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Exploring Visual Attention Patterns of Adults With Reported Adhd, Without Adhd, and Those With Malingering Adhd Symptoms

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EXPLORING VISUAL ATTENTION PATTERNS OF ADULTS WITH REPORTED ADHD, WITHOUT ADHD, AND THOSE WITH MALINGERING ADHD SYMPTOMS

By

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WITH REPORTED ADHD, WITHOUT ADHD, AND
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Abstract

Noncredible performance and the intentional faking of symptoms during psychological evaluations have been observed in those seeking to obtain personal benefits. Cognitive deficits, such as impairments in attention are common in mental health settings and many seek an evaluation to rule out an attention-deficit/hyperactivity disorder. Previous literature establishes a base rate for malingering to be between 22-47% in adult ADHD evaluations (Sullivan, 2007; Suhr et al., 2008; Marshall et al., 2010). However, those faking or exaggerating ADHD can go unnoticed on self-report measures. There are limited studies that have identified methods that can specifically discriminate true ADHD from malingered ADHD. Therefore, the purpose of this study was to investigate whether attention can be differentiated from effort in the ADHD population, non-ADHD population, and Malingering groups with the use of simple visual Spot the Difference tasks. Results from the study suggest that a pattern of incorrect responses may be displayed by the malingered group, while individuals with ADHD take longer to find an image than those without a reported history of ADHD, particularly on difficult tasks. Overall, results are promising for understanding visual attention reaction patterns in ADHD and one step closer to creating simple, fun tools designed to measure effort.

Keywords: ADHD, malingering, visual attention, Spot the Difference

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CHAPTER I

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder of childhood onset and has been known to persist into adulthood. Recent research has indicated a prevalence of 4.4% of ADHD in the adult population (Kessler et al., 2006) and about 2.8%-4.2% among adults in countries outside the U.S. (Michielsen et al., 2012). It is characterized by persistent patterns of behaviors involving inattention and hyperactivity/impulsivity. While ADHD in childhood involves difficulties and impairments at home and at school, adults can continue to encounter complications in higher education and have problems with maintaining a job or with having adequate social interactions (American Psychiatric Association, 2013). Essentially, ADHD symptoms persist through young adulthood, including symptoms of partial remissions (Faraone et al., 2006).

ADHD is a prevalent and important psychological and social concern, but diagnosis is complicated in adults because of its high rate of psychiatric comorbidity (Kooij et al., 2012). For example, men tend to have a higher rate of psychiatric comorbidities involving conduct disorders, while women tend to have a greater rate of internalizing disorders such as depression and anxiety (Yoshimasu et al., 2018).

When conducting ADHD evaluations, psychologists are strongly encouraged to consider credible from non-credible performance given the considerable amount of

available recommendations and benefits for individuals with attention deficits. Reality is that individuals are likely to be tempted to fake symptoms for the purpose of obtaining school or work benefits without truly needing them, thus resulting in malingering (Frazier et al., 2008; Marshall et al., 2010). For example, some individuals are likely to exaggerate or fake symptoms to obtain college/university level accommodations, disability services, and/or stimulant medications. In 2002, researchers conducted a survey with 131 members of the American Board of Clinical Neuropsychology (ABCN) to investigate an annual base rate of malingering cases (Mittenberg et al., 2002). Out of 33,000 clinical cases identified, prevalence rates for malingering showed 29% of those cases were due to personal injury, 30% disability or worker's compensation, 19% criminal cases, and 8% medical or psychiatric cases. Research also suggests that external incentives and other financial compensation motivate people to intentionally exaggerate or fabricate deficits (Belanger et al., 2005; Binder & Rohling, 1996; Binder et al., 1997). This gives rise to the personal intention of false symptomology, such that in compensation-seeking neuropsychological patients, about 40% of cases are considered to be giving poor effort during examinations (Larrabee, 2003). In ADHD evaluations, base rates for malingering have been identified to be between 22-47% (Sullivan et al., 2007; Suhr et al., 2008; and Marshall, 2010). In consideration to the malingering possibilities, evaluators should provide an accurate diagnosis by taking into consideration several factors that could affect the evaluative procedure.

Typical evaluations of adult ADHD consist of behavior self-report rating scales, a measure of cognitive or intellectual functioning, and specific measures that are designed to measure attention. One popular measure of attention used frequently by psychologists are computerized tests. Computerized tests (CPTs) of sustained attention are frequently used by various psychologists (Bloch et al., 2012) and are used to measure ADHD attention and response inhibition (Wasserstein, 2005). They provide scores for both inattention and impulsivity (Ricco et al., 1996). On these CPTs, commission and omission error variables are highly considered when interpreting the results. Individuals diagnosed with ADHD tend to make greater commission and omission errors (Losier et al., 1996; Epstein et al., 2003), but these variables tend to lack specificity with ADHD symptom domains. Epstein and colleagues demonstrated that out of the variables measured, only detectability and beta were highly correlated with symptoms of ADHD.

Boone (2009) suggested that continuous monitoring of effort is important throughout the assessment procedure. Very few research studies have contributed to malingering literature in the ADHD population. Many studies have reported the adequate use of symptom validity tests, which are assessments of effortful performance in ADHD evaluations (Jasinski et al., 2011; Sollman et al., 2010; Schneider et al., 2014). Because of the length of ADHD assessments, individuals are likely to become weary and tired, thus impacting their performance. Moreover, boring computerized games may not adequately identify individual impairments in organizational skills or other activities necessary for their daily functioning (Brown, 1999). It is important that assessments gain

credible performance through quick and reliable measures of attention deficits. Therefore, the purpose of this study is to investigate whether attention can be differentiated from effort in the clinical ADHD population, non-ADHD subjects, and poor effort groups with the use of simple visual tasks. Results of this study are important for psychologists because the effectiveness of interventions and treatment is influenced by poor effort during examinations.

CHAPTER II

Literature Review

Attention Deficit/Hyperactivity Disorder in Adults

Attention deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder with early onset in childhood years. An estimated prevalence of ADHD is said to be diagnosed in 5-8% of children and frequently persists into adolescence and adulthood with significant considerations to the societal impact of ADHD costs in adulthood (Biederman, 2004). Although some adults were first diagnosed as children with ADHD, many first receive the diagnosis as adults (Gibbens & Weiss, 2007). In 2006, The National Comorbidity Study replication of adults determined the prevalence rate of adult ADHD to be estimated at 4.4% (Kessler, 2006). Similarly, a previous published study by Faraone and Biederman (2005) identified a rate of 3.2% in a sample of 966 adults who randomly were surveyed over a telephone.

The Diagnostic and Statistical Manual of Mental Disorders (DSM-V) establishes nine core symptoms involving attention and hyperactivity-impulsive behavior (American Psychiatric Association [APA], 2013). The three subtypes are based on whether individuals display symptoms of predominance of inattention (ADHD-I), predominance of hyperactivity-impulsivity (ADHD-HI), and/or symptoms of both inattention and hyperactivity-impulsivity (combined; ADHD-C). Each subtype has been found to contribute to different types of impairment or dysfunction. The most common subtype is

said to be the ADHD-I according to a meta-analytic study conducted by Willcutt (2012), but ADHD-C cases are more likely to be referred for clinical service. Furthermore, Bush (2010) described that a diagnosis of ADHD requires extensive consideration of the presented concerns given the challenges that arise when quantifying symptoms (i.e., disorganization).

ADHD is a prevalent and important psychological and social concern. While childhood ADHD is typically associated with school and home impairments, adults with ADHD may experience problems associated with impairments in maintaining a job or having adequate social interactions (APA, 2013). Adults may also face problems related to diminished educational achievement in higher institutions (Gjervan et al., 2012). Adults have been linked to greater rates of being divorced/never married, less family networks, and loneliness (Michielsen et al., 2012). In 2002, Murphy and colleagues examined treatment histories of young adults with ADHD-C and ADHD-I and found that young adults with both subtypes were less likely to graduate from college, had significantly less education, and had a higher chance of being placed in special education services in high school. Klein et al. (2012) studied clinical and functional outcomes of males with childhood ADHD. They found that men diagnosed with childhood ADHD have been reported to undergo divorces by age forty-one. Additionally, when compared to non-ADHD males, adult males with childhood ADHD are at a significant economic disadvantage and earned less money in their employment. Unemployment also takes a toll on quality of life in adults with ADHD, such that they experience greater

psychological distress (Sobanski et al., 2007). A study investigating risk taking behavior in adult males who were previously identified with ADHD in childhood, indicated that they were more likely to be at fault for car accidents and accidents involving injury (Ramos Olazagasti et al., 2013). Moreover, women have also been studied by Owens et al. (2017. In their cross-sectional study, they found that adult females are also subject to low educational attainment, externalizing and internalizing problems, and social impairment.

One caveat to ADHD evaluations and treatment is that differential diagnosis of ADHD is complicated in adults. The literature suggests that it can be difficult to diagnose ADHD in adult populations because of its high rate of psychiatric comorbidity associated with main symptoms of ADHD. One study, as a result of a 10-year literature review, reported that a myriad of comorbid conditions exist that overlap or mimic symptoms of adult ADHD including hyperactivity, impulsivity, and/or attention (Kooij et al., 2012). These include but are not limited to anxiety, mood, substance use, learning, and sleep disorders. Comorbidity in adults makes it difficult to identify whether ADHD alone is causing difficulties in attention and/or hyperactivity. Yoshimasu et al. (2018) conducted a population-based longitudinal study to evaluate ADHD and adult comorbid psychiatric disorders. Participants included both adults diagnosed with ADHD since childhood and non-ADHD adults. Results found that women were more likely to have comorbid internalizing disorders (i.e., depression, dysthymia, anxiety), while men displayed greater externalizing comorbid disorders (i.e, substance/abuse, antisocial

personality). Women with ADHD have also been found to more likely have borderline personality disorder than men with ADHD (Cumyn et al., 2009). In Murphy et al. (2002), young adults with ADHD-C and young adults with ADHD-I subtypes were found to present a greater likelihood of dysthymia, alcohol dependence/abuse, cannabis dependence/abuse, learning disorders, and greater psychological distress than the control group. Young adults with ADHD-C are more likely to have an oppositional defiant disorder, are more likely to have been arrested, and are more likely to have attempted suicide more than the ADHD-I subtype (Murphy et al., 2002) indicating that greater impulsivity is associated with ADHD-C. What can be left unclear is the presentation of pure attention deficits. Moreover, it is important to consider how inattention presents itself in the adult population, as over 90% of ADHD cases report frequent inattentive symptoms (Millstein et al., 1997).

Given that inattention and impulsivity can often be observed in a wide range of psychopathology, diagnosis of adult ADHD is currently largely derived on a variety of information. Wasserstein (2005) emphasized that recognition of ADHD diagnosis in adults should largely be focused on current level of symptoms, degree of functional impairment, childhood history, developmental and family history, core symptoms present in childhood, family history, and diagnostic testing, and other medical conditions. While comprehensive assessments are recommended, adult evaluations rely heavily on self-reported symptoms and historical evidence of symptoms related to ADHD (Harrison, 2006).

Measuring Attention for an ADHD diagnosis

"Attention" is referred to as a cognitive and perceptual process that allows individuals to focus on a particular stimulus while filtering out irrelevant information (Callahan, 2015). Attention is a behavior that is achieved through complex brain mechanisms that allow one to select, modulate, and sustain focus on relevant information (Chun et al., 2011). Thus, attention can be internal (selection and maintenance of internally generated information; i.e., working memory) or external (selection and modulation of sensory information; i.e., modality-specific input). Some of the most studied characteristics of attention include selection, modulation, and vigilance (Chun et al., 2011). Chun and colleagues described that selection is the awareness that there are other competing stimuli, modulation refers to how the selected stimuli is processed and the behavioral performance. While modulation is the immediate effect once the stimuli is selected, vigilance is described as the ability to sustain this process over extended periods of time.

Moreover, research has come to distinguish main cognitive processes in attention components into areas of selective attention, sustained attention, and divided attention (Mueller et al., 2017; Tucha et al., 2015). One specific model tends to split attention into various areas including focused, selective, alternating, divided, and sustained component processes (see: Sohlberg & Mateer, 1989). For this study, only selective attention and sustained attention will be further described.

Selective attention is described with relation to a person's ability to focus on relevant stimuli in the presence of distracting stimuli (Sohlberg & Mateer, 1989). Selective attention is the preferential processing of one stimulus in the presence of distractors. Selective attention can be directed to specific visual or auditory stimuli. Because the human brain is only able to process limited external information, selective attention focuses on strengthening the association of distracting stimuli and their response using specific sensory, targeted stimuli (Sohlberg & Mateer, 1989; Lavie, 1995). Moreover, in selective attention, effortful concentration is required when attending to one targeted stimulus whilst ignoring irrelevant stimuli. Selective attention has been linked as one of the cognitive domains implicated in ADHD. Tucha and colleagues investigated sustained attention between ADHD and healthy adults and found that those with ADHD showed deficits in selective attention and divided attention (Tucha, 2015).

Sustained attention is defined as a person's ability to perform a task over a prolonged period of time without significant loss in performance (Mueller et al., 2017). One's behavioral responses are attained over repetitive and continuous task processing (Sohlberg & Mateer, 1989). Furthermore, maintenance of attention over a longer period of time requires individuals to keep focused concentration to one or more sources (Van Zomeren & Brouwer, 1994). Sustained attention is also found in the DSM-V as a crucial symptom of ADHD. A study that investigated sustained attention comparing ADHD groups with and without comorbidity to those with no ADHD found that both ADHD

groups displayed difficulties with sustained attention than the healthy controls (Marchetta et al., 2007).

Visual Attention and Brain Mechanisms

Visual selective attention is the cognitive process of retinal input for perceptual awareness, which helps guide goal-directed behavior (Chelazzi et al., 2013). In vision, acuity is limited to the fovea requiring eye movements to targets of interest (Chun et al., 2011). Attention is efficiently directed to targeted objects (Duncan & Humphreys, 1989; Itti & Koch, 2000). Visual search elements are important elements of visual attention because they allow a person to direct eye movements toward a target area based on scene dimensions while limiting demands on memory (Haber & Hershenson, 1973; Najemnik & Geisler 2005; Summerfield et al., 2006). As with selective attention, one of the most important characteristics of visual search is the ability to ignore visual distractors in order to identify the targeted item. Many visual search studies rely on assessing response times (Kristjansson, 2015). One study identified that reaction times tend to decrease as the number of distractors increase in certain aspects of visual attention (Bravo & Nakayama, 1992). Moreover, previous literature has expressed that visual processing speed measures differentiate ADHD children from nonclinical control groups (Kuehne et al., 1987; Shapiro & Herod, 1994).

Visual information is processed in the brain involving a complex network of neural mechanisms involving several brain areas working together. The information is first perceived in the striate cortex and extrastriate cortex (Fukuba et al., 2009). Then, the

visual cortical areas are divided into dorsal and ventral streams, which helps process the visual information and takes care of perceptual influences (Milner & Goodale, 1993). The ventral stream (commonly known as the "what" stream) takes care of processing and identifying all information or objects, while the dorsal stream (commonly known as the "where") guides the response or the behavior by attending to spatial information (Milner & Goodale, 1993; Adaval et al., 2019). Furthermore, visual information processing has been organized in two types: object processing and spatial processing (Adaval et al., 2019). In processing visual information, object processing through the ventral stream is associated with the examining properties including color, size, shape, and pictorial details. These higher order functions, visual attention and visual awareness have been linked to the ventral pathway (Fukuba et al., 2009). Spatial processing through the dorsal stream refers to the perception of location, movement, spatial relations, and transformation of objects and other stimuli. A study investigating neural activity involving the ventral attentional pathway found that response signals in the ventral pathway were weak in ADHD adult participants, indicating that shifting attention to unattended stimuli is likely to be defective (Helenius et al., 2011).

Attentional Measures to Diagnose ADHD

Computerized tests, such as continuous performance tasks (CPTs), of sustained attention are frequently used by various psychologists (Bloch et al., 2012). There are several versions of CPTs commercially available. As mentioned by DuPaul et al. (1992), most versions require the examinee to observe the presentation of pictures/numbers on a

screen and are asked to respond to a specific target letter/number as these rapidly appear on the screen. CPTs are known to measure primary cognitive domains associated with ADHD attention and response inhibition (Wasserstein, 2005). They provide scores for both inattention and impulsivity (Ricco et al., 1996). Traditionally, these CPTs require the respondent to respond rapidly to the target stimulus and avoid (inhibit) their responses to non-target items. However, CPTs exist in a myriad of versions that differ in the target stimuli presented and other situations such as signal probability, which has been found to produce more errors (Jerison et al., 1965). Most of these CPTs are visual in nature. During a CPT there is limited cognitive demand placed on the individual, but sustained attention is required given that it is a rather lengthy and repetitive task (Cohen, 1993). Hervey et al. (2004) evaluated the differences of thirty-three studies in their meta-analytic review and identified that while CPTs and measure of attentional functioning are useful in discriminating adults with and without ADHD, more information is needed to determine whether attention problems are in fact the source of impairments in memory, processing speed, and motor speed. Moreover, the meta-analysis revealed that individuals with ADHD seemed to perform more poorly on measures with verbal presentation as opposed to a visual presentation, possibly given added distracting stimuli in unison with target stimuli. A third interesting finding was the fact that adults with ADHD performed worse than non-ADHD controls as task demands increased. Other conditions can also affect performance on CPT measures. In a book review by Gates (2001), the CPT was found to be sensitive to brain dysfunction, but had minimal

specificity for differential diagnoses in children and adults, in specific, for ADHD diagnoses and a lack of clinical validity and the need for further research in the area before making the CPT a mainstream assessment for ADHD. People with an affective disorder showed significantly more impairment on results on measures of sustained attention, such as the CPT. Cohen et al. (2001) found that sustained attention did cause a severe impairment in affective illnesses. They also found that tasks with greatest demand on response selection and control, working memory, and speed of processing seemed to create greater impairment in attention capacity and focus. Interestingly, the authors also made an argument that visual attention does not seem to cause a significant disturbance in detecting target stimuli. Another study worked to discover how other areas of wellbeing affect performance. Levin and colleagues identified that adult smokers showed a reduction in reaction time on the CPT (Levin et al., 1996). Overall, the CPT seems to be an effective measure of dysfunction in the brain, and while it has been a popular measure of attention, it does not fully validate attention dysfunction alone.

Malingering of ADHD

Malingering or symptom exaggeration is evident in a variety of settings, but also in individuals who seek some type of compensations. Malingering is a potential factor to consider when adequately make an ADHD diagnosis. Malingering is defined as "the intentional production of false or grossly exaggerated physical or psychological symptoms" to gain external incentives such as to avoid work, obtain drugs, or to obtain financial compensation (American Psychiatric Association, 2013, p 726). People with

strong desire to acquire benefits without having a hindering disability are found in great frequency among clinical settings. In ADHD evaluations, the concern for evaluators lies in the fact that adults may likely be tempted to fake symptoms for the purpose of obtaining school or work benefits (Marshall et al., 2010). The demands of college or work is likely to cause greater difficulty for many individuals and may be tempted to seek an ADHD diagnosis (Frazier et al., 2008). Many individuals with a true diagnosis of ADHD are likely to receive the necessary support for their school or work struggles. For example, Adults with ADHD are likely to gain accommodations in college settings, disability services, and/or stimulant medications (Harrison, 2007).

Programs dedicated to granting payments to individuals with a disabling condition are affected by the commonality of malingering. In 2013, Chafetz and Underhill conducted a study to determine how much financial distribution in 2011 was provided to adults claiming mental and psychological disorders. Data from the Social Security Administration (SSA) was analyzed to approximate an amount of $20.02 billion had been issued to claimants meeting criteria for malingering in Federal and State Disability programs (Chafetz & Underhill, 2013). Chafetz (2011) conducted a study among individuals seeking compensation in Social Security Disability programs. Feigned illnesses were estimated to be in 45.8%-59.7% of adult cases. Previous studies have shown similar numbers breaking down the cases by clinical settings. In 2002, researchers conducted a survey with 131 members of the American Board of Clinical Neuropsychology (ABCN) to investigate an annual base rate of malingering cases

(Mittenberg et al., 2002). Out of 33,000 clinical cases identified, prevalence rates for malingering showed 29% of those cases were due to personal injury, 30% disability or worker's compensation, 19% criminal cases, and 8% medical or psychiatric cases.

Malingering criteria for many of the studies conducted over the past years has been based on that proposed by Slick et al. (1999). Slick and colleagues proposed a series of steps and inferences that evaluators should take into consideration when making a diagnosis of malingering. According to Slick and colleagues, a person suspected of malingering cognitive impairment should meet certain criteria including evidence of an external incentive, poor or exaggerated effort on neuropsychological testing, and the observed behavior of a person's behavior to be rational and volitional. Financial and personal incentives motivate people to engage in different actions to obtain a desired outcome. Malingering can occur by either fabricating symptomatic complains and/or by intentionally performing poorly on neuropsychological assessments (Iverson & Binder, 2000).

Marshall et al. (2010) identified the excessive need for psychological assessments to include measures of effort in evaluations for ADHD because individual seeking this diagnosis simply for the benefits are likely to exaggerate or fake responses on self-report measures of behavior and during cognitive assessments. In their study, Marshall and colleagues investigated results using the archival data of about 268 patients who were assessed for ADHD and who did not have other neurological conditions. Suspected effort was established two different ways: 1) when individuals failed two symptom

validity measures (SVT) or failed a SVT *and* exhibited impaired performance on a cognitive test, and 2) failed a SVT or exhibited impaired performance *and* demonstrated an invalid measure on behavior rating scales or exhibited discrepancies in their performance behavior. A rate of 22% suspect effort was identified in those seeking ADHD evaluations, which is higher than the common 15% established for general clinical populations.

Overall, cognitive functioning has been a topic of interest in malingering cases given that it is relatively easier to fake deficits in behavior by withholding a typical behavior such as attention, than to fake symptoms such as tics (Rogers, 1997). As described by Slick and colleagues, the level of effort an individual demonstrates during assessment should be considered by those evaluating for a diagnosis to rule out false symptomology. Clinical assessment of malingering involves the evaluators' capacity to detect a person's intention during formal testing by identifying whether a person is purposefully performing below what they are capable. After all, previous research has indicated that a person's behavior during testing may be motivated an external reward or motivation.

Embedded Indicators of Malingering

Embedded Validity Indicators (EVIs) are a cost-effective alternative measure of assessing test taking effort (Erdodi et al., 2017). One study has used the Visual and Auditory Continuous Performance Test (IVA CPT), which is a typical measure of attention, in an attempt to investigate malingering adults (Quinn, 2003) and found

promising results such that the IVA CPT was hard to fake (with a rate of 81%) in comparison to the behavior rating symptoms. Ord et al. (2010), for example, investigated attention-related deficits using the CPT variables to determine its validity for assessing malingered cognitive deficits. They found that the CPT is a reliable indicator to assess poor effort and malingering in individuals claiming mild traumatic brain injury deficits. An important limitation to the study was based on the fact that the researchers did not use the CPT's ability to examine performance on particular attention deficit disorders. Similarly, Marshall and colleagues investigated symptom validity measures and their significance in detecting suspect effort in 268 adults who presented for an ADHD assessment (Marshall et al., 2010). They found that 22% of cases engaged in exaggerated symptoms on behavior rating scales. Data analysis indicated that scores from measures such as the CPT, TOVA, and the WMT provided sensitivity to credible and effortful performance.

Erdodi et al. (2017) conducted a study to determine whether the CPT would be an accurate measure of performance validity tests in children. Results showed that for the most part it would be adequate to utilize the embedded CPT validity indices in children. The CPT was also found to be sensitive to poor test taking effort. Another study investigated the rate of failure in archival data from young adults who referred themselves for an ADHD evaluation (Suhr et al., 2008). Three groups were compared to each other: those who failed the Word Memory Test (WMT), those who met ADHD diagnostic criteria and a group of controls without ADHD but with some psychological

symptoms. Results showed a 31% rate of failure on the WMT in individuals with clinical reported symptoms of ADHD. While the authors explained that failing the WMT did not indicate malingering rates, performance credibility on assessments for ADHD evaluations should be considered.

Psychologists around the world continue to use CPTs. The CPT is a popular method of choice for quantifying sustained attention and vigilance and it is widely used in the diagnosis of ADHD (DuPaul et al., 1992; Huang-Pollock et al., 2012). In a simulation study by Sollman et al. (2010), the CPT was insensitive to ADHD symptomology. Those feigning ADHD symptoms exhibited deficits on the omissions and variability, which are often considered when making a ADHD diagnosis. However, it is important to note that the CPT is not the most accurate in correlating the ADHD symptoms. Individuals diagnosed with ADHD tend make greater commission and omission errors (Losier et al., 1996; Epstein et al., 2003), but these variables tend to lack specificity with ADHD symptom domains. Epstein and colleagues demonstrated that of the measures provided by the CPT performance, only detectability and beta were highly correlated with symptoms of ADHD. Furthermore, individuals with ADHD tend to struggle with executive functioning deficits but tend to engage better in tasks that are entertaining and producing a variety of stimuli (e.g., videos). Brown previously stated that expecting individuals who struggle with inattention to press a button on a rather boring computerized game may not adequately identify their impairments in organization or other activities necessary for their daily functioning (Brown, 1999). In Marshall et al.

(2010), the effectiveness of the symptom validity measures were identified with respect to sensitivity and specificity. Sensitivity for the Conner's CPT was measured at 56%. Given this, it is necessary to incorporate valid measures of inattention as it pertains to impairments in the adult population.

Measuring Poor Effort

Poor effort in compensation seeking cases has been frequently observed on attention tasks (Strauss et al., 1994). Poor effort is defined as a person's underperformance behavior during testing (Iverson, 2006). Poor effort is evidenced because assessment results do not correspond with known level of performance of individuals without impairment, which are typically measured using performance validity tests (PVTs). A person is said to be intentionally performing below their true potential when they score below established cut-off scores (Bush et al., 2005). The malingering research has mostly focused on the use of common PVTs to detect poor effort and motivation (for review see: Bianchini et al., 2001). Most PVTs are forced-choice tests (FCTs). These FCTs are performance-based assessment methods used to identify people exaggerating deficits or giving poor effort during evaluations. They are popular in testing cognitive-impairment due to their low level of difficulty.

The Test of Memory Malingering (TOMM; Tombaugh, 1996) was designed to detect individuals with memory impairments from those with poor memory performance due to reduced effort (Tombaugh, 1996). The TOMM validity has been researched and established as effective in assessing for effort in clinical adult populations including mild

traumatic brain injuries (Tombaugh, 1997; Merten et al., 2007) and anxiety/depression (Ashendorf et al., 2004). In the pediatric population, the TOMM has been effectively used with children and adolescents with neurological conditions (Brooks et al., 2011; Ploetz et al., 2014) and in children as young as 4 and 5-years-olds in clinical settings (Kirk et al., 2014; Schneider et al., 2014).

The TOMM has been researched in adult and children populations with ADHD referrals. Sollman et al. (2010) investigated college students with concerns in ADHD who were given the TOMM. Results indicated that Trial 1 of the TOMM yielded high specificity for the ADHD group and moderate sensitivity to faking condition. Furthermore, individuals with ADHD and comorbid disorders such as anxiety or learning disorders were given the TOMM and other performance validity measures in Williamson et al. (2014). Results showed good reliability in the TOMM to effectively differentiate ADHD groups from normal participants and those faking ADHD symptomologies.

Schneider et al. (2014) conducted a study to test the utility of the TOMM in children 4 – 7 years old with and without ADHD. No significant differences were found between groups in the overall score or in any of the trials. They found that children young as 4-years-old readily passed the TOMM. The only difference was observed in 4-year-old with disruptive behavior that reduced passing rate on the retention trial.

Another measure, the Word Memory Test (WMT; Green et al., 2003) has been used to detect suboptimal effort, including the opportunity to detect memory impairments. In Green et al. (2003), the authors found that WMT scores were indicative

of poor effort due to symptom exaggeration. Sullivan et al. (2007) investigated effortful performance using the WMT in college students who presented for ADHD and learning disorder assessments. Failure rates of the WMT were at found at the 24.5% in assessments of combined ADHD and LD, and even greater at 47% in ADHD only assessments. In their conclusion, they expressed a general base rate for symptom exaggeration is estimated to be about 25-48% in college sampled students. This number was similar to 25% in Binder (1992) and 30% in Constantinou et al. (2005). Furthermore, a more current study yielded very similar base rates. Suhr and colleagues conducted a study to identify noncredible performance in referrals for adult ADHD and found a 31% failure rate of the WMT in those with clinical levels of self-reported ADHD symptoms and deficits in neuropsychological performance (Suhr et al., 2008).

Spot the Difference

Visual attention and visual awareness are important concepts in games such as Spot the Difference. The Spot the Difference are simple games that allow individuals to compare a pair of similar pictures to detect differences between them (Fukuba et al., 2009). This game is achieved by visually and cognitively examining two identical pictures side-by side with the aim to find all the differences between them. More specifically, Spot the Difference games involves various processing areas including visual information through eye movements. It has been known to also involve visual perception, visual attention, visual awareness, and working/short-term memory. Very few studies in the literature have used Spot the Difference games to investigate brain

activation and cognition. Through the use of fMRI, Fukuba and colleagues investigated brain cortical regions involved in Spot the Difference games by comparing a group of participants instructed to play the game with a group of participants simply asked to view the pictures. They found that the right posterior parietal cortex (PPC) showed greater activation when engaged in playing the game and the volume correlated with the accuracy. Moreover, Spot the Difference games have been used in the research as measures of attention and memory to investigate true cognitive decline. For example, Nishiguchi et al. (2015) recruited over four-hundred elderly Japanese people who were presented with two scenery pictures and found that those with cognitive impairment showed lower scores than those with no cognitive impairment.

Overall, while research with Spot the Difference games have been very limited, it has been supported by knowledge in their capability to enhance visual sensory activation in the brain and through its found relationship as a cognitive memory and attention task.

Study Rationale and Purpose

Treatment, interventions, and financial compensation are typical outcomes of psychological and psychoeducational assessments. Currently, a diagnosis of adult ADHD is largely derived from a variety of information including self-report measures and performance during the assessment, thus complicating the assessment process. While many people seek a diagnosis for compensation purposes, it is important for examiners to understand how attention differs from inaccurate representations (i.e., poor effort) of behavior and true deficits of attention during assessments for diagnostic impressions.

This is important given the amount of potential benefits available for those who successfully meet criteria for a diagnosis. ADHD is typically considered a childhood disorder; but many adults continue with symptomology. In adults seeking a diagnosis, there is a base rate of malingering that has been identified at 22-47%, indicating a wide range of potential reason for exaggerated or faked symptomology. Research has widely investigated attentional networks and their relationship with a diagnosis in ADHD. One of the most frequently used measures of attention, the CPT, has been known to correlate with a high rate of commission and omission errors with ADHD diagnoses; however, Epstein et al. (2003) identified that these two variables did not adequately signify correlations with symptomology. Moreover, a psychological diagnostic impression of ADHD as adults can make it difficult to identify due to its comorbidity with other diagnoses and the lack of current appropriate diagnostic tools. Because individuals with true attention deficits are likely to be more engaged with visual or continuous stimuli, measures that focus on identifying true attention deficits should be succinct on detectability. Visual search is a component of visual attention and is described as the process to filter out visual sensory information from irrelevant environmental stimuli. It is important to determine whether simple games such as Spot the Difference games are likely to produce a better understanding of attention vs. poor effort. Therefore, the purpose of this study was to investigate whether attention can be differentiated from effort in the ADHD population, Non-ADHD population, and Malingering groups with the

use of simple visual tasks. The following question was of interest: Do differences exist in the amount of time it takes individuals to find/spot the difference?

Hypotheses

1. Individuals with a reported diagnosis of ADHD would present different reactions times than those without reported history of ADHD and Malingering groups.
2. Individuals with a reported diagnosis of ADHD would show faster reaction times than the Malingering group.
3. Individuals who reported not having an ADHD diagnosis (Non-ADHD group) would have faster reaction times than the Malingering group.

CHAPTER III

Method

Participants

Data was collected from approximately 147 adults from Amazon MTurk who completed the online survey in exchange for $0.25. The inclusion criteria involved adults over the age of 18 with either reported 1) a past or current diagnoses of ADHD or 2) no history of ADHD. Exclusionary criteria for receiving monetary compensation included participants that did not complete the survey and those that did not follow the instructions. Demographics was expected to be similar to that of the online MTurk system participant pool with the majority of Caucasian or White background. Additionally, participant IP addresses were not recorded, and all data was kept confidential on a password protected computer. This study was approved by the IRB at SFASU.

Exclusion criteria included participants with neurological conditions including head injuries, learning disabilities, intellectual disability, substance abuse/dependence, and other psychiatric disorders that hindered neurotypical intellectual performance. Participants who identified as having depression and anxiety were included as participants.

Measures

Demographics Questionnaire. A demographics questionnaire was presented to the participants with questions pertaining to their age, sex, career, and ethnicity. Furthermore, each participant was required to respond to whether they have ever been diagnosed with ADHD inattentive, hyperactive, or combined type. If so, they were further asked if this diagnosis was made by a medical physician or a psychologist and whether they are currently taking medication. In generally, this study took less than 30 minutes to complete.

Spot the Difference. A total of fourteen pictures were used as visual picture stimuli (see Appendix). The pictures were obtained from the website pexels.com. All the pictures were free to download and use. Each picture was slightly modified adhering to Pexel 2019 licensing terms in which one object was deleted for the purpose of the activity. The original and modified versions were collated side by side to create one full picture. The left side represents the original version and the modified picture was placed on the right side. Participants were visually presented with each picture and were asked to click on the missing object on the picture to the right side. Pictures increased in difficulty by increasing distractors on the picture and identified by the pilot study. The following features were of interest: Reaction time (time in seconds) and time to first mouse click (time in seconds).

Rey-15 Item Test. The Rey 15-Item test is a Visual Memory Test that is used as a measure to detect malingering memory deficits (Rey, 1964). It consists of 15 figures (3

columns x 5 rows) on one page that is presented to individuals for 10 seconds and then the participant is asked to immediately reproduce the figures from memory. The 15 items are categorically broken into 3 items in each set. For this study, participants were asked to study the 15 different figures for 10 seconds and participants were asked to type the figures they saw. The Rey-15 Item test was scored by totaling the number of figures obtained correctly. Poor performance (fail rate) was indicated when a person reproduced less than nine items correctly (Lezak, 1995).

Adult ADHD Self-Report Screening Scale (ASRS-v1.1). The ASRS-v1.1 is an18-item symptoms checklist that is used aid in screening for ADHD in adults aged 18 years and older and its available at https://www.hcp.med.harvard.edu/ncs/asrs.php. The ASRS was developed by the World Health Organization (WHO) and the Workgroup of Adult. Questions on the ASRS are closely aligned to symptoms and criteria addressed in the Diagnostic and Statistical Manual of Mental Disorders and can be used as a screener.

The State-Trait Anxiety Inventory (STAI). The STAI is a 20-item assessment used to assess for common traits of state anxiety (Spielberger et al., 1983). Higher scores on the STAI indicated greater states of anxiety. In this study, this measure was used as a measure of anxiety to compare groups.

Procedure

This study was conducted through an online survey created on Qualtrics for Stephen F. Austin State University and uploaded to Amazon MTurk. Informed consent was obtained from all participants at the beginning of each session. Participants were

informed about the nature of the study and the implications involved in voluntarily completing the study, as well as criteria for receiving monetary compensation. Only those that completed the study were compensated at $0.25 per participant.

All participants completed the demographics questionnaire followed by the following measures: ASRS and the STAI. A trial of two picture stimuli immediately followed the measures so that participants could familiarize themselves with the task and instructions. Then, instructions were given to each participant and participants will be asked to find the difference on the picture to the right and click on that spot.

Following the instructions, participants were exclusively asked to complete the study based on a presented scenario (see group assignment section below) depending on their response to having a history of ADHD. There were three total scenarios based on a malingering vignette that was utilized by Montaro and colleagues (2018). Deception was used as part of the study because participants were instructed that they must complete the study as requested by the short vignette in order to be compensated. After participants completed the fourteen images, they were presented with the Rey-15. Finally, participants were asked to provide responses to questions about the amount of effort they provided for the activity. At the end of the study, they were debriefed regarding the purpose and nature of the study and the importance of their participation. Participants were granted credit and compensated through MTurk.

Group Assignments

Participants were divided into three groups as detailed below. A disclaimer was integrated into each scenario which explained that participants must complete the study as indicated by the vignette in order to receive compensation.

ADHD group. The ADHD group consisted of participants who reported having a past or current diagnosis of ADHD from a medical doctor or a psychologist. This group received the following instructions for the completion of the survey:

> *Imagine being examined by a psychologist and you have to make them believe that you DO NOT HAVE attention problems and these problems DO NOT affect your job. So, you need to respond to the tasks giving your BEST attention, trying to be credible, and avoiding that ADHD problems are discovered. You will only be paid at the end of the study if we determine that you gave your best or full effort. Please respond to the next set of items with this scenario in mind.*

Non-ADHD group. The Non-ADHD group consisted of participants who responded that they had never been diagnosed with ADHD. These participants were given the following scenario*:*

> *Imagine being examined by a psychologist for a job that you really want. So, you need to respond to the tasks giving your full effort. You will only be paid at the end of the study if we determine that you gave your best or full effort. Please respond to the next set of items with this scenario in mind.*

Malingering group. The Malingering group consisted of participants that were asked to fake or exaggerate attention problems. This scenario was retrieved and modified for the study's purpose from Monaro et al. (2018). Participants were asked to complete the survey with the following scenario:

> *Imagine being examined by an insurance policy commission to receive compensation for psychological damage. You have to make them believe that YOU HAVE problems paying attention in a way that affects your job. So, you need to respond to the tasks exaggerating attention deficits, trying to be credible, and avoiding to be discovered. You will only be paid at the end of the study if you fake inattention in a way that is believable (without being extremely obvious). Please respond to the next set of items with this scenario in mind.*

Survey Distribution

First, 100 participants were recruited to participate in the online survey. Participants were divided into two groups: Malingering group and the ADHD group. Second, forty more participants were recruited to participate in the online survey. Participants were divided into two groups: Non-ADHD and ADHD group. Then because the number of ADHD participants was too low, fifteen more participants were recruited using the Non-ADHD and ADHD survey. After preliminary exclusions, the total number of participants resulted in 147 participants and a total of eight participants were excluded due to a lack of survey completion and difficulty following initial instructions. For data analysis, all group were combined for full data analysis.

Research Design

This study is an experimental research design to explore differences between groups and measuring the independent variable (*level of attention per group: ADHD, Non-ADHD, Malingering)* and the dependent variables (*% image found; reaction time in seconds*). Data was analyzed and interpreted using the IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA). Crosstab analyses and several one-way ANOVA's and independent samples *t*-tests were used to analyze results. Statistically significant results were analyzed at an alpha level of $p < .05$ and $p < .001$.

CHAPTER IV

Results

Preliminary Descriptive Statistics

The total number of participants was *N*= 147. Prior to analyzing results, an exploratory analysis was conducted using the full sample to detect discrepancies in time completion of the study. Using the 'duration time in seconds' variable, data was cleaned using a 95% confidence interval. It was found that several people spent too short of a time on the survey and a few spent longer than necessary. Individuals who spent less than 772 seconds or more than 3390 seconds were excluded. This was based on three standard deviations from the mean time spent. This excluded a total of thirty-two people in the survey. Thus, the sample resulted in a total number 115 participants (N= 115).

Descriptive Statistics Full Sample

Descriptive analysis of the full sample was complete. The majority of the sample consisted of males (60%, n = 69) with a *Mage* = 23 years old (*SD* = 2.24). The sample was primarily Caucasian (40%, n = 46), Asian/Pacific Islander (34.8%, n =40) and Hispanic or Latino (12.2%, n = 14). The sample consisted mainly of individuals with a bachelor's degree (50.4%, n = 58), a High School Diploma (11.3%, n = 13), and College Seniors (10.4%, n = 12). See Table 1 for full sample statistics:

Table 1

Demographic Characteristics of Participants for the Full Sample

Variable		*M*	*SD*
Age		23.78	2.24
Variable		***Frequency (n)***	***Percent (%)***
Sex	Male	69	60
	Female	46	40
Ethnicity	White or Caucasian	46	40
	Asian/Pacific Islander	40	34.8
	Hispanic/Latino	14	12.2
	Black/African American	8	7.0
	Native American Indian	3	2.6
	Other	4	3.5
Education	High School graduate	13	11.3
	College Freshman	5	4.3
	College Sophomore	5	4.3
	College Junior	4	3.5
	College Senior	12	10.4
	Associate's Degree	8	7.0
	Bachelor's Degree	58	50.4
	Master's Degree	8	7.0
	Doctoral or Other Professional Degree	1	.9

Descriptive statistics were evaluated for age, gender, ethnicity, and education to determine if the groups significantly differed on demographic characteristics. Analysis of variance (ANOVA) indicated no significant group differences in sex F (2,114) = 0.00; p = .996; age F (2,114) = 0.19; p = .830, Ethnicity F (2,114) = 1.92; p = .152, or Education F (2,113) =2.02; p = .138.

The full sample was further used to identify the perceived level of difficulty utilizing the total percentage of participants who correctly found the difference on each image and the time spent to submit the page. As expected, the first few images were perceived to be at an easier level of difficulty compared to the last images presented. Image 1 was considered the easiest with a total of 76.5% rate of participants who found the missing object with a mean time of 12.55 seconds (*SD* 9.95), while Image 13 was considered the most difficult image with only 20.9 % of the total participants finding the image and a mean time of 84.67 seconds (*SD* 106.08) spent on the page. See Table 2 below:

Table 2

Percentages, Means, Standard Deviations, and Images Ordered by Perceived Level of Difficulty

Images	% Target Found	*M* Time Spent (seconds)	*SD* Time (Seconds)	Perceived Difficulty Ordered
Image 1	76.5%	12.55	9.95	1
Image 2	69.6%	10.98	10.46	2
Image 3	59.1%	20.55	21.16	4
Image 4	71.3%	14.70	11.08	3
Image 5	67.8%	22.68	18.14	5
Image 6	67.8%	28.19	25.53	6
Image 7	59.1%	53.01	63.12	8
Image 8	47.0%	39.23	45.15	10
Image 9	57.4%	32.63	30.02	7
Image 10	53.9%	31.76	28.52	9
Image 11	49.6%	53.43	52.26	11
Image 12	35.7%	30.42	30.75	12
Image 13	20.9%	83.67	106.08	14
Image 14	24.3%	49.17	51.47	13

Participant frequencies were analyzed for each group. Results showed a total sample of twenty participants in the ADHD group, thirty-two in the Non-ADHD group, and sixty-three in the Malingering group.

Descriptive Statistics with Exclusions

The full sample (N=115) was further cleaned and divided into the groups based on their qualitative responses to further determine who did not follow instructions, particularly in the Malingering group. Groups were analyzed by group using a Crosstab method for their responses on whether they felt that "It was important for [them] to complete the study as instructed." This analysis excluded a total of sixteen participants in the Malingering group, thus resulting in a total sample of ninety-nine participants. The mean average age was consistent across groups. The total participants in the three groups were ADHD group (n = 20), the Non-ADHD group (n = 32), and the Malingering group (n= 47). See Table 3 for further description of final demographics by group.

Table 3

Demographic Characteristics of Participants for Each Group

Variable	ADHD (*N* =20)	Non-ADHD (*N* = 32)	Malingering (*N* =47)
	M(SD)	*M(SD)*	*M(SD)*
Age	23.95 (2.26)	23.91 (2.22)	23.68 (2.21)

Table 3 Continued

Demographic Characteristics of Participants for Each Group

Variable		ADHD (*N*= 20)	Non-ADHD (*N* =32)	Malingering (*N* =47)
		Frequency (n)	*Frequency (n)*	*Frequency (n)*
Sex	Male	12	19	26
	Female	8	13	21
Ethnicity	White or Caucasian	6	11	24
	Asian/Pacific Islander	10	12	14
	Hispanic/Latino	2	3	7
	Black/African American	1	3	2
	Native American Indian	0	1	0
	Other	1	2	0
Education	High School graduate	1	5	5
	College Freshman	1	1	3
	College Sophomore	0	0	4
	College Junior	0	1	1
	College Senior	1	4	7
	Associate's Degree	3	2	1
	Bachelor's Degree	12	17	21
	Master's Degree	1	2	4
	Doctoral or Other Professional Degree	1	0	0

Descriptive statistics were evaluated for age, gender, ethnicity, and education to determine if the groups significantly differed on demographic characteristics. Analysis of variance (ANOVA) indicated no significant group differences in sex F (2,98) = 0.09; p = .913, age F (2,98) = 0.15; p = .862, or education F (2,98) =2.31; p = .105. There was a difference observed in ethnicity between groups F (2,98) = 3.32; p = .040.

Descriptive statistics were conducted for each image and cases were selected for only those that found the missing object. Table 4 shows the results for each group. As noted, participants showed variability, yet steady rates for their ability to find and click on the image. For the ADHD group, the total mean rate of those that found the image was 62.85%. For the Non-ADHD group, the mean percent was 72.11%. The Malingering group obtained a total found rate of 36.9%.

Table 4

Group Frequencies and Percentage That Found the Difference

Images	ADHD (N = 20)		Non-ADHD (N = 32)		Malingering (N = 47)	
	n found	%	n found	%	n found	%
Image 1	18	90%	30	93.8%	31	66.0%
Image 2	17	85%	30	93.8%	25	53.2%
Image 3	14	70%	28	87.5%	18	38.3%
Image 4	17	85%	32	100%	24	51.1%
Image 5	16	80%	30	93.8%	23	48.9%
Image 6	16	80%	29	90.6%	25	35.7%
Image 7	13	65%	29	90.6%	17	36.2%
Image 8	11	55%	25	78.1%	12	25.5%
Image 9	12	60%	29	90.6%	18	38.3%
Image 10	11	55%	26	81.3%	16	34.0%
Image 11	10	50%	26	81.3%	16	34.0%
Image 12	9	45%	15	46.9%	11	23.4%
Image 13	7	35%	9	28.1%	5	19.6%
Image 14	5	25%	14	43.8%	6	12.8%

Fourteen, one-way ANOVAs were conducted for each image to determine if there were group differences in reaction time to find each image. Two images (Image 1 and Image 10) indicated significant differences in reaction times across groups. On Image 1,

participants in the ADHD group found and submitted their page faster, followed by the Non-ADHD group and then the malingering group, F (2,78) = 9.95; p = .000. On Image 10 participants in the Non-ADHD group found and submitted their page faster, followed by the ADHD group and then the malingering group, F (2,52) = 11.50, p = .000. See Table 5 for more details.

Table 5

Analyses for Group Differences Based on the Time Spent to Find the Difference

Images	ADHD (N = 20)	Non-ADHD (N = 32)	Malingering (N = 47)	*F* ratio	*p*
	M (SD) [n]	*M (SD) [n]*	*M (SD) [n]*		
Image 1	6.07 (2.52) [18]	8.64 (5.02) [30]	12.76 (6.59) [31]	9.95	.000*
Image 2	11.56 (19.78) [17]	6.94 (3.35) [30]	12.17 (9.67) [25]	1.72	.188
Image 3	20.54 (28.38) [14]	18.04 (16.58) [28]	18.75 (18.92) [18]	.07	.933
Image 4	14.21 (14.47) [17]	13.56 (12.50) [32]	13.50 (8.11) [24]	.02	.979
Image 5	17.46 (9.73) [16]	23.40 (22.87) [30]	18.38 (8.15) [23]	.92	.404
Image 6	24.80 (21.60) [16]	21.91 (22.80) [29]	28.84 (26.90) [25]	.56	.577
Image 7	53.67 (77.29) [13]	68.90 (78.40) [29]	33.21 (35.63) [17]	1.46	.241
Image 8	58.95 (85.89) [11]	35.62 (41.49) [25]	68.32 (61.40) [12]	1.44	.247
Image 9	32.10 (29.60) [12]	36.04 (42.64) [29]	26.60 (12.27) [18]	.43	.655
Image 10	66.25 (52.23) [11]	20.99 (15.52) [26]	26.00 (12.78) [16]	11.50	.000*
Image 11	88.40 (86.68) [10]	42.76 (40.23) [26]	72.38 (53.17) [16]	2.97	.061
Image 12	51.61 (73.74) [9]	23.12 (24.82) [15]	35.72 (34.15) [11]	1.15	.329
Image 13	148.87 (152.33) [7]	98.15 (94.29) [9]	138.38 (96.59) [5]	.41	.668
Image 14	57.20 (43.71) [5]	79.59 (50.03) [14]	74.28 (63.43) [6]	.34	.718

* Statistical group differences were found on Image 1 and Image 10, $p < .001$

Results were also plotted on Figure 1. Each image was plotted in the order that it was presented to individuals. Greater separation between groups are notable as images increase in difficulty. As each image increased in difficulty, less participants found the difference and spent longer on finding the image.

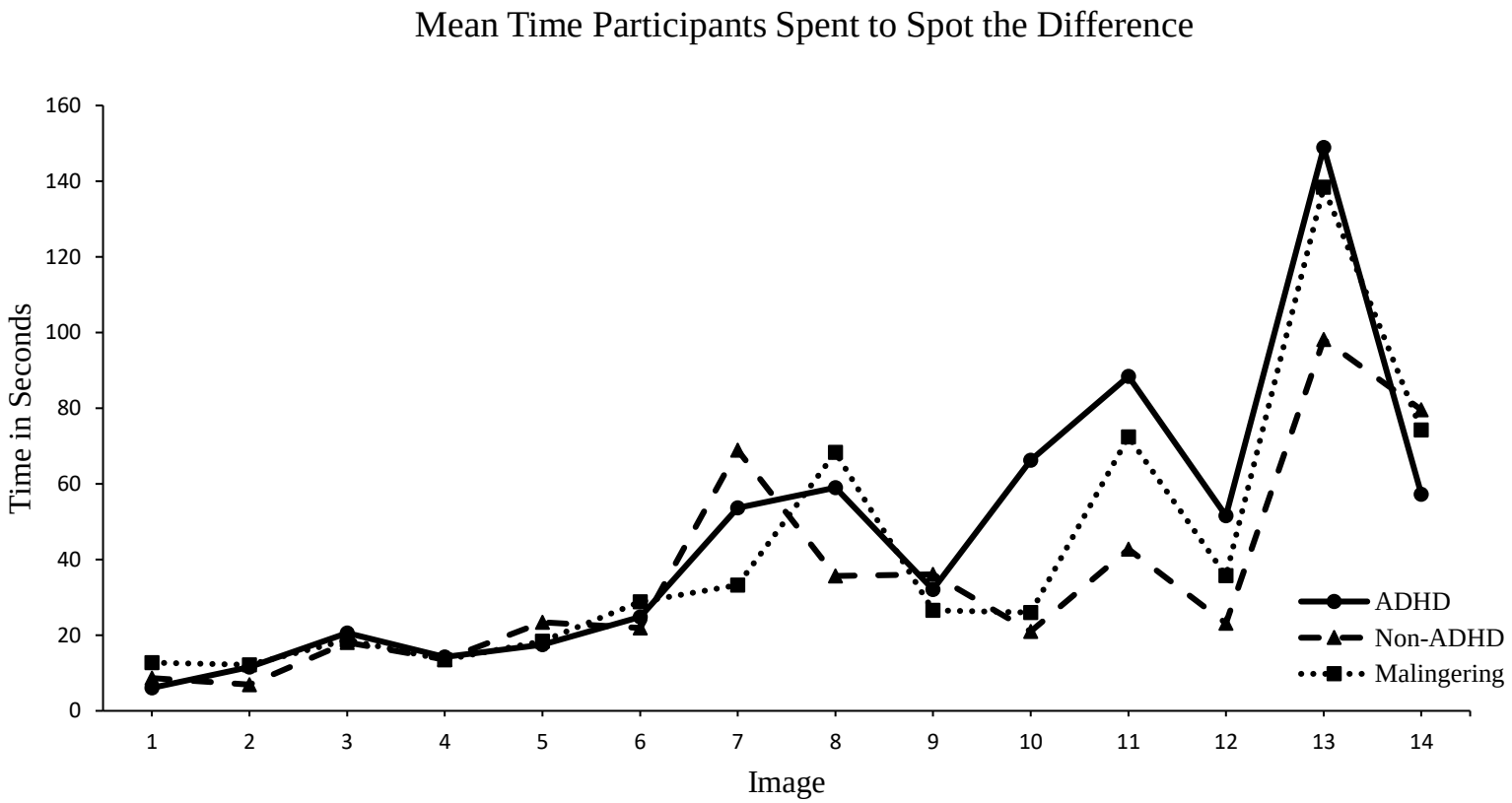

Figure 1: Each line represents the average amount of seconds each group spent to correctly find the difference on each image. Statistics group differences (p <.001) were found on Image 1 and Image 10.

Establishing Cutoffs for ADHD/Non-ADHD groups

PVT scores were transformed into a dichotomous variable of pass/fail scores. A frequency table (Table 6) presents the number of individuals in each group that passed or failed test for each condition according to established cutoff scores. As can be seen on the Rey-15, three failed in the ADHD group, six failed in the Non-ADHD group, and eight failed in the Malingering group. Within the Non-ADHD group, participants were expected to not fail the PVT and the malingering group, all thirty-nine who passed, should have failed, had they been true malingerers. Data was further analyzed to determine who found the image in the image in the groups.

Table 6

PVT Pass/Fail Performance

Variable	ADHD (N = 20)		Non-ADHD (N = 32)		Malingering (N = 47)	
	Pass (Fail)	*%*	*Pass (Fail)*	*%*	*Pass (Fail)*	*%*
Rey 15	17 (3)	20.7	26 (6)	31.7	39 (8)	47.6

Note: The numbers of participants excluded were defined by previously researched cutoff scores for each PVT. Passed rate based <9 on the Rey-15

The Malingering group was excluded in the concluding analysis in order to analyze results for the ADHD and Non-ADHD group. Results indicated that the ADHD group spent more time on finding the difference than the Non-ADHD group on most images, particularly the more difficult tasks (See Figure 2). Fourteen, independent samples t-tests were conducted to see if difference could be found between the ADHD and Non-ADHD groups. Only one image was found to be statically significant. On Image 10, the Non-

ADHD (N = 24; *M* = 21.63, *SD* = 15.97) group spent a less significant amount of time finding the difference than the ADHD group (N=11; *M* = 66.25, *SD* = 52.23). No other statistical differences were observed, see Table 7.

Table 7

Analyses Based on the Time Spent to Find the Difference Post-PVT Clean

Images	ADHD (*N* = 17)	Non-ADHD (*N* = 26)	*t*	*p*
	M (SD) [*n*]	*M (SD) [n]*		
Image 1	5.83 (2.25) [16]	7.81 (3.8) [25]	-1.86	.071
Image 2	12.16 (21.06) [15]	6.52 (3.45) [25]	1.32	.195
Image 3	21.17 (29.43) [13]	16.30 (15.80) [24]	0.66	.514
Image 4	15.26 (15.15) [15]	12.52 (12.83) [26]	0.62	.541
Image 5	18.10 (10.09) [14]	19.43 (20.94) [25]	-0.22	.824
Image 6	25.51 (22.15) [15]	21.31 (22.28) [24]	0.53	.569
Image 7	54.36 (80.68) [12]	69.10 (83.79) [23]	-0.50	.620
Image 8	58.95 (85.89) [11]	28.40 (28.96) [21]	1.49	.146
Image 9	31.84 (31.84) [11]	34.69 (43.54) [24]	-0.20	.847
Image 10	66.25 (52.23) [11]	21.63 (15.97) [24]	3.87	.000*
Image 11	88.40 (86.68) [10]	46.21 (41.56) [23]	1.91	.066
Image 12	51.61 (73.74) [9]	22.08 (26.43) [13]	1.34	.196
Image 13	173.40 (151.00) [6]	119.93 (99.82) [6]	.723	.486
Image 14	57.21 (43.72) [5]	80.02 (51.42) [11]	-0.86	.406

* Statistical group differences were found on Image 10, $p < .001$

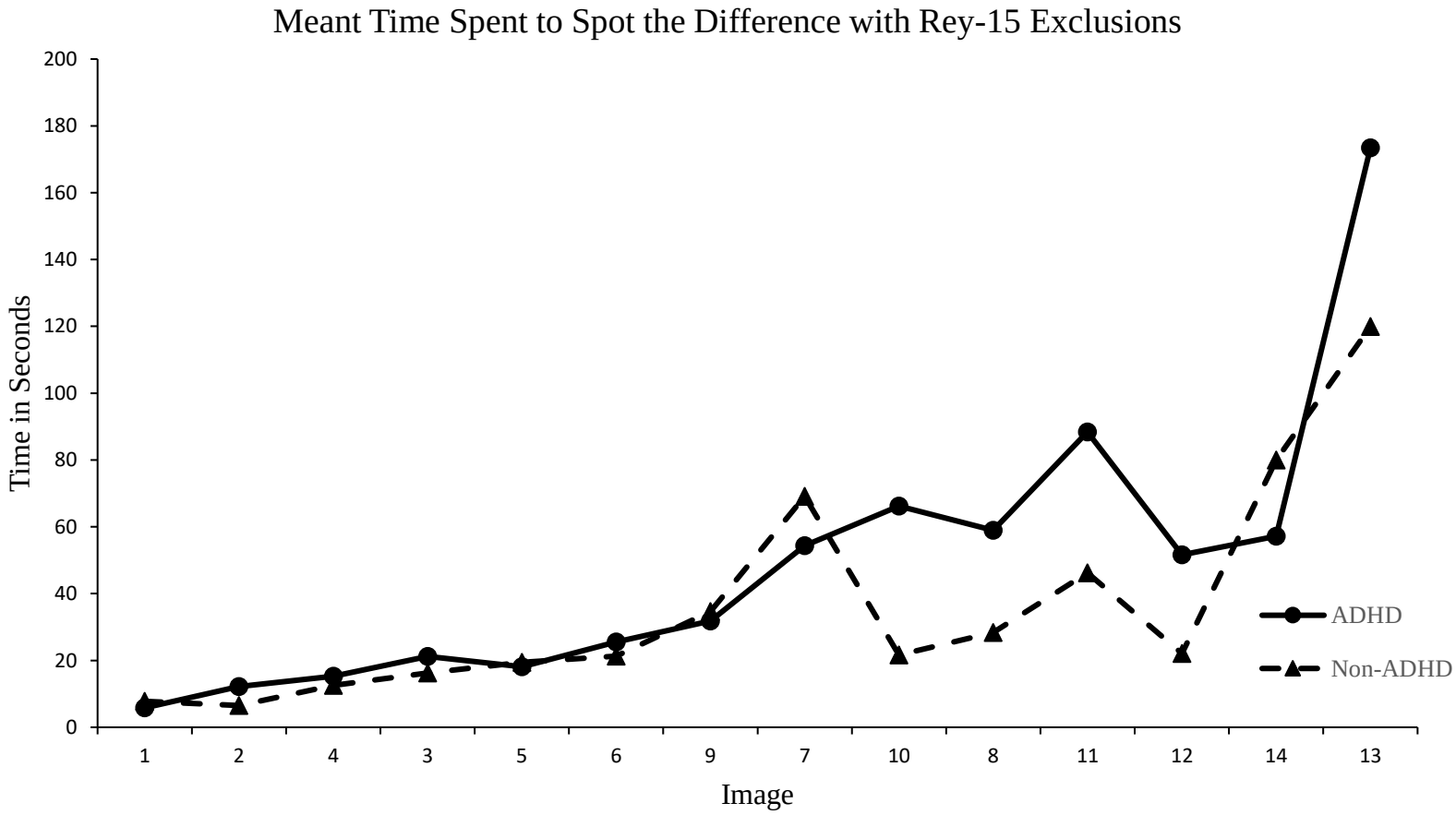

Figure 2. Represents the average amount of seconds each group spent to find the difference after Rey-15 exclusions. Images were ordered by level of perceived difficulty. Statistical group differences were found on Image 10 (p<.001).

Qualitative Analysis of Effort Strategies

Qualitative analyses were conducted on the group sample. Participants noted that they 'found the missing object and clicked elsewhere' with more frequency in the Malingering group than that Non-ADHD and ADHD group. A total of forty-seven other strategies were reported being used. Examples in the Non-ADHD group included "did my best," "I answered everything carefully," "I looked at both photos carefully and did my best to compare them," and "I took it seriously and tried to find the difference." Examples in the ADHD group included "clicked in the missing part of the right figure," "I clicked on all the differences correctly", "I searched for the missing object to fulfill primary goal (except for 2, I didn't find them so I did it randomly," and "studied the pictures and identified the difference." For the Malingering group, individuals indicated that they "looked for an item that stood out to me, "I moved slower, I tried to move onto the next picture without answering, and I answered some correctly to not be too obvious," and "I clicked on the left and sometimes I actually couldn't find the difference so I clicked somewhere randomly." Table 8 shows the descriptive frequencies for each group.

Table 8

Descriptive Frequencies of Strategies Used by Group

Statement	ADHD (*N* = 20)	Non-ADHD (*N* = 32)	Malingering (*N* = 47)
	n	*n*	*n*
Answered most/all item incorrectly	3	8	14
Found the missing object and clicked elsewhere on purpose	6	10	31
Clicked Randomly without looking for the missing object	2	1	4
Daydreamed while looking at picture then clicked randomly	-	-	7
Went fast and clicked anywhere on the right sided picture	2	-	1
Clicked somewhere on the left sided picture on purpose		1	6
Other	9	17	21

Further analysis of qualitative data focused on participants who met the cut-off criterion for the Rey-15. The Non-ADHD group reported a larger variability across answers in how important it was for them to complete the study and how important it was for them to earn the $0.25. About 60% of the Non-ADHD group reported that they cared to follow instructions “Very Much So” compared to the 80% for the ADHD group and 98% for the Malingering group. The Malingering group also reported a 98% rate of stating that it was important for them to follow instructions as instructed “Very Much So.” See Table 9 for more details.

Table 9

Percentage Frequencies of Reported Motivating Factors by Group

Statement	ADHD (N = 20)	Non-ADHD (N = 32)	Malingering (N = 47)
	Percentage	*Percentage*	*Percentage*
It was important for me to complete the study as instructed			
Not at All	-	-	-
Somewhat	-	12.5%	-
Moderately So	20%	28.1%	2.1%
Very Much So	80.0%	59.4%	97.9%
I followed the instructions closely so that I could earn my 25 cents			
Not at All	-	3.1%	-
Somewhat	-	3.1%	-
Moderately So	30.0%	31.3%	6.4%
Very Much So	70.0%	62.5%	93.6%
I did not care about the Instructions			
Not at All	80.0%	81.3%	97.8%
Somewhat	5.0%	6.3%	-
Moderately So	10.0%	6.3%	-
Very much so	5.0%	6.3%	2.2%
I forgot about the instructions during the study			
Not at All	60.0%	68.8%	87.2%
Somewhat	15.0%	12.5%	8.5%
Moderately So	25.0%	12.5%	2.1%
Very Much So	-	2.1%	6.3%

Chapter V

Discussion

This study investigated whether attention could be differentiated from effort in the reported ADHD population, non-ADHD participants, and Malingering ADHD groups with simple visual tasks. To ensure effort, participants were provided with a specific scenario and were instructed that they would not receive monetary compensation if they did not follow instructions or provided their best effort on each of the tasks. A targeted scenario was given to 1) individuals who reported a past or present history of ADHD and 2) individuals who did not report with a history of ADHD. The goal of this study was to investigate whether differences existed in the amount of time it took individuals to find or spot the difference between groups. The study's main hypotheses aimed to answer the question: Do differences exist in the amount of time it takes individuals to find the missing object in Spot the Difference games?

The current study first established that differences could be readily found between the ADHD and the Malingering group. The Malingering group showed interest in performing incorrectly and inaccurately. Findings were observed through total mean percentage found (per group) for the full sample, such that the mean average for the Malingering group was a total of 36.9%, while the ADHD group had a mean total of 62.85%. The ADHD group spotted the difference about 25% more than the Malingering

group, suggesting that the Malingering group opted to wrongly click while pretending to fake inattention. In specific, suspected malingerers may opt to purposefully choose or click the wrong answer. In this study, over half of the of the Malingering group participants in the full sample indicated they "found the missing object and clicked elsewhere on purpose." This further validates the idea of performance validity tests (PVTs) to detect feigned impairments.

Differences were not as readily found between the ADHD group and the Non-ADHD. Some individuals in the full sample group performed below the preestablished cutoffs for the chosen PVT, suggesting that not all participants gave full effort during the tasks. Groups were analyzed with participants who performed consistently with the published PVT scores in the ADHD and non-ADHD groups in order to determine if differences could be found via reaction time. The results from this study indicated no significant differences found between groups by finding the missing object, in fact the groups shared similar mean rates. The ADHD group found the missing object in approximately 44.69% of the overall images, while the Non-ADHD group found in the image about 44.63% of the time. While results did not significantly support this hypothesis across each image; there is a noticeable separation occurring after the 7th image (as observed in Figure 2 when images were organized by perceived difficulty.) Typically, individuals with ADHD appeared to spend more time searching for the image than the Non-ADHD group. Furthermore, results were only significant for one image. In specific, Image 10, was statistically significant in showing differences between the two

groups as observed by mean time spent to find the image. Therefore, results are promising and indicate that on easier tasks, adults with ADHD do not significantly differ in their reaction time from those without ADHD. However, the ADHD group appeared to react slower (or spent more time searching for the object) than Non-ADHD group. This supported previous research stating that reaction times tend to decrease at the number of distractors increase in certain aspects of visual attention (Bravo & Nakayama, 1992). These results also support evidence provided by one previous study of visual attention and processing in children in which it was found that attentional selectivity is intact, but children with ADHD struggle more with visual processing speed and sustained attention more than children without ADHD (McAvinue et al., 2012).

Ultimately, analyses across groups identified some interesting patterns. Even though not all the pictures indicated significant results to support the study's hypotheses, differences among all groups were found on two specific images (Image 1 and Image 10). Image 1 was considered an easy task with very little stimuli (see Appendix), in which it can be observed that the ADHD group found the correct missing object faster than both the Non-ADHD group and the Malingering group. The Non-ADHD group spent an average of two seconds more than the ADHD group, while the Malingering group spent an average of four seconds more than the ADHD group. Image 10 was considered a harder task with more stimuli (see Appendix). On this image, the ADHD group spent a significantly longer time than either the Non-ADHD or the Malingering group. The malingering group continued to spend only a few seconds longer than the Non-ADHD

group. Therefore, it appears that individuals with ADHD tend to have a harder time with more visual stimuli and on measures of visual attention than individuals with no previous history of ADHD. This supports previous literature by Hollingsworth et al. (2001), who identified that adults with ADHD tend to struggle with allocating controlled attention to several stimuli and with shifting attention to visual targets.

Computerized tasks have been shown to engage people's interest, which prompted the possibility of creating a battery of "spot the difference" games to study attention, alertness, orientation, and executive control in adults. Similar to this study, previous researchers have proposed a series of games designed for ADHD to improve attention, inhibitory and/or motor activity (Berger et al., 2000; Craven & Groom, 2015). Like the CPT using go/no-go signals and stop-signal tasks, these games have integrated the use of these concepts for the purpose of treatment and symptom monitoring (Craven & Groom, 2015). Shaw et al. (2005) also conducted a preliminary investigation in children ages 6-14 performance on the CPT and other commercially available computer games. Among other games, the Pokémon task was designed as an isomorphic task to the CPT with using Pokémon characters instead of letters. Results showed that children with ADHD exhibited a reduction in impulsive responding and an increase in on-task activity on the Pokémon Task compared to the CPT. They seemed to show greater impulsivity on a standardized measure, as opposed to typically developing children. What was interesting was that children with ADHD seemed to make less errors more on

the game-like activities, which was basically equivalent to that of typically developing children.

Mouse-tracking has also been useful in the study of cognitive processes such as attention. Brocas et al. (2014) investigated mouse-tracking in private information games and delineated details of attention to information during strategic thinking. Mouse tracking was used in the study of attention in Xiao and Yamauchi (2017). Xiao and Yamauchi focused on understanding the role of attention in unconscious semantic processing and concluded the temporal attention window lasts more than 1000ms. Their studies also supported the idea that top-down attention modulates and modifies subliminal semantic processing. Furthermore, video games have successfully proven to work in memory-related areas. For example, the short-term effects of attention were investigated with the use of video games in Tahiroglu et al. (2009). Children in this study were asked to play a video game and attention was measured before and after playing the games. The researchers found that cognition was worse in children with ADHD as opposed to the control groups. It has been argued that video games enhance attention, which is one of the reasons that research has now focused on how they impact learning or work ethic as opposed to simple entertainment. Balfe (2019) focused her study on the effects of video games and attention in people, focusing on the ADHD experience. While results were inconclusive on how video games impact attention directly, results did support an empathetic understanding of the participants toward those who have ADHD.

In this study, another one of the desired outcomes was to measure effort and motivation and to be able to differentiate attention patterns. Similarly, Slusarek et al. (2001) investigated the role of motivation. Their goal was to investigate the effects of different motivational incentives on the ability of children to inhibit actions. Children with ADHD were compared with a combined group of children with other psychiatric disorders (those including major depressive disorders, anxiety disorder, oppositional defiant disorder, or conduct disorder) and a different group including no psychiatric disorders. Under low incentives, children with ADHD were less able to inhibit their reactions and had longer stop-signal reaction times. However, under high incentive conditions, children performed just as well as the other groups. Ultimately, motivation and effort play a significant role in outcome performance, and this study is one step closer to providing support for distinguishing effort from attention with the use of simple visual tasks.

Limitations and Future Studies

Although this study shows promising evidence in the detection of attentional patterns, some limitations were observed. The lack of statistical results in group differences may be due to the way individuals approached each task and the strategies participants seemed to use. In this study participants were asked to follow scenario which urged them to provide effort based on an incentive. Participant motivation to complete each task as requested and the techniques used by each individual were recorded. Participants in the Non-ADHD group did not report a high level of interest in providing

full effort for the study. While the scenarios were relatively important in guiding the participant's external effort, the scenario may not have clearly specified the objective of the study.

In collecting data, the groups were established based on their self-report of whether they had been previously or currently diagnosed with an ADHD. This may be considered a limitation given a lack of objective/factual data to support this information. While some individuals were able to express if they were diagnosed by a medical physician or a psychologist, future studies would benefit from obtaining data from a formal clinical sample to ensure diagnostic authenticity. Another area of future interest for researchers to consider would be the comorbidity of assessing ADHD. In this study, no group differences were observed for anxious traits. In fact, the STAI mean for each group indicated that participants showed a moderate-to-high average level of anxiety despite no participants indicating they had a diagnosis of anxiety. Future studies may wish to further explore this area given the significant implications of co-morbid disorders among adults with ADHD.

Another limitation involved the exploratory nature of the study, given a lack of literature evidencing a direct link of the PVT (Rey-15) with the ADHD diagnosis. Previous research has validated its use with memory malingering studies, but not with visual attention. It would be worthwhile for future studies to utilize other measures that have been previously used with ADHD populations such as the Test of Memory Malingering (TOMM). Furthermore, another limitation considered involved the sample

population. Because ADHD is considered a neurodevelopmental disorder that is of childhood onset, it would be recommended that further research in the implication of visual attention be conducted with children or adults in the clinical setting.

Lastly, while this study exemplified a focus on visual attention and reaction patterns, this study lacked psychometric validation of visual eye movements. A highlighted recommendation for future studies would be for researchers to utilize eye tracking technology with Spot the Difference images.

Implications and Conclusions

Psychologists are often tasked with delineating and categorizing group of symptoms in various settings. A correct diagnosis prompts effective psychological treatment and interventions. However, misrepresentations and noncredible performance by examinees may lead to inaccurate treatment interventions. Intentional faking and poor performance of symptoms during a psychological assessment have been observed in those seeking to obtain benefits. Psychologists benefit from tools and measures that are designed to aid in psychological evaluations. The rapid growth in the research of adequate measures, techniques and tools may be interested in differentiating effort and motivation from true attention deficits. This study takes into consideration the gap in the literature concerning the number of available tools for assessing noncredible performance of ADHD. Simple visual tasks hold the potential to provide better estimates of visual attention with almost no weight on language and memory requirements. With continued research support, similar games to Spot the Difference could be implemented in clinical

and school practices. For instance, a battery of images could be used to as a screening tool to detect suspected malingering and as a supplement to common measures of inattention to classify ADHD.

In summary, the current study investigated whether attention can be differentiated from effort in the self-reported ADHD population, non-ADHD participants, and simulated Malingering ADHD groups with the use of simple visual tasks. Limited studies have investigated malingering of ADHD and a caveat to those studies is that they have used measures that are not specific to the malingering of attention deficits or ADHD. In this study, results are promising in that simple visual search tasks have the potential to improve the ability to differentiate credible performance from noncredible performance in ADHD evaluations. ADHD participants were distinguished from the Malingering group by their ability to find the correct missing object from a picture. It was harder to discriminate the ADHD group from the Non-ADHD group by reaction time. A thorough analysis identified that overall, the ADHD group spent about the same amount of mean time as the Non-ADHD group. However, there was clear evidence of a separation in their speed to find the missing target as the difficulty of the task increased. One image (Image 10) showed a significant difference in the groups' ability to find the correct missing spot. Those without ADHD spent less time and were able to find it at a higher rate than those with ADHD.

Overall, results are promising for understanding visual attention reaction patterns in ADHD and one step closer to creating simple, fun tools designed to measure effort.

Visual tasks (i.e., Spot the Difference) could be utilized as a screening tool to detect malingering and as a supplement to diagnostic measures (i.e., CPT-3) to identify ADHD. This could particularly be achievable with a stimulus such as Image 10. Eventually, psychologists and psychometricians who suspect noncredible performance during their assessments would be able to adapt this simple visual search element into their practice.

References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing.

Adaval, R., Saluja, G., & Jiang, Y. (2019). Seeing and thinking in pictures: A review of visual information processing. *Consumer Psychology Review*, *2*(1), 50-69. https://doi.org/10.1002/arcp.1049

Ashendorf, L. (2004). The effect of depression and anxiety on the TOMM in community-dwelling older adults. *Archives of Clinical Neuropsychology*, *19*(1), 125–130. https://doi.org/10.1016/S0887-6177(02)00218-4

Balfe, J. R. (2019). *A Study of an ADHD Experience Video Game's Effect on Users' Attention* (Doctoral dissertation, Purdue University Graduate School).

Belanger, H. G., Curtiss, G., Demery, J. A., Lebowitz, B. K., & Vanderploeg, R. D. (2005). Factors moderating neuropsychological outcomes following mild traumatic brain injury: A meta-analysis. *Journal of the International Neuropsychological Society*, *11*(3), 215-227. https://doi.org/10.1017/S1355617705050277

Berger, A., Jones, L., Rothbart, M. K., & Posner, M. I. (2000). Computerized games to study the development of attention in childhood. *Behavior Research Methods, Instruments, & Computers*, *32*(2), 297–303. https://doi.org/10.3758/bf03207798

Bianchini, K. J., Mathias, C. W., & Greve, K. W. (2001). Symptom validity testing: A critical review. *The Clinical Neuropsychologist*, *15*(1), 19-45. https://doi.org/10.1076/clin.15.1.19.1907

Biederman, J. (2004). Impact of comorbidity in adults with attention-deficit/hyperactivity disorder. *The Journal of Clinical Psychiatry*, *65 Suppl 3*, 3.

Binder, L. M., & Rohling, M. L. (1996). Money matters: a meta-analytic review of the effects of financial incentives on recovery after closed-head injury. *The American Journal of Psychiatry*, *153*(1), 7–10. https://doi.org/10.1176/ajp.153.1.7

Binder, L. M., Rohling, M. L., & Larrabee, G. J. (1997). A review of mild head trauma. Part I: Meta-analytic review of neuropsychological studies. *Journal of Clinical and Experimental Neuropsychology*, *19*(3), 421-431. https://doi.org/10.1080/01688639708403870

Bloch, Y., Fixman, M., Maoz, H., Bloch, A. M., Levkovitz, Y., Ratzoni, G., Aviram, S., & Gal, G. (2012). Can computerized cognitive tests assist in the clinical diagnosis of attention-deficit hyperactivity disorder? *The Journal of Neuropsychiatry and Clinical Neurosciences*, *24*(1), 111-114. https://doi.org/10.1176/appi.neuropsych.11010014

Boone, K. B. (2009). The need for continuous and comprehensive sampling of effort/response bias during neuropsychological examinations. *The Clinical Neuropsychologist*, *23*(4), 729–741. https://doi.org/10.1080/13854040802427803

Bravo, M. J., & Nakayama, K. (1992). The role of attention in different visual-search tasks. *Perception & Psychophysics*, 51(5), 465–472. https://doi.org/10.3758/bf03211642

Brocas, I., Carrillo, J. D., Wang, S. W., & Camerer, C. F. (2014). Imperfect choice or imperfect attention? Understanding strategic thinking in private information games. *The Review of Economic Studies, 81*(3), 944–970. https://doi.org/10.1093/restud/rdu001

Brooks, B. L., Sherman, E. M. S., & Krol, A. L. (2011). Utility of TOMM trial 1 as an indicator of effort in children and adolescents. *Archives of Clinical Neuropsychology, 27*(1), 23–29. https://doi.org/10.1093/arclin/acr086

Brown, T. E. (1999). Does ADHD diagnosis require impulsivity- hyperactivity? A response to Gordon & Barkley. *ADHD Report, 7*(6), 1-7.

Bush, G. (2010). Attention-deficit hyperactivity disorder and attention networks. *Neuropsychopharmacology, 35*(1), 278-300. https://doi.org/10.1038/npp.2009.120

Bush, S.S., Ruff, R.M., Troster, A.I., Barth, J.T., Koffler, S.P., Pliskin, N.H., Reynolds C.R., & Silver, C.H. (2005). Symptom validity assessment: Practice issues and medical necessity NAN policy & planning committee. *Archives of Clinical Neuropsychology, 20*(4), 419–426. https://doi.org/10.1016/j.acn.2005.02.002

Callahan, P. M., & Terry, J. (2015). Attention. *Handbook of Experimental Pharmacology, 228*, 161.

Chafetz, M. D. (2011). The psychological consultative examination for social security disability. *Psychological Injury and Law*, *4*(3-4), 235–244. https://doi.org/10.1007/s12207-011-9112-5

Chafetz, M., & Underhill, J. (2013). Estimated costs of malingered disability. *Archives of Clinical Neuropsychology*, *28*(7), 633-639. https://doi.org/10.1093/arclin/act038

Chelazzi, L., Perlato, A., Santandrea, E., & Della Libera, C. (2013). Rewards teach visual selective attention. *Vision Research*, *85*, 58–72. https://doi.org/10.1016/j.visres.2012.12.005

Chun, M. M., Golomb, J. D., & Turk-Browne, N. B. (2011). A taxonomy of external and internal attention. *Annual Review of Psychology*, *62*(1), 73–101. https://doi.org/10.1146/annurev.psych.093008.100427

Cohen, R. A. (1993). Neuropsychological assessment of attention. In *The Neuropsychology of Attention* (pp. 307-327). Springer, Boston, MA.

Cohen, R., Lohr, I., Paul, R., & Boland, R. (2001). Impairments of attention and effort among patients with major affective disorders. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *13*(3), 385–395. https://doi.org/10.1176/jnp.13.3.385

Constantinou, M., Bauer, L., Ashendorf, L., Fisher, J., & Mccaffrey, R. (2005). Is poor performance on recognition memory effort measures indicative of generalized poor performance on neuropsychological tests? *Archives of Clinical Neuropsychology*, *20*(2), 191–198. https://doi.org/10.1016/j.acn.2004.06.002

Craven, M. P., & Groom, M. J. (2015). Computer games for user engagement in attention deficit hyperactivity disorder (ADHD) monitoring and therapy. *2015 International Conference on Interactive Technologies and Games*. https://doi.org/10.1109/itag.2015.9

Cumyn, L., French, L., & Hechtman, L.T. (2009). Comorbidity in adults with attention-deficit hyperactivity disorder. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie, 54*(10), 673–683. https://doi.org/10.1177/070674370905401004

Duncan, J., & Humphreys, G. W. (1989). Visual search and stimulus similarity. *Psychological Review, 96*(3), 433–458. https://doi.org/10.1037/0033-295x.96.3.433

DuPaul, G. J., Anastopoulos, A. D., Shelton, T. L., Guevremont, D. C., & Metevia, L. (1992). Multimethod assessment of attention-deficit hyperactivity disorder: The diagnostic utility of clinic-based tests. *Journal of Clinical Child Psychology*, *21*(4), 394–402. https://doi.org/10.1207/s15374424jccp2104_10

Epstein, J. N., Erkanli, A., Conners, C. K., Klaric, J., Costello, J. E., & Angold, A. (2003). Relations Between Continuous Performance Test Performance Measures and ADHD Behaviors. *Journal of Abnormal Child Psychology*, *31*(5), 543-554. https://doi.org/10.1023/A:1025405216339

Erdodi, L. A., Lichtenstein, J. D., Rai, J. K., & Flaro, L. (2017). Embedded validity indicators in conners' CPT-II: Do adult cutoffs work the same way in children?

Applied Neuropsychology: Child, *6*(4), 355–363. https://doi.org/10.1080/21622965.2016.1198908

Faraone, S. V., & Biederman, J. (2005). What Is the Prevalence of Adult ADHD? Results of a Population Screen of 966 Adults. *Journal of Attention Disorders, 9*(2), 384-391. https://doi.org/10.1177/1087054705281478

Faraone, S. V., Biederman, J., & Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: A meta-analysis of follow-up studies. *Psychological medicine, 36*(2), 159–165. https://doi.org/10.1017/s003329170500471x

Frazier, T. W., Frazier, A. R., Busch, R. M., Kerwood, M. A., & Demaree, H. A. (2008). Detection of simulated ADHD and reading disorder using symptom validity measures. *Archives of Clinical Neuropsychology: The Official Journal of the National Academy of Neuropsychologists, 23*(5), 501-509. https://doi.org/10.1016/j.acn.2008.04.001

Fukuba, E., Kitagaki, H., Wada, A., Uchida, K., Hara, S., Hayashi, T., Oda, K., Uchida, N. (2009). Brain activation during the spot the differences game. *Magnetic Resonance in Medical Sciences: MRMS: An Official Journal of Japan Society of Magnetic Resonance in Medicine, 8*(1), 23-32. https://doi.org/10.2463/mrms.8.23

Gates, R. D. (2001). Cynthia A. Riccio, Cecil R. Reynolds, and Patricia A. Lowe (2001): Clinical Applications of Continuous Performance Tests: Measuring Attention and Impulsive Responding in Children and Adults. New York: Wiley, 396 pp. (ISBN

0-471-38032-6) $60.00 (US). *Child Neuropsychology, 7*(3), 196-197. https://doi.org/10.1076/chin.7.3.196.8745

Gibbins, C., & Weiss, M. (2009). Clinical recommendations in current practice guidelines for diagnosis and treatment of ADHD in adults. *Current Attention Disorders Reports, 1*(3), 116–122. https://doi.org/10.1007/s12618-009-0016-1

Gjervan, B., Torgersen, T., Nordahl, H. M., & Rasmussen, K. (2012). Functional impairment and occupational outcome in adults with ADHD. *Journal of Attention Disorders, 16*(7), 544–552. https://doi.org/10.1177/1087054711413074

Green, P., Lees-Haley, P. R., & Allen, L. M. (2003). The word Memory test and the validity of neuropsychological test scores. *Journal of Forensic Neuropsychology,* 2(3-4), 97–124. https://doi.org/10.1300/j151v02n03_05

Haber, R. N., & Hershenson, M. (1973). *The psychology of visual perception*. Holt, Rinehart & Winston.

Harrison, A. G. (2006). Adults faking ADHD: You must be kidding! *The ADHD Report, 14*(4), 1-7. https://doi.org/10.1521/adhd.2006.14.4.1

Harrison, A. G., Edwards, M. J., & Parker, K. C. H. (2007). Identifying students faking ADHD: Preliminary findings and strategies for detection. *Archives of Clinical Neuropsychology: The Official Journal of the National Academy of Neuropsychologists, 22*(5), 577. https://doi.org/10.1016/j.acn.2007.03.008

Helenius, P., Laasonen, M., Hokkanen, L., Paetau, R., & Niemivirta, M. (2011). Impaired engagement of the ventral attentional pathway in ADHD. *Neuropsychologia, 49*(7), 1889–1896. https://doi.org/10.1016/j.neuropsychologia.2011.03.014

Hervey, A. S., Epstein, J. N., & Curry, J. F. (2004). Neuropsychology of adults with attention-deficit/hyperactivity disorder: A meta-analytic review. *Neuropsychology, 18*(3), 485-503. https://doi.org/10.1037/0894-4105.18.3.485

Hollingsworth, D. E., McAuliffe, S. P., & Knowlton, B. J. (2001). Temporal allocation of visual attention in adult attention deficit hyperactivity disorder. *Journal of Cognitive Neuroscience, 13*(3), 298–305. https://doi.org/10.1162/08989290151137359

Huang-Pollock, C. L., Karalunas, S. L., Tam, H., & Moore, A. N. (2012). Evaluating vigilance deficits in ADHD: A meta-analysis of CPT performance. *Journal of Abnormal Psychology*, *121*(2), 360–371. https://doi.org/10.1037/a0027205

Itti, L., & Koch, C. (2000). A saliency-based search mechanism for overt and covert shifts of visual attention. *Vision Research, 40*(10-12), 1489–1506. https://doi.org/10.1016/s0042-6989(99)00163-7

Iverson, G. L. (2006). Ethical issues associated with the assessment of exaggeration, poor effort, and malingering. *Applied Neuropsychology, 13*(2), 77–90. https://doi.org/10.1207/s15324826an1302_3

Iverson, G. L., & Binder, L. M. (2000). Detecting exaggeration and malingering in neuropsychological assessment. *The Journal of Head Trauma Rehabilitation*, *15*(2), 829-858. https://doi.org/10.1097/00001199-200004000-00006

Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., Faraone, S.V., Greenhill, L.L., Howes, M.J., Secnik K., Spencer, T., Bedirhan Ustun, T., Walters, E.E., & Zaslavsky, A.M. (2006). The prevalence and correlates of adult ADHD in the United States: Results from the national comorbidity survey replication. *American Journal of Psychiatry*, *163*(4), 716-723. https://doi.org/10.1176/ajp.2006.163.4.716

Kirk, J. W., Harris, B., Hutaff-Lee, C. F., Koelemay, S. W., Dinkins, J. P., & Kirkwood, M. W. (2011). Performance on the test of memory malingering (TOMM) among a large clinic-referred pediatric sample. *Child Neuropsychology*, *17*(3), 242–254. https://doi.org/10.1080/09297049.2010.533166

Klein, R. G., Mannuzza, S., Olazagasti, M. A., Roizen, E., Hutchison, J. A., Lashua, E. C., & Castellanos, F. X. (2012). Clinical and functional outcome of childhood attention-deficit/hyperactivity disorder 33 years later. *Archives of General Psychiatry*, *69*(12), 1295–1303. https://doi.org/10.1001/archgenpsychiatry.2012.271

Kooij, J. J. S., Huss, M., Asherson, P., Akehurst, R., Beusterien, K., French, A., Sasané, R., Hodgkins, P. (2012). Distinguishing comorbidity and successful management

of adult ADHD. *Journal of Attention Disorders*, *16*(5_suppl), 3S-19S. https://doi.org/10.1177/1087054711435361

Kristjansson, A. (2015). Reconsidering visual search. *i-Perception*, *6*(6). https://doi.org/10.1177/2041669515614670

Kuehne, C., Kehle, T. J., & McMahon, W. (1987). Differences between children with attention deficit disorder, children with specific learning disabilities, and normal children. *Journal of School Psychology*, *25*(2), 161–166. https://doi.org/10.1016/0022-4405(87)90025-2

Jasinski, L. J., Harp, J. P., Berry, D. T. R., Shandera-Ochsner, A. L., Mason, L. H., & Ranseen, J. D. (2011). Using Symptom Validity Tests to Detect Malingered ADHD in College Students. *The Clinical Neuropsychologist*, *25*(8), 1415-1428. https://doi.org/10.1080/13854046.2011.630024

Jerison, H. J., Pickett, R. M., & Stenson, H. H. (1965). The elicited observing rate and decision processes in vigilance. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 7(2), 107–128. https://doi.org/10.1177/001872086500700204

Larrabee, G. J. (2003). Detection of malingering using atypical performance patterns on standard neuropsychological tests. *The Clinical Neuropsychologist*, *17*(3), 410-425. https://doi.org/10.1076/clin.17.3.410.18089

Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. *Journal of Experimental Psychology: Human Perception and Performance*, *21*(3), 451–468. https://doi.org/10.1037/0096-1523.21.3.451

Levin, E. D., Conners, C. K., Sparrow, E., Hinton, S. C., Erhardt, D., Meck, W. H., Rose, J.E., & March, J. (1996). Nicotine effects on adults with attention-deficit/hyperactivity disorder. *Psychopharmacology*, *123*(1), 55–63. https://doi.org/10.1007/bf02246281

Lezak, M.D. (1995). Neuropsychological Assessment (3rd ed.). New York: Oxford University Press.

Losier, B. J., McGrath, P. J., & Klein, R. M. (1996). Error patterns on the continuous performance test in non-medicated and medicated samples of children with and without ADHD: A meta-analytic review. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *37*(8), 971–987. https://doi.org/10.1111/j.1469-7610.1996.tb01494.x

Ocasio, W. (2011). Attention to Attention. *Organization Science*, *22*(5), 1286-1296. https://doi.org/10.1287/orsc.1100.0602

Ord, J. S., Boettcher, A. C., Greve, K. W., & Bianchini, K. J. (2010). Detection of malingering in mild traumatic brain injury with the conners' continuous performance test–II. *Journal of Clinical and Experimental Neuropsychology*, *32*(4), 380-387. https://doi.org/10.1080/13803390903066881

Owens, E. B., Zalecki, C., Gillette, P., & Hinshaw, S. P. (2017). Girls with childhood ADHD as adults: Cross-domain outcomes by diagnostic persistence. *Journal of Consulting and Clinical Psychology, 85*(7), 723–736. https://doi.org/10.1037/ccp0000217

Ploetz, D. M., Mazur-Mosiewicz, A., Kirkwood, M. W., Sherman, E. M. S., & Brooks, B. L. (2014). Performance on the test of memory malingering in children with neurological conditions. *Child Neuropsychology*, *22*(2), 133–142. https://doi.org/10.1080/09297049.2014.986446

Najemnik, J., & Geisler, W. S. (2005). Optimal eye movement strategies in visual search. *American Journal of Ophthalmology, 139*(6), 1152–1153. https://doi.org/10.1016/j.ajo.2005.04.009

Marchetta, N., Hurks, P., de Sonneville, L., Krabbendam, A., & Jolles, J. (2008). Sustained and focused attention deficits in adult ADHD. *Journal of Attention Disorders, 11*(6), 664-676. https://doi.org/10.1177/1087054707305108

Marshall, P., Schroeder, R., O'Brien, J., Fischer, R., Ries, A., Blesi, B., & Barker, J. (2010). Effectiveness of symptom validity measures in identifying cognitive and behavioral symptom exaggeration in adult attention deficit hyperactivity disorder. *The Clinical Neuropsychologist, 24*(7), 1204-1237. https://doi.org/10.1080/13854046.2010.514290

McAvinue, L. P., Vangkilde, S., Johnson, K. A., Habekost, T., Kyllingsbæk, S., Bundesen, C., & Robertson, I. H. (2012). A componential analysis of visual

attention in children with ADHD. *Journal of Attention Disorders*, *19*(10), 882–894. https://doi.org/10.1177/1087054712461935

Merten, T., Bossink, L., & Schmand, B. (2007). On the limits of effort testing: Symptom validity tests and severity of neurocognitive symptoms in nonlitigant patients. *Journal of Clinical and Experimental Neuropsychology*, 29(3), 308–318. https://doi.org/10.1080/13803390600693607

Michielsen, M., Comijs, H. C., Aartsen, M. J., Semeijn, E. J., Beekman, A. T. F., Deeg, D. J. H., & Kooij, J. J. S. (2013). The relationships between ADHD and social functioning and participation in older adults in a population-based study. *Journal of Attention Disorders*, *19*(5), 368–379. https://doi.org/10.1177/1087054713515748

Michielsen, M., Semeijn, E., Comijs, H. C., van de Ven, P., Beekman, A. T. F., Deeg, D. J. H., & Kooij, J. J. S. (2012). Prevalence of attention-deficit hyperactivity disorder in older adults in The Netherlands. *The British Journal of Psychiatry: The Journal of Mental Science, 201*(4), 298–305. https://doi.org/10.1192/bjp.bp.111.101196

Millstein, R. B., Wilens, T. E., Biederman, J., & Spencer, T. J. (1997). Presenting ADHD symptoms and subtypes in clinically referred adults with ADHD. *Journal of Attention Disorders, 2*(3), 159–166. https://doi.org/10.1177/108705479700200302

Milner, A. D., & Goodale, M. A. (1993). Chapter 28 Visual pathways to perception and action. *Progress in Brain Research*, 317–337. https://doi.org/10.1016/s0079-6123(08)60379-9

Mittenberg, W., Patton, C., Canyock, E. M., & Condit, D. C. (2002). Base rates of malingering and symptom exaggeration. *Journal of Clinical and Experimental Neuropsychology*, *24*(8), 1094-1102. https://doi.org/10.1076/jcen.24.8.1094.8379

Monaro, M., Toncini, A., Ferracuti, S., Tessari, G., Vaccaro, M. G., De Fazio, P., Pigato, G.., Meneghel, T., Scarpazza, C., & Sartori, G. (2018). The detection of malingering: A new tool to identify made-up depression. *Frontiers in Psychiatry*, *9*. https://doi.org/10.3389/fpsyt.2018.00249

Mueller, A., Hong, D. S., Shepard, S., & Moore, T. (2017). Linking ADHD to the neural circuitry of attention. *Trends in Cognitive Sciences*, *21*(6), 474–488. https://doi.org/10.1016/j.tics.2017.03.009

Murphy, K. R., Barkley, R.A., & Bush, T. (2002). Young adults with attention deficit hyperactivity disorder: Subtype differences in comorbidity, educational, and clinical history. *The Journal of Nervous and Mental Disease*, *190*(3), 147–157. https://doi.org/10.1097/00005053-200203000-00003

Najemnik, J., & Geisler, W. S. (2005). Optimal eye movement strategies in visual search. *American Journal of Ophthalmology*, *139*(6), 1152–1153. https://doi.org/10.1016/j.ajo.2005.04.009

Nishiguchi, S., Yamada, M., Fukutani, N., Adachi, D., Tashiro, Y., Hotta, T., Morino, A., Aoyama, T., Tsuboyama, T. (2015). Spot the Difference for Cognitive Decline: a quick memory and attention test for screening cognitive decline. *Journal of Clinical Gerontology and Geriatrics*, 6(1), 9–14. https://doi.org/10.1016/j.jcgg.2014.08.003

Pettersson, R., Söderström, S., & Nilsson, K. W. (2018). Diagnosing ADHD in adults: an examination of the discriminative validity of neuropsychological tests and diagnostic assessment instruments. *Journal of Attention Disorders*, *22*(11), 1019–1031. https://doi.org/10.1177/1087054715618788

Quinn, C. (2003). Detection of malingering in assessment of adult ADHD. *Archives of Clinical Neuropsychology, 18*(4), 379–395. doi:10.1016/s0887-6177(02)00150-6

Ramos Olazagasti, M. A., Klein, R. G., Mannuzza, S., Belsky, E. R., Hutchison, J. A., Lashua-Shriftman, E. C., & Castellanos, F. X. (2013). Does childhood attention-deficit/hyperactivity disorder predict risk-taking and medical illnesses in adulthood?. *Journal of the American Academy of Child and Adolescent Psychiatry*, *52*(2), 153–162.e4. https://doi.org/ 10.1016/j.jaac.2012.11.012

Rey, A. (1964). Rey 15-item memory test. PsycTESTS Dataset. https://doi.org/10.1037/t27240-000

Riccio, C. A., Cohen, M. J., Hynd, G. W., & Keith, R. W. (1996). Validity of the auditory continuous performance test in differentiating central processing auditory

disorders with and without ADHD. *Journal of Learning Disabilities*, 29(5), 561–566. https://doi.org/10.1177/002221949602900510

Rogers, R. (1997). Structured interviews and dissimulation. In R. Rogers (Eds.), *Clinical Assessment of Malingering and Deception* (p. 301-327). New York: The Guilford Press.

Schneider, H. E., Kirk, J. W., & Mahone, E. M. (2014). Utility of the test of memory malingering (TOMM) in children Ages 4–7 years with and without ADHD. *The Clinical Neuropsychologist*, *28*(7), 1133–1145. https://doi.org/10.1080/13854046.2014.960004

Shapiro, S. K., & Herod, L. A. (1994). Combining Visual and Auditory Tasks in the Assessment of Attention-Deficit Hyperactivity Disorder. *Disruptive Behavior Disorders in Childhood*, 87–107. https://doi.org/10.1007/978-1-4899-1501-6_4

Shaw, R., Grayson, A., & Lewis, V. (2005). Inhibition, ADHD, and computer games: The inhibitory performance of children with ADHD on computerized tasks and games. *Journal of Attention Disorders*, 8(4), 160–168. https://doi.org/10.1177/1087054705278771

Slick, D. J., Sherman, E. M., & Iverson, G. L. (1999). Diagnostic criteria for malingered neurocognitive dysfunction: Proposed standards for clinical practice and research. *The Clinical Neuropsychologist*, *13*(4), 545-561. https://doi.org/10.1076/1385-4046(199911)13:04;1-y;ft545

Slusarek, M., Velling, S., Bunk, D., & Eggers, C. (2001). Motivational effects on inhibitory control in children with ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(3), 355–363. https://doi.org/10.1097/00004583-200103000-00016

Sobanski, E., Brüggemann, D., Alm, B., Kern, S., Deschner, M., Schubert, T., Philipsen, A., Rietschel, M. (2007). Psychiatric comorbidity and functional impairment in a clinically referred sample of adults with attention-deficit/hyperactivity disorder (ADHD). *European Archives of Psychiatry and Clinical Neuroscience*, 257(7), 371–377. https://doi.org/10.1007/s00406-007-0712-8

Sohlberg, M. M., & Mateer, C. A. (1989). *Introduction to cognitive rehabilitation: Theory and practice*. Guilford Press.

Sollman, M. J., Ranseen, J. D., & Berry, D. T. R. (2010). Detection of Feigned ADHD in College Students. *Psychological Assessment*, *22*(2), 325-335. https://doi.org/10.1037/a0018857

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Strauss, E., Spellacy, F., Hunter, M., & Berry, T. (1994). Assessing believable deficits on measures of attention and information processing capacity. *Archives of Clinical Neuropsychology*, *9*(6), 483-490. https://doi.org/10.1016/0887-6177(94)90039-6

Suhr, J., Hammers, D., Dobbins-Buckland, K., Zimak, E., & Hughes, C. (2008). The relationship of malingering test failure to self-reported symptoms and neuropsychological findings in adults referred for ADHD evaluation. *Archives of clinical neuropsychology: the official journal of the National Academy of Neuropsychologists*, *23*(5), 521–530. https://doi.org/10.1016/j.acn.2008.05.003

Sullivan, B. K., May, K., & Galbally, L. (2007). Symptom exaggeration by college adults in attention-deficit hyperactivity disorder and learning disorder Assessments. *Applied Neuropsychology*, *14*(3), 189-207. https://doi.org/10.1080/09084280701509083

Summerfield, J. J., Lepsien, J., Gitelman, D. R., Mesulam, M. M., & Nobre, A. C. (2006). Orienting attention based on long-term memory experience. *Neuron*, *49*(6), 905–916. https://doi.org/10.1016/j.neuron.2006.01.021

Tahiroglu, A. Y., Celik, G. G., Avci, A., Seydaoglu, G., Uzel, M., & Altunbas, H. (2009). Short-term effects of playing computer games on attention. *Journal of Attention Disorders*, *13*(6), 668–676. https://doi.org/10.1177/1087054709347205

Tombaugh, T. (1996). *Test of Memory Malingering.* New York, NY: MultiHealth Systems.

Tombaugh, T. N. (1997). The Test of Memory Malingering (TOMM): Normative data from cognitively intact and cognitively impaired individuals. *Psychological Assessment*, *9*(3), 260-268. https://doi.org/10.1037/1040-3590.9.3.260

Tucha, L., Fuermaier, A. B. M., Koerts, J., Buggenthin, R., Aschenbrenner, S., Weisbrod, M., Thome, J., Lange, K., & Tucha, O. (2015). Sustained attention in adult ADHD: Time-on-task effects of various measures of attention. *Journal of Neural Transmission*, *124*(S1), 39–53. https://doi.org/10.1007/s00702-015-1426-0

Van Zomeren, A.H., & Brouwer, W.H. (1994). Clinical neuropsychology of attention. Oxford University Press, New York

Wasserstein, J. (2005). Diagnostic issues for adolescents and adults with ADHD. *Journal of Clinical Psychology*, *61*(5), 535–547. https://doi.org/10.1002/jclp.20118

Willcutt E. G. (2012). The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. *Neurotherapeutics: The Journal of the American Society for Experimental NeuroTherapeutics*, *9*(3), 490–499. https://doi.org/10.1007/s13311-012-0135-8

Williamson, K. D., Combs, H. L., Berry, D. T., Harp, J. P., Mason, L. H., & Edmundson, M. (2014). Discriminating among ADHD alone, ADHD with a comorbid psychological disorder, and feigned ADHD in a college sample. *The Clinical Neuropsychologist*, *28*(7), 1182-1196. https://doi.org/10.1080/13854046.2014.956674

Xiao, K., & Yamauchi, T. (2017). The role of attention in subliminal semantic processing: A mouse tracking study. *PLOS ONE*, *12*(6), e0178740. https://doi.org/10.1371/journal.pone.0178740

Yoshimasu, K., Barbaresi, W. J., Colligan, R. C., Voigt, R. G., Killian, J. M., Weaver, A. L., & Katusic, S. K. (2018). Adults with persistent ADHD: Gender and psychiatric comorbidities—A population-based longitudinal study. *Journal of Attention Disorders, 22*(6), 535-546. https://doi.org/10.1177/1087054716676342

Appendix

Picture Stimuli

Image 1

Image 2

Image 3

Image 4

Image 5


modernism
Walls Frames
CONTAINER ATLAS
PERU
Coffee
EATALY
PASTA
DESIGN
CRAFT MAKERS
CONCRETE

Image 6

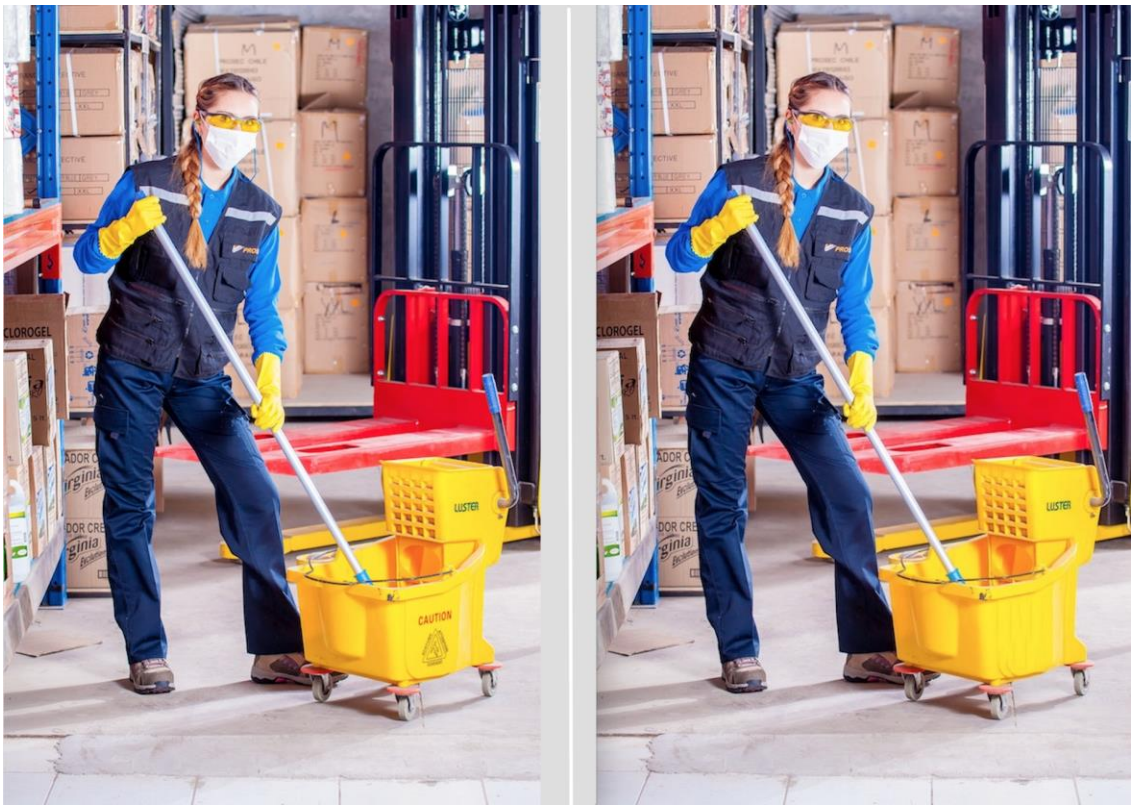

Image 7

Image 8

Image 9

Image 10

Image 11

Image 12

Image 13

Image 14

VITA

After graduating from Central High School, Pollok, TX in 2009, Roselia entered Stephen F. Austin State University at Nacogdoches, Texas. She earned the degree of Bachelor of Science in Psychology in December 2012 and the degree of Master of Arts in School Psychology in May 2019. Her Master's thesis was on the 'Electrical Brain Activity and the Examinee's Level of Effort During Performance Validity Tasks'. Roselia completed a Licensed Specialist in School Psychology (LSSP) internship with Central ISD (2017-2018) in Pollok, TX and completed an accredited doctoral internship in clinical psychology with Easterseals Rehabilitation Center in Evansville, Indiana (2019-2020). In pursuance of her professional licensure and following her PhD graduation, she will complete a Psychology Fellowship position with Deaconess Clinic (Behavioral Health) in Evansville, Indiana.

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