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The Development of a Scale to Detect Feigned Attention-Deficit/Hyperactivity Disorder (ADHD) in Adults

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By

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DECLARATION OF CO-AUTHORSHIP / PREVIOUS PUBLICATION

I. Co-Authorship

I hereby declare that this thesis incorporates material that is result of joint research, as follows:

Part of Chapter 2 was co-authored with Dr. Carlin Miller and Dr. Laszlo Erdodi. The key ideas, primary contributions, experimental designs, data analysis, interpretation, and writing were performed by the author, and the contribution of co-authors was primarily through the provision of guidance and supervision. Both Dr. Miller and Dr. Erdodi provided feedback on the refinement of ideas and editing of the manuscript.

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Thesis Chapter	Publication title/full citation	Publication status
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ABSTRACT

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental condition characterized by a pattern of attentional deficits, hyperactivity, and/or impulsivity that tends to persist into adulthood for a subset of the individuals affected. In an attempt to address the high base rate of feigned ADHD in university settings (estimates ranging from 25 to 50% of those assessed), the objective of the present study was to develop and validate the Hyperactivity/Inattention Trait Scale (HITS), specifically designed to differentiate between feigned and genuine adult ADHD. The HITS was administered online to a sample of undergraduate students, along with several performance validity tests, aimed at detecting non-credible performance. An exploratory factor analysis was conducted in order to examine the underlying structure of the HITS. A seven-factor structure was retained, containing the following factors: executive dysfunction, invalid responding, somatization, impulsivity, hyperactivity, thought disorder, and positive impression management. The HITS demonstrated good classification accuracy in the detection of executive dysfunction (.80 sensitivity, .80 specificity). Importantly, the HITS contains two subscales that approximate the "Larrabee limit" (.50 sensitivity at .90 specificity) in terms of identifying non-credible responding. The combination of the detection of executive dysfunction and non-credible performance allows for the distinction of genuine from feigned symptoms of ADHD in a single self-report measure.

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Chapter I

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental condition characterized by a pattern of attentional deficits, hyperactivity, and/or impulsivity that tends to persist into adulthood for a subset of the individuals affected. For university students, symptoms of ADHD may contribute to poor academic outcomes, as well as psychosocial difficulties (Weyandt & DuPaul, 2008), including anxiety, depression, emotional instability, disruptions in peer relations and substance abuse (Blase et al., 2009). Thus, the benefits that accompany the diagnosis of ADHD, including access to stimulant medication and academic accommodations, may improve academic outcomes and psychosocial functioning. However, the high estimated base rate of feigned ADHD in university settings (estimates ranging from 25-50% of those assessed; Marshall et al., 2010; Suhr, Hammers, Dobbins-Buckland, Zimak, & Hughes, 2008; Sullivan, May, & Galbally, 2007) may result in the misappropriation of educational and health care resources. Despite these implications, there are currently no self-report measures that can accurately identify feigned ADHD.

In an attempt to address this issue, the objective of the present study was to develop and validate the Hyperactivity/Inattention Trait Scale (HITS), specifically designed to differentiate between feigned and genuine adult ADHD. The goal of the following review is to outline prior literature in the areas of ADHD, malingering, and the assessment of both.

Chapter II

Review of Literature

ADHD Characteristics

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) defines attention-deficit/hyperactivity disorder (ADHD) as a neurodevelopmental disorder characterized by a pattern of attentional deficits, hyperactivity, and/or impulsivity that persists for at least six months and significantly interferes with functioning. As in the previous edition, individuals may be specified as having one of three subtypes of ADHD. In order to meet diagnostic criteria for *predominantly inattentive* subtype (ADHD-I), children must exhibit six or more symptoms (five or more symptoms for adults) of inattention, such as distractibility and difficulty focusing, and must not meet criteria for any other subtype. For the *predominantly hyperactive subtype* (ADHD-H), children must exhibit six or more symptoms (five or more symptoms for adults) of hyperactivity, such as fidgeting and interrupting, and must not meet criteria for any other subtype. Diagnosis of the *combined* subtype (ADHD-C) requires that individuals meet criteria for both ADHD-I and ADHD-H for the prior six months. In order to be diagnosed with any subtype of ADHD, the DSM-5 indicates that several symptoms must have been present prior to age 12 (age 7 in previous editions), and that the symptoms must be present in two or more settings (e.g., at home and at school). Finally, the symptoms must significantly interfere with the individual's social, academic, and/or occupational functioning, and cannot be better explained by another psychological disorder.

According to the DSM-5, prevalence of ADHD is estimated to be 5% in children and 2.5% in adults (APA, 2013). Although ADHD is more prevalent in children, researchers have shown that approximately 42% of children show syndromatic persistence (i.e., meeting full diagnostic criteria) of ADHD into adulthood (Kessler et al., 2005). Similarly, a more recent longitudinal study found that 10 years after diagnosis (mean age = 22 years), 22% of all male participants (N = 110) were considered to be fully remitted (i.e., experiencing fewer than half of the required symptoms for diagnosis). However, 78% of them showed some evidence of persistence, whether that was syndromatic, symptomatic (i.e., meeting subthreshold criteria, with more than half, but not all, of the symptoms required for diagnosis), or functional (i.e., not meeting subthreshold criteria, but functionally impaired with a Global Assessment of Functioning [GAF] score of ≤60) (Biederman, Petty, Evans, Small, & Faraone, 2010). In university students specifically, Weyandt and DuPaul (2006) conducted a review of 23 studies and reported prevalence estimates ranging from 2% to 8% in university students in the United States. This variability in prevalence rates may be related to under-reporting due to stigma, or over-reporting due to external incentives.

Executive Dysfunction. Executive functioning (EF) is an umbrella term referring to goal-directed behaviour, including processes such as planning, organizing, set-shifting, working memory, inhibition, and selective attention (Best & Miller, 2010). There are several prominent theories related to the role of EF in ADHD. Barkley's (1997) theory of ADHD describes that individuals with ADHD have a core deficit in inhibition, which then causes difficulties with other executive functions, including self-regulation, motor control (contributing to hyperactivity), and working memory. Similarly, Quay's (1997)

ADHD model also proposes that individuals with ADHD may have an "underreactive behavioral inhibitory system" (Quay, 1997, p. 7).

Neuroanatomical substrates involved in ADHD vary across previous studies. Overall, meta-analyses have found that several brain regions are implicated, including the basal ganglia (Nakao, Radua, Rubia, & Mataix-Cols, 2009; Valera, Faraone, Murray, & Seidman, 2007) and, in adults, the prefrontal cortex (Ernst et al., 2003), the dorsal part of anterior cingulate cortex (Ernst et al., 2003), and the cerebellum (Ashtari et al., 2005). As expected, aside from the basal ganglia, these brain regions have been found to be related to executive functioning.

Research with adults has found that although symptoms of ADHD are similar between children and adults, executive deficits are particularly salient in adults with ADHD (Wasserstein, 2005). Psychometrically, they manifest as poor performance on measures of cognitive flexibility, response inhibition, and selective and divided attention (Tucha et al., 2008). While executive dysfunction is present in about 50% of children with ADHD (i.e., aside from hyperactivity), recent work has shown that these deficits are more likely to persist into adulthood than hyperactivity, even remaining present in subjects with remittent ADHD (Kamradt, Ullsperger & Nikolas, 2014; van Lieshout, Luman, Buitelaar, Rommelse, & Oosterlaan, 2013).

Although research findings have been inconsistent, there is some evidence for the executive deficits in at least a proportion of adults with ADHD (Biederman et al., 2004; Nigg, Willcutt, Doyle, & Sonuga-Barke, 2005). In fact, past research has indicated that those with both ADHD and EF impairment may, in fact, represent a separate subtype of ADHD (Lambek et al., 2010; Nigg et al., 2005). Consistent with this, recent research has

established that a subset of children with ADHD show persistent difficulties into adulthood (van Lieshout et al., 2013). These difficulties appear to be more related to executive dysfunction (including inattentiveness) than to the hyperactivity dimension more common in childhood (van Lieshout et al., 2013), and also tends to be related to impairments in occupational functioning (Barkley & Fischer, 2011).

In a longitudinal study by Miller, Ho, and Hinshaw (2012), 140 females with ADHD and 88 matched controls were assessed at a mean age of 9.6 years. Ten years later, 93% of the ADHD group and 98% of the control group were assessed at a mean age of 19.6 years. Both the ADHD-I and the ADHD-C groups showed significantly poorer performance (small-to-medium effects for both comparisons) than the control group on measures of response inhibition and working memory, as well as on all trials of the Rey Complex Figure Test (RCFT). Interestingly, although 25% of the individuals with ADHD in childhood no longer met criteria for diagnosis in adulthood, both the remitted group and the group that continued to meet criteria for ADHD performed worse than the control group (small-to-medium effect). Additionally, the remitted group and the group that continued to meet criteria for ADHD in adulthood did not differ from each other. These findings support the idea that EF impairment appears to persist even when the hyperactivity dimension of ADHD remits.

Sluggish Cognitive Tempo (SCT). SCT is a construct that was originally seen as a component of ADHD-I. However, recent research suggests that SCT is an entirely separate cluster of symptoms, perhaps representing a distinct psychiatric disorder (Becker et al., 2015). Core symptoms of SCT include (but are not limited to) daydreaming, feeling sleepy/drowsy, being underactive, psychomotor slowing, staring blankly, feeling ‘foggy’,

feeling lethargic, feeling sluggish, intermittent changes in alertness, loss of cognitive set, low initiative and persistence, and lack of motivation (Becker et al., 2015).

SCT also appears to be uniquely associated with lower self-esteem and difficulties with emotional self-regulation after controlling for ADHD in children with and without ADHD (Watabe, Owens, Evans, & Brandt, 2014). A recent meta-analysis of 23 factor analytic studies suggests that SCT may represent a cluster of symptoms distinct from ADHD and its current subtypes (Becker et al., 2015). In fact, several studies have failed to find an association between SCT and the hyperactivity-impulsive symptoms of ADHD after controlling for inattention, while inattention remains associated with the hyperactivity-impulsive symptom of ADHD after controlling for SCT (Becker et al., 2015). This may indicate a specific distinction between ADHD-I and SCT.

Only one study to date has examined SCT and neuropsychological functioning, and found no significant associations (Jarrett, Rapport, Rondon, & Becker, 2014). After controlling for symptoms of inattention, two studies found that SCT was associated with limitations in sustained attention and processing speed (Wåhlstedt & Bohlin, 2010; Willcutt et al., 2014). Authors suggest that relationships between SCT and response inhibition, working memory, and reaction time might be due to comorbid ADHD-I (Wåhlstedt & Bohlin, 2010; Willcutt et al., 2014). This suggests that there is a need for better delineation of symptoms and characterization of SCT before its unique contribution to ADHD symptoms can be meaningfully assessed. Furthermore, if ADHD and SCT are independent constructs that require different interventions, differentiating between them is important from a treatment selection point of view.

Typical Assessment of ADHD. Based on the diagnostic criteria outlined by the DSM-5, clinicians must evaluate the number, frequency, and pervasiveness of symptoms, the level of functional impairment, and must also rule out other conditions that may be causing similar symptoms. For both children and adults, the collection of collateral report is recommended (Surman, 2013), both to target 'blind spots' in the individual's self-report, and to ascertain the presence of symptoms in various settings. Although neuropsychological testing can be viewed as an objective way to assess cognitive processes such as attention, as well as rule out other conditions with similar patterns of deficits, cognitive testing is not required in the diagnosis of ADHD by DSM-5 criteria (Pritchard, Nigro, Jacobson, & Mahone, 2011; Surman, 2013).

Typical evaluation procedures for ADHD, usually conducted by psychologists, involve the use of clinical interview and behavioural rating scales completed by the individual and collateral informants. Depending on age and circumstances, they may be parents, teachers, siblings, spouses, or coworkers (Miller, Rinsky, & Hinshaw, 2013). However, the most recent estimates suggest that more than 50% of children with ADHD are diagnosed and treated by primary care physicians (Leslie, Stallone, Weckerly, McDaniel, & Monn, 2006).

Physicians are unlikely to use the above outlined evaluation procedures due to limited time, resources, and training in this area (Pritchard et al., 2011). Although the American Academy of Pediatrics (AAP) provides guidelines to assist physicians in the assessment of ADHD, only 61% of those physicians who are familiar with the guidelines (77% of PCPs) report incorporating these guidelines into their practice (Rushton, Fant, &

Clark, 2004). Thus, a substantial proportion of patients are diagnosed with ADHD through suboptimal assessment methods.

Diagnosis in Adults. Although the DSM-5 allows ADHD to be diagnosed in adulthood, several issues make it difficult to assess adult ADHD. Diagnosis requires that several symptoms be present before age 12, which is difficult to verify retrospectively for several reasons. Adults may have difficulty recalling their childhood symptoms of ADHD, and may not be able to accurately remember or judge the severity of functional impairment experienced in childhood (Miller, Newcorn, & Halperin, 2010). In fact, prior research has indicated that retrospective report of childhood symptoms of ADHD were not specific to the disorder (Suhr, Zimak, Buelow, & Fox, 2009).

Instead, Dvorsky, Langberg, Molitor, and Bourchtein (2016) reported that parent ratings of childhood symptoms of ADHD in young adults were the strongest predictors of current diagnostic status, confirming the importance of parent ratings in ADHD diagnosis. However, most adults are not accompanied to assessments by parents or older siblings who may be able to more objectively evaluate the client's childhood symptoms (Quinn, 2003). Similarly, adults may be unable to provide objective evidence of early impairment (e.g., school report cards, results of standardized achievement tests).

Because clinicians may have difficulty using a multi-modal approach to diagnosing ADHD in adults, including collateral report and objective evidence of childhood symptoms, it is important to note the significant potential for inaccuracies in adults' self-report of past and present ADHD symptoms. Furthermore, adults with ADHD may experience different symptoms and/or different manifestations of symptoms from children with ADHD, reflected by the changes in the descriptions and examples of the

criteria listed in the DSM-5. While some researchers have proposed other symptoms in addition to those listed in the DSM-IV that may distinguish ADHD in adulthood from ADHD in childhood, results have been mixed.

Fedele, Hartung, Canu, and Wilkowski (2010) examined Barkley, Murphy, and Fischer's (2007) 87-item pool of symptoms of adult ADHD. They reported that two factors (*cognitive inflexibility* and *disinhibition*) had diagnostic utility above and beyond DSM-IV items. They also found that eight out of nine of Barkley et al.'s (2007) typical adult ADHD symptoms did not predict impairment above and beyond DSM-IV items.

To the author's knowledge, no research on further delineation of ADHD symptoms in adults has been published subsequent to the advent of the DSM-5. A recent field trial consisting of 18- and 19-year-old young adults (Matte et al., 2015) found that inattentive symptoms were the strongest predictors of impairment in adults. In addition, the best cut-offs for adults were ≥5 symptoms of inattention (0.73 sensitivity and 0.49 specificity) and ≥4 symptoms of hyperactivity/impulsivity (0.54 sensitivity and 0.61 specificity). A structured interview for DSM-5 ADHD symptoms served as the criterion. However, further research is required to better characterize the types of symptoms commonly exhibited by adults with ADHD, particularly with regard to executive dysfunction.

Differential Diagnosis. The presentation of ADHD in adults is characterized by fewer externalizing symptoms (Karam et al., 2009) and a higher degree of psychiatric comorbidity. It is relatively common for adults with ADHD to also present with anxiety disorders (47%) and mood disorders (38%; Kessler et al., 2006). In one previous study,

70% of adults with ADHD reported a significant lifetime occurrence of depression or anxiety (Halmøy, Fasmer, Gillberg, & Haavik, 2009).

Therefore, diagnosing adult ADHD is further complicated by symptom overlap with other psychological disorders (McGough & Barkley, 2004). For example, one of the diagnostic criteria of a manic episode is "More talkative than usual or pressure to keep talking" (APA, 2013, p. 124). This criterion is markedly similar to the ADHD criteria "Often talks excessively" and "Is often 'on the go,' acting as if 'driven by a motor'" (APA, 2013, p. 60). Similarly, the diagnostic criteria for generalized anxiety disorder include, "Restlessness or feeling keyed up or on edge" (APA, 2013, p. 222), which is also reminiscent of the hyperactivity associated with ADHD. These factors, along with the rate of comorbidity in adults with ADHD, complicate assessment and treatment planning. Thus, an exploration of an improved diagnostic algorithm is warranted.

Malingering and Symptom Exaggeration

The DSM-5 defines *malingering* as the "intentional production of false or grossly exaggerated physical or psychological symptoms, motivated by external incentives such as avoiding military duty, avoiding work, obtaining financial compensation, evading criminal prosecution, or obtaining drugs" (APA, 2013, p. 726). In an oft-cited response to commentary, Larrabee, Millis, and Meyers (2009) argue that the base rate for malingering in settings with external incentives is approximately 40-50%. While this figure is consistent with prior research that estimated base rates of malingering of 38.5-40% in individuals with mild traumatic brain injury (mTBI) seeking disability benefits (Mittenberg, Patton, Canyock, & Condit, 2002; Larrabee, 2003), and 45-60% in Social Security disability applicants (Chafetz, 2008), a recent, comprehensive review of several

studies estimates the base rates of malingering in forensic disability cases to be much lower (~15±15%; Young, 2015).

This lower range of base rates has been supported by subsequent examinations of malingering in individuals with mild, moderate, and severe TBI (Ruff, Klopfer, & Blank, 2016), as well as inpatients with mTBI or PTSD within the Veterans Health Administration (Young, Roper, & Arentsen, 2016). A previous examination of possible malingering in Canadian post-secondary students seeking evaluations for ADHD or learning disorders found a base rate of 14.6% (Harrison & Edwards, 2010), in line with Young's (2015) estimate. Estimates of the prevalence of malingered ADHD in university settings vary, with studies reporting base rates ranging from 25% to 50% (Marshall et al., 2010; Suhr, Hammers, Dobbins-Buckland, Zimak, & Hughs, 2008; Sullivan, May, & Galbally, 2007). Nevertheless, it is difficult to ascertain exact base rates of malingering, partially because individuals who are intentionally feigning (i.e., malingering) tend not to confess to feigning (see 'The Evaluation of Malingering'; Williamson et al., 2014). To the author's knowledge, base rates of malingered ADHD in other settings are not available in the literature.

Incentives for Malingering. According to the DSM-5, symptom exaggeration or feigning must occur in the presence of external incentives to be defined as *malingering* (APA, 2013). This criterion is most likely to be met in university students who experience salient incentives to obtain a psychiatric diagnosis that qualifies them for status as a student with disability. Having a documented disability on a college or university campus is associated with a range of benefits, such as academic accommodations (including extra time for exams and assignments, reduced homework,

separate or private testing environments, lighter workloads, and flexible deadlines for assignments), and even financial aid (Harrison, 2006). As such, the ability to successfully feign ADHD has numerous tangible rewards in a higher education setting.

Perhaps most problematically, an ADHD diagnosis can also be used to acquire stimulant medication to be used either recreationally, or for its cognitive performance-enhancing properties (Bordoff, 2017; Harrison, 2006). At therapeutic doses, stimulant medication promotes greater concentration, learning, and memory in individuals with and without ADHD (Smith & Farah, 2011). A recent meta-analysis found that stimulant medication significantly enhanced short-term episodic memory (small effect), delayed episodic memory (medium effect), inhibitory control (small effect), and working memory (small effect) in healthy populations (Ilieva, Hook, & Farah, 2015).

The ability of these medications to improve functioning even in neurocognitively healthy individuals makes psychostimulants a good candidate for illicit use. Advokat, Guidry, and Martino (2008) reported that 43% of students without a diagnosis of ADHD acknowledged using stimulant medication. Of those diagnosed with ADHD and who had received prescriptions for stimulant medication, 84% reported being asked to share their medication with peers at no cost, while 54% reported being asked to sell their medication. Of this group, 19% reported being asked to teach others how to feign ADHD (Advokat et al., 2008).

Societal values reflect an apparent double standard regarding the principle of equal opportunity in athletic and academic competitions. A recent comparison of perceptions of performance-enhancing medication in athletic versus academic domains found that students find athletes who misuse anabolic steroids to be less ethical and

acceptable than students who misuse prescription stimulant medication. The authors suggest that this may reflect the high base rate of prescription stimulant misuse among university students, which, in turn, may normalize the practice (Dodge, Williams, Marzell, & Turrisi, 2012).

In a random sample of 9,161 undergraduate students, the most prevalent motives for using prescription stimulant medication were to help with concentration (58%), increase alertness (43%), and provide a 'high' (43%; Teter, McCabe, Cranford, Boyd, & Guthrie, 2005). The recreational effects of some ADHD medications is deemed to be similar to that provided by cocaine (Sharp & Rosén, 2007). A high percentage (65.2%) of students report misusing stimulant medication for 'partying', with 40% reporting intranasal use as their preferred method of intake (White, Becker-Blease, & Grace-Bishop, 2006).

Although it is possible to purchase stimulant medication illicitly, it is considered easier and less expensive to obtain a prescription (White et al., 2006). In addition, possession of psychostimulants without a prescription (i.e., an official diagnosis of ADHD) constitutes an infraction with serious legal repercussions in most jurisdictions. Taken together, these factors create a strong incentive to successfully feign ADHD, and significant potential consequences for those who do.

The Evaluation of Non-Credible Performance. Intent to feign is a necessary component of malingering, and is considered more crucial than the presence of external incentives, which has been found to be limited in terms of predictive power (Hurtubise, Scavone, Sagar, & Erdodi, 2017). Nevertheless, non-credible performance (i.e., with or without intent to feign) has been most studied within the context of mTBI patients

seeking disability benefits or other compensation, perhaps due to the relatively high base rate of suspected malingering in this population. Estimates range from 15% (Young, 2015) to as high as 60% (Chafetz, 2008). Malingering has been long recognized as relatively common and serious threat to the validity of neuropsychological assessment.

The Policy and Planning Committee of the National Academy of Neuropsychology issued a position paper, establishing the assessment of performance validity as a crucial component of a neuropsychological evaluation (Bush et al., 2005). Larrabee (2012) introduced the terms *performance validity*, to distinguish the credibility of cognitive test performance, in contrast to *symptom validity*, referring to the credibility of symptom report. Performance validity tests (PVTs) are either stand-alone measures, traditionally considered the gold standard for evaluation of non-credible performance (Green, 2013), or embedded validity indicators (EVIs).

EVIs represent a novel approach to validity assessment as they utilize information already collected for clinical purposes. Originally, they were designed to complement stand-alone PVTs, as they were considered less sensitive to non-credible performance (Miele, Gunner, Lynch & McCaffrey, 2012). However, more recent investigations found EVIs to have sensitivity comparable (Boone, 2103; Erdodi et al., 2014) or even superior to stand-alone PVTs (An, Kaploun, Erdodi & Abeare, 2017). Over time, given the cumulative evidence base supporting their clinical utility in combination with numerous practical advantages, EVIs have gained significant popularity and professional acceptance (Boone, 2013; Erdodi, Lichtenstein, Rai & Flaro, 2016; Lichtenstein, Erdodi & Linnea, 2016).

Typically, stand-alone PVTs are based on the forced choice recognition paradigm. They are designed to appear more difficult than they really are by containing a higher number of items or multiple trials. Traditionally, scores below chance level (as defined by the binomial probability distribution) on forced choice recognition tests are considered indicative of definite malingering (Binder, Larrabee, & Millis, 2014; Slick, Sherman & Iverson, 1999). The majority of individuals with genuine cognitive impairment, such as severe brain injury and dementia, pass PVTs (Walter, Morris, Swier-Vosnos, & Pliskin, 2014).

The confidence in classifying a response set as *invalid* increases with the number of failed PVTs/SVTs. In fact, Larrabee (2008) reported that ≥3 PVT failures identified 100% of patients in a sample of compensation-seeking examinees classified as having "definite malingered" (p. 670) neurocognitive dysfunction based on the Slick et al. (1999) criteria. Despite the consensus on the importance of using multiple PVTs in an assessment (Boone, 2009; Bush et al., 2005; Chafetz, Williams et al., 2015; Heilbronner, Sweet et al., 2009; Lynch, 2004; Shutte, Axelrod & Montoya, 2015), this practice has recently been criticised for inflating false positive rates (Berthelson, Mulchan, Odland, Miller & Mittenberg, 2013; Silk-Eglit, Stenclik, Miele, Lynch & McCaffrey, 2015). Although these claims have since been refuted (Davis & Millis, 2014; Larrabee, 2014; Lichtenstein, Erdodi, Rai, Mazur-Mosiewicz & Flaro, 2016) and empirically-based models were proposed to control false positive rates in multivariate models of performance validity assessment (Odland, Lammy, Martin, Grote & Mittenberg, 2015), this controversy is far from being resolved (Bilder, Sugar & Hellemann, 2014; Bush et al., 2014; Chafetz et al., 2015; Proto et al., 2014).

Theoretical concerns aside, the cost of administering multiple stand-alone PVTs can be prohibitive in the current climate of cost-conscious health care systems (Erdodi, Abeare, et al., 2017). As such, EVIs can serve as a viable alternative, as they address several practical issues around the extensive use of stand-alone PVTs. First, they provide information about both performance validity and cognitive ability without requiring the purchase of extra tests or additional assessment. Second, there is some evidence that EVIs are more robust to coaching, particularly because they are less identifiable as PVTs than stand-alone measures (Schutte, Axelrod, & Montoya, 2015). Third, they can provide continuous monitoring of potential malingering throughout the assessment (Boone, 2009; Chafetz et al., 2015) without extending the test battery. This is especially important when assessing individuals who are medically or emotionally fragile (Lichtenstein et al., 2017). Finally, they help assessors avoid the appearance of alpha bias (Erdodi & Lichtenstein, 2017) as evidenced by test selection (Boone, 2013).

Symptom validity scales, usually embedded within self-report questionnaires, are designed to assess the fabrication or exaggeration of clinical symptoms, inconsistent/random responding, endorsing of highly unusual symptoms that have a very low base rates even in clinical populations, as well as defensive response styles (i.e., 'faking good'). In general, research on such embedded indices has been mixed. While some scales within questionnaires have been shown to accurately detect symptom exaggeration in general clinical populations (Sellbom & Bagby, 2010), the singular use of these scales to detect response bias (i.e., without other validity measures) has generally been controversial in the literature (Piedmont, McCrae, Riemann, & Angleitner, 2000). The Symptom Validity Scale (previously called the Fake Bad Scale) from the Minnesota

Multiphasic Personality Inventory (Second Edition; MMPI-2), a popular self-report of personality and psychopathology, has been found to be particularly weak with regard to its psychometric integrity (Gass, Williams, Cumella, Butcher, & Kally, 2010).

The evidence regarding the relationship between SVTs and PVTs is mixed. Symptom validity scales embedded within self-report measures have variable concordance rates with PVTs, and there is some evidence of their differential predictive validity (Copeland et al., 2016). Previous research found that the validity scales embedded within the MMPI-2 did not correlate with performance on either the Test of Memory Malingering (TOMM) or the Rey 15-Item Test, two commonly-used PVTs (McCaffrey, O'Bryant, Ashendorf, & Fisher, 2003). Similarly, one study found that the three response bias scales of the Personality Assessment Inventory (PAI) did not predict performance on the Word Memory Test (WMT) in college students seeking assessments for ADHD and learning disorders (Sullivan et al., 2010).

However, scales developed independent of the original self-report measures have demonstrated better classification accuracy. The Response Bias Scale (RBS; Gervais, Ben-Porath, Wygant, & Green, 2007) was developed separately for the MMPI-2 by selecting 28 items that accurately discriminated between individuals who passed and those who failed at least one of three PVTs. The RBS has demonstrated superiority to the MMPI-2's original validity scales in predicting failure on the TOMM (Whitney, Davis, Shepard, & Herman, 2008). Similarly, the PAI's somatization subscale has been shown to have adequate sensitivity (.93) and specificity (.76) in predicting passing or failing the TOMM at a cut-off of T > 87 (Whiteside et al., 2010). Previously, the PAI's negative impression management (NIM) and infrequency (INF) subscales were found to predict

TOMM performance. However, the results of classification accuracy analyses were not reported (Whiteside, Dunbar-Mayer, & Waters, 2009).

Symptom Validity in ADHD Assessment

As noted previously, the diagnostic criteria for ADHD do not require the use of cognitive measures. In practice, there is no widely-used standard diagnostic method for diagnosing adult ADHD (Kingston, Ahmed, Gray, Bradford, & Seto, 2013; Sollman, Ranseen, & Berry, 2010). Prior research has shown that despite the deviation from the criteria outlined in the DSM-5, many clinicians only employ tallied self-reported symptoms from clinical interview and/or on a paper-and-pencil symptom inventory when diagnosing ADHD (Joy, Julius, Akter, & Baron, 2010; Nelson, Whipple, Lindstrom, & Foels, 2014).

Although the accuracy of self-report data has been a long-standing concern in psychological assessment (Manor et al., 2012; Wilson & Dunn, 2004) in general, establishing the veracity of patient report during a diagnostic interview or while reviewing the scores on self-reported symptoms on paper-and-pencil questionnaires is not an official practice standard for ADHD evaluations. In fact, one study has found that the Conners' Adult Attention Deficit/Hyperactivity Rating Scale (CAARS), an ADHD symptom checklist, had unacceptably high false positive rates (15-22%, depending on the cut-off used; Harrison, Nay, & Armstrong, 2016), indicating that this particular scale over-classifies individuals as ADHD patients. In general, the literature suggests that it is difficult to discriminate between those with and without ADHD using self-report measures alone, regardless of potential feigning.

This seems to be a critical omission in the existing diagnostic system, as research has shown that people are often unable to accurately describe their own behaviour, or judge how they might be perceived by others (Wilson & Dunn, 2004). Adults with ADHD symptoms specifically have been found to underreport symptoms of inattention, hyperactivity, and impulsivity, and under-estimate the frequency of their symptoms (Manor et al., 2012 Miller, Newcorn, & Halperin, 2010). Concerns about the reliability and validity of self-reported symptoms attributable to inherent limitations in individuals' ability to introspect, are compounded by an increased awareness of symptom exaggeration or outright feigning within the context of ADHD assessment in young adults.

Despite well-recognized external incentives to successfully feign ADHD, there is a paucity of literature psychometric methods designed to detect malingered ADHD (Tucha, Fuermaier, Koerts, Groen, & Thome, 2015). The classification accuracy of a few prominent and robust self-report measures, including the PAI and the MMPI-2, have been investigated. However, most self-report measures either lack sensitivity for experimentally induced feigned ADHD in general, or currently lack clear cut-off scores that separate genuine from feigned ADHD (see Tucha et al., 2015, for a review). A recent study (Musso, Hill, Barker, Pella, & Gouvier, 2016) examined the PAI validity indices in the detection of experimentally induced feigned ADHD, and found that cut-offs of ≥77 on the NIM scale, ≥3 on the malingering (MAL) index, and ≥1 on the Rogers Discriminant Function (RDF) yielded excellent specificities (.93, .98, and .97, respectively), but low sensitivities (.33, .30, and .20, respectively).

An infrequency index (CII) developed for the Conners' Adult Attention Deficit/Hyperactivity Rating Scale (CAARS) had perfect specificity, but low sensitivity (.30) at a cut-off of 20 in detecting feigned ADHD when experimentally induced, and also predicts failure on the Word Memory Test (WMT; Suhr, Buelow, & Riddle, 2011). However, subsequent research on the CII has been mixed. While one study reported that a cut-off of ≥21 on the CII had adequate sensitivity (.52) and excellent specificity (.97) to non-credible self-report (Cook, Bolinger, & Suhr, 2016), another study has found that the CII was unable to discriminate between genuine and simulated feigned ADHD (Fuermaier et al., 2016).

Importantly, the study by Fuermaier and colleagues (2016) did not include any PVTs to be used as criterion measures, instead only using clinical interview to assess participants for ADHD. Thus, the results from this study should be interpreted with caution, as the validity of the symptom report is unknown. Nevertheless, these mixed findings do support the need to delineate the extent to which self-report inventories can serve to detect non-credible performance. To date, previous research has largely shown that self-report symptom inventories are generally not sensitive to the detection of feigned ADHD (see review by Tucha et al., 2015).

The commonly accepted explanation for the failure of existing psychometric tools to detect non-credible presentation is that those feigning ADHD do not necessarily over-report or exaggerate symptoms (Sollman et al., 2010), which is a common presentation of malingering. Instead, some believe that individuals who are attempting to feign ADHD will endorse an "appropriate level" of attention deficit/hyperactivity symptoms. In other words, they report just enough symptoms to qualify for the diagnosis.

Since gross exaggeration of symptoms is one of the classic psychometric markers of non-credible report (Graham, 2000), most cases of feigned ADHD are undetected. To make matters worse, as the diagnostic criteria for ADHD are transparent, it is relatively easy to keep the content of symptom endorsement within the believable clinical range. Given that endorsing unusual symptoms is another common strategy of malingering detection, this is yet another manifestation of non-credible presentation that successfully evades detection.

The CII consists of pre-existing items from the CAARS. As such, higher scores on the CII may represent symptom exaggeration (Suhr et al., 2011). However, these items were originally constructed to measure ADHD symptoms. Therefore, they are not specific to assessing response bias (Suhr et al., 2011), which inherently limits its classification accuracy.

Harrison and Armstrong's (2016) attempt at constructing an exaggeration index to detect feigned ADHD was promising, yielding .94 specificity and .34 sensitivity at a cut-off of >2. They addressed the limitation of the CII by adding 18 additional items, 17 of which were taken from the Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986), and one that relates to a belief that one's marks should be better than they are (Harrison & Armstrong, 2016).

However, their index was not immune to the endemic limitation of repurposing test items that are ill-suited for the new psychometric challenge. Although they included additional items from the DES, neither the items included from the CAARS (relating specifically to genuine adult ADHD), nor those from the DES (relating specifically to dissociative phenomena), were specific to the assessment of response bias. Furthermore,

the items constructed specifically for the new index had high false positive rates in addition to low sensitivity (actual values were not reported). Thus, classification accuracy for feigned ADHD may improve when items are developed specifically to address common presentations of feigned ADHD.

Performance-based measures used specifically to assess inattention and other associated cognitive deficits (processing speed, working memory, executive functions) have shown to vary in their utility to detect feigned ADHD thus far, although research in this area is limited. When comparing controls, participants with ADHD, and ADHD simulators on a battery of cognitive measures, simulators scored similarly to those with ADHD. Therefore, the Processing Speed Index (PSI), the Digit Span subtest, and the Letter-Number Sequencing subtest of the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; Booksh, Pella, Singh, & Gouvier, 2010) were unable to differentiate simulators from those with ADHD. However, simulators performed significantly worse on the Trail-Making Test, Part A (TMT-A) and on the Conners' Continuous Performance Test – Second Edition (CPT-II), particularly on its index of response time variability.

Interestingly, both the CPT-II (Erdodi, Pelletier & Roth, 2016; Erdodi et al., 2016; Erdodi, Roth, Kirsch, Lajiness-O'Neill, & Medoff, 2014; Lange, Iverson et al., 2013; Marshall, Schroeder et al., 2010; Ord, Boettcher, Greve & Bianchini, 2010) and the TMT (Ashendorf, Clark & Sugarman, 2017; Busse & Whiteside, 2012; Iverson, Lange, Green & Franzen, 2002; Ruffolo, Guilmette & Willis, 2000; Shura, Miskey, Rowland, Yoash-Gantz & Denning, 2016) have been validated as PVTs. On both measures, unusually poor performance on select scales was associated with invalid performance. This may explain why ADHD simulators scored low on these tests. In fact, the evidence suggests that

despite its original purpose (i.e., provide a performance-based measures of inattention), the TMT-A may be more sensitive to non-credible responding than to ADHD (Booksh et al., 2010). A possible interpretation of these findings is that PVTs developed in different clinical populations might be useful in detecting feigned ADHD.

However, the empirical evidence the detection of feigned ADHD remains equivocal, and expert conclusions are mixed. Overall, Booksh et al. (2010) were unable to identify consistent performance differences on cognitive measures between simulators and those diagnosed with ADHD. In their review, Musso and Gouvier (2014) similarly found that coached simulators were able to believably feign ADHD, and score in the same range of performance as did actual ADHD patients on many neuropsychological measures. Therefore, they concluded that cognitive measures were generally unable to detect feigned ADHD with reasonable accuracy. However, they noted that although results vary across studies, CPTs and the Stroop task appear to be the most promising out of all neuropsychological measures in detecting feigned ADHD.

Based on extant literature, PVTs are currently the most promising psychometric tools for the detection of feigned ADHD, above and beyond the sensitivity of CPTs and the Stroop task (Musso & Gouvier, 2012; Tucha et al., 2015). Sollman and colleagues (2010) compared the utility of several measures, including self-report measures, cognitive measures, and SVTs and PVTs, in the detection of feigned ADHD. They reported that the TOMM, the Digit Memory Test (DMT), the Letter Memory Test, Card Version (LMT), and Green's Nonverbal–Medical Symptom Validity Test (NV-MSVT) were all adequately sensitive (ranging from .47 to .52) and highly specific (≥.90) to feigned

ADHD. The TOMM Trial 1 ≤45, in particular, was found to be highly sensitive (.87) to feigned ADHD (Sollman et al., 2010).

Sollman and colleagues (2010) also tested a multivariate model of performance validity assessment. They dichotomized seven validity indices as pass/fail along their respective cut-off scores: TOMM Trials 1 + 2 (<90), TOMM Retention Trial (≤45), DMT (<90), LMT (<93), NV-MSVT Criterion A (≤90), and NV-MSVT Criterion B (<88). The three TOMM trials were counted as independent PVTs. The researchers found that failure of two PVTs resulted in a modest decline in overall sensitivity (.50), but led to a marked increased in specificity (.93), suggesting that failure of two or more PVTs was highly predictive of feigning. Essentially, this study demonstrated that the well-established forensic rule of thumb (≥2 PVT failures = invalid response set) can also be applied to feigned ADHD.

Jasinski and colleagues (2011) replicated the multivariate model of performance validity assessment by examining the TOMM, the LMT, the DMT, the NV-MSVT, and the b Test. All measures were found to be adequately sensitive (.33 to .48) and highly specific (.90 to 1.00) to experimentally induced feigned ADHD individually. As with Sollman and colleagues' (2010) study, Jasinski and colleagues (2011) found that failure of two or more PVTs resulted in adequate sensitivity (.48) and perfect specificity in the detection of experimentally induced feigned ADHD.

Due to concerns that feigned ADHD has a higher base rate in university students and other educated adults, Musso and Gouvier (2012) concluded that there is a need for standalone SVTs specifically designed for detecting feigned ADHD that have better classification accuracy than existing tests. This suggestion is based on the premise that

new standalone SVTs designed for feigned ADHD should be able to detect more sophisticated forms of malingering, rather than the simple over-reporting of symptoms. Indeed, Harrison, Edwards, & Parker (2007) found that those feigning ADHD were more likely to skip items and respond inconsistently rather than over-report symptoms, suggesting that validity scales used to assess inconsistent responding may be more sensitive to detecting feigned ADHD than validity scales used to assess over-reporting or exaggerating. To the author's knowledge, there are currently no PVTs or SVTs specifically targeted to identifying feigned ADHD.

The Present Study

The purpose of the present study was to develop and validate a new self-report measure that performed several functions. First, the new instrument would allow for the formulation of a clinical diagnosis of adult ADHD based on DSM-5 criteria. The DSM-5 includes updated examples to reflect typical symptom presentation by adults, including references to difficulty related to "duties in the workplace" and "running errands" (APA, 2013, p. 59). Importantly, the diagnostic criteria also clarify ADHD symptoms in adults. For example, being distracted by extraneous stimuli also includes being distracted by unrelated thoughts for older adolescents and adults. At present, no other self-report measures pertaining to the DSM-5 updated criteria exist specifically for adults. The proposed self-report measure includes items that closely follow DSM-5 criteria.

Secondly, the developed self-report measure includes items related to emergent symptoms of (or related to) adult ADHD proposed in the literature thus far, including symptoms of executive dysfunction and SCT. Including these items in the measure allowed for the collection of preliminary normative data. Although previous research has

proposed that executive dysfunction is the most salient feature of ADHD in adults, there is a dearth of research examining the proportion of the adult ADHD population that also has symptoms of executive dysfunction. This study aimed to empirically examine that hypothesis. Similarly, SCT has been proposed to either be a component of ADHD or a separate disorder altogether. The inclusion of a subscale pertaining to SCT in the proposed instrument will help to clarify the relationship between SCT-type symptoms and core ADHD symptoms.

The third and most important function the present study was to develop a self-report measure cross-validated against developed and established PVTs, with the aim of developing an SVT specifically designed to detect feigned ADHD. By cross-validating the developed measure with established PVTs, it may be more sensitive to feigned ADHD than other SVTs. An experimental malingering paradigm was employed in order to create a known group of those feigning on the developed self-report measure.

Due to the exploratory nature of this project, no hypotheses were proposed. However, the following questions served to guide the research:

1. Will symptoms of executive dysfunction emerge as the most salient factor (i.e., with the highest factor loadings) in adults with symptoms of ADHD?
2. Will SCT emerge as a distinct factor?
3. Will non-credible responding emerge as a distinct factor?
4. Will participants who are asked to feign ADHD exhibit a higher base rate of failure (BR_{Fail}) on PVTs?

In summary, the objective of this study is to develop and validate a self-report measure that can accurately discriminate between genuine and feigned ADHD, as well as further clarify the symptomatology related to executive dysfunction, ADHD, and SCT.

CHAPTER III

Methods

Participants

Participants were recruited from the University of Windsor's and Ryerson University's Psychology Participant Pools, and received bonus marks in exchange for their participation. A total of 164 participants (88% female; mean age: 23) completed the study as part of the control group. A total of 66 additional participants (86% female; mean age: 22) were assigned to the experimental malingering group. Exclusion criteria include a self-reported diagnostic history of traumatic brain injury with loss of consciousness, unipolar or bipolar depressive disorders, schizophrenia, and psychotic episodes.

Table 1
Demographic Information

Variables		N	%
Sex	Male	28	12.2
	Female	202	87.8
	Other	0	0
Age	18-25	195	84.8
	26-35	20	8.7
	36-45	12	5.2
	46-55	2	.9
	56-65	1	.4
Education	Some high school, no diploma	2	.9
	High school graduate	123	53.7
	Some college credit, no degree	62	27.1
	Trade/vocational training	4	1.7
	Associate degree	7	3.1
	Bachelor's degree	27	11.8
	Master's degree	3	1.3
	Professional Degree	1	.4
Year of Study	Year 1	41	18.1
	Year 2	74	32.6
	Year 3	69	30.4
	Year 4	33	14.5
	Year 5	7	3.1

	Year 6+	3	1.3
Marital Status	Single, never married	206	89.6
	Married or domestic partnership	15	6.5
	Widowed	1	.4
	Divorced	6	2.6
	Separated	2	.9
Ethnicity	White	37	16.1
	Hispanic or Latino	86	37.4
	Black or African American	4	1.7
	Native American	14	6.1
	Asian/Pacific Islander	13	5.7
	Middle Eastern	43	18.7
	Other	33	14.3
Previous diagnoses	None	147	63.9
	ADHD	10	4.3
	GAD	14	6.1
	PD	1	.4
	Other AD	15	6.5
	Depression	11	4.8
	Bipolar Disorder (I or II)	1	.4
	RD	1	.4
	ADHD + other diagnosis	7	3
	Multiple diagnoses (without ADHD)	24	10.4
Current Academic Accommodations	No	208	91.2
	Yes	18	7.9
Trauma History	None	121	52.6
	Physical	8	3.5
	Emotional	25	10.9
	Sexual	5	2.2
	Multiple	14	6.1
	Prefer not to say	55	23.9

Note. Based on complete sample of 230 participants. GAD: Generalized Anxiety Disorder; PD: Panic Disorder; AD: Anxiety Disorder; RD: Reading Disorder/Dyslexia.

Procedure

Undergraduate psychology students were given the opportunity to participate in the proposed study via the participant pools at the University of Windsor and at Ryerson University. If students met the inclusion/exclusion criteria, they could view an advertisement for the study. It was anticipated that the study would take 1.5 hours in its entirety, and participants received 1.5 bonus points in exchange for their participation.

Upon signing up for the study, participants were randomly assigned to either the Control group or the Experimental Malingering (EXP_{MAL}) group, and randomly assigned to one of two pre-determined test orders (see Table 2). Because the EXP_{MAL} group was a pilot group, assignment to that group was terminated after 75 individuals had been assigned. Recruitment continued, but subsequent participants were assigned only to the Control group.

After being assigned to a group, participants were immediately taken to an online consent form. On this form, participants checked a box to indicate their consent to participate in the study, and typed their names in lieu of a signature. After giving consent, those in the control group were provided with instructions asking them to complete the measures to the best of their abilities. Participants assigned to EXP_{MAL} group were provided with instructions on how to feign ADHD, including information on how to perform on cognitive testing in order to produce a set of scores resembling impairment related to ADHD.

The participants then completed several measures online, on their own computers. Upon completing all measures, participants were presented with an online post-study

information letter. However, the full nature of study was not disclosed, as the participants must remain blind to the conditions of the study.

Participants in the EXP_{MAL} group were asked to complete a short debriefing survey about their experience after completing all measures. A manipulation check was included in this survey, which asked what strategies they used in their attempts to feign ADHD. All participants were allowed to delete their data and withdraw from the study without penalty at any point during the study. The data were submitted if the participant did not choose to withdraw from the study. All participants had up to two weeks to withdraw their participation by contacting the author.

Table 2
Test Order – Versions A and B

Version A	# Validity Indicators	Version B
Demographics Questionnaire	-	Demographics Questionnaire
PHQ-9	-	GAD-7
GAD-7	-	PHQ-9
AEFI	-	AEFI
Visual Analog Scale	-	Visual Analog Scale
Rey-15 with recognition	2	Rey Word Recognition Test
RCFT Copy	-	RCFT Copy
HITS	-	HITS
RCFT 3-min FR	-	RCFT 3-min FR
ACT 3-9-18	-	WAIS-III Digit Span
HITS	-	HITS
RCFT FR & recognition	3	RCFT FR & recognition
WAIS-III Digit Span	3	ACT 3-9-18
RCFT FCR	-	RCFT FCR
Social Adaptation Scale	-	Social Adaptation Scale
Rey Word Recognition Test	1	Rey-15 with recognition
Visual Analog Scale	-	Visual Analog Scale
Total # of PVTs	9	

Measures

With the exception of the experimental self-report measure, all other tasks are online adaptations of pre-existing and well-established cognitive measures, selected specifically for this project.

The Hyperactivity/Inattention Trait Scale (HITS). The HITS is a new self-report measure developed for the purposes of this study. The major goals of this measure were to diagnose ADHD in adulthood, and more importantly, discriminate between genuine and feigned ADHD. Because scale construction should start with an over-inclusive preliminary pool of items (Clark & Watson, 1995), approximately 250 items under several subscales were constructed. After several rounds of revision, 65 items were dropped, and the 185-item HITS was used in this study.

Several items follow the diagnostic criteria for ADHD listed in the DSM-5 (APA, 2013), while several other items were constructed to tap other facets related to adult ADHD, such as cognitive inflexibility and disinhibition (Fedele et al., 2010). Because certain symptoms of anxiety and bipolar spectrum disorders (BSD) overlap with symptoms of ADHD (APA, 2013), items related to these disorders were constructed in order to promote accuracy of diagnosis.

Validity subscales include items related to positive impression management (PIM), negative impression management (NIM), inconsistent responding, and infrequently reported symptoms. Based on Harrison and Armstrong's (2016) inclusion of items related to dissociative disorders in creating a validity scale to detect ADHD symptom exaggeration, such items were also constructed for the HITS.

PRIME-MD Patient Health Questionnaire (Spitzer, Williams, Kroenke, Hornyak, & McMurray, 2000). This scale is a self-report instrument used in primary care settings to screen for various psychological conditions, including mood and anxiety disorders. Two subscales relating to depression (Patient Health Questionnaire-9 [PHQ-9]) and anxiety (Generalized Anxiety Disorder-7 [GAD-7]) were used in the current study.

Social Adaptation Scale. This experimental scale, consisting of 13 true-or-false statements, provides an estimate of the extent to which social desirability affects self-report. By design, this scale contains items related to PIM.

Amsterdam Executive Function Inventory-Modified (AEFI; Baars, Bijvank, Tonnaer, & Jolles, 2015). The original AEFI was originally validated in a sample of adolescents. The items included in the modified AEFI were altered to better suit university students. This scale is a short, 10-item measure of EF, rated along a 3-point Likert scale. The AEFI-M retains higher levels of reliability than the original scale for its three subscales: attention (three items; $\alpha = .78$), planning/initiative (three items; $\alpha = .65$), and self-control/self-monitoring (four items; $\alpha = .69$).

Rey 15-Item Memory Test (Rey-15; Lezak, 1995) and Recognition Task (Boone, Salazar, Lu, Warner-Chacon, & Razani, 2002). This task is one of the most commonly used PVTs, used to detect feigned memory impairment. In this task, the participant is shown a simple 3x5 matrix of sequential information (e.g., A-B-C) for ten seconds. In the online adaptation, after ten seconds, the participant was asked to recall and type the information into a text box from memory. The recognition task for the Rey-15 contains 15 target items from the original matrix and 15 foils. In the online adaptation, the participant was presented with the recognition task after completing the typed portion,

and was then be able to click on the items that the participant recognized as part of the original matrix. Although not part of the original instrument, recent work has found that a combined score [recall correct + (recognition correct – false positives)] of <21 yielded 70% sensitivity and 92.8% specificity in the detection of non-credible performance (Morse, Douglas-Newman, Mandel, & Swirsky-Sacchetti, 2013), which is a significant improvement in the typically low sensitivity of the Rey-15 (Reznek, 2005).

Rey Word Recognition Test (RWRT; Lezak, 1995). The RWRT is a standalone PVT used to detect feigned memory impairment. In this task, 15 words are read aloud to the participant at a rate of one word per second. Following this, the participant is immediately provided with a sheet containing the same 15 target words, as well as 15 foils, and is told to circle only the words that were read out loud. In the online adaptation, the participant listened to an audio recording of the words, and was then able to click on the words that the participant recognized as part of the original reading. Previous work has found that a cut-off total score of ≤6 yields .71 sensitivity and .92 specificity in detecting feigned memory impairment in the overall sample (Nitch, Boone, Wen, Arnold, & Alfano, 2006). Although Nitch and colleagues (2006) found gender differences in their sample, requiring different cut-off scores for males and females, more recent research confirmed that a cut-off total score of ≤6 was best for both genders, yielding .87 and .90 specificities for males and females, respectively (Bell-Sprinkel et al., 2013).

Digit Span. The Digit Span subtest of the WAIS-III, an auditory attention and working memory task, has been found to be a promising indicator of test taking effort. The participant is asked to listen to random series of numbers of varying length, and repeat them, first forward and then backward. Each span has two trials.

This classic paradigm was adapted for online use in a task designed specifically for this study. The participant was asked to listen to an audio recording of series of numbers increasing in length, and then type the numbers into a text box that will appear after the audio recording is complete. The recommended cut-off for the Reliable Digit Span (RDS; the sum of the longest series of numbers with both trials correct, for both forward and backward repetitions) is ≤7, and has been shown to vary in sensitivity (.49-.86) and specificity (.57-.96) in the literature (Babikian, Boone, Lu, & Arnold, 2006). Furthermore, it remains cited as one of the best-validated embedded validity tests (Heinly, Greve, Bianchini, Love, & Brennan, 2005).

Rey Complex Figure Task (RCFT) – Recognition Trial (Meyers & Meyers, 1995) and Experimental Forced Choice Trial. The RCFT is a commonly used neuropsychological measure used to assess several functions, including visuoconstructional ability, planning, and organization. The recognition trial has also been validated as a PVT. In addition, the memory error pattern (MEP) proposed by Meyers & Meyers (1995) in their update to Osterrieth's (1945) original figure task provides information about performance validity.

In this task, the participant is shown a complex figure, and is asked to copy it as accurately as possible. The participant then draws the figure from memory after a three-minute delay, and again after a 30-minute delay. Then, in the recognition trial, the participant is asked to select aspects of the figure from 12 target shapes (i.e., fragments of the original stimulus) and 12 foils.

Eight of the 12 foils are considered 'Atypical Recognition Errors', and while they are rarely selected by either typical or brain-injured populations, they have found to be

selected with significantly higher frequency by non-credible participants (Lu, Boone, Cozolino, & Mitchell, 2003). In the experimental forced choice trial, the participant is shown pairs of aspects of the figure, consisting of one target and one foil, and is asked to identify the target. In the online adaptation of this task, participants completed all drawing trials (copy, immediate recall, delayed recall) via an on-screen digital drawing paradigm, using their computer mice to draw the complex figure when asked.

As this task is being used solely as a PVT for the purposes of this study, constructional components of the task were not be scored. After the delayed recall trial, participants were administered the recognition trial. A cut-off of <16 yields .32 sensitivity and .88 specificity (Whiteside, Wald, & Busse, 2011). Participants were then asked to identify the target out of a pair of stimuli in the experimental forced choice trial.

Auditory Consonant Trigrams (ACT). The ACT, also known as the Brown-Peterson Task, is a well-established measure of working memory (Lezak, Howieson, & Loring, 2012), a component of EF. In this task, the participant is asked to listen to a series of three consonants, and then count backwards from a two- or three-digit number until told to stop. Then, the participant was asked to recall the series of three consonants. The length of the delay, during which the participant was counting backwards, is randomized, and may be either three seconds, nine seconds, or 18 seconds long, depending on the trial.

There are a total of 20 trials, of which five trials are for practice (i.e., no interference task). In the online adaptation of the ACT, the participant listened to a recording of the consonants, and was then asked to count backwards from a particular number until a text box appears. The participant then entered the series of consonants in this text box at that time. Interestingly, the ACT has been shown to be particularly

sensitive to ADHD-I (Gansler et al., 1998), and has also been shown to successfully discriminate between adults with ADHD and healthy controls (Healey, 2013).

Visual Analog Scale. This is a simple response scale for mood states. Participants were asked to drag a slider in order to indicate their subjective degree of energy, depression, anxiety, fatigue, and pain experienced at the time of the study. This was used as a quick assessment of the participant's mood while completing the measures in the study. The scale was administered once at the beginning of the study, and once at the end of the study, in order to monitor time-related changes in mood.

Statistical Analyses

Prior to conducting any statistical analysis, all identifying information was removed from the data. Cases were identified by ID numbers assigned by Fluidsurveys. Consent-related information was separated from the remainder of the data. The data was analyzed using the Statistical Package for Social Science (SPSS) for Mac OS X, version 21, and R, version 3.3.3.

A small portion of data was missing from one variable only (AEFI) due to a technological mishap. Because the missing data was not related to any variables or participant factors, it was considered ignorable, and multiple imputation was used to replace the missing values. Correlational analyses were used to determine the degree of multicollinearity between scale items. In EFA, moderate-to-high correlations should exist between variables (referring, in this case, to the items of the HITS); variables should not be uncorrelated, but should have no higher correlations than r=.9, in order to be able to

determine the unique contributions of the variables to particular factors (Pituch & Stevens, 2016).

Further to the assumptions of EFA, although there is no official assumption of normality, factor analysis results are considered more replicable when items are drawn from relatively normal distributions (Pituch & Stevens, 2016). Thus, skewness and kurtosis of each scale item were examined. Items drawn from non-normal distributions (e.g., skewness and kurtosis values below -2 or above +2) were assessed for deletion on a case-by-case basis (see 'Results' section for more detail).

EFA was conducted to examine the underlying organizational structure of the HITS. The correlation matrix was factored, and several methods (Velicer's Minimum Average Partial [MAP] test, parallel analysis, and scree plot) were used to determine the number of factors to be extracted. The iterative principal axis method was used to extract the factors (Pituch & Stevens, 2016). Direct Oblimin, an oblique rotation, was requested to improve interpretability.

The sensitivity and specificity of the validity-related factors/subscales of the HITS were calculated to examine the predictive power of the HITS against the PVTs described in the 'Measures' section. By convention, sensitivity = true positives/(true positives + false negatives), while specificity = true negatives/(true negatives + false positives) (Grimes & Schulz, 2005).

Independent *t*-tests were used to compare the control and EXP_{MAL} groups on all relevant variables in order to determine the effect of feigned ADHD on neuropsychological performance. The Holm-Bonferroni Sequential Correction (Holm,

1979) was used to correct for the large number of significance tests. Thus, all results reported as *significant* are significant according to the Holm-Bonferroni procedure.

Where relevant, Cohen's *d* was used as a measure of effect size. As per Cohen (1988), $d = .2$ is considered a small effect, while $d = .5$ is considered a medium effect, and $d = .8$ is considered a large effect. All PVTs were dichotomized as *Pass/Fail* along published cut-offs (see Study A's 'Measures' section). Then, the chi-squared test of independence was conducted in order to determine the statistical significance of the difference in the base rates of PVT failure (including the HITS) in the control group versus the EXP_{MAL} group.

CHAPTER IV

Results

Data Cleaning

After completing data entry, the accuracy of the data was examined through the use of descriptive statistics on all relevant variables. In this case, the relevant variables include: the HITS' individual items, which are considered variables in EFA; Rey-15 free recall correct score, recognition correct score, and combined score; RDS; RCFT recognition trial score and the forced choice recognition total score; Rey WRT total score; and, the ACT total score. All entered data were deemed to be accurate.

A total of 44 incomplete cases (i.e., cases that did not complete the study) were removed from all conditions. The data from each condition was evaluated for univariate outliers on the "completion time" variable using a standardized residual cut-off of ±2. A total of eight cases were classified as significant outliers and were removed from the Control group, resulting in a final sample size of 164. A total of four cases were classified as significant outliers and were removed from the EXP_{MAL} group, resulting in a final sample size of 66.

Due to a smaller number of cases than variables (number of scale items: 185), it was not possible to examine multivariate outliers on the items of the HITS at this stage. However, upon reduction of the scale to 126 items after factor analysis (see 'Main Analyses' for more detail), Mahalanobis' distance was calculated for the retained scale items, and no multivariate outliers were found [Chi-square(126, N=164) = 180.799, $p <$ .001]. Even after item reduction, multivariate outliers could not be checked for the experimental group.

Assumptions Testing

EFA. As mentioned, factor analysis results are considered more replicable when items are drawn from relatively normal distributions (Pituch & Stevens, 2016). Thus, the skewness and kurtosis for each item on the scale were examined, with values between -2 and +2 considered acceptable (Pituch & Stevens, 2016). Items drawn from non-normal distributions (e.g., skewness and kurtosis values below -2 or above +2) were assessed for deletion on a case-by-case basis. From 185 items, three items had skewness values below -2, and 37 items had skewness values above +2. While no items had any kurtosis values below -2, 48 items had kurtosis values of above +2. As expected, all items that were particularly skewed and kurtotic were validity items, and retained for analysis.

Bivariate correlations were examined in order to assess the level of multicollinearity, or the degree of correlation between variables (i.e., such that one can be predicted by the other). Based on this analysis, most correlations between variables were below r=.6, with the highest correlation being r=.74, indicating a general lack of multicollinearity between variables. However, the degree of collinearity was also assessed by examining variance inflation factor (VIF) for the variables. According to a very liberal rule of thumb, a VIF of ≥10 indicates severe problems with multicollinearity (Cohen, Cohen, West, & Aiken, 2003). Most of the variables examined had VIF factors of ≥10, indicating a very high degree of multicollinearity within the HITS items. Although these results were inconsistent, it may be the case that multicollinearity was overestimated due to the small sample size (Cohen et al., 2003). However, it is more likely that the initial, over-inclusive pool of items did include very similar, overlapping

items. Due to the possibility of multicollinearity, it is important to interpret the results of the EFA with caution.

***t*-Tests.** All cognitive test variables included in this study are continuous in nature. While outliers were managed during data cleaning, normality of variables was assessed by examining the skewness and kurtosis for each variable. Skewness and kurtosis values between -2 and +2 are considered acceptable (Pituch & Stevens, 2016). The Rey-15 Total Recall, the 18-second ACT trial, the RCFT True Negatives, the Reliable Digit Span, Longest Digits Forward, and the Digit Span Forward Total Raw Score variables had skewness values below -2. There were no variables with skewness values above +2. The AEFI Total, Rey-15 Total Recall, Rey-15 Total Recognition, the 9-second ACT trial, the 18-second ACT trial, the RCFT True Negatives, the Reliable Digit Span, Longest Digits Forward, and the Digit Span Forward Total Raw Score variables had kurtosis values above +2. There were no variables with kurtosis values below -2. Because of the large number of non-normal variables, likely due to the fact that many of them are measures of performance validity, the variables were retained. Due to this violation of the normality assumption, the results should be interpreted with caution. Most critically, *t*-tests assume that population variances are equal. This assumption was assessed using the Levene's Test for Equality of Variances, and variances were found to be equal.

Chi-Square Test of Independence. Non-parametric tests such as the chi-square test make no assumptions about underlying population parameters. However, the chi-square test does require independence of groups and samples, which is the case in the

current study. This test also requires that each cell contain a sample of at least five cases or more, which is also the case in the current study.

Main Analyses

Test Order. Measures were administered in two pre-determined test orders. T-tests were conducted in order to assess the effect of test order on cognitive performance. In the control group, cognitive performance was not affected by test order on any measure. In the EXP_{MAL} group, performance on the RWRT was affected by test order, $t(60) = 2.25$, $p < .05$, $d = .57$, with participants recognizing more words if they were administered the RWRT earlier in the testing session.

Educational Institution. Students from the University of Windsor and Ryerson University participated in the present study. Students from Ryerson University, however, could only be assigned to the control group; thus, they were compared only to control participants from the University of Windsor. T-tests were conducted to assess the effect of educational institution on cognitive performance. A significant difference emerged only on the RWRT, with students from Ryerson University being able to recognize more words than students from the University of Windsor, $t(72) = -2.69$, $p < .05$, $d = .45$.

EXP_{MAL} Instructions. Participants in the EXP_{MAL} group completed a manipulation check in the form of a questionnaire. Results of this questionnaire are reported in Table 3.

Table 3
Manipulation Check Questionnaire Results

Questions		N	%
How well do you think that you understood the instructions provided to you?	Did not really understand the instructions	2	3
	Understood part of the instructions	19	28.8
	Understood most of the instructions	30	45.5
	Understood all of the instructions	15	22.7
How hard did you try to follow these instructions?	Tried somewhat	4	6.1
	Tried moderately	11	16.7
	Tried significantly	31	47
	Tried very hard	20	30.3
How successful do you think you were at faking ADHD?	Not at all successful	7	10.6
	Somewhat successful	28	42.4
	Moderately successful	19	28.8
	Significantly successful	10	15.2
	Very successful	2	3
If you think you were successful in faking ADHD, what helped you fake?	I have knowledge of ADHD	22	33.3
	I have known people with ADHD	22	33.3
	I am able to follow instructions well	10	15.2
	I'm a quick learner	3	4.5
	Other	6	9.1
Do you believe you were successful in keeping the researcher from discovering you were faking?	Not at all successful	11	16.7
	Somewhat successful	31	47
	Moderately successful	18	27.3
	Significantly successful	4	6.1
	Very successful	2	3
If you do not think that you were able to fake well, what hampered you?	I am too honest	21	36.2
	I didn't understand the instructions	16	27.6
	The tests were too easy	5	8.6
	The tests were too hard	4	6.9
	Other	12	20.7

Note. Based on the EXP_{MAL} group, consisting of 66 participants.

Factor Structure of the HITS. As mentioned, EFA was conducted on the control group to examine the underlying organizational structure of the HITS. Several methods (Velicer's Minimum Average Partial [MAP] test, parallel analysis, and scree plot) were used to determine the number of factors to be extracted, prior to factoring the correlation matrix. Velicer's MAP test suggested the extraction of only two factors.

However, parallel analysis and examination of a scree plot suggested the extraction of eight factors, which was more representative of the theory behind the HITS. Finally, examining Eigenvalues of the items suggested the extraction of 19 factors (i.e., there were 19 items with Eigenvalues above 1). Based on this broad range of factor extraction suggestions, several factor models were examined. The iterative principal axis method was used to extract the factors (Pituch & Stevens, 2016), and Direct Oblimin was used to improve interpretability.

Despite rotation, four-, five-, six-, seven-, eight-, and twelve-factor models all produced poor pattern matrices, likely due to (1) the large number of items included in the scale, and (2) the relatively small sample size. Thus, following an iterative process, items were removed if they loaded onto more than one factor, or if they did not contribute highly to any factor (i.e., if factor loadings were less than .3). In total, 59 items were dropped from this preliminary analysis, resulting in a scale of 126 items. The best-fitting factor structure produced was a seven-factor structure, consisting of factors (in order of variance explained): Executive Dysfunction, Invalid Responding, Somatization, Impulsivity, Hyperactivity, Thought Disorder, and PIM. The resulting factor structure, and the items subsumed under each factor, are presented in Table 4 (see Appendix B). However, item content is not presented in order to preserve test security.

An EFA was conducted on the EXP_{MAL} group using the revised HITS (126 items). Due to the inadequate sample size (N=66; below Stevens' [2009] guideline of N=150 for factor analysis), factor loadings were generally unstable. The same seven-factor solution as above was uninterpretable with the EXP_{MAL} group. Instead, parallel analysis and examination of a scree plot suggested the extraction of only three factors, namely (in order of variance explained): Executive Dysfunction, Invalid Responding, and Somatization. This factor structure was not examined further due to its instability.

Reliability of the HITS subscales. Cronbach's alpha was calculated for each subscale of the HITS, based on the seven factors extracted: Executive Dysfunction (α = .98), Invalid Responding (α = .95), Somatization (α = .87), Impulsivity (α = .89), Hyperactivity (α = .93), Thought Disorder (α = .88), and PIM (α = .52).

Classification Accuracy of the HITS. As mentioned, the sensitivity and specificity of some of the factors/subscales of the HITS were calculated to examine the predictive power of the HITS against measures described in the 'Measures' section.

Executive Dysfunction subscale. The AEFI, being a relatively new scale, has no published cut-offs. Scores on the AEFI were slightly positively skewed (skewness of .325; SE = .160), with most participants scoring a total of 10. Thus, the AEFI was dichotomized along a cut-off of ≥10 (out of a maximum possible score of 30), and used as a criterion measure for the executive dysfunction subscale of the HITS (HITS-ED). The HITS-ED subscale was dichotomized along several possible cut-offs (maximum possible score: 220 for 44 scale items), and sensitivity and specificity values were calculated for each.

The aim was to find a cut-off for the HITS-ED that resulted in high sensitivity in the detection of executive dysfunction, using the AEFI as the criterion measure, in order to minimize the possibility of false negatives. The first cut-off examined, a score of ≥110 (i.e., half of the maximum possible score) on the HITS-ED, produced acceptable sensitivity (.84) and specificity (.73) against the AEFI. Decreasing the cut-off to ≥100 dropped sensitivity (.80) and improved specificity (.80). Setting the cut-off to ≥120 resulted in better sensitivity (.89), but decreased specificity (.67). Changing the cut-off on the AEFI to ≥11 or ≥12 did not produce any discernable change in sensitivity or specificity.

Invalid Responding subscale. In contrast, for the invalid responding subscale of the HITS (HITS-INV), the aim was to find a highly specific cut-off that approximates the "Larrabee limit" (.50 sensitivity at .90 specificity; Erdodi, Kirsch et al., 2014; Lichtenstein, Erdodi, & Linnea, 2017). As previous work has found that multivariate models of performance validity assessment are superior to the use of individual PVTs (Davis & Millis, 2014; Larrabee, 2008; 2014a; 2014b), a composite score entitled Performance Validity Index-9 (PVI-9) was created to be used as the criterion measure for the HITS-INV. The PVI-9 consists of *Pass/Fail* scores on the Rey-15 Recall, Rey-15 Recall+Recognition, RCFT Recognition Total, RCFT True Positives, RCFT True Negatives, RWRT, Digit Span (Longest Forward), Digit Span (Longest Backward), and Reliable Digit Span. Each failure (along established cut-offs for each measure; see 'Measures' section) was summed and evaluated as follows.

Based on Sollman and colleagues' (2010) work indicating that failure of two or more PVTs was highly predictive of feigning, failure on one or no components of the

PVI-9 was defined as a *Pass*, with one PVT failure perhaps reflecting a 'near pass' (Bigler, 2014). These cases were coded as 0. In order to establish pure criterion groups, failure on two or three components of the PVI-9 was defined as *borderline* performance, and these cases were excluded from classification accuracy analyses (Greve & Bianchini, 2004; Lichtenstein, Erdodi, Rai, Mazur-Mosiewicz, & Flaro, 2016; Erdodi, Sagar, Seke, Zuccato, Schwartz, & Roth, in press; Erdodi, Seke, Shahein, Tyson, Sagar, & Roth, in press). Finally, failure on four or more components of the PVI-9 was defined as an unequivocal *Fail*, and coded as 1 (Table 5).

Table 5
Frequency, Percentage and Cumulative Percentage and Classification Ranges for PVI-9

	PVI-9			Classification	
PVI-9	*f*	%	$\%_{Cumulative}$	By Row	Overall
0	124	54.4	40.8	PASS	PASS
1	46	20.2	59.2	Pass	
2	31	13.6	70.1	Borderline	
3	10	4.4	85.4	Borderline	
4	6	2.6	89.8	Fail	FAIL
5	5	2.2	94.9	Fail	
6	4	1.8	96.2	FAIL	
7	1	0.4	98.1	FAIL	
8	0	0	98.7	FAIL	
9	1	0.4	100.0	FAIL	

Note. PVI-9 consists of *Pass/Fail* scores of the following validity measures: Rey-15 Free Recall, Rey-15 Recall + Recognition, RCFT Recognition Total, RCFT True Positives, RCFT True Negatives, RWRT, Digit Span (Longest Forward), Digit Span (Longest Backward), and Reliable Digit Span.

The HITS-INV was first conservatively dichotomized along a cut-off of ≥60 (out of a maximum possible score of 120). A cut-off of ≥60 on the HITS-INV produced a good combination of sensitivity (.75) and specificity (.94) against the PVI-9. Decreasing

the cut-off ≥50 significantly decreased sensitivity (.54), but did not improve specificity (.94).

Somatization subscale. Based on Whiteside and colleagues' (2010) work, which found that the PAI's somatization subscale was sensitive (.93) and specific (.76) to the failure of the TOMM at a cut-off of T > 87, several items related to somatic symptoms were included in the HITS. The goal was to find a highly specific cut-off for the somatization subscale of the HITS (HITS-SOM), which is serving as a measure of non-credible performance. The HITS-SOM was dichotomized along a cut-off of ≥45 (out of a maximum possible score of 90). A cut-off of ≥45 resulted in very low sensitivity (.12) and high specificity (.94). Increasing the cut-off to ≥55 did not change the level of sensitivity (.12), and resulted in slightly lower specificity (.93). A cut-off of ≥65 slightly improved sensitivity (.22) without changing the level of specificity (.93). Finally, a cut-off of ≥75 resulted in slightly improved sensitivity (.25) and good specificity (.91).

Thought Disorder subscale. Disordered thought may be a symptom of several disorders, including bipolar disorder and delirium. The thought disorder subscale of the HITS (HITS-TD), however, contains items specific to disordered thinking as it pertains to schizophrenia spectrum and other psychotic disorders. These disorders have a very low lifetime prevalence overall (<1%; APA, 2013). For this reason, items related to thought disorders were originally included in the HITS to serve as items that are very infrequently endorsed. Thus, because this scale serves as a measure of non-credible performance, the goal was to find a highly specific cut-off. The HITS-TD was first dichotomized along a cut-off of ≥32 (out of a maximum possible score of 65). When validated against the PVI-9, a cut-off of ≥32 resulted in adequate sensitivity (.53) and high specificity (.95).

Increasing the cut-off to ≥40 resulted in slightly improved sensitivity (.57) and slightly lower specificity (.93). Interestingly, increasing the cut-off to ≥50 resulted in decreased sensitivity (.50), as well as lower specificity (.91).

PIM subscale. The SAS was dichotomized along a cut-off of ≥7 (L. Erdodi, personal communication, July 24, 2017), and used as a criterion measure for the PIM subscale of the HITS (HITS-PIM). As with the HITS-INV, the goal was to find a highly specific cut-off. The HITS-PIM was first conservatively dichotomized along a cut-off of ≥20 (out of a maximum possible score of 40). This resulted in low sensitivity (.21) and specificity (.82) against the SAS. Increasing the cut-off to ≥25 did not change the sensitivity (.21) or specificity (.81) significantly. A cut-off of ≥30 resulted in very low sensitivity (.14) and inadequate specificity (.78) against the SAS.

When validated against the PVI-9, a cut-off of ≥20 produced very low sensitivity (.09) and adequate specificity (.87). A cut-off of ≥25 resulted in lower sensitivity (.06) and slightly lower specificity (.86). Increasing the cut-off to ≥30 did not change the sensitivity (.06), but increased the level of specificity (.90).

Base Rates of PVT Failure. Chi-square tests of independence showed a significant association between group and base rate of failure on the RWRT, χ^2 (2, N=230) = 4.90, $p < .05$, RR = 2.2, with a greater proportion of those in the EXP_{MAL} group scoring below the cut-off of ≤6 on the RWRT. Similarly, there was a significant association between group and base rate of failure on the RDS, χ^2 (2, N=230) = 6.89, $p < .05$, RR = 4.3, with a higher rate of failure in the EXP_{MAL} group. There was also a significant association between group and base rate of failure on the LDF, χ^2 (2, N=230) = 5.01, $p < .05$, RR = 3.7, with a higher rate of failure in the EXP_{MAL} group. Importantly,

there was no significant association between group and base rate of failure on the HITS-INV. The remainder of the associations between group and other PVTs were also not significant.

Simulated Feigned ADHD and Neuropsychological Performance. In order to examine the effect of simulated feigned ADHD on neuropsychological performance, *t*-tests were used to compare test scores between the control and EXP_{MAL} groups. Overall, participants in the EXP_{MAL} group performed worse on the Combined Recall and Recognition Score of the Rey-15, $t(226) = 2.00$, $p < .05$, $d = .29$. They also had lower Reliable Digit Span scores, $t(228) = 2.75$, $p < .01$, $d = .40$ as well as lower Digit Span Forward scores, $t(228) = 4.70$, $p < .01$, $d = .69$, and Digit Span Backward scores, $t(228) = 2.45$, $p < .05$, $d = .36$. Finally, those in the EXP_{MAL} group were able to remember shorter strings of digits than those in the control group (Longest Digits Forward: $t(228) = 3.01$, $p < .01$, $d = .44$; Longest Digits Backward: $t(228) = 2.02$, $p < .01$, $d = .30$). There were no other cognitive differences between groups.

Simulated Feigned ADHD and Emotional Functioning. Participants in the EXP_{MAL} group endorsed more symptoms of depression, $t(228) = -4.19$, $p < .01$, $d = .61$, and anxiety, $t(225) = -3.54$, $p < .01$, $d = .52$, than those in the control group. Those in the EXP_{MAL} group also reported a greater degree of functional impairment due to anxiety, $t(225) = -4.52$, $p < .01$, $d = .66$, than those in the control group. Finally, participants in the in the EXP_{MAL} group also produced higher scores on the AEFI, $t(228) = -3.54$, $p < .01$, $d = .58$.

Simulated Feigned ADHD and the HITS. Aside from HITS-PIM, the control and EXP_{MAL} groups differed on every subscale of the HITS. The EXP_{MAL} group endorsed

significantly more symptoms of executive dysfunction ($t(228) = -5.87$, $p < .01$, $d = .86$), somatization ($t(228) = -4.49$, $p < .01$, $d = .66$), impulsivity ($t(228) = -6.89$, $p < .01$, $d = 1.09$), hyperactivity ($t(228) = -5.95$, $p < .01$, $d = .87$), and thought disorders ($t(228) = -4.75$, $p < .01$, $d = .70$). The EXP_{MAL} group also had higher scores on the HITS-INV, $t(228) = -4.56$, $p < .01$, $d = .67$.

Self-Reported Diagnosed ADHD. Individuals who reported a prior diagnosis of ADHD (N=10) were compared as a separate group before being included in the control group. These participants had higher scores on the AEFI, $t(162) = -2.74$, $p < .01$, $d = .90$. They showed no significant difference on any other cognitive or psychological measures as compared to the remainder of the control participants.

Individuals who reported a prior diagnosis of ADHD did, however, score higher on the HITS-ED, $t(162) = -2.77$, $p < .01$, $d = .91$, and on the hyperactivity subscale of the HITS, $t(162) = -2.95$, $p < .01$, $d = .97$, as compared to the remainder of the control participants.

CHAPTER V

Discussion

The main purpose of this study was to develop a new self-report measure that accurately differentiates between feigned and genuine ADHD. Two main conclusions can be drawn from prior work in this area: (1) many clinicians rely solely on client self-report during the assessment of ADHD (Joy et al., 2010; Nelson et al., 2014), and (2) PVTs are currently the most promising tools for the accurate classification of feigned ADHD (Musso & Gouvier, 2012; Tucha et al., 2015). To that end, the HITS, a self-report measure, was developed and validated using a multivariate composite of nine validity indices. This resulted in the development of two validity subscales (HITS-INV and HITS-TD) with a good combination of sensitivity and specificity for the accurate classification of feigned ADHD.

Factor Structure of the HITS

One of the primary goals of this study was to examine the underlying structure of the HITS in order to better understand both credible and non-credible presentations of ADHD. A seven-factor model provided an interpretable, albeit preliminary, factor structure, with the scale items accounting for approximately 60% of the variance.

Factors Related to ADHD. Consistent with previous research (Kamradt et al., 2014; Van Lieshout et al., 2013; Wasserstein, 2005), symptoms of executive dysfunction emerged as the most salient factor (i.e., with the most and highest factor loadings) in every model examined for the HITS. These findings suggest that self-reported symptoms of executive dysfunction were amongst the strongest and most frequent indicators of

ADHD in the current sample. This finding is supported by the extant literature, which has found that adults with ADHD are particularly affected by persistent EF impairment (Biederman et al., 2004; Kamradt et al., 2014; Van Lieshout et al., 2013). Previous research has used .80 and .70 as the minimum acceptable sensitivity and specificity, respectively, for diagnostic tests (Mouthaan, Sijbrandij, Reitsma, Gersons, & Olff, 2014; Pettersson, Bengtsson Boström, Gustavsson, & Ekseliu, 2015). A cut-off of ≥100 on the HITS-ED subscale produced adequate sensitivity (.80) and specificity (.80) to the detection of executive dysfunction, with the AEFI used as the criterion measure.

Interestingly, while inattention-related items were subsumed under the executive dysfunction factor of the HITS, both impulsivity and hyperactivity emerged as individual, separate factors. This is partly supported by previous research that has found the hyperactivity dimension of ADHD to be separate from the executive dysfunction dimension, particularly within adults (van Lieshout et al., 2013). Similarly, previous research has found that hyperactivity diminishes while executive deficits persist in adults with ADHD (Kamradt et al., 2014; van Lieshout et al., 2013). This is adequately reflected in the overall HITS model, with a significantly larger amount of variance contributed to by items related to executive dysfunction than hyperactivity.

It is less clear why impulsivity emerged as a separate factor from the executive dysfunction factor. Impulsivity is often seen as a mental counterpart to physical or motor hyperactivity. In fact, impulsivity and hyperactivity are often measured as a single construct on rating scales (Bauermeister, Canino, Polanczyk, & Rohde, 2010). However, impulsivity tends to persist (along with other executive deficits) into adulthood, while hyperactivity diminishes in adolescence (Moyá, Stringaris, Asherson, Sandberg, &

Taylor, 2014), lending evidence to impulsivity's close relationship to the remainder of the executive functions. Impulsivity is a less-understood construct in the literature, with the contemporary idea being that impulsivity is a multidimensional trait rather than a global construct (Meda et al., 2009). Whiteside, Lynam, Miller, and Reynolds (2005) proposed a four-factor model of impulsivity, consisting of the following factors: urgency, lack of premeditation, lack of perseverance, and sensation seeking. This model of impulsivity is generally well-accepted in the literature, and has been found to be accurately represented in everyday life in a non-clinical sample of adults (Sperry, Lynam, Walsh, Horton, & Kwapil, 2016). Nevertheless, there still appears to be no agreement on a single, core definition of impulsivity (Congdon & Canli, 2008).

Although Whiteside and colleagues' (2005) four factors all seem to be related to EF, the current study's model presents a distinction between impulsivity and the remainder of the executive functions. The separation of impulsivity from general executive dysfunction in the HITS may be due to a failure in scale design; there may not have been enough separation between the several dimensions of impulsivity within the scale items in order to wholly capture the construct. However, a recent factor analysis found that a three-factor model consisting of inattention, hyperactivity, and impulsivity, provided the best fit for the DSM-5 ADHD criteria (Parke et al., 2015). The results of the present study do support those findings, with executive dysfunction (including items related to inattention, planning/organization, inhibition, and emotional regulation) emerging separately from impulsivity and hyperactivity.

Despite including items related to SCT in the original pool of items, a distinct SCT factor did not emerge during EFA. Instead, the SCT-related items were subsumed

under the executive dysfunction factor. This may be due to one of two reasons. First, it is possible that SCT is, in fact, a subtype of ADHD, making it difficult to differentiate symptoms of SCT from ADHD symptoms. If SCT is a sub-construct of ADHD, it is unlikely for SCT to emerge as a distinct factor within the HITS, even with a much larger sample size. However, it is also possible that SCT items were not constructed adequately. Because SCT is a relatively new construct in the literature, the SCT items created for the HITS may not have accurately represented the construct.

Factors Related to Non-Credible Performance. The underlying structure of the HITS also contains an atypical response factor, represented by the HITS-INV subscale. As mentioned, this subscale was validated against a multivariate composite of *Pass/Fail* scores (PVI-9). A cut-off of ≥60 resulted in a good combination of sensitivity (.75) and specificity (.94) in the accurate classification of feigned ADHD against the PVI-9. These findings indicate that the HITS-INV subscale is highly accurate in its ability to classify non-credible performance, as originally indicated by scores on nine validity measures.

As mentioned, items related to thought disorders (included in the HITS-TD subscale) were included in the HITS to serve as items that are very infrequently endorsed; thus, endorsing several of these items may represent non-credible responding. A cut-off of ≥40 resulted in sensitivity (.57) and specificity (.93) values that approximate the "Larrabee limit" (.50 sensitivity at .90 specificity; Erdodi, Kirsch et al., 2014; Lichtenstein, Erdodi, & Linnea, 2017) against the PVI-9, indicating that this subscale is also an adequate measure of non-credible performance.

Several items related to somatic symptoms were included in the HITS based on Whiteside and colleagues' (2010) work. Thus, the emergence of a somatization factor in

the HITS was not an unexpected finding. However, it was surprising that the somatization-related items contributed more variance to the model than did the hyperactivity- and impulsivity-related items. Previous research has found that adults with ADHD tend to report more muscle pain and physical discomfort (Kessler, Lane, Stang, & Van Brunt, 2009; Stray, Kristensen, Lomeland, Skorstad, Stray, & Tønnessen, 2013; Young & Redmond, 2007). This may be due to a gradual increase in muscle tone that tends to occur in children with ADHD (Stray, Stray, Iversen, Ruud, Ellertsen, & Tønnessen, 2009).

In terms of its ability to function as a measure of non-credible performance, the HITS-SOM had good specificity but unacceptably low sensitivity, which inflates the probability of false negatives. Thus, this subscale, as it stands, is an inadequate tool for the classification of non-credible performance. This, too, can be explained by the increased prevalence of somatic symptoms in adults with ADHD (Kessler et al., 2009; Stray et al., 2013; Young & Redmond, 2007). If adults with ADHD do, in fact, experience more somatic symptoms than otherwise healthy adults, the somatic symptoms are unlikely to be representative of non-credible performance in adults with ADHD.

Similarly, although the underlying structure of the HITS contains a PIM factor, this subscale was inadequate in terms of its classification accuracy. When validated against the SAS and the PVI-9 as criterion measures, the HITS-PIM produced acceptable levels of specificity, but very low sensitivity, inflating the probability of false negatives. Thus, the HITS-PIM is currently an inadequate tool to detect non-credible responding. To the author's knowledge, there is no reason specific to adults with ADHD or university students that would affect the classification accuracy of PIM items. However, it is notable

that while every other subscale of the HITS has a Cronbach's alpha value of above .80, the HITS-PIM has a Cronbach's alpha value of only .52. Therefore, this subscale is inadequate as a measure of PIM. This may be a consequence of subpar item construction or inadequate criterion measure.

Factor Structure in the EXP$_{MAL}$ Group. While EFA was attempted on the data collected from the EXP$_{MAL}$ group, factor loadings were generally unstable. While this is likely due to a large discrepancy between sample size and the large number of variables contained in the HITS, it is also possible that participants in the EXP$_{MAL}$ group exhibited more random responding, which may have confounded the extraction of a simple factor structure. Furthermore, there was some variability in how well participants in the EXP$_{MAL}$ group understood and/or followed the instructions provided to them. For example, although the majority (46%) of the participants reported understanding most of the instructions, the majority (42%) of the participants also reported being only somewhat successful at feigning ADHD. When asked what may have hampered their attempts to feign ADHD, most (36%) of the participants reported being "too honest", while the second-largest subset (28%) of participants reported not understanding the instructions. Thus, it is not clear whether instructions were strictly followed by most of the participants in the EXP$_{MAL}$ group.

Group Differences

A small subset of participants in the control group reported receiving a prior diagnosis of ADHD. As expected, these individuals reported more symptoms of executive dysfunction on the AEFI, as well as on the HITS-ED, and also had higher

scores on the hyperactivity subscale of the HITS. Interestingly, and unlike the EXP_{MAL} group, they did not show a greater rate of failure on PVTs or the HITS-INV, as compared to the remainder of the control group.

Overall, the EXP_{MAL} group showed poorer performance on six out of the nine validity indices calculated for the purposes of this study. They were twice as likely as the control group to fail the RWRT, four times as likely to fail the RDS, and almost four times as likely to fail the LDF. Participants in the EXP_{MAL} group also reported experiencing more symptoms of depression and anxiety, as well as greater functional impairment due to anxiety. As expected, they reported greater symptoms of executive dysfunction as compared to the control group. Finally, the EXP_{MAL} group received higher scores on every subscale of the HITS, except on the HITS-PIM.

Because PVTs are currently considered the most promising method of detecting feigned ADHD (Musso & Gouvier, 2012; Tucha et al., 2015), the EXP_{MAL} group exhibiting poorer performance on the majority of the PVTs administered during this study is not an unexpected finding. However, it is important to note that the significant group differences were accompanied by small-to-medium effect sizes. In fact, the effect sizes on the Combined Recall and Recognition Score of the Rey-15, Digit Span Backward, and Longest Digits Backward were small enough to be of little practical significance. Small effect sizes in an experimental malingering paradigm are surprising, given that the EXP_{MAL} group was instructed to perform poorly, while participants in the control group were instructed to put forth their best effort. This may be because an undergraduate university population was used for this study. There have been mixed findings on the validity of undergraduate student performance on neuropsychological

measures. While some previous work has found that undergraduate students perform adequately, with low rates of non-credible performance (Ross et al., 2015; Santos, Kazakov, Reamer, Park, & Osmon, 2014), other studies have found that a sizeable portion of non-clinical, healthy undergraduate students fail validity indicators (An, Kaploun, Erdodi, & Abeare, 2017; An, Zakzanis, & Joordens, 2012; DeRight & Jorgensen, 2015). Most of these studies have involved undergraduate students who participated in research in exchange for course credit, as was the case in the present study. Thus, participants had incentive to complete the study, but had no incentive to perform well or poorly. All participants also received the same number of 'points' (i.e., course credit), regardless of how much time each individual participant spent completing the study. Therefore, the ability to complete the study as quickly as possible may have been incentivized, resulting in suboptimal effort afforded to the study by some of the participants.

Furthermore, as mentioned, how well the EXP_{MAL} group followed the instructions provided to them is unclear (see 'Factor Structure in the EXP_{MAL} Group'). Due to the online paradigm used in this study, participants who did not understand the instructions were not given the opportunity to ask for clarification from the researcher. This may have contributed to the smaller effect sizes observed between groups on neuropsychological measures.

Limitations

To the author's knowledge, the current work is the first to introduce a new SVT aimed at the detection of feigned ADHD. However, the study faced several limitations.

Firstly, the sample used in this study was largely homogeneous, consisting of 88% female undergraduate psychology students. Thus, generalizability is limited to the current population. Future work with the HITS should aim to validate the scale with males and individuals with variable education levels.

The sample size of the control group was considerably smaller than recommended for EFA. Although Stevens (2009) indicated that an overall sample size of over 150 was sufficient for EFA, other experts have suggested that when communalities are small-to-medium, as is the case in this study, an absolute sample size of 200-400 is needed for reliable factors (Fabrigar & Wegener, 2012). The current study's control group sample size (N=164), falls short of this guideline, and may affect both the reliability and the interpretability of the extracted factors.

Furthermore, with fewer cases than variables, it was not possible to assess for multivariate outliers prior to conducting EFA, which may have affected the extracted factors. If multivariate outliers do exist in the current sample, extracted factors are based on much more variable performance on the HITS, and are likely to be less stable and representative of their underlying constructs. Overall, future versions of the HITS should be administered to larger samples of participants in order to validate the proposed factor model.

The current study used online, electronic versions of traditional, well-validated neuropsychological measures. The online versions of the tasks were developed specifically for this study. Although the online tasks were developed to be as similar as possible to the traditional measures, the online tasks have not yet been validated. Thus, there is currently no evidence that the online versions of these tasks measure the same

constructs as the traditional measures, nor is there any evidence that the same cut-offs used for in-person administration of these measures hold the same classification accuracy when used for the online versions. Some traditional PVTs have successfully been converted to electronic versions and demonstrated equivalence, such as the WMT (Hoskins, Binder, Chaytor, Williamson, & Drane, 2010) and the TOMM (Vanderslice-Barr, Miele, Jardin, & McCaffrey, 2011). This raises the possibility that the electronic tasks used in this study may be equivalent to the traditional versions. Nevertheless, these preliminary results should be interpreted with caution. Future development of the HITS should include well-validated criterion measures in order to strengthen its external validity.

In order to better understand feigned ADHD, as well as non-credible performance on the HITS, an experimentally induced (simulated) malingering paradigm was used in the current study. The use of an EXP_{MAL} group is considered standard in the research of non-credible performance, usually because it is difficult to collect a sample of individuals who are intentionally feigning (Williamson et al., 2014). However, there are some methodological issues related to the use of a simulated malingering paradigm. First, it is unclear how much the data collected through this paradigm is generalizable to individuals who intentionally feign or malinger in clinical settings (Suhr, Tranel, Wefel, & Barrash, 1997). Similarly, it is unclear whether it is possible to simulate malingering in a way that is perfectly representative of individuals who malinger, who are likely to be more motivated to deceive than simulators (Faust & Ackley, 1998).

Future Directions

As this study focused on the preliminary development of the HITS, future research should involve the continued testing of scale items and confirmation of the seven-factor model. Importantly, a larger sample of participants may contribute to a more stable factor structure, which may or may not be the same as the seven-factor model reported in this study. Upon deriving a stable factor structure, future studies should include criterion measures to assess the external validity of all of the HITS subscales.

Another important step for the future development of the HITS is to develop tools that detect other presentations of non-credible responding. The current study includes an atypical responding index (the HITS-INV) and an infrequent responding index (the HITS-TD). However, there are other psychometric markers of non-credible report that could be included in the HITS that would improve its ability to discriminate between feigned and genuine ADHD. For example, it has been suggested that an index of inconsistent responding may be more sensitive to the detection of feigned ADHD (Harrison et al., 2007). Thus, it is particularly important that future versions of the HITS include an index for inconsistent responding, as well as other psychometric markers of non-credible responding (e.g., 'critical items', consisting of items that are selected with much higher frequency by non-credible responders).

Finally, it would also be beneficial to assess the HITS in a sample with a more balanced distribution of genders. Although certain characteristics have been found to differ by gender in children with ADHD (Arnett, Pennington, Willcutt, DeFries, & Olson, 2015), there appears to be a more complicated relationship between gender and symptoms of ADHD in adulthood (Williamson & Johnston, 2015). Nevertheless, there is

some evidence that cognitive functioning and psychosocial impairment may differ between genders in adults with ADHD (Williamson & Johnston, 2015), which may be particularly relevant to the development of the HITS. Thus, future studies should attempt to validate the HITS with a more gender-balanced sample.

Conclusions

The overarching goal of the current work was to develop a self-report measure that accurately differentiates between feigned and genuine ADHD. The seven-factor model presented provides a preliminary account of the multidimensional nature of ADHD, which includes symptoms of executive dysfunction, hyperactivity, and impulsivity. The HITS-ED is able to detect symptoms of executive dysfunction with good sensitivity and specificity, and may be useful in the assessment of ADHD in adults. Furthermore, although the data presented has been preliminary, two subscales of the HITS (the HITS-INV and HITS-TD) were found to distinguish between feigned and genuine ADHD with adequate sensitivity and specificity. This work represents the first step in the development and validation of a self-report measure designed specifically to classify non-credible presentations of ADHD, alongside the detection of genuine ADHD. By clarifying the nature of feigned ADHD, future work may help to contribute to the development of improved diagnostic algorithms for genuine ADHD.

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APPENDIX B

Table 4
Seven-Factor Structure of the HITS

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS6_6	**0.676**						
HITS3_8	**0.661**						
HITS8_7	**0.65**						
HITS3_0	**0.632**						
HITS2_6	**0.63**						
HITS5_3	**0.603**						
HITS6_1	**0.597**						
HITS7_10	**0.592**						
HITS6_7	**0.569**						
HITS5_15	**0.568**						
HITS4_17	**0.549**						
HITS7_1	**0.531**						
HITS5_2	**0.53**						
HITS6_15	**0.51**						
HITS5_19	0.497						
HITS2_10	0.495						
HITS6_11	0.489						
HITS8_3	0.459						
HITS6_9	0.454						

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS3_3	0.437						
HITS7_16	0.437						
HITS4_7	0.435					-0.347	
HITS9_11	0.427						
HITS9_8	0.422						
HITS3_7	0.417			0.326			
HITS4_6	0.411						
HITS7_9	0.397						
HITS7_7	0.388						
HITS10_4	0.377						
HITS8_13	0.376						
HITS6_18	0.375						
HITS4_16	0.355						
HITS6_13	0.351			0.324			
HITS8_19	0.347						
HITS2_19	0.343						
HITS4_0	0.335						
HITS1_19	0.312						
HITS6_4	0.308						
HITS4_14	0.307						
HITS2_8	0.3			0.415			
HITS4_15	-0.306	0.48					

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS1_0			**0.698**				
HITS1_1				-0.324			
HITS1_4			0.343		**0.501**		
HITS1_5		**0.656**					
HITS1_6		**0.564**					
HITS1_7							
HITS1_11			-0.384				
HITS1_13		0.398					
HITS1_14					**0.593**		
HITS1_15							
HITS1_16					0.332		
HITS1_18							
HITS2_2						**0.684**	
HITS2_7							
HITS2_9						0.431	
HITS2_12		0.415				0.305	
HITS2_14				0.311			
HITS2_15							
HITS2_16			-0.321			0.477	
HITS2_17							
HITS2_18							**-0.596**

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS3_1				**0.561**			
HITS3_5			-0.428			-0.303	
HITS3_6		**0.587**					
HITS3_9		0.437					
HITS3_10		**0.557**					
HITS3_11		0.304					
HITS3_12			0.454				
HITS3_14					0.499		
HITS4_2			0.428				
HITS4_4					**0.697**		
HITS4_8				0.316	-0.333		
HITS4_9				**0.508**			
HITS4_11		**0.567**					
HITS4_13				**0.572**			
HITS4_18					**0.622**		
HITS5_4		**0.54**					
HITS5_5						**-0.746**	
HITS5_6		0.313		0.33			
HITS5_8		**0.535**					
HITS5_11		**0.94**					
HITS5_14			0.388				

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS5_17						**-0.511**	
HITS5_18				0.327			
HITS6_0		**0.649**					
HITS6_3				0.401			
HITS6_10				**0.628**			
HITS6_14					-0.397		
HITS6_16		0.323			0.321		
HITS6_17			**0.634**				
HITS6_19					0.311		
HITS7_0				**0.673**			
HITS7_2				0.422			
HITS7_3		**0.53**					
HITS7_4			0.371				
HITS7_8			0.336				
HITS7_12				**0.682**			
HITS7_13				0.341		-0.302	
HITS7_15			**0.843**				
HITS7_18				0.4			
HITS7_19			0.318				
HITS8_0			**0.657**				
HITS8_2					0.338		

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS8_4						-0.428	
HITS8_5					**0.663**		
HITS8_12					0.406		
HITS8_16				**0.685**			
HITS8_17				**0.637**		-0.342	
HITS8_18				**0.747**			
HITS9_1		0.305			0.379		
HITS9_3		**0.82**					
HITS9_4			0.329				
HITS9_5				**0.663**			
HITS9_6					0.361		
HITS9_7		0.374					
HITS9_9					0.321		
HITS9_14			0.459				
HITS9_15							
HITS9_16			0.368				
HITS9_17		**0.58**					
HITS9_18		**0.873**					
HITS9_19			0.412				
HITS10_1							
HITS10_2		**0.715**					

Table 4 Continued

Items	Executive Dysfunction	Invalid Responding	Somatization	Impulsivity	Hyperactivity	Thought Disorder	PIM
HITS10_3		**0.547**					

Note. Based on the Control group, consisting of 164 participants. Factor loadings below 0.3 were suppressed. Test items not presented in order to preserve test security

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