioning tasks. In future studies, recruiting participants who have been already diagnosed with ADHD from a hospital or school setting or using a more comprehensive ADHD diagnostic tool may lead to a more accurate results.

Conclusion and Implication

In the current study, adolescents with ADHD showed no significant difference in memory for arguments compared to non-ADHD peers, although the literature in the area has revealed that individuals with ADHD show deficits in memory and reading skills.

However, this study showed an indirect association between ADHD and memory. The indirect nature of the relationship could be due to the specificity of the predicate recall scoring method. On the other hand, participants with ADHD had significantly lower reading scores than their non-ADHD peers, which was consistent with the current literature. Because the interrelationships among ADHD, memory skills, and reading skills are complex, more research is needed to better understand the inconsistent results.

The findings of this study have implications for use in schools for both ADHD and general populations. Targeted interventions for students struggling with reading comprehension is critical. This study provides support for interventions that focus on selectively attending to verbs and predicates when reading text, such as nonfiction, textbooks, journal articles, analyzing political debates, and reading newspapers. Individuals who effectively recall predicates of arguments, are able to more precisely evaluate arguments. Having memory of the predicate of the arguments appear to allow readers to have a clear representation of what they read, making their comprehension and evaluation of that argument more accurate.

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APPENDICES

APPENDIX 1

Consent to Participate in Research

Assessment of Memory Abilities

You are invited to participate in a research study conducted by Jordan Poll and Dr. Assege HaileMariam, from the Psychology department at Eastern Illinois University. Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand, before deciding whether or not to participate.

- **PURPOSE OF THE STUDY**

The study is designed to examine memory abilities of college students. In addition, reading comprehension skills will be assessed. You will be assessed to see the association between reading comprehension and memory ability.

- **PROCEDURES**

If you volunteer to participate in this study, you will be asked to:

You will read statements one at a time out of a packet. After reading each statement, you will turn the page of the packet and recall the statement in the blank space to the best of your ability. Statements will be presented one at a time using a paper packet. The recall task will take approximately 30 minutes. Second, a 30 minute reading test will be administered to assess for reading comprehension abilities.

All procedures will take place in one of the labs in the physical sciences building for a total of 1 hour.

- **POTENTIAL RISKS AND DISCOMFORTS**

Participation in this research involves no potential risks.

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate in this research project, you will not have to complete any of the materials. You may change your mind later and stop participating even if you agreed earlier.

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose and all information collected from you will be discarded. It is your choice and all of your rights will still be respected.

If the study is terminated, all data collected will be saved for no longer than three years.

- **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

The knowledge that we receive from doing this research will be shared through a public forum during thesis defense, and depending on the results, presentation at a research conference and publication in peer reviewed journals will be considered. The thesis can also be accessed through the library. Confidential information will not be shared.

Society can benefit from this study Society may benefit from this research because we may learn more about memory difficulties. This could lead to better educational techniques that could lead to higher educational and vocational success rates.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of both the reading comprehension response page and the recall task packet will be number coded. You will be identified as no. 1, no. 2 and so on. No identifying information, such as name is required, and only aggregate data will be reported. Data will be saved in a password secured file and computer, and the paper and pencil task will be stored in a locked filing cabinet in the thesis supervisor's office; and only the primary researcher and his supervisor can access it. Records (including those who formally withdraw) will be permanently deleted or shredded after three years.

- **PARTICIPATION AND WITHDRAWAL**

Participation in this research study is voluntary and not a requirement or a condition for being the recipient of benefits or services from Eastern Illinois University or any other organization sponsoring the research project. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are otherwise entitled.

There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled. You may also refuse to answer any questions you do not want to answer.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about this research, please contact:

Faculty: Dr. Assege HaileMariam, ahailemariam@eiu.edu, (217) 581-6615

Jordan Poll: jwpoll@eiu.edu, (630) 687-0893

- **RIGHTS OF RESEARCH SUBJECTS**

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board

Eastern Illinois University

600 Lincoln Ave.

Charleston, IL 61920

Telephone: (217) 581-8576

E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I voluntarily agree to participate in this study. I understand that I am free to withdraw my consent and discontinue my participation at any time. I have been given a copy of this form.

_____

Printed Name of Participant

_____

Signature of Participant Date

APPENDIX 2

Demographic Information

ID #_____

Demographic Information: Please tell us about yourself, please write your response.

1. What is your age?

   _____

2. What is your Sex?

   _____

3. What is your GPA?

   _____

4. Have you ever been diagnosed with ADHD? Please circle one of the following.

   1. Yes 2. No

   If yes, how was it treated? Please circle all that apply.

   1. Medication 2. Behavioral therapy 3. No treatment at all

5. Do you currently have a diagnosis of ADHD? Please circle one of the following.

   1. Yes 2. No

   If yes, when were you diagnosed with ADHD?

   _____

   Are you currently on any medication for ADHD? Please circle one of the following

   1. Yes 2. No

   If yes, please identify (write down) all medication you are currently taking for ADHD.

APPENDIX 3

Reading Comprehension Questions

ID Number _____

1. Reptile eggs look a lot like bird eggs. Some are almost perfectly _____ like ping-pong balls; others are oblong.

2. When Helen cut her finger, she washed the dirt from it and then wrapped it with a small cloth. She wished that she had a _____, but she would have to wait until she got home.

3. What if you were _____? If someone stood right in front of you and looked right at you, they would still not be able to see you.

4. A mother eagle drops food over the cliff to encourage her baby to fly. She knows that her baby is scared to take its first flight out of the nest. The mother understands the baby's _____.

5. In order to motivate my students to keep their desks clean, our classroom has a desk angel. No one knows when the _____ will come, but when she does, she leaves a treat.

6. Leather comes from animal skin from which all flesh and hair has been removed. The _____ is put through a manufacturing process that makes it soft and flexible and prevents it from rotting.

7. And what should be done with the forests that once, perhaps half a century ago, heard the ring of axes and breathed the smoke of frontier cabins? The question had raged east of the Mississippi, where most of the national _____ were once logged.

8. Family-type live musical entertainment will again be offered in the amphitheater. _____ presented nightly will focus on state, regional, and national themes.

9. Students in the high school _____ class have joined a nationwide program designed to help others. As part of this vocational project, these competent students are building three-bedroom homes for needy families.

10. A good composition has an interesting introduction and a strong conclusion. The body is _____ the beginning and the end.

11. By stockpiling harvested grain, farming people of the region can cope better than the nomads. Few of the _____, though, are willing to become tillers of the soil.

12. Eight planets besides the earth circle the sun. Of the eight, Mars comes closer to us than any other _____ Venus.

13. It is one thing to demonstrate that modern war is harmful to the species. It is another thing to do something about _____ it.

14. Summer is gone with all its infinite wealth, and still nature is genial to man. _____ he no longer bathes in the stream or reclines on the blank or plucks berries on the hills, still he beholds the same inaccessible beauty around him.

15. One motivation source is competition, since the desire to excel over others as well as over one's own past record is one of the basic drives of human nature. Take advantage of this _____ by providing competitive situations.

16. Some swimmers get freaked by the cold water and nasty currents and go away without trying. Others are invigorated by the _____, which is considered an ultimate test of human endurance.

17. Most scratches on airplane windows are caused by dirt and other particles in the air. When an airplane is traveling at 600 miles an hour, these particles become very _____.

18. Our procedure obviously extends to any number of positions, and we have thus reduced a formidable design problem to simplicity _____ finding a repetitive pattern in the logic design.

19. Hikers who venture into the Grand Canyon complain that the park's majestic tranquility is too often disturbed by the buzz of airplanes overhead. Last week the National Park service announced equitable _____ that it hopes will satisfy both the backpackers and the flying sightseers.

20. In the 19th century, politicians were rewarded for having booming oratorical voices or an imposing physical presence. Successful political leaders have always been those who _____ best to the dominant communications medium of the day.

APPENDIX 4

ADHD Screener

Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months.

Items	Never	Rarely	Some times	Often	Very Often
1) How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?					
2) How often do you have difficulty getting things in order when you have to do a task that requires organization?					
3) How often do you have problems remembering appointments or obligations?					
4) When you have a task that requires a lot of thought, how often do you avoid or delay getting started?					
5) How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?					
6) How often do you feel overly active and compelled to do things, like you were driven by a motor?					
7) How often do you make careless mistakes when you have to work on a boring or difficult project?					
8) How often do you have difficulty keeping your attention when you are doing boring and repetitive work?					
9) How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?					
10) How often do you misplace or have difficulty finding things at home or at work?					
11) How often are you distracted by activity or noise around you?					
12) How often are you do you leave your seat in meetings or other situation in which you are expected to remain seated?					
13) How often do you feel restless or fidgety?					
14) How often do you have difficulty unwinding and relaxing when you have time to yourself?					

15) How often do you find yourself talking too much when you are in social situations?					
16) When you're in a conversation, how often do you find yourself finishing the sentences of the people you are talking to, before they can finish them themselves?					
17) How often do you have difficulty waiting your turn in situations when turn taking is required?					
18) How often do you interrupt others when they are busy?					

APPENDIX 5

Argument Packet

ID # _____

INSTRUCTIONS

In the pages that follow this one, you will read a set of simple two-sentence/two-clause arguments, presented one argument per page.

For each argument, Please decide if it is logically flawed or logically OK argument, regardless of whether you agree with it or not. You want to consider only the structure of the argument not how convincing it is given everything you know. **Circle "Flawed" if it is flawed and "OK" if it is not flawed for each of the arguments.**

Also rate how confident you are about whether or not it is flawed (1 means it is definitely flawed and 6 means it is definitely not flawed) on a 6-point scale. **Circle a number from 1 (meaning Definitely Flawed) to 6 (meaning Definitely NOT Flawed), which best reflects your confidence in the judgment.**

Please do not return to an item after you have completed it.

Kids in school should not be forced to recite the Pledge of Allegiance because not all students believe in a Christian God
Theme: Pledge of allegiance
Predicate: should not be forced

Uniforms should be required in all public schools because schools that require uniforms have fewer behavioral problems
T: Uniforms
P: Should be required

Physician assisted suicide for terminally ill patients is good for society because it is legal in the United States
T: Physician assisted suicide
P: is good

Grades in college should be abolished because grading students causes them to become more focused on getting grades rather than learning
T: Grades in college
P: should be abolished

Handguns benefit society because handguns are constitutionally protected by the second amendment
T: Handguns

P: Benefit

A human expedition to mars would be worthwhile because millions of dollars can be diverted from other space projects
T: Human expedition to mars
P: would be worthwhile

Children should be allowed to watch violent TV programs because research shows that watching violence does not make kids commit more violent acts
T: violent tv programs
P: should be allowed

One's parents' level of education determines their child's level of education because learning ability is solely determined by your genes
T: parents' level of education
P: determines

Owning pets is beneficial because it is everyone's right to own a pet
T: owning pets
P: is beneficial

Many pop stars do not make good role models because they don't promote images of self-respect
T: pop stars
P: do not make

"America's Most Wanted" TV show should be taken off the air because nobody is ever caught because of the show
T: "America's Most Wanted" TV show
P: should be taken off

Elementary school teachers should not promote failing students to the next grade because attending elementary school is mandated by law
T: Elementary school teachers
P: should not promote

Banning cell phone use while driving is unfair because cell phone conversations can keep drivers awake
T: Cell phone use
P: is unfair

Dating in the work place should not be allowed because it distracts people from work
T: Dating in the work place
P: Should not

We are experiencing low mortgage interest rates because people usually buy houses to help

improve our economy
T: low mortgage interest rates
P: we are experiencing

Satanism is an acceptable religion because the rituals and people who practice it never harm others
T: Satanism
P: is an acceptable

It is important for modern families to eat dinner together at the kitchen table because communication strengthens the bonds of the family
T: modern families
P: it is important

People should not be allowed to file bankruptcy because people use it as an easy way to avoid responsibility
T: file bankruptcy
P: should not be

Banks shouldn't charge ATM fees because banks are financial institutions
T: ATM fees
P: shouldn't

Marijuana should be legalized because it does not have any side effects
T: marijuana
P: Should be

Companies are overcharging for gas because they are making billions of dollars profit
T: gas
P: are overcharging

Selling soda and candy bars in high schools is unhealthy for students because most kids do not have much money
T: selling soda and candy bars
P: is unhealthy

Americans should support a two-party system because the two parties are the republicans and democrats
T: two-party system
P: should support

It is wrong to burn an American flag because the government should honor our veterans
T: American Flag
P: it is wrong

APPENDIX 6

Argument terms

Argument- An attempt to convince a reader or listener to accept an assertion (the claim) using supporting reasons. Arguments include support of a claim using reasons. All arguments in the current study were presented in a claim-reason order.

Claim- An assertion. The key element of the argument. Claims act as an organizer for the remaining discourse and establishes the logical relationship among the elements of the argument to make it coherent. Claims are broken up into themes and predicates.

Theme- The topic of the argument. It is often the subject noun in the claim.

Predicate- Typically the main verb in the claim. It can also be the predicate adjective in the claim.

Memory terms

Auditory memory- Mental preservation of sounds.

Auditory processing- The process of taking in sound and interpreting it.

Crystallized Intelligence- The ability to use skills, knowledge, and experience. It relies on information from long-term memory.

Iconic memory- Enables the brain to recall an image that is displayed later. This is the picture or representation of an image that is produced in a person's brain. It consists of two components, visible persistence and informational persistence.

Informational persistence- Information about the visual properties of the stimulus that remains available to the observer for a time after the stimulus is no longer seen.

Memory capacity- The amount of words individuals can store in their memory.

Phonological memory- A process of receiving, analyzing, and processing elements of sound in language.

Processing speed- the ability to automatically and fluently perform cognitive tasks. The ability to process information.

Recall- Bringing a piece of information back into one's mind and recounting it to others.

Selective memory- The ability to selectively memorize high-value items

Short-term memory- The capacity for holding information in a readily available state for a short period of time. The capacity is 5-9 elements.

Visible persistence- When an image continues to be visible to the person for a time after it is no longer seen.

Visual memory- Mental preservation of stimuli that are seen.

Reading terms

Decoding- The ability to apply knowledge of letter-sound relationships, including knowledge of letter patterns, to pronounce words correctly.

Lexical items-words, parts of words, or a chain of words.

Orthographic coding- Requires participants to differentiate words from non-words that are identical in sound (i.e., rain-rane). Refers to the ability to create permanent memory of written words linked to their pronunciation and meaning (Wrightslaw.com).

Phoneme awareness- The ability to hear and manipulate individual sounds.

Phonological decoding- Pronouncing letters based on knowledge of spelling-sound correspondences.

Reading fluency- The ability to read text accurately and quickly. Fluency is a skill that follows word recognition and precedes comprehension. Fluent readers recognize words automatically without sounding them out.

Semantic language- Refers to vocabulary concepts including synonyms and antonyms and the appropriate use of language, such as words with multiple meanings and figurative language. Semantic language is more commonly referred to as vocabulary.

APPENDIX 7

Detailed Interrelationships among ADHD, Reading Skills, and Memory Skills.