5-2014

An Examination of Factors Related to Suboptimal Cognitive Validity Test Performance in a Mildly Concussed Military Sample

Elizabeth M. Seats
University of South Carolina - Aiken, SEATS@email.usca.edu

An Examination of Factors Related to Suboptimal Cognitive Validity Test Performance in a

Mildly Concussed Military Sample

_____

A Thesis

Presented to

the Faculty of the Department of Psychology

University of South Carolina Aiken

_____

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

_____

By

Elizabeth M. Seats

May 2014

Abstract

While cognitive and emotional symptoms which persist beyond what is typical following a mild traumatic brain injury (mTBI) are often attributed to the physical or neurological impact of the concussion, numerous studies have suggested that these symptoms are maintained by other factors, such as psychiatric symptoms and compensation seeking (Binder & Rohling, 1996; Feinstein, Ouchterlony, Iverson & Lange, 2003; Somerville & Jardine, 2011). The current study utilized archival data to examine these factors in an active military sample (*N*=76). Effort and ethnicity's impact on participants' cognitive validity test (CVT) performance was also examined. It was hypothesized that a subset of clinical and subscale scores from the Personality Assessment Inventory (PAI) would mediate the relationship between ethnicity and performance on CVTs (Test of Memory Malingering and Reliable Digit Span). It was also predicted that involvement with a Medical Evaluation/Physical Evaluation Board would moderate the relationship between PAI results and performance on CVTs. Statistical analyses were run using PROCESS, a logistic regression based program that estimates direct and indirect effects (Hayes, 2012). While some direct effects were found (e.g., higher scores on scales measuring depressive, somatic, and traumatic stress symptoms were associated with failure on a greater number of CVTs), the predicted mediational and moderational relationships were not supported. Results from the study provide support for the notion that cognitive validity tests are associated with psychological and emotional symptoms and not always secondary gain. Additionally, findings show that differences in the way people from different ethnic backgrounds express psychopathology may impact cognitive validity test performance. As not all predictions were supported, future studies

should examine other factors (e.g., substance abuse) that may influence CVT performance in an active military population with history of mTBI.

An Examination of Factors Related to Suboptimal Cognitive Validity Test Performance in a Mildly Concussed Military Sample

Since 2001, almost two million U.S. soldiers have deployed to Iraq and Afghanistan in support of Operation Enduring Freedom and Operation Iraqi Freedom/Operation New Dawn (Rigg & Mooney, 2011). It is estimated that as many as 12-35% of U.S. soldiers who have deployed to Iraq and Afghanistan have suffered a mild traumatic brain injury (mTBI; Rigg & Mooney, 2011; Wilk et al., 2010). Mild traumatic brain injuries, or concussions, due to blasts, falls, and blows to the head, have become a much more prevalent issue in U.S. soldiers who have served in the Global War on Terrorism, as compared to previous wars. Whereas blasts would have been fatal in previous wars, better protective equipment has aided in the reduction of fatalities in the wars in Iraq and Afghanistan (Hoge et al., 2008; Warden, 2006; Wilk et al., 2010). The symptoms which commonly follow a mTBI have become a clinical focus in treatment centers for soldiers returning from deployment. The persistence of symptoms, the impact they have on soldiers' level of functioning, as well as the underlying causes of long-term symptoms are topics of interest to practitioners and researchers alike.

Cognitive and physical sequelae commonly associated with mTBI include: difficulties with memory and attention, headaches, and insomnia. Typically the changes in the brain following a mTBI are subtle thus subsequent cognitive impairments are usually temporary and resolve within a short time after the concussion (McCrea, 2008). Continuous problems with recollection and concentration are more commonly seen in individuals who have endured more extensive structural damage to the brain as a result of a severe TBI. Evidence of structural

changes to the brain, which can result in cognitive difficulties, may be found through the use of neuroimaging tests. While techniques such as CT (Computed Tomography) scans and MRI (Magnetic Resonance Imaging) are useful tools for the detection of structural damage to the brain in emergency neurosurgical situations and severe brain injury, they do not have adequate sensitivity to detect abnormalities characteristic of a typical mTBI (McCrea, 2008). Since neurological changes after a mTBI are usually minor and resolve quickly, researchers have attempted to identify the factors involved in the maintenance of the subsequent cognitive, physical, and emotional symptoms which comprise the disorder known as postconcussional syndrome.

Postconcussional Syndrome

Postconcussional syndrome (PCS) is a disorder comprised of a collection of symptoms, including impairments in attention, memory, affect, and functional behavior, experienced following a mTBI. This collection of symptoms seen post-mTBI has been recognized for over 100 years, but theories regarding the origin and maintenance of these symptoms have changed significantly over time. Some clinicians have hypothesized that post-mTBI symptoms are the result of organic changes of the brain due to the injury, while others have attributed the symptoms to psychological distress, compensation seeking, or malingering. Strauss and Savitsky (1934) called attention to a small group of clinicians who believed that their patients' post-mTBI symptoms were psychogenic in nature until they themselves suffered a mTBI and expressed certainty that their symptoms were a result of organic changes in their brains.

The controversy centering on the question of whether symptoms and functional impairments, which continue past the expected or usual period of recovery, are maintained by neurological, psychological, or situational factors continues today. Furthermore, there has not

been one clear, accepted definition of the disorder. The two most commonly referred to definitions of PCS are from the 10th edition of the International Classification of Diseases (ICD-10) and the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; McCrea, 2008). The criteria of PCS vary somewhat between the ICD-10 and the DSM-IV, however both sources require that a head injury has been sustained (APA, 2000; World Health Organization [WHO], 2008). The ICD-10, a tool used by physicians worldwide to code and classify diseases and symptoms, requires at least three of eight symptoms (i.e., headache, dizziness, fatigue, irritability, insomnia, concentration or memory problems, inability to tolerate distress, emotion, or alcohol) for at least one week following the injury (WHO, 2008).

The DSM-5 is the current version of the standardized classification of mental disorders used by mental health practitioners (i.e., counselors, social workers, psychologists, psychiatrists, etc.) in a variety of clinical settings (American Psychiatric Association, 2013). The research cited here utilizes the DSM-IV-TR criteria, however. PCS is recognized by the DSM-IV-TR as impairment in cognitive functioning following a closed head injury, with subsequent physical and emotional symptoms that last for at least three months (APA, 2000; Iverson & Lange, 2003). Unlike the ICD-10, which allows for a diagnosis of PCS to be made based on subjective self-reports of impaired cognitive functioning, the DSM-IV-TR criteria for PCS requires that cognitive impairment be verified through neuropsychological assessment (Boake et al., 2004). According to the DSM-IV, in order to receive a diagnosis of PCS, one must experience post-concussive symptoms for at least three months, whereas the ICD-10 requires symptoms for one week post-TBI (APA, 2000; WHO, 2008). Due to the subjective nature in which a diagnosis of PCS is made using the ICD-10, and required time frame (one week versus three months), the

incidence of PCS is much higher (6 times) than when using the DSM-IV-TR criteria (Boake et al., 2005; McCauley et al., 2005).

The most current version of the DSM, the DSM-5, eliminated PCS. Individuals with history of a mild TBI who met DSM-IV criteria for PCS may meet the DSM-5 criteria for Mild Neurocognitive Disorder Due to Traumatic Brain Injury. This diagnosis requires evidence of a TBI with loss of consciousness, posttraumatic amnesia, disorientation and confusion, or neurological signs, as well as evidence (i.e., concern of the individual and modest impairment in cognitive performance) of modest cognitive decline which began immediately following the injury. The DSM-5 states that if the severity of neurocognitive symptoms appear to be inconsistent with the severity of the TBI, somatic symptom disorder may be considered (APA, 2013).

Parallel to the DSM-IV criteria for PCS, research showed that symptoms typically resolve within three months following a mTBI (Garden, Sullivan & Lange, 2010; Iverson & Lange, 2003; Meares et al., 2008; Rigg & Mooney, 2011; Vanderploeg, Curtiss & Belanger, 2005). The prevalence of symptoms that persist for more than three months varies across studies with a range of 7 to 36% of individuals (Binder et al., 1997; Boake et al., 2004). For a minority (approximately 5% or less), symptoms continue for six months or more, sometimes for years (Alexander, 1992; Iverson, 2005).

Factors associated with PCS. Factors that have been found to be associated with developing PCS, and potentially with the length of time someone reports experiencing PCS symptoms, include injury related characteristics, demographic characteristics (i.e., gender; Meares et al., 2008), IQ (Meares et al., 2008), posttraumatic stress disorder (Meares et al., 2008; Rigg & Mooney, 2011), depression (Iverson & Lange, 2003; Mittenberg & Roberts, 2008), pre-

morbid psychiatric history (Meares et al., 2008; Ponsford et al., 2000), personality traits, litigation status, and expectations about recovery (Mittenberg, DiGiulio, Perrin & Bass, 1992). Although post-concussive symptoms may be, in part, a result of the neurological and physical impact of the concussion itself, many researchers have found evidence that the maintenance of these symptoms is largely attributed to psychological and situational factors (Belanger, Curtiss, Demery, Lebowitz & Vanderploeg, 2005; Binder & Rohling, 1996; Feinstein et al., 2011; Ness, 2010; Paniak et al., 2002; Schneiderman et al., 2008).

Identification of the factors that are contributing to the maintenance of post-concussive symptoms is difficult given that many of the symptoms typically seen following a mTBI are also commonly seen in individuals with psychiatric disorders, as well as healthy persons without a history of brain injury (Fox, Lees-Haley, Brown, Williams & English, 1995; Iverson & Lange, 2003; Lees-Hayley & Brown, 1995; Wang, Chan & Deng, 2006). For example, difficulty concentrating, memory problems, fatigue, irritability, persistent depressed mood and/or psychological distress related to health problems, and disordered sleep, all symptoms characteristic of PCS, are also commonly seen in people suffering from chronic pain (Smith-Seemiller, Fow, Kant & Franzen, 2003), anxiety states (Horner & Hamner, 2002), and depression (APA, 2000; Iverson & Lange, 2003). It is possible for many of those with PCS that psychological issues or medical conditions were present prior to the mTBI, and thus could account for the cognitive, physical, and/or emotional symptoms they are experiencing. A cry for help is one explanation for an individual's reporting of persistent PCS symptoms. Relatedly is the idea that people like to be able to label their experiences with a diagnostic label as it provides acknowledgement of and a reason for their negative experiences. Researchers have found that people reported feeling relief and joy upon receiving a diagnosis (Young et al., 2008).

A study by Iverson and Lange (2003) demonstrated the symptom overlap that exists between PCS and depression, as well as the overlap between PCS and difficulties that exist within non-TBI samples. Healthy community participants, with no history of TBI, completed measures that were designed to assess the presence and severity of depressive symptoms and post-concussive symptoms. The researchers found that the healthy participants reported experiencing a high rate of many of the post-concussive symptoms assessed for (i.e., fatigue, disordered sleep, irritability, temper problems, poor concentration, and memory problems) in this study. Interestingly, based on participants' endorsement of post-concussive symptoms, 79.6% met DSM-IV symptom (Category C) criteria and 72.1% met ICD-10 symptom criteria for PCS. It was also found that post-concussive symptoms were highly associated with symptoms of depression. Approximately half of individuals who reported at least a mild level of depression reported experiencing a moderate to severe level (based on Likert scales measuring frequency and intensity of symptoms) of PCS symptoms (i.e., nervousness, fatigue, and irritability, sadness, concentration and memory difficulties, and sleep disturbance).

Posttraumatic stress disorder (PTSD) and PCS are both associated with a set of common difficulties, some of which are included in the symptom criteria for one or both disorders (e.g., difficulty falling or staying asleep, irritability, displays of anger or aggression with little or no provocation, and concentration, attention, and memory deficits; APA, 2000; Horner & Hamner, 2002). Meares and colleagues (2008) examined the relationships between preinjury characteristics, psychological factors, and post-concussive symptoms in a mTBI sample and in a non-brain injured sample, both of which were recruited from a level 1 trauma hospital. Researchers found that 5 days following participants' injuries, 43% of the mTBI sample and 44% of the non-brain injured sample met ICD-10 criteria for PCS, providing further evidence

that PCS symptoms are not exclusive to the mTBI population. It was also observed that with increasing levels of PTSD, the likelihood of meeting criteria for PCS became greater.

The association between PCS and PTSD was also found in an earlier study that examined the presence of PCS and PTSD symptomatology within samples of mTBI and non-brain injured individuals who were recruited from a trauma hospital following a motor vehicle accident (Bryant & Harvey, 1999). At 6 months post-injury, 20% of the mTBI sample met diagnostic criteria for PTSD, and reported more concentration difficulty, dizziness, fatigue, headaches, sensitivity to noise, and visual disturbance than the mTBI sample who did not meet criteria for PTSD. The authors hypothesized that the intensified anxiety and cognitive load characteristic of PTSD may reduce an individual's available cognitive resources, thereby contributing to the maintenance of PCS. In other words, PTSD likely complicates the clinical picture and can worsen the impact of mTBI on an individual's health and functioning (Bryant & Harvey, 1999; Horner & Hamner, 2002; Rigg & Mooney, 2011).

Hoge and colleagues (2008) investigated both PTSD and depression as possible mediating variables in the relationship between mTBI and physical health outcomes, positing that these disorders may account for the maintenance of the physical post-concussive symptoms (i.e., stomach and back pain, headache, heart racing, fatigue, sleep disturbance, memory problems, irritability, etc.). The researchers surveyed U.S. soldiers who had recently (within 3 to 4 months) returned from a one-year deployment in Iraq, 15% of whom had sustained a mTBI while deployed. The survey contained questions designed to assess the soldiers' injuries, combat experiences, physical health/symptoms, cognitive difficulties, symptoms of depression and symptoms of PTSD. Multivariate logistic-regression analysis was used to examine whether PTSD and depression served as mediators between mTBI and physical health outcomes. Hoge

and colleagues found that the associations between mTBI and physical health outcomes disappeared, except for the association between mTBI and headaches. While headaches were the only physical health outcome associated with mTBI after controlling for PTSD and depression in the analysis, PTSD and depression were each strongly associated with all of the physical health outcomes included in the analyses. The results of the analyses indicated that the physical symptoms experienced in this sample of mTBI soldiers, were mediated largely by psychological difficulties.

Assessment of cognitive impairment. Following a mild TBI a neuropsychological evaluation may be completed in order to detect the presence of cognitive impairment and/or disorder, malingering or suboptimal performance due to other factors such as emotional or psychological variables. A neuropsychological evaluation is comprised of information gathering (i.e., social, familial, educational, medical, and psychiatric histories) from self-reports, medical records, and sometimes family members' reports, as well as a battery of tests which assess major domains of cognitive functioning (i.e., intellectual functioning, academic achievement, language processing, verbal learning and memory, attention and concentration, visual learning and memory, executive functions, processing speed, motor speed and strength, and motivation). Cognitive testing are assessments that quantitatively gauge an individual's memory, abstract reasoning, verbal fluency, etc. An individual's scores are compared to the normative data for each assessment. This determines how their performance compares to the average score of the population to which they belong (e.g., age group). Each piece of a neuropsychological evaluation is considered in a clinician's determination of the individual's diagnoses and treatment recommendations (Malik, Turner & Sohail, 2013).

Psychopathology and Cognitive Validity Testing

Given the findings that PCS symptoms are experienced by those with and without a mTBI and those diagnosed with other disorders (i.e., PTSD and depression), researchers have questioned what underlying factors are involved in the experience of these symptoms across groups of people with different physical and psychological health histories. Thus a number of researchers have examined the role of psychopathological variables in the experience and report of PCS symptoms (Whiteside et al., 2010). In addition to examining the association between psychiatric symptoms and the experience of PCS symptoms, researchers have also investigated the utility of personality measures as a method of assessing validity (conscious or nonconscious over-reporting) of cognitive symptoms in individuals being evaluated for the presence of a cognitive disorder (Boone & Lu, 1999).

Suboptimal performance on cognitive validity indicators. Suboptimal performance on cognitive validity indicators is determined by established cutoff scores on various cognitive validity tests. There are a number of explanations for suboptimal performance, including decreased interest and effort due to genuine cognitive impairment or due to a comorbid condition, expectations of failure, stress, and instances of somatization, poor motivation, opposition, secondary gain, and malingering. It is important to emphasize that suboptimal performance on cognitive validity indicators is not always a case of malingering, which is defined as intentional feigned or exaggerated presentation of symptoms for personal or secondary gain (Strauss, Sherman & Spreen, 2006).

Boone and Lu (1999) differentiated between conscious (malingering) and nonconscious symptom production in their study that examined the relationship between a particular Minnesota Multiphasic Personality Inventory-2 (MMPI-2; Butcher et al., 2001) profile type and performance on malingering tests. Someone who engages in nonconscious symptom production

was described by Butcher and colleagues as someone who unintentionally creates symptoms in response to psychological distress; the distress primarily involving somatization/conversion (as indicated by elevations on the Hypochondriasis and Hysteria scales). Elevated somatization/conversion indicates that the individual tends to nonconsciously express his or her psychological distress in the form of physical or neurological symptoms (e.g., pain, headaches, dizziness, vision problems, seizures, etc.).

Boone and Lu (1999) stated that discrimination can be made between conscious vs. nonconscious symptom production utilizing scores on the F scale ("faking bad" scale). The sample in their study had an average score of 53.1 on the F scale, suggesting that participants were not over-reporting psychiatric symptoms in a noncredible way. Since the cognitive validity tests used in Boone and Lu's (1999) study, and in the current study, are traditionally known as malingering tests, they are primarily viewed as methods for detecting conscious symptom exaggeration. Boone and Lu (1999) examined whether or not these malingering tests would also detect nonconscious symptom production of individuals whose highest MMPI-2 elevations were on the Hypochondriasis and Hysteria scales. They retrospectively selected 19 participants, who completed the MMPI-2 and 7 neuropsychological tests from patient files at a Neuropsychology Unit in a major medical center. The researchers found that 13 of the 19 participants exhibited noncredible efforts on the malingering assessments, indicating that symptom production associated with somatization/conversion personality types can stretch to include noncredible cognitive symptoms; not solely physical/neurological complaints. This finding also indicates that test methods designed to detect conscious symptom production, or malingering, may also be able to detect nonconscious symptom production.

MMPI-2 and PAI. Like Boone and Lu (1999), other researchers have examined the association between elevated scales on the MMPI-2 and performance on cognitive validity indicators. When evaluating the usefulness of a measure in the detection of psychopathology, sensitivity and specificity are two properties examined. Sensitivity is a measure of how well a test is able to detect true positives (e.g., a depression measure has high sensitivity if it is able to detect individuals who are truly depressed). Specificity, on the other hand, is a measure of how well a test recognizes true negatives (healthy individuals without psychopathology). For example, a depression measure with high specificity is able to detect test-takers who do not have depression. Symptom validity tests high in sensitivity and specificity are able to recognize which individuals offered truthful and accurate endorsements of their symptoms and which offered exaggerated or feigned symptom reports, respectively.

It has been found that the "conversion V" MMPI-2 profile, which consists of elevations on the Hypochondriasis, Hysteria, and Depression scales, is associated with failure on neuropsychological and cognitive symptom validity tests (Butcher & Williams, 1996; Larrabee, 1998; Smart et al., 2008;). Larrabee (1998) noticed that in MMPI-2 profiles of patients claiming to have suffered a mTBI (no abnormal findings on brain scans) with Hypochondriasis and Hysteria elevations, the F (Infrequency) scale would often not be elevated. The F scale was created to detect random and/or infrequent responding, but an elevation on the F scale, when inconsistency measures are within normal limits, can indicate that an individual is purposefully exaggerating their symptoms to portray themselves as being worse off than they actually are (Butcher, Graham, Ben-Porath, Tellegen & Dahlstrom, 2001).

Since the F scale is designed to identify overreporting of psychopathology, and contributes only 1 item to the Hypochondriasis and Hysteria scales, Larrabee (1998) suggested

that the F scale may be insensitive to *somatic* symptom fabrication or exaggeration. Instead, Larrabee (1998) suggested that the Fake Bad Scale may be a better method for detecting somatic symptom fabrication or exaggeration. The Fake Bad Scale (FBS) is an experimental scale specifically developed, after the original scales of the MMPI-2, in order to address the lack of detection method of individuals who feign or exaggerate cognitive or physical health problems among compensation seeking or litigating individuals (Lees-Haley, English & Glenn, 1991). The FBS has exhibited sensitivity to inflated cognitive, emotional, and somatic complaints in a number of studies involving participants in personal injury litigation (Larabee, 1998; Slick, Hopp, Strauss & Spellacy, 1996).

Larrabee (1998) examined case files of litigating, minor brain injury (i.e., mTBI, neurotoxic exposure, or transient hypoxic encephalopathy) patients who demonstrated evidence of noncredible cognitive symptoms, as measured by a failing score on a symptom validity instrument. All patients included in the study had clinical elevations on the MMPI-2 (T=65) or MMPI (T=70) Hypochondriasis and Hysteria scales. Larrabee (1998) commented that both the MMPI-2 and MMPI groups' mean scale elevations on the Hypochondriasis and Hysteria scales were higher than those observed in chronic pain and TBI patient studies. Only 3 of the 12 participants in the study had elevated scores on the F scale, whereas 11 of the 12 participants had elevations on the FBS scale. These results support the notion that the FBS scale has better sensitivity for the detection of somatic symptom exaggeration in litigating populations.

Miller and Donders (2001) also provided support for the validity of the FBS scale in mTBI samples. When comparing a compensation seeking mTBI group, a non-compensation seeking mTBI group and a non-compensation seeking moderate-to-severe TBI group, they found that the compensation seeking group was twice as likely to have elevated FBS scores, indicative

of symptom exaggeration. They also found significant correlations between TBIs of mild severity, financial compensation seeking, and elevated FBS scores, suggesting that both mTBI and a compensation seeking status significantly increase the chance that symptom exaggeration will be detected on the MMPI-2. Another important finding from the Miller and Donders (2001) study is that both mTBI groups scored paradoxically higher on all MMPI-2 scales than did a moderate-to-severe TBI group.

This paradoxical severity effect on the MMPI-2 has been found in TBI samples across numerous studies (Burke, Imhoff & Kerrigan, 1990; Hoffman, Scott, Emick & Adams, 1999; Leininger, Kreutzer & Hill, 1991; Miller & Donders, 2001; Novack, Daniel & Long, 1984; Youngjohn, Burrows & Erdal, 1995; Youngjohn, Davis & Wolf, 1997). Leininger and colleagues (1991) compared MMPI-2 profiles of mTBI and severe TBI groups and found that while the pattern of scale elevations were very similar between groups (the majority of the mean scale elevations for the two severity groups were separated by 5 or fewer points), the mTBI group scored significantly higher than the severe TBI group on the Hypochondriasis, Hysteria, and Psychasthenia scales. These findings indicate that the mTBI group endorsed more preoccupation with physical symptoms and concentration difficulties than the severe TBI group.

The Personality Assessment Inventory (PAI; Morey, 1991) is a 344-item test of personality designed to assess psychopathological constructs relevant to many major mental disorders in adults. The PAI is comprised of validity indices, clinical scales, and clinical subscales. Items on are rated on a 4-point scale from False to Very True. The PAI was developed using a construct validation framework. This framework involved the selection of constructs based on their importance within the mental health classification system and within clinical practice (Morey, 2007). The developer determined the importance of these constructs by

reviewing historical and contemporary literature. Based on their findings, 18 construct scales were created. Items for each of these scales were developed by reviewing the literature on each specific construct and identifying the components that were most central to the definition of each construct. Questions were then created in order to assess these components (Morey, 2003).

The development of the PAI differed fundamentally from the development of the MMPI-2. Rather than taking a more theoretical approach to the development of scales, as did the PAI developers, the original MMPI developers used an empirical criterion-keying approach. The emphasis in this approach to test development is the sensitivity (i.e., ability of items to detect the clinical population they are designed to detect) and specificity (i.e., ability of items to discriminate one group of people from another) of items, whereas in the development of the PAI, more weight was put on the actual theoretical content of the items (Whitcomb & Merrell, 2013, p.223). In the criterion-keying framework, items were collected from sources like psychiatric case studies and reports, text books, and previously published measures. The MMPI developers then narrowed down the pool of items so that there was not any redundancy. The items were then given to groups of patients who were categorized by their diagnosis and to a "normal", non-patient group. Items that discriminated among the normal and the clinical groups were kept. The scales were then cross-validated using different normal and clinical groups (Nichols, 2011). The assessment was updated and restandardized for the MMPI-2 in the early 1980s. The MMPI-2 included new items added to address topics of clinical concern that were not included in the original item collection. The disadvantages of using the MMPI-2 are that, because of the method used in its development, internal consistency reliability is not very high for most of its validity and clinical scales (α= .57 to .74 for validity scales; α= .39 to .87 for clinical scales; Hilsenroth &

Segal, 2004, p.32). The PAI also holds practical advantages over the MMPI-2, such as shorter administration time, lower required reading level, and lower cost of administration.

Measures like the MMPI-2 and PAI are utilized in a number of contexts and for various purposes. For instance, rehabilitation counselors may ask clients to take the MMPI-2 or PAI to assess for job-relevant behaviors and temperament in order to gauge their readiness for employment and to match them up with a job. In a clinical setting, a personality measure may be used to assess for a client's psychopathological symptoms or experiences, and to assist the clinician in making a diagnosis and/or developing a treatment plan. The current study utilizes the PAI in its examination of whether mood and/or psychopathological experiences, not necessarily psychological disorders, are associated with CVT performance.

While evidence supports the adequacy of validity indices on the PAI in the detection of psychopathological symptom exaggeration or malingering, the same sensitivity to the detection of *cognitive* symptom exaggeration has not been found. The three validity scales developed to identify test-takers who are endorsing items in a way to portray themselves more negatively are the Negative Impression Management (NIM) scale, the Malingering Index (MAL), and the Rogers Discriminant Function (RDF; Morey, 2007). The NIM scale detects profiles that portray someone as having more severe psychopathology (potentially including subjective cognitive impairments in memory and attention) than would normally be reported by an objective observer describing the respondent. If the NIM score is elevated, it may be indicative of malingering. An elevated NIM score may also be indicative of someone who has a more negative style of self-evaluation, which is characteristic of some mental disorders, like depression (Morey, 2003). The MAL, another indicator of negative impression management, is comprised of features that are more often observed in PAI profiles of individuals imitating a mental disorder than in actual

patients with the disorder. The RDF, a third indicator of negative impression management, was created to discriminate between real patients and individuals simulating the real patients (Morey, 2007). The RDF is a formula, which includes weighted combinations of 20 different PAI scores, and for which a score of greater than 0 indicates malingering (Morey, 2003). Findings from numerous studies indicate that the RDF has the highest sensitivity (.63 to .95) and specificity (.80 to .96) of the three negative impression management scales on the PAI (Morey & Lanier, 1998; Rogers, Sewell, Morey & Ustad, 1996; Scragg, Bor & Mendham, 2000), and large effect sizes when distinguishing authentic patients from simulator patients (Bagby et al., 2002). Morey (2003) explains that the RDF likely exhibits superior sensitivity and specificity because it appears to be free from any influence of true psychopathology, unlike the NIM and MAL scales, and thus detects effortful presentation distortion. This was demonstrated during standardization studies, when the RDF yielded similar mean scores and standard deviations across community (healthy individuals) and clinical (individuals with genuine psychological symptoms/diagnoses) samples (Morey, 2007).

The negative profile distortion indicators of the PAI do an adequate job of detecting psychological symptom exaggeration and distinguishing between actual and simulated mental health patients. The little research that has been done has had inconsistent findings regarding PAI validity scales' ability to detect *cognitive* symptom exaggeration or malingering. Few of these studies have shown any significant association with failure on cognitive symptom validity testing. The NIM scale was found to have a moderate significant association with the Victoria Symptom Validity Test (Slick, Hopp, Strauss & Thompson, 1997) and the Test of Memory Malingering (Tombaugh, 1996), two instruments designed to assess the validity of cognitive symptom complaints (Haggerty, Frazier, Busch & Naugle, 2007; Whiteside, Dunbar-Mayer &

Waters, 2009). Armistead-Jehle (2010) examined performance on cognitive validity tests in U.S. veterans referred for a neuropsychological evaluation after sustaining mTBI. He found that there were no significant differences between veterans who passed and veterans who failed the Medical Symptom Validity Test (Green, 2004), a verbal memory measure, on any of the PAI validity scales used (NIM, MAL, and RDF).

There is also a lack of research on the relationship between PAI clinical scales and cognitive validity testing. Whiteside et al. (2010) found that in a neuropsychological sample the Somatic Complaints (SOM) scale was the PAI clinical scale that had the most significant and consistent relationship with performance on Trial 2 of the Test of Memory Malingering (TOMM), a test that detects noncredible memory dysfunction. The findings suggest that very high SOM scores (T > 87) should raise concerns about the credibility of cognitive symptoms. It was also found that the Anxiety, Schizophrenia, and Depression clinical scales trended toward a significant association with Trial 2 of the TOMM. Additionally, when examining PAI clinical subscales, researchers found a significant association between SOM-C (cognitive) and Trial 2 of the TOMM, however significant associations between the other SOM subscales and Trial 2 of the TOMM were not found. To the author's knowledge there have not been any other studies that have examined the relationship between PAI clinical subscales and cognitive validity tests.

It is important to note that particular PAI scales have been found to be elevated in some mTBI samples. Demakis and colleagues (2007) conducted a study in which they examined PAI data from mTBI and moderate to severe TBI patients located in either a rehabilitation or military hospital. The study participants consisted of 60 civilians and 35 members of the armed forces. The researchers found that there were no significant differences on PAI clinical scale scores between the two groups with different TBI severity levels. Most participants (65%) had elevated

clinical scale scores, the highest being on the Somatic Complaints, Depression, Borderline

Features, Paranoia, and Schizophrenia scales. These elevations on the PAI are similar to what

has been found previously in the TBI population using the MMPI-2, which were elevations on

the Hypochondriasis, Depression, Schizophrenia, and Hysteria scales (Alfano et al., 1992;

Butcher & Williams, 1996; Hessen & Nestvold, 2009; Kurtz, Shealy & Putnam, 2007; Leininger,

Kreutzer & Hill, 1991). Demakis and colleagues (2007) were not aware of the litigation status of

their participants and therefore acknowledged that litigation status may have influenced the lack

of differences found between severity groups in PAI scores.

Till and colleagues (2009) suggested that the reason for specific PAI scale elevations in

mTBI samples may be that these scales are comprised of some items which partially reflect the

physical/neurological symptoms commonly experienced after sustaining a mTBI. The

researchers distinguished between transdiagnostic and nontransdiagnostic items on the PAI.

Transdiagnostic items are defined as those items that are associated with their intended content

as well as physical and neuropsychological symptoms related to TBI (e.g., "My thinking has

become confused" from the SCZ-T subscale and "I've been moving more slowly than usual"

from the DEP-P subscale). In other words, these items assess symptoms that are found in both

psychiatric and neurological disorders. Till et al. defined nontransdiagnostic items as items

which reflect behavioral disorders common in individuals with a TBI, but which do not appear to

be confounded with neurological symptoms (e.g., "People have to earn my trust" from the PAR-

H subscale and "I've never been in trouble with the law" from the ANT-A subscale).

Transdiagnostic items were identified on the MMPI-2 within a TBI sample, and it was found that

when a neurocorrective approach was used to adjust for these items, elevations on the

Psychasthenia and Schizophrenia scales significantly decreased (Van Balen, de Mey, & van

Limbeek, 1999). Elevations on these MMPI-2 scales reflect difficulty concentrating and disorganized thinking, as well as more affective symptoms. The decrease in these scales after correction demonstrates that elevations on these scales within a TBI sample were due to the neurological and cognitive post-TBI symptoms as opposed to symptom exaggeration or symptoms of schizophrenia.

There has been little research exploring transdiagnostic items vs. nontransdiagnostic items on the PAI. One published study conducted by Till and colleagues (2009) found transdiagnostic items between psychological and neurological symptoms within the Depression (DEP), Somatic Complaints (SOM), and Schizophrenia (SCZ) scales of the PAI. They found, as well, that participants who demonstrated better functional independence in both cognitive and motor areas were less likely to endorse these transdiagnostic items. This suggests that these items are associated with mTBI sequelae and are more likely to be endorsed by individuals with a history of mTBI, thereby potentially elevating the scales to which they belong. When Till et al. corrected the DEP, SOM, and SCZ scales for the transdiagnostic items within each, there were significant changes in the scores for the SOM and SCZ scales. The change in the SOM scale score is congruent with what Morey (2007) states in the PAI manual - that elevations on the SOM scale may reflect functional and/or organic symptoms. The significant change seen on the SCZ scale after correction supports Morey's assertion that elevations on the SCZ-T (thought disorders) subscale may indicate cognitive symptoms caused by something other than schizophrenia (Morey, 2003). Till et al. (2009) advised that, because of these significant changes after correction, the SOM and SCZ scales be interpreted with caution within a TBI population. In other words, elevations on these scales may not necessarily be indicative of somatization or

psychological symptoms, rather they may be due to genuine cognitive dysfunction or feigned symptoms for secondary gain.

Most of the research examining psychopathology in mTBI populations has utilized the MMPI-2. A few investigators have been examining the utility of the PAI in identifying participants demonstrating suboptimal effort in cognitive testing. For example, Kurtz et al. (2007) sought out to determine whether the paradoxical effect found with the MMPI-2 and TBI was also demonstrated with the PAI. Participants were selected from an archival database comprised of mild TBI and moderate to severe TBI patients who were seen at one of two rehabilitation hospitals or a private practice. Participants had completed administrations of both the MMPI-2 and the PAI. Kurtz and colleagues found that the mTBI group scored higher than the moderate to severe TBI group on all of the 10 basic scales of the MMPI-2, and significantly so on the Hypochondriasis, Depression, Hysteria, and Psychasthenia scales. On the PAI, it was found that mean score elevations across the 11 clinical scales were not significantly different between the two groups, with the exceptions of the mTBI group having significantly higher scores on the Somatization and Depression scales, and the moderate to severe TBI group having significantly higher scores on the Antisocial Features and Alcohol Problems scales. These findings partially support the idea that the paradoxical severity effect is specific to the MMPI-2, but also demonstrate that mTBI samples report greater levels of depression and somatization than severe TBI samples on both the MMPI-2 and PAI. The differences in findings between the two measures can partly be explained by the fact that the PAI does not have equivalents to the Hysteria and Psychasthenia scales on the MMPI-2.

Kurtz and colleagues (2007) suggested that the paradoxical severity effect was not seen on PAI scales other than Somatization and Depression because the PAI has better discriminant

validity than the MMPI-2. Specifically, the MMPI-2 at instrument development included items which discriminated between patients who had a particular disorder and non-patients, while the PAI included items, which not only discriminated between patients and non-patients, but also between patients with one disorder and patients with another disorder (Morey, 2007). Since many symptoms are transdiagnostic, an assessment which does not have high discriminant validity may show high scores on multiple scales for an individual who only has one particular disorder. This may partly explain why mTBI individuals scored significantly higher than moderate or severe TBI individuals on all MMPI-2 clinical scales. Since mTBI is more commonly associated with neurotic and somatic symptoms as compared to more severe TBI, it is reasonable to expect that MMPI-2 scales reflecting these types of symptoms would be more elevated in the mTBI group, however this does not explain higher scores on other MMPI-2 scales.

Military and mTBI. In order to know how military personnel affected by mTBI are likely to score on the PAI, it is important to be aware of how military personnel who have not experienced a mTBI score on the PAI. Because the daily life and work of a soldier, particularly when deployed, is vastly different from that of a civilian, their PAI profiles may reflect these differences. Deployed soldiers are at a substantial risk for harm, are separated from their loved ones and often experience or witness potentially traumatic events. While these aspects make deployed military personnel unique, Morey et al. (2011) found that PAI scale scores were similar in a sample of soldiers deployed in Iraq, without a history of TBI, and a sample of the original PAI community standardization sample, matched for age and gender. Morey and colleagues' (2011) research suggests that deployed military personnel and civilians report similar levels of anxiety, depression, anger, health concerns, stress, suicidal thoughts, and social support.

Previous data has demonstrated that rates of PTSD in military members who served in Iraq and Afghanistan are three times those found in the civilian population (Schell & Marshall, 2008). The differences in results between the Morey et al. (2011) and Schell and Marshall (2008) studies may stem from differences in study methodology, specifically time between end of deployment and time of evaluation. Morey and colleagues (2011) evaluated soldiers during their deployment in Iraq, while Schell and Marshall (2008) evaluated soldiers as long as 36 months after the end of their last deployment. This is an important difference, because there is data that suggests that rates of PTSD increase with time following the end of a deployment, indicating a "late onset PTSD" (Sundin, Fear, Iverson, Rona & Wessely, 2010). Morey and colleagues discussed one possible interpretation; that soldiers during deployment have adaptive mechanisms that sustain them in a high-stress environment, permitting them to normalize their experiences in a way that may not be maintained in post-deployment life. Fontana and Rosenheck (2008) identified factors, such as social support and youth, that serve as adaptive advantages for soldiers coping with stress or adversity after returning from deployment. Schnurr and colleagues' (2004) examined factors related to the development and maintenance of PTSD and they found that weakening levels of soldiers' social and emotional support was associated with the development of PTSD. The combination of results from these studies suggest that depending on the time of evaluation, soldiers may or may not report similar levels of emotional difficulties on the PAI as civilian populations.

Ethnicity and the PAI. Differences between ethnic groups in their expression of psychopathology were first noted and studied in the early 20th century by the famous psychiatrist Emil Kraepelin on his travels from Germany to Asia and North America. According to Marsella and Yamada (2000), the western psychiatry worldview in favor of universal expression of

psychopathology remains the predominant perspective and has been challenged more in recent years as ethnic minorities and members of non-Western cultures have grown in number and in influence among the mental health sciences. Despite the increased focus on cultural factors and mental health, there has been little research examining the role of ethnicity in the assessment of psychopathology. One of the few studies conducted found a medium effect size in the relationship between African Americans and the tendency to report distress in terms of physical symptoms (Cuellar & Paniagua, 2000). This finding was also reflected on MMPI-2 scores when Castro and colleagues (2008) examined MMPI-2 clinical (CS) and restructured clinical (RCS) scales in a sample of Caucasian and African American outpatient therapy clients. They found that African American participants scored significantly higher than Caucasian participants on the Hypochondriasis (CS1) and Somatic Complaints (RC1) scales, in addition to a few other scales (i.e., Cynicism [RC3], Ideas of Persecution [RC6], and Aberrant Experiences [RC8] scales). Consistent with Castro et al's (2008) findings, an earlier investigation found that African Americans were more likely than Caucasians to meet full criteria for Somatization Disorder (Zhang & Snowden, 1999).

Latino individuals also tend to express emotional distress as physical symptoms (Cuellar & Paniagua, 2000). It has been reported that somatic symptoms are more commonly seen in individuals of lower level socioeconomic status (Cuellar & Paniagua, 2000). Cueller & Paniagua (2000) and Choudhury (2003) suggest that this may partly explain why Hispanics and African Americans are more likely than Caucasians to express distress in physical terms, as disparities in income and educational level exist between ethnic groups.

While not extensive, there has been some research conducted which examined ethnic differences in symptom reporting post-mTBI or within a military sample. Over 1,300 Hispanic,

African American, and Caucasian TBI patients (50.3% severe, 16.3% moderate, and 33.3% mild) from the National Institute on Disability and Rehabilitation's TBI Model Systems (TBIMS) database were compared on their endorsement of post-TBI symptoms (Arango-Lasprilla, 2012). Participants completed the Neurobehavioral Functioning Inventory (NFI; Marwitz, 2000), a self-report measure comprised of six subscales (depression, somatic, memory/attention, communication, aggression, and motor), which assesses presence and severity of symptoms common to TBI. Before adjusting for injury demographics, it was found that Hispanic participants displayed significantly higher levels of somatic complaints, communication deficits, and motor impairment compared to Caucasian participants, as well as significantly higher levels of depression, memory/attention difficulties, and aggressive behaviors compared to Caucasian and African American participants. When injury demographics (i.e., Functional Independence Measure, Disability Rating Scale, and length of stay in acute care or rehabilitation; injury severity was not included in adjustment due to the unavailability of Glasgow Coma Scale scores for many of the participants) were accounted for, it was found that Hispanics scored significantly higher on the depression, somatic difficulties, and memory/attention difficulties subscales compared to Caucasians and African Americans. Additionally, the Hispanic participants had significantly higher scores on the communication deficits and motor impairment compared to Caucasians. Notably, there were no differences between Caucasians and African Americans on any of the NFI subscales after adjusting for injury characteristics (Arango-Lasprilla, 2012).

Some studies have also found that Hispanics report more symptoms of depression than do Caucasians and African Americans following a TBI, however other studies have found similar levels of depression among African Americans and Hispanics following a TBI (Dunlop, Song, Lyons, Manheim & Chang, 2003; Seel et al., 2003). These mixed findings may partly be due to

methodology differences. For example, Arango-Lasprilla (2012), who found higher depressive symptom reporting in Hispanics than African Americans, measured depression one year post-TBI, while Seel (2003), who found comparable levels of depression between Hispanics and African Americans, measured depression almost three years post-TBI. Additionally, Arango-Lasprilla (2012) and Seel (2003) used different operational definitions of depression in their studies, which may have contributed to the differences found in levels of depression across ethnic groups. Arango-Lasprilla (2012) operationally defined depression as the score on the Depression subscale of the NFI, whereas Seel (2003) grouped NFI items together within each of the nine depressive symptom domains described in the DSM-IV-TR and then organized the domains into three major categories (mood, somatic, and cognitive). Items in the Seel (2003) study were categorized as clinically problematic or clinically non-problematic depending on how they were rated by participants on a 5-point scale.

Mixed findings also exist regarding ethnic differences in psychopathology within veteran populations. For example, Frueh and colleagues (1997) compared Caucasian and African American veterans who were being treated at a VA outpatient PTSD clinic on measures of depression and PTSD and on the MMPI-2. They found no significant differences between groups on any of the measures they examined. Munley et al. (2001) examined ethnic differences on the MMPI-2 in African American and Caucasian male inpatient psychiatric patients at a VA medical center who were matched in terms of primary discharge diagnosis and marital status. Unlike Frueh and colleagues, Munley et al. also assessed for possible differences on the content scales of the MMPI-2. Consistent with Frueh and colleagues, Munley et al. found no significant differences between Caucasians and African Americans on the validity, clinical, or supplementary MMPI-2 scales. On four of the content scales (Fears, Bizarre Mentation,

Cynicism, and Antisocial Practices), however, African Americans scored significantly higher than Caucasians. A significant difference between Caucasians and African Americans on the Bizarre Mentation content scale was also found in a 2002 study that examined MMPI-2 profiles in veterans with combat-related PTSD (Monnier, Elhai, Frueh, Sauvageot & Magruder, 2002). However, Monnier and colleagues (2002) found no other significant differences between Caucasians and African Americans on any other MMPI-2 scales. Munley (2001) explained that the difference between ethnic groups found on the Antisocial Practices content scale may be related to the significant differences in the type of substance abuse comorbidity (i.e., a diagnosis of alcohol or drug abuse/dependence in addition to the primary discharge diagnosis) between groups. There was no significant difference in the number of substance abuse comorbidity diagnoses found between ethnic groups in the Monnier (2012) study, however differences in type of substance abuse comorbidity was not reported. Munley (2001) explained that the significant differences found between ethnic groups on the FRS and CYN content scales may be related to differences in worldviews. Perhaps African Americans, because they are more often victims of discrimination and prejudice, tend to have more negative and fixed worldviews.

  While there have been a number of investigations examining ethnic differences on the MMPI-2, there is a lack of research on ethnic differences on the PAI. The MMPI was first published in 1943 and has been called the gold standard for personality testing (Peltier, 2011). In 1989 the MMPI-2 was published utilizing a new normative data set more representative of the current population characteristics. The PAI is comprised of clinical scales and subscales, some which measure similar psychopathological symptoms as scales on the MMPI-2 (e.g., somatic complaints, depression, and bizarre mentation). Scores on MMPI-2 scales measuring these psychopathological constructs were found to be different between ethnic groups. The SOM

clinical scale on the PAI measures levels of concern about physical health and perceived distress

related to physical symptoms. The DEP scale measures the overall level of depression, while the

DEP subscales measure the physiological, cognitive, and affective components of depression

(Morey, 2003). While there is no PAI scale that measures all of the symptoms that the MMPI-2

grouped together to call 'bizarre mentation', the PAR-P subscale of the PAI measures

persecution paranoia, a major feature of the BIZ MMPI-2 content scale. The current study will

examine differences between ethnic groups on the PAI clinical scales and subscales of interest,

as well as examine whether or not concern about or distress related to physical symptoms acts as

a partial mediator in the relationship between ethnic minority status and suboptimal performance

on cognitive validity indicators.

Medical/Physical Board Evaluation

The MEB and PEB are part of a process utilized to determine if a soldier with a medical

illness, including a mental health condition(s) or physical injury, is fit to continue active duty in

the military. Medical and Physical Evaluation Boards (MEB/PEB) are panels composed of

administrative officers and active duty physicians. A MEB is initiated if an active duty military

member has physical or mental health problems that are incompatible with continuing military

duty, or if they have been prohibited to deploy overseas for 12 months due to their medical

problems (Powers, 2007). The MEB is comprised of active duty physicians, who review clinical

case files of individuals deemed unhealthy or injured. Using an established list of medical

standards for continued military service, they make a decision about whether the individual has a

medical condition that is incompatible with continued military service. If the MEB determines

that an individual may not be fit to return to duty, the case then gets passed on to the PEB, a

board who reviews the case and makes a recommendation that the individual returns to duty

(with or without assignment limitations), be placed on a temporarily disabled list, be separated from active duty, or be medically retired from the military. The PEB's recommendation is given to a central medical board, where the ultimate decision is made. If the decision is made to medically retire or separate a soldier from active duty, he or she may receive retirement payments if they are eligible. Eligibility is based on the number of years a soldier has served in active duty and on the reason the soldier being retired (Powers, 2007). Since the MEB and/or PEB process can potentially result in receiving monetary compensation, similar to litigation due to an injury, involvement in the MEB/PEB process can result in secondary gain.

The process of going before the Medical and/or Physical Evaluation Board (MEB/PEB) is one factor that may impact a soldier's performance on neuropsychological and personality assessments. Findings have been mixed when it comes to the question of whether or not litigation/compensation seeking has an effect on symptom reporting. A study by Lees-Haley and Brown (1993) examined differences in levels of reported neuropsychological symptoms between a personal injury claimant group (non-TBI patients filing claims for emotional and/or work-related stress) and a control group (patients recruited from a family practice clinic visiting for symptoms including sore throat, respiratory complaints, headaches, flu, hypertension, etc.). It was found that the personal injury claimants reported higher levels of symptoms than did the control group, the highest of which were symptoms of anxiety, disordered sleep, depression, and headaches. One explanation for the difference in symptom reporting is that the personal injury group sought compensation due to greater level of symptoms experienced compared to those who were not seeking compensation. While neither group consisted of head-injured individuals, the compensation-seeking group was found to be significantly more likely to endorse neuropsychological symptoms as compared to the control group (Lees-Haley & Brown, 1993).

The endorsement of neuropsychological symptoms by non-head injured individuals has been seen across a number of studies (Fox et al., 1995; Hoge et al., 2008; Iverson & Lang, 2003; Lees-Haley & Brown, 1993).

A number of studies have compared groups of head injured individuals to examine whether an association exists between compensation seeking/litigation status and symptom endorsement. The direction of causality in the association between compensation seeking and symptom severity is complicated. A number of arguments exist, one being that individuals experiencing a greater amount or severity of symptoms would be more likely to become involved in litigation or seek compensation. Another is that individuals who decide to seek compensation purposely report a greater number or severity of symptoms than what they actually experience in order to increase their chance of receiving compensation. Other explanations for the association between compensation seeking and symptom severity include attention seeking and non-conscious symptom production or exaggeration. Since symptoms are frequently assessed for via self-report measures, not all of which have validity indices, it is difficult for clinicians to determine the true number and severity of an individual's symptoms. Even symptom validity tests, which are able to detect the credibility of the examinee's symptom reporting, do not have the capability to explain the underlying cause(s) of an examinee's invalid responses. Malingering or symptom exaggeration is only one explanation for noncredible or suboptimal performance on a symptom validity test.

Paniak et al. (2002) found that a compensation seeking mTBI group reported a greater level of symptoms (common complaints of those with a traumatic brain injury) than did the non-compensation seeking mTBI group, even after receiving a treatment rated highly by patients. The only variable found in this study to be positively predictive of the decision to seek compensation

following a mTBI was a prescription of post-injury analgesic, neurological, or psychopharmacological medications. It would make sense that individuals who experience a greater level of symptoms would be more likely to be prescribed or to take these types of medications; therefore the relationship between post-injury prescriptions and compensation seeking status could be explained by a greater severity of symptoms. To investigate this relationship, Paniak and colleagues (2002) covaried a prescription of analgesic, neurological and/or psychopharmacological medication in a repeated measures analysis. They found that a significant difference in symptom reporting between those who were and were not compensation seeking still existed, indicating that other factors may be related to this difference in groups. Paniak and colleagues suggested that those who seek compensation may report more symptoms or more severe symptoms because they feel the need to convince compensators. This explanation does not discredit the presence of symptoms in those seeking compensation, but instead suggests that greater symptom reporting by compensation seekers is a means of increasing their chance at receiving compensation.

Dunn and colleagues' (1995) findings may offer support to the idea that symptom over-reporting and compensation seeking are attributable to pre-morbid emotional/psychological difficulties. Dunn et al. examined the reporting of neuropsychological symptoms in three groups of participants: a non-claimant group with a history of head injury, a non-claimant group without a history of head injury (who were seeking an examination or treatment with their family physician), and a personal claimant group seeking an evaluation for emotional/psychological problems (no history of head injury or exposure to neurotoxins). Researchers found that the personal claimant group seeking compensation for an emotional/psychological evaluation reported suffering from significantly more neurotoxin and/or neuropsychological symptoms than

did the non-claimant group with a history of head trauma or toxin exposure. While results from this study may be explained by pre-morbid emotional/psychological problems, just as reasonable is the explanation that those who seek compensation feign or exaggerate their symptoms.

Researchers have attempted to better understand the relationship between compensation seeking and symptom reporting by utilizing assessments that are not face valid and include validity indices. A study by Youngjohn and colleagues (1997) examined MMPI-2 scores within a group of moderate TBI participants, a group of severe TBI participants (some of whom were involved in litigation) and a group of litigating mTBI participants. They found that severe TBI participants who were litigating had significantly higher elevations on the Hypochondriasis, Hysteria, Schizophrenia, and Health Concerns scales than did the non-litigating severe TBI group. The researchers noted that both the litigating and non-litigating severe TBI groups had equivalent severity indicators (no significant differences in hours of loss of consciousness, Glasgow Coma Scale score, and hours of posttraumatic amnesia between groups), which is an indication that both groups sustained injuries of similar severity levels. They found a paradoxical effect (mentioned earlier) as the litigating mTBI group had significantly higher elevations on the Hysteria, Depression, Psychasthenia, and Hypochondriasis scales compared to both of the litigating and non-litigating moderate and severe TBI groups.

Putnam and Millis (1994) reviewed the literature on compensation seeking and symptom reporting, and reported that mTBI patients who reported a high level of symptomatology also typically had psychosocial difficulties that increased the likelihood of illness behavior and pursuit of secondary gain. They also pointed out that illness behavior is not necessarily always conscious. There are possible explanations for unconscious illness behavior, such as growing up in a family that has adopted a tendency to express emotional distress as somatic complaints, or

one that reinforces its children for playing the sick role. These children can carry on their learned behaviors into adulthood without much or any conscious effort, and therefore be more likely to pursue litigation because they believe they are truly disabled.

A study by Binder (1993) examined performance on a forced-choice measure of recognition memory (a measure often used when assessing individuals for possible malingering) in three groups of brain-injured individuals: compensation seeking participants with a history of mTBI, compensation seeking individuals with a brain dysfunction, and non-compensation seeking participants with brain dysfunction. Brain dysfunction was defined as an injury that involved structural damage to the brain as evidenced by brain scans, whereas an mTBI did not show neurologic abnormalities on brain scans. Binder (1993) found that the compensation seeking group with mTBI performed significantly worse on the measure of recognition memory than did the non-compensation seeking group and worse than the compensation seeking group with brain dysfunction. These results are contrary to what would be expected. If severity of structural damage to the brain and compensation seeking status are positively associated with failure on a memory assessment, as is the general consensus, one would expect to find that the compensation seeking brain dysfunction group would perform the worst on a forced-choice measure. Binder's (1993) findings conflict with this expectation, and suggest that the poor performance by the mTBI group is attributable to factors other than genuine memory impairment. Notably, it was found that 17% of the mTBI compensation seeking group and 3% of the brain dysfunction group seeking compensation obtained below chance scores on the measure, indicating that a likelihood that these test-takers were purposely choosing the incorrect answers.

While there has been support for a relationship between compensation seeking and symptom reporting, cognitive effort, and scale elevations on personality measures, there have

also been a number of studies that found no relationship among these variables. Two studies, in

which mTBI participants were assessed for cognitive symptom validity, found no significant

association between compensation-seeking status and suboptimal performance on cognitive

validity tests (Ross, Putnam & Adams, 2006; Stulemeijer, Andriessen, Brauer, Vos & van der

Werf, 2007). Ross and colleagues (2006) suggest that their findings may be the result of coding

compensation seeking status as a dichotomous variable (whether or not the participant has an

unsettled claim related to their injury; instead of coding compensation based on type of litigation

[i.e., personal injury litigation or worker's compensation, etc.]), therefore limiting its range, and

possibly underestimating the true effect of compensation seeking status on cognitive validity

indicator performance. While the types of litigation that participants are involved in have been

reported in most studies, compensation seeking/litigation has typically been coded as a

dichotomous variable for purposes of statistical analyses. This is likely due to there being too

few participants in a study to be separated out into categories of litigation type, which if done,

decreases the statistical power and increases the likelihood for Type II error. Stulemeijer et al.

(2007) attributed their lack of significant findings to the design of their study. They recruited

participants from the emergency department at a university medical center and informed them

that all data collected was for research purposes only and would not be communicated to anyone

involved in their litigation process. Also, some of their participants who demonstrated

suboptimal performance on cognitive validity measures were on sick leave and receiving

monetary benefits from the state, but were not classified as having a "litigation status". Had these

participants been included in the "litigation status" group, there may have been more of an

association found between litigation status and noncredible cognitive symptom reporting.

No significant association between compensation seeking status and MMPI-2 scale elevation was found in a study by Kurtz and colleagues (2007), in which participants sustained either a mild or moderate to severe TBI. They also found a lack of significant association between compensation seeking status and PAI scale elevations, with the exception of the Malingering (MAL) index. It was found that compensation seeking participants scored marginally higher on the MAL index as compared to non-compensation seeking participants; however this difference was not significant.

Current Study

While there have been studies which have looked at each of the components involved in the current study (i.e., PAI elevations in a mTBI population, associations between PAI elevations and performance on cognitive validity indicators, relationship between compensation seeking status and cognitive validity test performance, and ethnic differences on measures of psychopathology), to the author's knowledge no study has examined all of these factors, nor have they all been studied within an active duty military population. Most previous research that has examined PAI elevations within a mTBI sample have focused on the main clinical scales. The current study will investigate clinical scale and subscale elevations within a mTBI sample in hopes of gaining a greater understanding of the relationship between symptom reports and cognitive validity assessment in such populations.

Elevations on scales that measure somatic concerns have been found in mTBI samples across multiple studies. In addition, elevations on the SOM and SOM-C scales have been shown to be significantly associated with failure of Trial 2 on the Test of Memory Malingering (TOMM; Whiteside et al., 2010), one of the cognitive validity indicators used in the current study. Based on the symptoms assessed by the SOM-S and SOM-H subscales, elevations on

these scales would be expected in a mTBI sample seeking a neuropsychological evaluation for symptoms experienced after a concussion. An elevated SOM-S (Somatization) subscale reflects complaints about common physical concerns (i.e., headaches, back ache, stomach ache, etc.) and general dissatisfaction with overall health. These complaints are commonly reported by individuals who have sustained a mTBI. An elevation on the SOM-H (Health Concerns) subscale indicates a preoccupation with one's health and attempts to get better. Those who are motivated by some form of secondary gain may exaggerate the physical symptoms and their subjective impact, reflected in these subscales.

While particular elevated PAI scales/subscales (SOM and SOM-C) have shown to be significantly associated with failure on Trial 2 of the TOMM, a trend toward significance was found between elevations on the DEP scale and failure on Trial 2 of the TOMM in a study by Whiteside (2010) using participants with significant emotional disorders or mild head injuries. It has also been found that higher levels of depression have been reported by compensation seeking individuals as compared to non-compensation seeking persons with a moderate to severe TBI (Lees-Haley & Brown, 1993; Youngjohn et al., 1997). While, to the author's knowledge, elevations on the DEP subscales within mTBI samples have not been examined in previous investigations, based on the symptoms assessed by the DEP subscales, it might be expected that mTBI participants would exhibit elevated DEP subscale scores. Elevations on the DEP-C (Cognitive), DEP-A (Affective), and DEP-P (Physiological) reflect decision-making and concentration difficulties, sadness, anhedonia, and dissatisfaction with one's current condition, and the physical characteristics of depression (i.e., sleep problems, reduced appetite and energy level), respectively (Morey, 2003). The symptoms reflected in the DEP subscale items are also commonly seen in individuals with PCS.

There is some evidence to support the idea that those with a high level of depressive symptoms are more likely than the non-depressed to demonstrate specific cognitive impairments (inhibition, inhibition/switching, and category fluency) on cognitive performance testing (Hammar, 2009; Hammar, 2011; Trichard, 1995). These particular cognitive impairments are typically assessed for in a standard neuropsychological battery used when evaluating someone with a mTBI.

Due to symptom overlap between PCS and PTSD and the suggestion that the presence of PTSD influences the maintenance of postconcussive symptoms, elevations on measures of trauma-related anxiety might be expected within some mTBI samples (Meares et al., 2008; Rigg & Mooney, 2011). Posttraumatic Stress Disorder has been found to be associated with cognitive impairments, specifically in concentration and attention (Rigg & Mooney, 2011), therefore, it may increase the likelihood of demonstrating suboptimal performance on CVTs.

Cognitive difficulties, such as memory, attention, and word finding impairment, are complaints common to PCS and the mTBI population. The SCZ-T (Thought Disorder) subscale reflects these problems when elevated. When there is an elevated SCZ-T subscale without an elevation on the SCZ clinical scale, this may suggest problems related to disorders like brain injuries (Morey, 2003).

The current study also examines the role of MEB/PEB status on the relationship between elevated PAI scales and suboptimal performance on cognitive validity indicators. Previous literature has demonstrated that mTBI individuals tend to perform worse on cognitive validity tests than more severe brain injured participants, regardless of whether they were compensation seeking (Binder, 1993). Based on this finding, it is possible that compensation seeking or

involvement in the MEB/PEB process could serve as a moderator in the relationship between elevated PAI scales and suboptimal performance on cognitive validity indicators.

Given the literature indicating that some cultures tend to express their emotional distress through physical complaints, the relationship between ethnicity and the main constructs of interest will also be examined in the present study. While there have been some mixed results, the majority of the literature has supported that African American and Hispanic individuals have shown higher rates of somatic complaints and somatization disorder diagnoses compared to Caucasians (Castro et al., 2008; Zhang & Snowden, 1999). This may be related to cultural and social differences between ethnic groups, specifically that Hispanics and African Americans may be more likely to experience and/or express depression in physical and possibly cognitive terms (Cuellar & Paniagua, 2000). In the current study, because the sample consists of mTBI patients who report physical and cognitive complaints, elevated scores on the SOM clinical scale and SOM-C (Conversion) subscale are expected to be seen across ethnic groups. However, because of the overarching trends seen in African American and Hispanic samples, there may still be differences found between ethnic groups on the SOM clinical scale and SOM-C subscale.

High rates of depressive symptoms have been found in mTBI populations across numerous studies. Some of the literature has found that Caucasians and Hispanics report higher rates of depressive symptoms or have higher rates of depression diagnoses when compared to African Americans in TBI and in non-TBI samples (e.g., Arango-Lasprilla, 2012; Dunlop et al., 2003). An elevation on the DEP-P indicates difficulties with sleep, energy level, and appetite (Morey, 2003). All of these complaints are commonly reported by those who have sustained a mTBI, as well as by those who experience PCS. In the current study it is expected that scores on

the DEP clinical scale and subscales will be significantly higher for Caucasian and Hispanic participants than for African American participants.

There is limited research on which to base a prediction about ethnic-related differences on the SCZ scale and its subscales, however the SCZ-T (Thought Disorder) subscale is important to examine, since elevations on this subscale, in the absence of an elevation on the SCZ clinical scale, can reflect sequelae (concentration and memory deficits) of a brain injury (Morey, 2003). In the Arango-Lasprilla (2012) study, which examined ethnic-related differences in post-concussive symptoms within a TBI sample, Hispanics reported significantly higher levels of memory and attention difficulties when compared to African Americans and Caucasians. There is no clear understanding of why ethnic differences in the report of cognitive symptoms exist following a TBI, however these differences could be related to how Hispanics express their emotional distress in physical or cognitive symptoms. In Hispanic cultures, an individual is considered strong if he or she is able to control oneself when dealing with a stressful time. Hispanics may be less likely to seek treatment or report emotional symptoms for fear of being perceived as weak (Romero, 2000). Perhaps this could account, in part, for the higher reported rate of memory and attention (rather than psychological symptoms) problems in Hispanics in the Arango-Lasprilla (2012) study. While Caucasians and African Americans have shown higher rates of Schizophrenia diagnoses (Arango-Lasprilla, 2012), the current study's prediction is made based upon which ethnic group has been shown to experience a higher rate of symptoms associated with elevations on the SCZ-T subscale. Endorsement of SCZ-T subscale items (e.g., "My thinking has become confused" and "My thoughts tend to quickly shift around to different things") indicates concentration and memory deficits and a decreased ability to think clearly (Morey, 1991).

Interestingly two studies that examined ethnic differences on MMPI-2 scale scores found that African Americans scored significantly higher than Caucasians on the BIZ content scale (Monnier et al., 2002; Munley et al., 2001). The difference found between ethnic groups on the BIZ scale may be related to experiences of discrimination and oppression suffered by African Americans. As a result, African Americans may be more skeptical and less likely to trust others. The PAR-P (Persecution) subscale on the PAI is thought to be similar to the BIZ scale from the MMPI-2, as they both measure persecutory type paranoia, therefore it might be expected that African Americans score significantly higher than Caucasians on the PAR-P subscale.

There have been no studies that the author is aware of involving TBI participants who are litigating and/or compensation seeking, which report ethnic differences on cognitive validity test and/or personality test performance. In fact, most of the literature, which examines test performance within a TBI and/or litigation compensation population, does not report the ethnic breakdown of their participants, as they do with other participant demographics (i.e., age, gender, education level, etc.). The current study will examine ethnic differences in the relationship between PAI scale/subscale elevations and suboptimal performance on cognitive validity indicators. Additionally, the current study will investigate the role of somatization in the relationship between ethnic minority status and suboptimal cognitive validity indicator performance. Individuals from ethnic groups that tend to experience distress through physical symptoms may be thought to be malingering on neuropsychological tests. Results from this investigation will provide objective test data that may reveal significant associations between the way one expresses distress on the PAI and performance on cognitive validity tests, as well as any ethnic differences in these associations.

Hypotheses

Hypothesis 1. It was predicted that significant associations would be found between elevations on certain PAI scales/subscales (e.g., Somatic Complaints [SOM] clinical scale, SOM-Conversion subscale, SOM-Health Concerns subscale, SOM-Somatization subscale, Anxiety-Related Disorders [ARD] Traumatic Stress subscale, Depression [DEP] clinical scale, DEP-Affective subscale, DEP-Cognitive subscale, DEP-Physiological subscale, and Schizophrenia [SCZ] Thought Disorder subscale) and suboptimal performance on cognitive validity indicators, coded as the number (0, 1, or 2) of failed CVTs (i.e., TOMM and RDS). Failure on CVTs was determined by a score that falls below the established cutoff scores for each of the CVTs. More specifically, it was hypothesized that the more elevated a participant's scores were on the scales mentioned above, the more likely they were to demonstrate suboptimal performance on cognitive validity indicators. Clinical PAI scales were included in the first analysis examining their association with performance on CVTs. For any PAI clinical scales found to be significantly correlated with performance on CVTs, a second analysis of each of their subscales were performed to test for significant relationships between subscales and CVT performance.
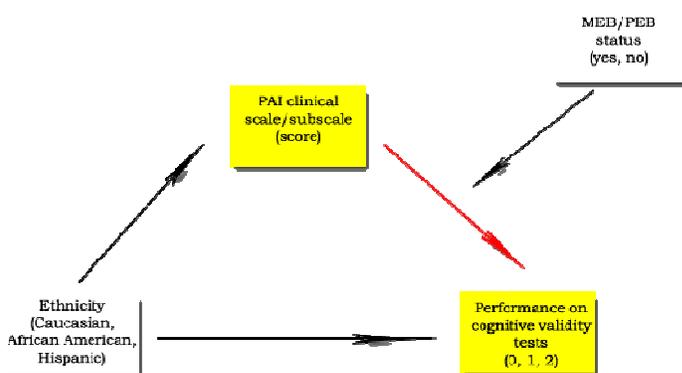

Figure 1. Hypothesis 1 is represented by the highlighted section of the model.

Hypothesis 2. Secondly, it was predicted that a status of Medical and/or Physical Board Evaluation would serve as a moderator in the relationship between scores on the predicted PAI scales and subscales and performance on cognitive validity indicators. Specifically, it was hypothesized that a status of MEB and/or PEB would increase the strength of PAI scale elevations' capacity to predict suboptimal performance on cognitive validity indicators. Clinical PAI scales were included in the first analysis examining their association MEB/PEB status. For any PAI clinical scales found to be significantly correlated with MEB/PEB status, a second set of analyses of each of their subscales were performed to test for significant relationships between subscales and MEB/PEB status.
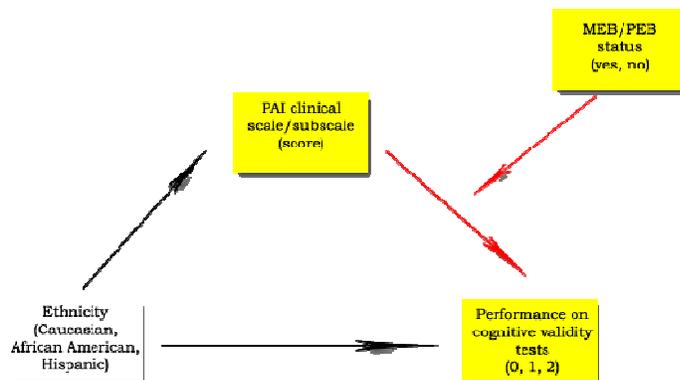

Figure 2. Hypothesis 2 is represented by the highlighted section of the model.

Hypothesis 3. The following predictions were made in regards to ethnic differences on the PAI. It was hypothesized that an ethnic status of African American or Hispanic would be significantly more positively correlated with scores on the SOM clinical scale and SOM-C subscale than an ethnic status of Caucasian. It was predicted that an ethnic status of Caucasian or Hispanic would be significantly more positively correlated with scores on the DEP clinical scale than an ethnic status of African American. It was predicted that an ethnic status of Hispanic would be significantly more positively correlated with scores on the SCZ-T subscale than an

ethnic status of Caucasian or African American. Additionally, it was hypothesized that an ethnic status of African American would be significantly more positively correlated with scores on the PAR-P subscale than an ethnic status of Caucasian. Clinical PAI scales were included in the first analysis examining their association ethnic status. For any PAI clinical scales found to be significantly correlated ethnic status, a second analysis of each of their subscales was performed to test for significant relationships between subscales and ethnic status. Ethnic status was coded using dummy variables. For example, when analyzing the first predicted difference in the association between ethnic status and PAI scores, African American/Hispanic was coded as 0 and Caucasian was coded as 1.
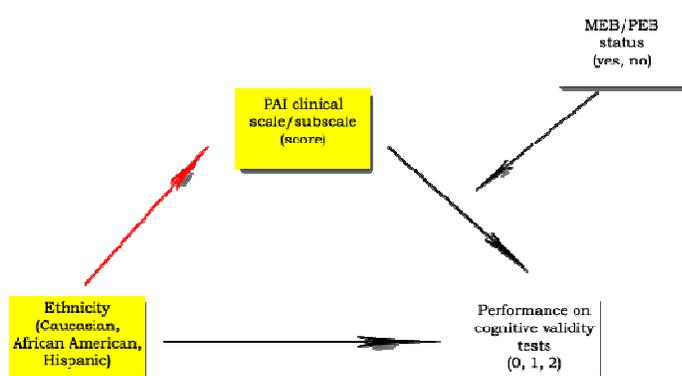
Figure 3. Hypothesis 3 is represented by the highlighted section of the model.

Hypothesis 4. It was predicted that an ethnic status of Hispanic or African American would demonstrate a significantly greater association with suboptimal performance on cognitive validity indicators than an ethnic status of Caucasian. Two separate analyses were performed in order to examine the differences in association between Hispanics and Caucasians on CVT performance and African Americans and Caucasians on CVT performance.
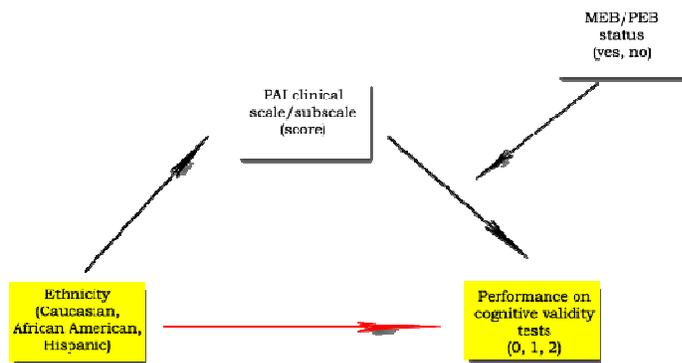
Figure 4. Hypothesis 4 is represented by the highlighted section of the model.

Hypothesis 5. It was hypothesized that somatic symptoms, as measured by the SOM

scale of the PAI, would partially mediate the relationship between ethnicity (Caucasian, African

American, or Hispanic) and suboptimal performance on cognitive validity indicators.

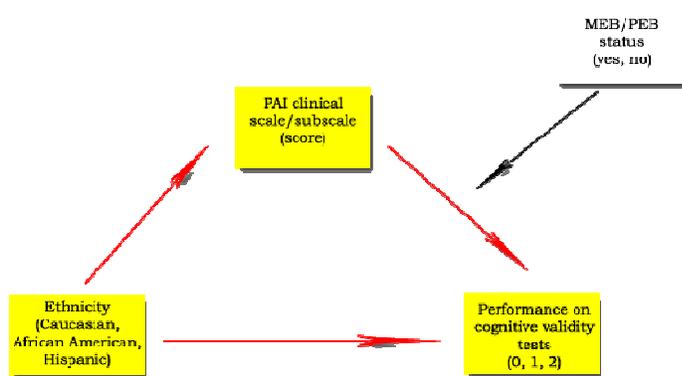*Figure 5.* Hypothesis 5 is represented by the highlighted section of the model.

Method

Participants

Participants were selected from a Neuropsychological Database consisting of data

collected during the neuropsychological evaluations in the TBI Clinic from October 2010 to

February 2012. The final sample (*N*=76) was comprised of male (*n*=70) and female (*n*=6), active

U.S. military personnel who were seen consecutively in the TBI Clinic of Dwight D. Eisenhower Medical Center in Fort Gordon, Georgia. Participants underwent neuropsychological evaluations at the TBI Clinic after experiencing physical, cognitive, or emotional complaints following a mTBI. Following their evaluations participants were referred to treatment that was deemed necessary/appropriate by the neuropsychologist and medical doctor.

Some participants were involved in the MEB/PEB process at the time of evaluation and were referred to the TBI Clinic to help the board determine whether they were fit to continue active duty. Only individuals in the database who were active duty, National Guard, or Reserves soldiers, and who had sustained a mTBI were included in the initial sample. Determination of TBI severity sustained by individuals in the database was made by the TBI clinic neuropsychologist by examining medical history and the duration of loss of consciousness reported by each individual. Any individuals, who reported history of a neuropsychological disorder, such as dementia or Parkinson's Disorder, or loss of consciousness that lasted longer than 30 minutes, were considered to either have a disorder that could confound results on cognitive validity tests or history of a TBI of greater than mild severity. Thus these individuals were excluded as participants for the present study.

After omitting six participants from the initial sample (*n*=82) who endorsed their ethnicity as something other than Caucasian, African American, or Hispanic, the subsequent sample of participants (*N*=76) was used in the current study's analyses. The final sample consisted of 92.1% males and 7.9% females ranging in age from 19 to 59 years (*M*=35.86, *SD*=9.33). In terms of ethnicity, 60.5% of participants identified themselves as Caucasian (*n*=46), 23.7% as African American (*n*=18), and 15.8% as Hispanic (*n*=12). Years of education achieved by participants ranged from 7 to 20 years (*M*=13.3, *SD*=2.36). The majority of

participants (84.2%) endorsed English as their primary language, while 5.3% reported that

English was not their primary language. Information about participants' primary language was

not available for 10.5%. Participants were enlisted in the United States Army (97.4%), Navy

(1.3%), and Air Force (1.3%). The majority of participants (80.3%) had a status of active duty

during the time of their evaluation at the TBI clinic, while the remaining participants were

members of the National Guard (13.1%) or Reserves (5.2%). The number of deployments

reported by participants ranged from 0-16 (*M*=2.55, *SD*=1.95). Of the participants who reported

the location(s) of their past deployment(s), 83% reported deploying to Iraq, Afghanistan, or both.

At the time of evaluation participants indicated whether or not they were previously or currently

involved in a military disability evaluation. If they endorsed being currently involved, they

indicated whether they were at the MEB phase or the PEB phase in the evaluation process.

Almost half (45.7%) of the participants who endorsed their military disability evaluation status

reported that they were currently involved in the MEB process. Only 6.3% of those who reported

their Physical Evaluation Board (PEB) status reported that they were currently involved in the

PEB process.

Measures

   Personality Assessment Inventory (PAI; Morey, 1991). Participants completed the PAI

as part of a battery of neuropsychological assessments during their evaluation at the TBI Clinic

at Dwight D. Eisenhower Medical Center. The PAI is a 344-item self-report inventory of

psychopathological symptoms (e.g., depression, anxiety, and aggression) for adults. The PAI

profile provides validity indices, clinical scales, and clinical subscales. Respondents rate each

item on a 4-point scale from False to Very True. *T* scores equal to or greater than 70 suggest

significant symptoms, while scores between 60 and 69 reflect moderate elevations (Morey,

1991). Boyle and Lennon (1994) and Rogers, Flores, et al. (1995) examined the psychometric properties of the PAI validity and clinical scales. Their results combined with the results from the standardization samples indicate that the PAI validity and clinical scales demonstrate good test-retest reliability (.73 to .82). The PAI validity and clinical scales exhibit adequate internal consistency reliability (.70 to .80) as well (Morey, 1991).

The majority of the PAI clinical scales have been found to have adequate construct validity, as they were significantly correlated with two or more life event variables, or criterion variables (Slavin-Mulford et al., 2012). While Slavin-Mulford and colleagues (2012) did not find adequate construct validity for the MAN scale, ANX scale, and ANX subscales, other studies reported that these scales did demonstrate adequate construct validity (Arbisi, Sellbom & Ben-Porath, 2008; Ruiz & Edens, 2008). Slavin-Mulford et al. (2012) suggest that the difference in findings is likely due to the use of different significance thresholds across studies. Data obtained from PAI standardization samples indicate that the PAI also exhibits discriminatory and convergent validity (Morey, 1991).

The following clinical scales and subscales of the PAI are included in the current study's predictions: Somatic Complaints [SOM] clinical scale, SOM-Conversion subscale, SOM-Health Concerns subscale, SOM-Somatization subscale, Anxiety-Related Disorders [ARD] Traumatic Stress subscale, Depression [DEP] clinical scale, DEP-Affective subscale, DEP-Cognitive subscale, DEP-Physiological subscale, Schizophrenia [SCZ] Thought Disorder subscale, and Paranoia Persecution (PAR-P) subscale (See Appendix A for full PAI scale/subscale names).

The SOM clinical scale is comprised of items that reflect concerns about physical health and functioning. Elevated scores on the SOM clinical scale ($t > 70$) suggests that the individual believes he or she is in poor health and is focused on his or her physical symptoms. The SOM-C

subscale is comprised of items that reflect symptoms of conversion disorders (i.e., impairments in vision or hearing, numbness, motor problems like paralysis). The SOM-S subscale is comprised of items that reflect common physical complaints (i.e., headaches and back pain) and one's discontent with these physical complaints. Items comprising the SOM-H subscale indicate a preoccupation with one's own health and level of functioning. The SOM-H subscale is a measure of concern about rather than a measure of severity of one's symptoms (Morey, 2003).

The ARD-T subscale reflects common experiences following a traumatic event (i.e., nightmares and feelings of being forever affected by the traumatic event). Elevated scores in the ARD-T subscale indicate distress and anxiety associated with the traumatic event(s).

The DEP clinical scale score represents a broad range of depressive symptomatology, including cognitive, affective, and physiological symptoms. The DEP-C subscale reflects beliefs about one's own inadequacy and feelings of worthlessness and hopelessness. The DEP-C subscale is also comprised of items that reflect difficulty concentrating and making decisions. The DEP-A subscale indicates the affective aspect of depression, including feelings of sadness and a loss of interest or pleasure in things one once enjoyed. Physiological symptoms of depression are reflected in the items from the DEP-P subscale. These items indicate symptoms such as decreased energy, sleep difficulty, and changes in appetite (Morey, 2003).

Elevations on the SCZ-T subscale reflect confusion, difficulties with thought clarity and decision-making. Elevated scores on the SCZ-T subscale are not exclusively seen in schizophrenia populations, but also in depressed, manic, substance abusing, and brain injured populations.

Lastly, the PAR-P subscale reflects beliefs that one is being treated unfairly or that others are attempting to challenge or work against him/her. Elevated scores on this subscale may indicate delusional beliefs and/or strained social relationships (Morey, 2003).

Cognitive validity tests. For the study's statistical analyses, performance on cognitive validity tests was coded as the number of tests failed (0, 1, or 2). It is the standard operating procedure in a neuropsychological clinic to administer two or more cognitive symptom validity test procedures (S. Mooney, personal communication, April 29, 2013). Generally each of these CVTs assesses different areas of cognition, such as memory and attention. The likelihood of failing two or more CVTs is very low, therefore when an individual fails two or more they are deemed as having demonstrated poor effort and the neuropsychological evaluation is discontinued. Variable effort is demonstrated when an examinee performs suboptimally, or below an established cutoff score, on just one CVT. When an examinee passes all CVTs administered to them their performance is determined to be adequate. While variable effort could be attributed to a number of possible factors, failure of two or more CVTs indicates a higher likelihood that the examinee is malingering (S. Mooney, personal communication, April 29, 2013).

Test of Memory Malingering (TOMM; Tombaugh, 1996). The TOMM is a 50-item visual recognition measure constructed to assist in discriminating between memory malingering and genuine memory impairments. The TOMM was standardized with individuals over the age of 16. It is comprised of two learning trials and one optional Retention Trial. The TOMM demonstrated good specificity and sensitivity (greater than 90%) within community, clinical, and "at-risk for malingering" individuals included in TOMM validation studies (Tombaugh, 1996). The TOMM has good internal consistency reliability (Trial 1= .94; Trial 2= .95; Retention Trial=

.94), and good convergent validity with the Forced Choice Recognition task, another measure

that assesses cognitive performance (Tombaugh, 1996; Moore & Donders, 2004). In the current

study, utilized cutoff scores were as published in the TOMM manual and peer reviews.

Reliable Digit Span (RDS; Wechsler, 1981). Reliable Digit Span (RDS) is a symptom

validity test that originated from the Digit Span subtest of the Wechsler Adult Intelligence Scale-

Revised. The RDS is used to discriminate individuals demonstrating credible performance from

those who are putting forth questionable effort (Schroeder, Twumasi-Ankrah, Baade & Marshall,

2012). The RDS requires participants to repeat increasingly long strings of numbers. After being

asked to repeat the strings of numbers in the same order as the administrator (forward span),

participants are then asked to repeat increasingly long strings of numbers in reverse order

(backward span). According to a meta-analysis by Schroeder and colleagues (2012), the

established cutoff score used in the current study demonstrated a mean sensitivity rate of 72%

and mean specificity rate of 81%.

Results

Statistical Plan

The predictions made in the current study assume a moderated mediational relationship

involving all of the factors examined (i.e., PAI clinical scale/subscale scores, performance on

CVTs, Ethnicity, and MEB/PEB status). A moderated mediational model is one in which the

indirect effect of the independent variable (X) on the dependent variable (Y) by way of a

mediator variable (M) is dependent upon the value of a moderator variable (W). Figure 1 shows

a conceptual model of a moderated mediational relationship involving the factors examined in

the current study. Each of the current study's hypotheses is an aspect of this model. To test for

this relationship statistically, a computational method called PROCESS was implemented using

SPSS. This procedure is able to estimate coefficients of a model utilizing a bootstrap approach

and linear or logistic regression, as well as generate direct and conditional indirect effects for

moderated mediation models. PROCESS can examine individual interactions and estimate

multiple mediators and/or moderators of the interactions. PROCESS has an advantage over the

popular causal steps approach in that PROCESS allows for the use of non-normal data (Hayes,

2012).

Each prediction in the current study, with the exception of Hypothesis 1, was analyzed

using the PROCESS method in SPSS. PAI validity scale scores were included as covariates in all

analyses using PROCESS. Analyses examining PAI clinical scales and clinical subscales were

run separately in order to minimize the issue of multicollinearity.
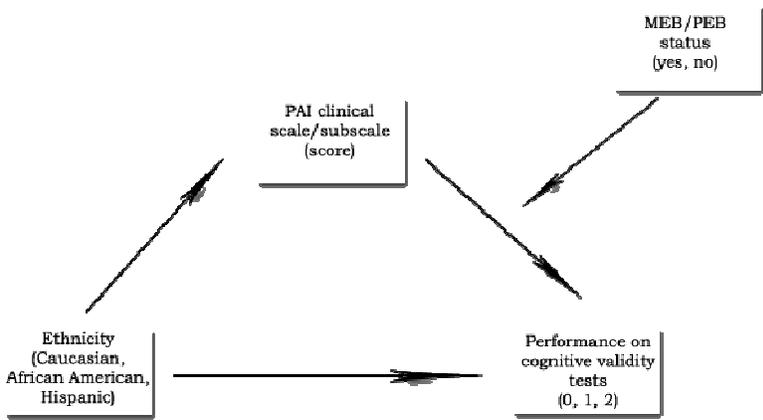

Figure 6. A moderated mediation model with ethnicity as the independent variable (X),

performance on cognitive validity tests as the dependent variable (Y), PAI scores (specifically on

the SOM clinical scale) as the mediator (M) through which X effects Y, and MEB/PEB status as

the moderator (W) to the interaction between M and Y.

Data Analysis

Data was analyzed using IBM's Statistical Package for the Social Sciences (SPSS), version 20, and PROCESS (Hayes, 2013). Significance was set at an alpha level of .05. The skewness and kurtosis of all variables involved in the hypothesized models were examined in order to identify outliers in the data. Distributions of each variable's data found to have skewness and kurtosis ratios above 1.96 were determined to be significantly skewed or leptokurtic/platykurtic (Field, 2009). Distributions of the PAI scales and subscales that showed significant skewness or kurtosis were examined in the form of boxplots in order to identify outliers (data points which fell more than 1.5 box lengths beyond the upper or lower hinges). All scores that were deemed outliers were changed to equal +/- 3 standard deviations from the mean (Field, 2009). The independent variable of ethnicity was dummy coded in each analysis (e.g., 0 for Caucasian and 1 for African American). The Personality Assessment Inventory (Morey, 1991) scores were included in analyses as interval data. Participants who endorsed current involvement or previous involvement in a medical or physical board evaluation were combined because previous involvement in the military disability evaluation process (MEB) requires follow-up evaluations to determine if a soldier still meets criteria for limited duty (PEB). Therefore, the MEB/PEB status variable used in analyses is dichotomous; either participants were or had been involved in the MEB/PEB processes (52%) or they had no history of being involved in this processes (48%).

The number of participants included in analyses addressing each hypothesis varied, as various data points were missing for some cases. PROCESS (Hayes, 2013) utilizes listwise deletion, while pairwise deletion was utilized in correlational analyses.

Examination of Hypothesis 1. Spearman's correlation coefficients were calculated in SPSS in order to test each of the current study's predictions that elevated scores on particular PAI (Morey, 1991) scales (i.e., Somatic Complaints [SOM] clinical scale, SOM-Conversion subscale, SOM-Health Concerns subscale, SOM-Somatization subscale, Anxiety-Related Disorders [ARD] Traumatic Stress subscale, Depression [DEP] clinical scale, DEP-Affective subscale, DEP-Cognitive subscale, DEP-Physiological subscale, and Schizophrenia [SCZ] Thought Disorder subscale) would be significantly associated with the number of CVTs failed. Table 1 shows that each of the predictions was supported with the exception of the hypothesis that SOM-H scores would be significantly associated with the number of CVTs failed.

Examination of Hypothesis 2. It was predicted that involvement in the medical/physical evaluation board (MEB/PEB) process would increase the strength of particular PAI scales' ability to predict suboptimal effort on CVTs. A test of simple moderation (model 1) using PROCESS was performed for each of the following PAI scales: SOM, ARD-T, DEP, and SCZ-T. Bias-corrected confidence intervals for each of the analyses were based on 5,000 bootstrap samples. The number of participants included in each of these analyses was 67.

The prediction that MEB/PEB status would moderate the associations between the SOM, ARD-T, DEP, and SCZ-T clinical scales/subscales on the PAI and performance on CVTs was not supported. The regression coefficients for the interaction effects of SOM ($b = -.02$, $p = .196$), ARD-T ($b = -.01$, $p = .53$), DEP ($b = .003$, $p = .84$), and SCZ-T ($b = -.01$, $p = .26$) clinical scale scores and MEB/PEB status on CVT performance were not significantly different from zero. These results indicate that the relationships between the SOM, ARD-T, DEP, and SCZ-T scores and CVT performance do not depend on MEB/PEB status, thereby not supporting Hypothesis 2.

Examination of Hypothesis 3. The current study made nine predictions regarding differences between Caucasian, African American, and Hispanic participants on PAI scale scores. A moderated mediational PROCESS (Hayes, 2013) analysis was utilized to examine each of the predictions under Hypothesis 3. For each prediction, two groups were compared (e.g., for the first prediction, African Americans and Hispanics vs. Caucasians).

It was predicted that African American and Hispanic participants would score significantly higher on the SOM clinical scale and SOM-C subscale than Caucasian participants. It was predicted that Caucasian and Hispanic participants would score significantly higher on the DEP clinical scale than African American participants. It was hypothesized that Hispanic participants would score significantly higher on the SCZ-T subscale than Caucasian or African American participants. Lastly, it was expected that African American participants would score significantly higher on the PAR-P subscale than Caucasian participants. For each of the predicted differences between ethnic groups on PAI scales, p-values were greater than .05, indicating that none of the examined differences were statistically significant and thus that Hypothesis 3 was not supported. Table 2 shows the results for each prediction regarding ethnic group differences on PAI scales/subscales.

Examination of Hypothesis 4. It was predicted that an ethnic status of African American and Hispanic would have a stronger association with suboptimal performance on CVTs than an ethnic status of Caucasian. Results for these two predictions were taken from the simple mediation analyses utilized to test hypothesis 5 using PROCESS (Model 4; Hayes, 2013). Dummy variables were created for ethnicity, because PROCESS can only test mediation models with a dichotomous categorical X variable. A significant direct effect ($b = .44$, $p = .04$) was found between ethnicity of the participant and CVT performance when Caucasian (X=0) and

African American (X=1) participants were included in the analysis. Specifically, these results indicate that African American participants failed more CVTs than Caucasian participants, which support the current study's prediction. A significant association was not found between CVT performance and ethnicity when comparing Hispanics and Caucasians ($b = .05$, $p = .85$). Table 3 shows the number of CVTs failed by ethnicity.

        Examination of Hypothesis 5. It was predicted that somatic complaints, as reflected in the SOM clinical scale score, would mediate the relationship between ethnicity and suboptimal performance on CVTs. Simple mediation analyses were run using PROCESS (Model 4; Hayes, 2013). Dummy variables were created for ethnicity. The results of these two analyses (i.e., Caucasian vs. African American and Caucasian vs. Hispanic) did not support the current study's prediction. When Caucasian (X=0) and African American (X=1) participants were included in the first mediation analysis ($n = 63$), the indirect effect of ethnicity on CVT performance through the SOM score revealed a non-significant bootstrap confidence interval of -.133 to .188. The second mediation analysis ($n = 55$) including Caucasian (X=0) and Hispanic (X=1) participants also resulted in a non-significant bootstrap confidence interval of -.338 to .236, meaning that there was no evidence that the SOM score mediated the relationship between ethnic status and performance on CVTs.

        Examination of the entire model. A significant conditional indirect effect of ethnicity on CVT performance through PAI scores was predicted to be found in participants involved in the MEB/PEB process. Specifically, it was expected that compared to Caucasian participants, African American and Hispanic participants involved in MEB/PEB would fail significantly more CVTs as mediated by scores on the SOM PAI scale. When Caucasian and Hispanic participants were included in the PROCESS analysis, the bootstrap confidence interval [.004 to .244] for the

conditional indirect effect was entirely above zero in those who had a status of MEB/PEB involvement. This result provides support for the predicted indirect effect when MEB/PEB=1.

In order to better understand the meaning of this finding, a moderational analysis (from Hypothesis 2) including only Caucasian participants (n=44) was run using PROCESS. The regression coefficient for the interaction effect of SOM (b = -.04, p = .01) clinical scale scores and MEB/PEB status on CVT performance were found to be significantly different from zero. This result indicates that the relationship between the SOM scores and CVT performance does depend on MEB/PEB status. The bootstrap confidence interval [.025 to .072] for the conditional effect of SOM scores on number of CVTs failed was entirely above zero in Caucasians who were not involved in the MEB/PEB process. These findings indicate that as SOM scores increase, the number of CVTs failed decreases for Caucasians not involved in the MEB/PEB process which was not consistent with what was predicted. A moderational analysis could not be run with only Hispanic participants included, most likely due to the small number of Hispanic participants.

Discussion

Postconcussive symptoms following mild TBIs have become a greater focus in neuropsychological and other medical settings, as well as in research, since the start of Operation Enduring Freedom and Operation Iraqi Freedom/Operation New Dawn (Rigg & Mooney, 2011). The factors that have been posited to maintain these postconcussive symptoms beyond 3 months, the time-frame during which they typically resolve, have been examined in a number of studies. Results have been mixed across studies with some finding that depressive, negativistic, dependent, and anxious personality traits are associated with the prolonged report of postconcussive symptoms (Garden, Sullivan & Lange, 2010; Iverson & Lange, 2003) and others supporting that posttraumatic stress, chronic pain issues, and sleep problems serve to maintain

symptoms of PCS (Rigg & Mooney, 2011; Schneiderman, Braver & Hang, 2008). The purpose

of the current study was to examine factors predicted to be associated with patients' report of

postconcussive symptoms among military personnel being evaluated for cognitive disorders after

sustaining a mild TBI given the high stakes for both the government and military personnel

reporting cognitive problems following these experiences. Results can be used to add to

clinicians' understanding of factors that may be contributing to the continued report of

postconcussive symptoms following the typical recovery period and/or affect performance on

neuropsychological testing.

PAI Scale/Subscale Relationship to CVT Performance

It was predicted that higher scores on specific PAI scales (i.e., SOM, SOM-C, SOM-H, SOM-S,

DEP, DEP-A, DEP-C, DEP-P, ARD-T, and SCZ-T) would be significantly related to a greater

number of failed CVTs. Each of these predictions was supported by results from Spearman's

correlation tests with the exception of the non-significant relationship found between the SOM-H

subscale and CVT performance.

The significant results are consistent with Whiteside's (2010) study, which found a

significant relationship between high scores on the SOM clinical scale and SOM-C subscale and

performance on trial 2 of the TOMM. Whiteside (2010) also found relationships trending toward

significance between scores on the DEP and SCZ clinical scales and performance on trial 2 of

the TOMM. Results from Hypothesis 1 are also consistent with those from previous studies that

found significant associations between elevated scores on the Hypochondriasis, Hysteria, and

Depression scales on the MMPI-2 and suboptimal performance on cognitive validity testing

(Boone & Lu, 1999; Butcher & Williams, 1996; Larrabee, 1998; Smart et al., 2008; Thomas &

Youngjohn, 2009). Stulemeijer and colleagues (2007), who utilized multiple measures of distress

and personality (e.g., the SCL-90 Anxiety Subscale, the Eyseneck Personality Questionnaire, etc.), found more severe depressive and post-traumatic stress symptoms in mTBI patients who demonstrated suboptimal performance on CVTs as compared to mTBI patients who demonstrated adequate performance.

A potential reason for the association found between psychiatric symptomotology and suboptimal performance on CVTs is that participants may have been intentionally feigning symptoms for secondary gain. Another explanation is that participants were experiencing elevated levels of distress (specifically in the form of somatic, depressive, and/or anxiety symptoms) and in an attempt to call attention to their need for help they intentionally performed sub-optimally on CVTs.

A possible explanation for the non-significant relationship found between the SOM-H subscale and CVT performance is related to items within the subscale and what they assess. The SOM-H subscale is a measure of one's focus on or concern for their health issues. One could perform below the established cutoff scores on CVTs for a number of potential reasons, including malingering or putting forth inadequate effort for secondary gain. In these cases it is plausible to argue that the test-taker may not be very concerned with their symptoms and is likely more concerned with obtaining compensation or some other form of secondary gain. The significant associations found between the other SOM subscales, which gauge symptoms of physical and cognitive impairments, and CVT performance may be because those who fail more CVTs are reporting more symptoms; however, they may not actually be more concerned about their symptoms than those who fail fewer CVTs.

Effect of MEB/PEB Involvement on the Relationship Between the PAI and CVTs

It was predicted that a significantly stronger association would be found between particular PAI clinical scales/subscales (SOM, SOM-C, SOM-H, SOM-S, DEP, DEP-A, DEP-C, DEP-P, ARD-T, and SCZ-T) and performance on CVTs among participants who had a history of review by the Medical or Physical Evaluation Board. In other words, it was predicted that involvement in MEB/PEB would serve as a moderator and strengthen the ability of particular PAI scales/subscales to predict performance on CVTs. Results from a PROCESS simple moderation analysis did not support any of the current study's predictions from Hypothesis 2.

Studies which have examined the effect of psychopathological symptoms on CVT performance have had mixed findings. Other factors, such as litigation status, normal aging, premorbid emotional difficulties, or previous concussions may be involved in the different findings across studies. The current study aimed to examine how one potential factor (i.e., compensation seeking or MEB/PEB status) influences this relationship. While there has been evidence to support the influence of compensation seeking status on symptom reporting, the current study did not find that compensation seeking was a moderating factor in the relationship between symptom endorsement on the PAI and CVT performance. A study by Ross (2006) found that depression, general fearfulness of situations commonly associated with phobias (as measured by the MMPI-2), and incomplete effort (as defined by Recognition Memory Test scores falling below established cutoffs) were the best predictors of poor neuropsychological test performance. It was not found that compensation seeking significantly predicted neuropsychological performance and in fact, of the 74.8% of the sample who were litigating during the time of evaluation only 20% demonstrated incomplete effort. This was approximately the same percentage of non-litigating participants who showed incomplete effort (18%) and

suggests that litigating or compensation seeking itself does not make it more likely that one will perform suboptimally on neuropsychological tests. Table 3 shows number of CVTs failed across MEB/PEB statuses in the current sample.

Aside from psychopathological features that have been shown to be significantly related to performance on CVTs, such as somatization and depression, there may be other factors which moderate the association between the PAI and CVT performance in the current study. Since previous research has found that normal aging and education level influences neuropsychological test performance (Dikmen, Machamer & Temkin, 2001; Heaton, Ryan, Grant & Matthews, 1996; Sherrill-Pattison, Donders & Thompson, 2000), post-hoc analyses in the current study were conducted using separate moderation PROCESS analyses for age and education (in place of MEB/PEB) to test whether they moderated any of the predicted relationships between PAI scales and CVT performance. Three levels of the moderator 'age' were used in the analysis (i.e., the mean age of participants, minus one standard deviation from the mean, and plus one standard deviation from the mean). The same was done when 'education' was included as the moderator (i.e., the mean education level in years of participants, minus one standard deviation from the mean, and plus one standard deviation from the mean). Age and education did not show significant conditional effects on the relationships between PAI scales and CVT performance, nor did they have any significant direct effect on CVT performance in the current study.

Another possible explanation for the association between the PAI and CVT performance is that participants may be engaging in a cry for help. In other words, individuals perform on CVTs in such a way that supports the symptoms/experiences they endorsed on the PAI. . This may have been the case for participants in the current study who were undergoing a

neuropsychological evaluation in order to seek treatment for their symptoms and not for the MEB/PEB process.

Ethnic Differences on PAI Scores

Predictions were made about ethnic differences in scores on particular PAI scales and subscales based on previous research that has found cultural differences in how psychopathology is experienced and expressed. None of the predictions related to ethnicity and PAI scores were supported in the current study. It was hypothesized that African American and Hispanic participants would score significantly higher on the SOM clinical scale and SOM-C subscale than Caucasian participants. Caucasian and Hispanic participants were expected to score significantly higher on the DEP clinical scale than African American participants. It was also predicted that Hispanic participants would score significantly higher on the SCZ-T subscale than Caucasian or African American participants. Lastly, it was hypothesized that African American participants would score significantly higher on the PAR-P subscale than Caucasian participants.

Previous research examining ethnic differences on measures of psychopathology has resulted in mixed findings. Methodological differences may have contributed to the differences in findings across previous studies. A study by Dunlop (2003) examined prevalence rates of depression in a mixed ethnic sample and the findings supported the current study's hypothesis regarding ethnic differences on the DEP scale. Researchers found that when participants were matched on sociodemographic, health, and economic factors, depression rates were significantly higher in Caucasian and Hispanic participants than in African American participants. Participants in the current study were not matched on the same factors as participants were in the Dunlop (2003) study, therefore the opposing results may be partially explained by this. Also, the sample in the Dunlop (2003) study was comprised of older civilian adults (mean age of 59 years).

Methodological differences are also seen between the Seel (2003) and Arango-Lasprilla (2012) studies which examined ethnic differences in depressive symptoms. Seel et al. (2003) found that African Americans were significantly more likely to report symptoms of depression than Caucasians on the Neurobehavioral Functioning Inventory (NFI), while Arango-Lasprilla and colleagues (2012) found no significant difference between Caucasians and African Americans on NFI depression scores. These two studies operationally defined depression differently, even though they both utilized items from the NFI. Arango-Lasprilla (2012) utilized the score on the Depression subscale of the NFI, whereas Seel (2003) grouped NFI items together and organized them into 3 major categories (mood, somatic, and cognitive). Items were then categorized as clinically problematic or clinically non-problematic based on a 5-point rating scale. Additionally, the time depressive symptoms were measured from when the TBI occurred differed between the two studies (1 year post-TBI [Arango-Lasprilla, 2012] and 3 years post-TBI [Seel, 2003]).

In addition, the inconsistent findings could be due to the makeup of the samples, as well as the measures used in the studies. It remains unclear how well some measures differentiate individuals who are malingering from those who are not across ethnic groups. Many of the popularly used CVTs have been validated with a primarily Caucasian normative sample. A cross-validation study by Schroeder and colleagues (2012) found that specificity rates were poorer (below 90%) on the Reliable Digit Span for Hispanic individuals and participants whose 2nd language was English. Brickman and colleagues (2006) point out that ethnicity itself does not cause variability in CVT scores, but are markers for contributing variables such as quality of education and acculturation. Many studies comparing the MMPI-2 results between ethnic groups have found differences; however, in most studies civilian populations were used and the level of

acculturation of participants was not reported. Considering that U.S. military personnel are required to be proficient in English, as assessed by an entrance exam when enlisting in the military, it can be presumed that the sample was relatively accultured to American society. Only 5% of the sample in this study reported English as their 2nd language. This is a small proportion compared to the percentage (approximately 26%) of the U.S. population whose primary language is something other than English (United States Census Bureau, 2013). The homogeneity of the current study's sample in terms of acculturation and language spoken could account for the non-significant differences found between ethnic groups on the PAI.

Unlike the MMPI-2, no studies using the PAI as a measure of psychopathology have addressed ethnicity differences across clinical scales. MMPI-2 studies that utilized military/veteran samples found that Caucasian and African American participants did not significantly differ in their reported symptoms (Frueh et al., 1997; Monnier et al., 2002; Munley et al., 2001). The non-significant differences on the PAI found between ethnic groups in a military sample could be attributed to a characteristic of the military culture; reluctance to report or minimization of one's symptoms (Rigg & Mooney, 2011). Supporting the idea that military samples may report less symptoms than non-military mTBI samples are results from a study by Kurtz and colleagues (2007). Average scores on the SOM and DEP scales for civilian participants from the Kurtz (2007) study were higher than the average scores of the military participants in the current study. Also, participants in previous studies, which found no significant difference in reported symptoms on the MMPI-2 between ethnic groups, were combat veterans who were seeking treatment for combat related trauma and not necessarily a head injury. It is possible that ethnic group differences in psychological symptom reporting might be more pronounced in military samples with histories of mTBI; however, future research is needed

to examine this possibility and should include ethnic group comparisons on PAI scales in

military samples with histories of mTBIs. It is possible that the PAI is better at measuring

pathology across ethnicities than the MMPI-2, which could explain the lack of ethnic differences

found on PAI scores in the current study. Items for the PAI were constructed in a way so that

they are free from cultural expressions or references that might limit the cross-cultural validity of

the test (Hersen, 2004).

Ethnic Differences in CVT Performance

It was hypothesized that there would be an association between ethnicity and CVT

performance in that Hispanics and African Americans would fail significantly more CVTs than

Caucasians. This prediction was partially supported by results from a correlational analysis using

PROCESS that demonstrated that African American participants in the current sample performed

suboptimally on a significantly greater number of CVTs than did Caucasian participants. In the

current study, there was no significant difference found on the SOM or SOM-C scales between

Caucasian and African American participants. A number of studies have found that Caucasians

and African Americans differ on their neuropsychological test performance, but researchers have

struggled to uncover variables that explain these differences. Factors that have been examined in

relation to ethnic differences on cognitive test performance are years of education, early

environmental histories, age, and gender (Byrd et al., 2006; Norman et al., 2011). To the writer's

knowledge no variables have been found to account for a significant portion of the CVT

performance variance between ethnic groups.

A significant association was not found between ethnicity and CVT performance when

Caucasian and Hispanic participants were included in the analysis. The small number of

Hispanic ($n=12$) participants in the sample compared to the number of Caucasian ($n=46$) participants may have resulted in a Type II error.

Relationship Between Ethnicity and CVT Performance Mediated by Somatic Complaints

It was predicted that somatic complaints, as indicated by the SOM clinical scale on the PAI, would mediate the relationship between ethnicity and CVT performance. Results of the simple mediation analyses using PROCESS showed no significant indirect effects of SOM clinical scale scores on the relationship between ethnicity and CVT performance. While the SOM clinical scale and CVT performance were found to be significantly associated and while African Americans were found to perform suboptimally on a significantly greater number of CVTs as compared to Caucasians, the current study's data does not support SOM as a mediator to the relationship between ethnicity and CVT performance. As mentioned in the discussion of hypothesis 4, other variables have been examined as possible mediators to the relationship between ethnicity and CVT performance, but to the author's knowledge no significant results were found. Researchers have proposed that substance abuse may play a role in suboptimal CVT performance in mTBI populations as it has been found that individuals with history of mTBI are at a higher risk of developing addiction-related disorders than individuals who have not sustained a mTBI. Substance abuse has been shown to impact one's levels of motivation, anxiety, and alertness, which could thereby influence one's CVT scores. Substance Abuse was not a variable accounted for in the current study, however because military members are at a higher risk for substance abuse following a TBI, this could have influenced performance on CVTs in the current study (Dunn et al. 1995; Miller et al., 2013). If the severity of substance abuse was different between Caucasians and African Americans, this could possibly account for, at least partially, the significant difference in CVT performance.

Whole Model Involving Relationships Between PAI Scores, CVT Performance, MEB/PEB Status, and Ethnicity

It was predicted that a significant conditional indirect effect of ethnicity on CVT performance through PAI scores would be found in participants involved in the MEB/PEB process. Specifically, it was expected that compared to Caucasian participants, African American and Hispanic participants involved in MEB/PEB would fail significantly more CVTs as mediated by scores on the SOM scale. While the predicted difference between Caucasian and African American participants was not found, the predicted difference between Caucasian and Hispanic participants was. In an attempt to better understand the findings from this moderated meditational analysis, a moderational analysis including only Caucasian participants was conducted. The analysis showed that SOM scores and the number of CVTs failed were more strongly positively correlated when Caucasian participants were not involved in the MEB/PEB process (MEB/PEB=0) as compared to when they were. When this same moderational analysis was run including participants of all ethnicities, the strength of the relationship between SOM scores and CVT performance did not depend on MEB/PEB involvement. It is clear that there are different relationships between the factors examined in the current study (PAI scores, number of CVTs failed, and MEB/PEB involvement) depending on ethnicity, however explanations for why these differences exist is not so clear.

Limitations & Future Directions

A number of limitations of the current study should be taken into account when considering the present findings. First, the demographic makeup of the sample does not represent the general population of the military. According to Defense Manpower Research (2013), active duty U.S. military has a larger Caucasian population (74.6%), as well as a much larger

proportion of females (29.3%) compared to the current study's sample. Results of the study may not apply to females given the small number of female participants in the sample. The sample was comprised largely of Caucasian participants (60.5%) and so few Hispanic participants (15.8%; however, fewer Hispanic participants were included in statistical analyses due to listwise deletion) that analyses including these participants (all were not significant) may be the result of Type II error. Due to the nature of the study and its use of a pre-existing data set that was comprised of individuals seeking an evaluation for post-concussive complaints, the author had no control over the variability of demographic characteristics in the final sample. Also, since the current study utilized archival data taken from an active neuropsychological testing site, not everyone in the original sample received administration of the exact same battery of tests. The final sample size was affected by exclusion of a number of participants who did not meet inclusion criteria for the study.

Another limitation to the current study is that TBI severity of the participants in the original database was determined using a limited amount of information accessible to the researcher. Therefore, it is possible that the final sample included participants with a greater than mild severity TBI. While this is a possibility, multiple indicators (i.e., medical history and history of loss of consciousness) were utilized to exclude participants with moderate to severe TBIs or any other brain dysfunctions.

Little is known about ethnic differences on the PAI and whether these differences are as prevalent within the military population as they are in the general population. The sample utilized in the current study was too limited in demographic makeup to adequately address this issue. Future studies should examine this matter in a much more demographically diverse military sample. While results from the current study suggest that African Americans are more

likely than Caucasians to perform suboptimally on CVTs, the current study was unable to identify factors that influence this relationship. Future studies should examine other potential variables that could account for this ethnicity difference in CVT performance. Also, future researchers examining factors related to CVT performance should control for presence of substance abuse. Substance abuse has been noted to negatively influence cognitive validity performance (Dunn et al., 1995). Substance abuse, particularly of alcohol and prescription pain medications, is prevalent in military members with a history of deployment and higher in soldiers who have been exposed to combat (National Institute on Drug Abuse, 2013). Increased risk of substance abuse and developing substance dependence has also been observed during the first 30 days following a mild TBI (Miller et al., 2013). As there is a high incidence of substance abuse within these sub-populations, this variable should be considered in future studies examining CVT performance.

Future research should examine the variables focused upon in the current study within a new model. The current study found a significant correlation between SOM scores on the PAI and the number of CVTs failed; however, the strength of this relationship appeared to depend on the ethnicity of the participant. A new model where ethnicity is the moderator between SOM scores and number of CVTs failed should be examined. Substance Abuse could also be included in the model as a second moderator, making it a multiple moderation model.

References

Alexander, M.P. (1992). Neuropsychiatric correlates of persistent postconcussive syndrome. *Journal of Head Trauma Rehabilitation*, *7* (2), 60-69. doi: 10.1097/00001199-199206000-00009

Alfano, D.P., Neilson, P.M., Paniak, C.E., & Finlayson, M.A.J. (1992). The MMPI and closed head injury. *The Clinical Neuropsychologist*, *6* (2), 134-142. doi: 10.1080/13854049208401850

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.), text revision. Washington, DC: American Psychiatric Association.

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

Arango-Lasprilla, J. C., Ketchum, J. M., Drew, A., Hammond, F., Powell, J. M., Kreutzer, J., Lim, P. C., & Carr, C. (2012). Neurobehavioral symptoms 1 year after traumatic brain injury: A preliminary study of the relationship between race/ethnicity and symptoms. *Brain Injury*, *26*(6), 814-824. doi: 10.3109/02699052.2012.655360

Arbisi, P.A., Sellbom, M., & Ben-Porath, Y.S. (2008). Empirical correlates of the MMPI-2 restructured clinical (RC) scales in psychiatric patients. *Journal of Personality Assessment, 90*(2), 122-128. doi: 10.1080/00223890701845146

Armistead-Jehle, P. (2010). Symptom validity test performance in U.S. veterans referred for evaluation of mild TBI. *Applied Neuropsychology*, *17*(1), 52-59. doi: 10.1080/09084280903526182

Bagby, R. M., Nicholson, R. A., Bacchiochi, J. R., Ryder, A. G., & Bury, A. S. (2002). The predictive capacity of the MMPI-2 and PAI validity scales and indexes to detect coached and uncoached feigning. *Journal of Personality Assessment*, *78*(1), 69-86. doi: 10.1207/S15327752JPA7801_05

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

Berry, D. T. R., Wetter, M. W., Baer, R. A., Youngjohn, J. R., Gass, C. S., Lamb, D. G., …Buchholz, D. (1995). Overreporting of closed-head injury symptoms on the MMPI-2. *Psychological Assessment*, *7*(4), 517-523. doi: 10.1037/1040-3590.7.4.517

Binder, L. M. (1993). Assessment of malingering after mild head trauma with the Portland Digit Recognition Test. *Journal of Clinical and Experimental Neuropsychology*, *15*(2), 170-182. doi: 10.1080/01688639308402555

Binder, L. M., & Rohling, M. L. (1996). Money matters: A meta-analytic review of the effects of financial incentives on recovery after closed-head injury. *The American Journal of Psychiatry*, *153*(1), 7-10.

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

Boake, C., McCauley, S. R., Levin, H. S., Contant, C. F., Song, J. X., Brown, S. A., Goodman, H. S.,…Merritt, S.G. (2004). Limited agreement between criteria-based diagnoses of postconcussional syndrome. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *16*(4), 493-499. doi: 10.1176/appi.neuropsych.16.4.493

Boake, C., McCauley, S. R., Levin, H. S., Pedroza, C., Contant, C. F., Song, J. X., Brown, S.A., … Diaz-Marchan, P. J. (2005). Diagnostic criteria for postconcussional syndrome after mild to moderate traumatic brain injury. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *17*(3), 350-356. doi: 10.1176/appi.neuropsych.17.3.350

Boone, K. B., & Lu, P. H. (1999). Impact of somataform symptomatology on credibility of cognitive performance. *The Clinical Neuropsychologist*, *13*(4), 414-419. doi: 10.1076/1385-4046(199911)13:04;1-Y;FT414

Boyle, G. J., & Lennon, T. (1994). Examination of the reliability and validity of the Personality Assessment Inventory. *Journal of Psychopathology and Behavioral Assessment*, *16*(3), 173-187. doi: 10.1007/BF02229206

Brickman, A.M., Cabo, R., Manly, J.J. (2006). Ethical issues in cross-cultural neuropsychology. *Applied Neuropsychology, 13*(2), 91-100.

Bryant, R. A., & Harvey, A. G. (1999). Postconcussive symptoms and posttraumatic stress disorder after mild traumatic brain injury. *The Journal of Nervous & Mental Disease*, *187*(5), 302-305. doi: 10.1097/00005053-199905000-00006

Burke, J. M., Imhoff, C. L., & Kerrigan, J. M. (1990). MMPI correlates among post-acute TBI patients. *Brain Injury*, *4*(3), 223-231. doi: 10.3109/02699059009026171

Butcher, J. N., Graham, J. R., Ben-Porath, Y. S., Tellegen, A., & Dahlstrom, W. G. (2001). *MMPI-2 (Minnesota Multiphasic Personality Inventory-2) manual for administration, scoring, and interpretation* (Revised ed.). Minneapolis, Minnesota: University of Minnesota Press.

Butcher, J. N., & Williams, C. L. (1996). *Essentials of MMPI-2 and MMPI-A interpretation*. Minneapolis, Minnesota: University of Minneapolis Press.

Byrd, D.A., Miller, S.W., Reilly, J., Weber, S., Wall, T.L., Heaton, R.K. (2006). Early environmental factors, ethnicity, and adult cognitive test performance. *The Clinical Neuropsychologist, 20*(2), 243-260. doi: 10.1080/13854040590947489

Castro, Y., Gordon, K. H., Brown, J. S., Anestis, J. C., & Joiner, T. E. (2008). Examination of racial differences on the MMPI-2 clinical and restructured clinical scales in an outpatient sample. *Assessment*, *15*(3), 277-286. doi: 10.1177/107319110731273

Choudhury, S. (2003). Racial and ethnic differences in wealth and asset choices. *Social Security Bulletin, 64*(4), 1-15.

Connor, D.J., Drake, A.I., Bondi, M.W., Delis, D.C. (1997). *Detection of feigned cognitive impairment in patients with a history of mild to severe closed head injury*. Presented at the meeting of the American Academy of Neurology, Boston.

Cuellar, I., & Paniagua, F. A. (2000). *Handbook of multicultural mental health* (1st ed.). San Diego, California: Academic Press.

Defense Manpower Research. (2013, November 23). *Demographics of active duty U.S. military*. Retrieved from http://www.statisticbrain.com/demographics-of-active-duty-u-s-military/

Demakis, G.J., Hammond, F., Knotts, A., Cooper, D.B., Clement, P., Kennedy, J., & Sawyer, T. (2007). The Personality Assessment Inventory in individuals with traumatic brain injury. *Archives of Clinical Neuropsychology*, *22*(1), 123-130. doi: 10.1016/j.acn.2006.09.004

Dikmen, S., Machamer, J., & Temkin, N. (2001). Mild head injury: Facts and artifacts. *Journal of Clinical and Experimental Neuropsychology*, 23 (6), 729-738. doi: 10.1076/jcen.23.6.729.1019

Donders, J. & Nesbit-Greene, K. (2004). Predictors of neuropsychological test performance after pediatric traumatic brain injury. *Assessment, 11*(4), 275-284. doi: 10.1177/1073191104268914

Dunlop, D. D., Song, J., Lyons, J.S., Manheim, L.M., & Chang, R. W. (2003). Racial/ethnic differences in rates of depression among preretirement adults. *American Journal of Public Health*, *93*(11), 1945-1952. doi: 10.2105/AJPH.93.11.1945

Dunn, J. T., Lees-Haley, P. R., Brown, R. S., Williams, C. W., & English, L. T. (1995). Neurotoxic complaint base rates of personal injury claimants: Implications for neuropsychological assessment. *Journal of Clinical Psychology*, *51*(4), 577-584. doi: 10.1002/1097-4679(199507)51:4<577::AID-JCLP2270510418>3.0.CO;2-E

Feinstein, A., Ouchterlony, D., Somerville, J., & Jardine, A. (2001). The effects of litigation on symptom expression: A prospective study following mild traumatic brain injury. *Medicine, Science and the Law*, *41*(2), 116-121.

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). Thousand Oaks, CA: SAGE Publications Inc.

Fisher, R.A. (1922). On the interpretation of chi square from contingency tables, and the calculation of P. *Journal of the Royal Statistical Society, 85*, 87-94.

Flaskerud, J. H., & Hu, L. H. (1992). Relationship of ethnicity to psychiatric diagnosis. *Journal of Nervous and Mental Disease*, *180*(5), 296-303. doi: 10.1097/00005053-199205000-00003

Fontana, A., & Rosenheck, R. (2008). Treatment-seeking veterans of Iraq and Afghanistan: Comparison with veterans of previous wars. *Journal of Nervous and Mental Disease*, *196*(7), 513-521. doi: 10.1097/NMD.0b013e31817cf6e6

Fox, D.D., Lees-Haley, P.R., Earnest, K., & Dolezal-Wood, S. (1995). Base rates of post-concussive symptoms in HMO patients and controls. *Neuropsychology*, *9*(4), 606-611. doi: 10.1037//0894-4105.9.4.606

Frueh, B. C., Gold, P. B., de Arellano, M. A., & Brady, K. L. (1997). A racial comparison of combat veterans evaluated for PTSD. *Journal of Personality Assessment*, *68*(3), 692-702. doi: 10.1207/s15327752jpa6803_14

Garden, N., Sullivan, K. A., & Lange, R. T. (2010). The relationship between personality characteristics and postconcussion symptoms in a nonclinical sample. *Neuropsychology*, *24*(2), 168-175. doi: 10.1037/a0017431

Green, P. (2004). *Green's Medical Symptom Validity Test (MSVT) for Microsoft Windows (user manual)*. Edmonton, Canada: Green's Publishing.

Greiffenstein, M.F., & Baker, W.J. (2001). Comparison of premorbid and postinjury MMPI-2 profiles in late postconcussion claimants. *The Clinical Neuropsychologist*, *15*(2), 162-170. doi: 10.1076/clin.15.2.162.1895

Haggerty, K. A., Frazier, T. W., Busch, R. M., & Naugle, R. I. (2007). Relationships among

    Victoria Symptom Validity Test indices and Personality Assessment Inventory validity

    scales in a large clinical sample. *The Clinical Neuropsychologist*, *21*(6), 917-928. doi:

    10.1080/13854040600899724

Hammar, A., Sorensen, L., Ardal, G., Oedegaard, K.J., Kroken, R., Roness, A. & Lund, A.

    (2010). Enduring cognitive dysfunction in unipolar major depression: A test-retest study

    using the Stroop paradigm. *Scandinavian Journal of Psychology, 51*(4), 304-308. doi:

    10.1111/j.1467-9450.2009.00765.x

Hammar, A., Strand, M., Ardal, G., Schmid, M., Lund, A. & Elliott, R. (2011). Testing the

    cognitive performance hypothesis of cognitive impairment in major depression. Nordic

    Journal of Psychiatry, 65(1), 74-80. doi: 10.3109/08039488.2010.494311

Hawes, S.W., & Boccaaccini, M.T. (2009). Detection of overreporting of psychopathology on

    the Personality Assessment Inventory: A meta-analytic review. *Psychological

    Assessment*, *21*(1), 112-124. doi: 10.1037/a0015036

Hayes, A.F. (2012). PROCESS: A versatile computational tool for observed variable mediation,

    moderation, and conditional process modeling. [White paper]. Retrieved from

    http://www.afhayes.com/public/process2012.pdf

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: a

    regression-based approach*. New York, NY: The Guilford Press.

Heaton, R.K., Ryan, L., Grant, I., & Matthews, C.G. (1996). Demographic influences on

    neuropsychological test performance. In I. Grant & K.M. Adams (Eds.),

    Neuropsychological Assessment of Neuropsychiatric Disorders (2nd ed., pp. 141-163).

    New York: Oxford University Press.

Hersen, M. (2004). *Comprehensive handbook of psychological assessment, personality assessment* (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Hessen, E., & Nestvold, K. (2009). Indicators of complicated mild TBI predict MMPI-2 scores after 23 years. *Brain Injury*, *23*(3), 234-242. doi: 10.1080/02699050902748349

Hilsenroth, M. J., & Segal, D. L. (2004). *Comprehensive handbook of psychological assessment, personality assessment*. (Vol. 2, p.32). Hoboken, NJ: John Wiley & Sons, Inc.

Hoffman, R. G., Scott, J. G., Emick, M. A., & Adams, R. L. (1999). The MMPI-2 and closed-head injury: Effects of litigation and head injury severity. *Journal of Forensic Neuropsychology*, *1*(2), 3-13. doi: 10.1300/J151v01n02_02

Hoge, C. W., McGurk, D., Thomas, J. L., Cox, A. L., Engel, C. C., & Castro, C. A. (2008). Mild traumatic brain injury in U.S. soldiers returning from Iraq. *The New England Journal of Medicine*, *358*(5), 453-463. doi: 10.1056/NEJMoa072972

Holm, L., Cassidy, J. D., Carroll, L. J., & Borg, J. (2005). Summary of the WHO Collaborating Centre for Neurotrauma Task Force on Mild Traumatic Brain Injury. *Journal of Rehabilitation Medicine*, *37*(3), 137-141. doi: 10.1080/16501970510027321

Horner, M. D., & Hamner, M. B. (2002). Neurocognitive functioning in posttraumatic stress disorder. *Neuropsychology Review*, *12*(1), 15-30. doi: 10.1023/A:1015439106231

Iverson, G. L. (2005). Outcome from mild traumatic brain injury. *Current Opinion in Psychiatry*, *18*(3), 301-317. doi: 10.1097/01.yco.0000165601.29047.ae

Iverson, G. L., & Lange, R. T. (2003). Examination of "postconcussion-like" symptoms in a healthy sample. *Applied Neuropsychology*, *10*(3), 137-144. doi: 10.1207/S15324826AN1003_02

Kennepohl, S., Shore, D., Nabors, N. & Hanks, R. (2004). African American acculturation and neuropsychological test performance following traumatic brain injury. *Journal of the International Neuropsychological Society, 10*(4), 566-577. doi: 10.1017/S1355617704104128

Kurtz, J.E., Shealy, S.E., & Putnam, S.H. (2007). Another look at paradoxical severity effects in head injury with the Personality Assessment Inventory. *Journal of Personality Assessment*, *88*(1), 66-73. doi: 10.1080/00223890709336836

Lange, R. T., Iverson, G. L., & Rose, A. (2010). Post-concussion symptom reporting and the "good-old-days" bias following mild traumatic brain injury. *Archives of Clinical Neuropsychology*, *25*(5), 442-450. doi: 10.1093/arclin/acq031

Lanyon, R. I., & Almer, E. R. (2002). Characteristics of compensable disability patients who choose to litigate. *Journal of the American Academy of Psychiatry and the Law*, *30*(3), 400-404.

Larrabee, G. J. (1998). Somatic malingering on the MMPI and MMPI-2 in personal injury litigants. *The Clinical Neuropsychologist*, *12*(2), 179-188. doi: 10.1076/clin.12.2.179.2008

Lees-Haley, P. R., & Brown, R. S. (1993). Neuropsychological complaint base rates of 170 personal injury claimants. *Archives of Clinical Neuropsychology*, *8*(3), 203-209. doi: 10.1016/0887-6177(93)90036-Z

Lees-Haley, P. R., English, L. T., & Glenn, W. J. (1991). A fake bad scale on the MMPI-2 for personal injury claimants. *Psychological Reports*, *68*(1), 203-210. doi: 10.2466/pr0.1991.68.1.203

Leininger, B. E., Kreutzer, J. S., & Hill, M. R. (1991). Comparison of minor and severe head injury emotional sequelae using the MMPI. *Brain Injury*, *5*(2), 199-205. doi: 10.3109/02699059109008090

Malik, A.B., Turner, M.E., & Sohail, M. (2013). Neuropsychological evaluation. *Medscape*. Retrieved from http://emedicine.medscape.com/article/317596-overview#a1

Marsella, A.J. & Yamada, A.M. (2000). Culture and mental health: An introduction and overview of foundations, concepts, and issues. In Cuellar, I. & Paniagua, F.A. (Eds.), *Handbook of multicultural mental health* (pp. 3-24). San Diego, California: Academic Press.

Marwitz, J. (2000). The Neurobehavioral Functioning Inventory. The Center for Outcome Measurement in Brain Injury. Retrieved from http://www.tbims.org/combi/nfi

McCauley, S. R., Boake, C., Pedroza, C., Brown, S. A., Levin, H. S., Goodman, H. S., & Merritt, S. G. (2005). Postconcussional disorder: Are the DSM-IV criteria an improvement over the ICD-10? *The Journal of Nervous and Mental Disease*, *193*(8), 540-550. doi: 10.1097/01.nmd.0000172592.05801.71

McCrea, M. A. (2008). *Mild traumatic brain injury and postconcussion syndrome*. (pp. 61-71). New York, NY: Oxford University Press.

Meares, S., Shores, E. A., Taylor, A. J., Batchelor, J., Bryant, R. A., Baguley, I. J., … Marosszeky, J.E. (2008). Mild traumatic brain injury does not predict acute postconcussion syndrome. *Journal of Neurology, Neurosurgery & Psychiatry*, *79*(3), 300-306. doi: 10.1136/jnnp.2007.126565

Miller, L. J., & Donders, J. (2001). Subjective symptomatology after traumatic head injury. *Brain Injury*, *15*(4), 297-304. doi: 10.1080/02699050118115

Miller, S.C., Baktash, S.H., Webb, T.S., Whitehead, C.R., Maynard, C., Wells, T.S., …Gore, R.K. (2013). Risk for addiction-related disorders following mild traumatic brain injury in a large cohort of active-duty U.S. airmen. *The American Journal of Psychiatry, 170*(4), 383-390. doi: 10.1176/appi.ajp.2012.12010126

Mittenberg, W., DiGiulio, D. V., Perrin, S., & Bass, A. E. (1992). Symptoms following mild head injury: Expectation as aetiology. *Journal of Neurology, Neurosurgery, and Psychiatry*, *55*(3), 200-204. doi: 10.1136/jnnp.55.3.200

Mittenberg, W., Roberts, D.M. (2008). Mild traumatic brain injury and postconcussion syndrome. In J.E. Morgan & J.H. Ricker, (Eds.), *Textbook of clinical neuropsychology: Studies on neuropsychology, neurology and cognition* (pp.430-436). New York, NY: Taylor & Francis.

Mittenberg, W., & Strauman, S. (2000). Diagnosis of mild head injury and the postconcussion syndrome. *Journal of Head Trauma Rehabilitation*, *15*(2), 783-791. doi: 10.1097/00001199-200004000-00003

Millis, S. R., Rosenthal, M., Novack, T. A., Sherer, M., Nick, T. G., Kreutzer, J. S., …Ricker, J. H. (2001). Long-term neuropsychological outcome after traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *16*(4), 343-355. doi: 10.1097/00001199-200108000-00005

Monnier, J., Elhai, J. D., Frueh, B. C., Sauvageot, J. A., & Magruder, K. M. (2002). Replication and expansion of findings related to racial differences in veterans with combat-related PTSD. *Depression and Anxiety*, *16*(2), 64-70. doi: 10.1002/da.10060

Moore, B. A., & Donders , J. (2004). Predictors of invalid neuropsychological test performance after traumatic brain injury. *Brain Injury*, *18*(10), 975-984. doi: 10.1080/02699050410001672350

Morey, L.C. (1991). Personality Assessment Inventory [Item booklet].

Morey, L. C. (2003). *Essentials of PAI assessment*. Hoboken, NJ: John Wiley & Sons, Inc.

Morey, L.C. (2007). Personality Assessment Inventory professional manual (2nd ed.). Lutz, FL: Psychological Assessment Resources.

Morey, L.C., & Lanier, V.W. (1998). Operating characteristics of six response distortion indicators for the Personality Assessment Inventory. *Assessment*, *5*(3), 203-214. doi: 10.1177/107319119800500301

Morey, L.C., Lowmaster, S.E., Kelly, M.P., Coldren, R.L., Parish, R.V., & Russell, M.L. (2011). Personality Assessment Inventory profiles of deployed combat troops: An empirical investigation of normative performance. *Psychological Assessment*, *23*(2), 456-462. doi: 10.1037/a0022173

Mozley, S.L., Miller, M.W., Weathers, F.W., Beckham, J.C., & Feldman, M.E. (2005). Personality Assessment Inventory (PAI) profiles of male veterans with combat-related posttraumatic stress disorder. *Journal of Psychopathology and Behavioral Assessment*, *27*(3), 179-189. doi: 10.1007/s10862-005-0634-6

Munley, P. H., Morris, J. R., Murray, D. A., & Baines, T. C. (2001). A comparison of African American and White American veteran MMPI-2 profiles. *Assessment*, *8*(1), 1-10. doi: 10.1177/107319110100800101

National Institute on Drug Abuse. (2013). Substance abuse in the military. *Drug Facts*. Retrieved from http://www.drugabuse.gov/sites/default/files/drugfacts_military_0.pdf

Ness, D. (2007). Physical therapy management for conversion disorder: Case series. *Journal of Neurologic Physical Therapy*, *31*(1), 30-39. doi: 10.1097/01.NPT.0000260571.77487.14

Nichols, D. S. (2011). *Essentials of MMPI-2 assessment*. Hoboken, NJ: John Wiley & Sons, Inc.

Norman, M.A., Moore, D.J., Taylor, M., Franklin, D., Cysique, L., Ake, C., …Heaton, R.K. (2011). Demographically corrected norms for African Americans and Caucasians on the Hopkins Verbal Learning Test–Revised, Brief Visuospatial Memory Test–Revised, Stroop Color and Word Test, and Wisconsin Card Sorting Test 64-card version. *Journal of Clinical and Experimental Neuropsychology, 33*(7), 793-804. doi: 10.1080/13803395.2011.559157

Paniak, C., Reynolds, S., Toller-Lobe, G., Melnyk, A., Nagy, J., & Schmidt, D. (2002). A longitudinal study of the relationship between financial compensation and symptoms after treated mild traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology*, *24*(2), 187-193. doi: 10.1076/jcen.24.2.187.999

Peltier, B. (2011). *The psychology of executive coaching: Theory and application* (2nd ed.). New York, NY: Routledge.

Ponsford, J., Willmott, C., Rothwell, A., Cameron, P., Kelly, A., Nelms, R., …Ng, K. (2000). Factors influencing outcome following mild traumatic brain injury in adults. *Journal of the International Neuropsychological Society*, *6*(5), 568-579.

Powers, R. (2007, November 10). Military disability (medical) separations and retirements. Retrieved from http://usmilitary.about.com/od/theorderlyroom/a/medseparation.htm

Putnam, S. H., & Millis, S. R. (1994). Psychosocial factors in the development and maintenance of chronic somatic and functional symptoms following mild traumatic brain injury. *Advances in Medical Psychotherapy*, *7*, 1-22.

Rigg, J. L., & Mooney, S. R. (2011). Concussions and the military: Issues specific to service members. *PM&R*, *3*(10), 380-386. doi: 10.1016/j.pmrj.2011.08.005

Rogers, R., Flores, J., Ustad, K., & Sewell, K. W. (1995). Initial validation of the Personality Assessment Inventory- Spanish version with clients from Mexican American communities. *Journal of Personality Assessment*, *64*(2), 340-348. doi: 10.1207/s15327752jpa6402_12

Rogers, R., Sewell, K. W., Morey, L. C., & Ustad, K. L. (1996). Detection of feigned mental disorders on the Personality Assessment Inventory: A discriminant analysis. *Journal of Personality Assessment*, *67*(3), 629-640. doi: 10.1207/s15327752jpa6703_15

Romero, A.J. (2000). Assessing and treating Latinos: Overview of research. In I. Cuellar & F.A. Paniagua (Eds.), *Handbook of multicultural mental health* (pp.209-223). San Diego, CA: Academic Press.

Ross, S. R., Putnam, S. H., & Adams, K. M. (2006). Psychological disturbance, incomplete performance, and compensation-seeking status as predictors of neuropsychological test performance in head injury. *Journal of Clinical and Experimental Neuropsychology*, *28*(1), 111-125. doi: 10.1080/13803390590929270

Ruiz, M.A. & Edens, J.F. (2008). Recovery and replication of internalizing and externalizing dimensions within the Personality Assessment Inventory. *Journal of Personality Assessment, 90*(6), 585-592. doi: 10.1080/00223890802388574

Schell, T.L., & Marshall, G.N. (2008). Survey of individuals previously deployed for OEF/OIF. In T. Tanelian & L. H. Jaycox (Eds.), *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery* (pp.87-115). Santa Monica, CA: Rand Corporation.

Schneiderman, A. I., Braver, E. R., & Kang, H. K. (2008). Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts in Iraq and Afghanistan: Persistent post concussive symptoms and posttraumatic stress disorder. *American Journal of Epidemiology*, *167*(12), 1446-1452. doi: 10.1093/aje/kwn068

Schnurr, P.P., Lunney, C.A., & Sengupta, A. (2004). Risk factors for the development versus maintenance of posttraumatic stress disorder. *Journal of Traumatic Stress, 17*(2), 85-95. doi: 10.1023/B:JOTS.0000022614.21794.f4

Schroeder, R. W., Twumasi-Ankrah, P., Baade, L. E., & Marshall, P. S. (2012). Reliable Digit Span: A systematic review and cross-validation study. *Assessment*, *19*(1), 21-30. doi: 10.1177/1073191111428764

Scragg, P., Bor, R., & Mendham, M. C. (2000). Feigning post-traumatic stress disorder on the PAI. *Clinical Psychology and Psychotherapy*, *7*(2), 155-160. doi: 10.1002/(SICI)1099-0879(200005)7:2<155::AID-CPP237>3.0.CO;2-Z

Seel, R.T., Kreutzer, J.S., Rosenthal, M., Hammond, F.M., Corrigan, J.D., & Black, K. (2003). Depression after traumatic brain injury: a national institute on disability and rehabilitation research model systems multicenter investigation. *Archives of Physical Medicine and Rehabilitation, 84*(2), 177-184. doi:10.1053/apmr.2003.50106

Sherrill-Pattison, S., Donders, J., & Thompson, E. (2000). Influence of demographic variables on neuropsychological test performance after traumatic brain injury. *The Clinical Neuropsychologist, 14*(4), 496-503. doi: 10.1177/1073191104268914

Sinclair, K.L., Ponsford, J.L., Rajaratnam, S.M.W., & Anderson, C. (2013). Sustained attention

following traumatic brain injury: Use of the psychomotor vigilance task. *Journal of

Clinical and Experimental Neuropsychology, 35*(2), 210-224. doi:

10.1080/13803395.2012.762340

Slavin-Mulford, J., Sinclair, S. J., Stein, M., Malone, J., Bello, I., & Blais, M. A. (2012).

External validity of the Personality Assessment Inventory (PAI) in a clinical sample.

Journal of Personality Assessment, *94*(6), 593-600. doi: 10.1080/00223891.2012.681817

Slick, D. J., Hopp, G., Strauss, E., & Spellacy, F. J. (1996). Victoria Symptom Validity Test:

 Efficiency for detecting feigned memory impairment and relationship to

neuropsychologists tests and MMPI-2 validity scales. *Journal of Clinical and

Experimental Neuropsychology*, *18*(6), 911-922. doi: 10.1080/01688639608408313

Slick, D., Hopp, G., Strauss, E. & Thompson, G.B. (1997). *Victoria Symptom Validity Test*.

Odessa, FL: Psychological Assessment Resources.

Smart, C. M., Nelson, N. W., Sweet, J. J., Bryant, F. B., Berry, D. T. R., Granacher, R. P., &

Heilbronner, R. L. (2008). Use of the MMPI-2 to predict cognitive performance: A

hierarchically optimal classification tree analysis. *Journal of the International

Neuropsychological Society*, *14*(5), 842-852. doi: 10.1017/S1355617708081034

Smith, T. C., Ryan, M. A. K., Wingard, D. L., Slymen, D. J., Sallis, J. F., & Kritz-Silverstein, D.

(2008). New onset and persistent symptoms of post-traumatic stress disorder self reported

after deployment and combat exposures: Prospective population based US military cohort

study. *BMJ*, *336*(7640), 366-371. doi: 10.1136/bmj.39430.638241.AE

Smith-Seemiller, L., Fow, N. R., Kant, R., & Franzen, M. D. (2003). Presence of post-concussive syndrome symptoms in patients with chronic pain vs mild traumatic brain injury. *Brain injury*, *17*(3), 199-206. doi: 10.1080/0269905021000030823

Somervell, P. D., Leaf, P. J., Weissman, M. W., Blazer, D. G., & Bruce, L. M. (1989). The prevalence of major depression in black and white adults in five United States communities. *American Journal of Epidemiology*, *130*(4), 725-735.

Spearman, C. (1910). Correlation calculated with faulty data. *British Journal of Psychology*, *3*, 271-295.

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary*. (3rd ed.). New York, NY: Oxford University Press.

Strauss, I., & Savitsky, N. (1934). Head injury. *Archives of Neurology and Psychiatry, 31*, 893-897.

Stulemeijer, M., Andriessen, T. M. J. C., Brauer, J. M. P., Vos, P. E., & van der Werf, S. (2007). Cognitive performance after mild traumatic brain injury: The impact of poor performance on test results and its relation to distress, personality and litigation. *Brain Injury*, *21*(3), 309-318. doi: 10.1080/02699050701209980

Sundin, J., Fear, N.T., Iversen, A., Rona, R.J., & Wessely, S. (2010). PTSD after deployment to Iraq: Conflicting rates, conflicting claims. *Psychological Medicine*, *40*(3), 367-382. doi: 10.1017/S0033291709990791

Thomas, M.L., Youngjohn, J.R. (2009). Let's not get hysterical: Comparing the MMPI-2 validity, clinical, and RC scales in TBI litigants tested for performance. *The Clinical Neuropsychologist*, *23*(6), 1067-1084. doi: 10.1080/13854040902795000

Till, C., Christensen, B.K., & Green, R.E. (2009). Use of the Personality Assessment Inventory (PAI) in individuals with traumatic brain injury. *Brain Injury*, *23*(7-8), 655-665. doi: 10.1080/02699050902970794

Tombaugh, T. N. (1996). *Test of Memory and Malingering*. North Tonawanda, NY: Multi-Health Systems.

Trichard, C., Martinot, J.L., Alagille, M., Masure, M.C., Hardy, P., Ginestet, D. & Feline, A. (1995). Time course of prefrontal lobe dysfunction in severely depressed in-patients: a longitudinal neuropsychological study. *Psychological Medicine, 25*(1), 79-85. doi: 10.1017/S0033291700028105

United States Census Bureau (2013). Language use in the United States: 2011. *American Community Survey Reports, 22.*

Van Balen, H.G.G., de Mey, H.R.A., van Limbeek, J. (1999). A neurocorrective approach for MMPI-2 use with brain-damaged patients. *International Journal of Rehabilitation Research*, *22*(4), 249-259. doi: 10.1097/00004356-199912000-00001

Vanderploeg, R. D., Curtiss, G., & Belanger, H. G. (2005). Long-term neuropsychological outcomes following mild traumatic brain injury. *Journal of International Neuropsychological Society*, *11*(3), 228-236. doi: 10.1017/S1355617705050289

Wang, Y., Chan, R.C.K., Deng, Y. (2006). Examination of postconcussion-like symptoms in healthy university students: Relationships to subjective and objective neuropsychological function performance. *Archives of Clinical Neuropsychology*, *21*(4), 339-347. doi: 10.1016/j.acn.2006.03.006

Warden, D. (2006). Military TBI during the Iraq and Afghanistan wars. *Journal of Head Trauma Rehabilitation*, *21*(5), 398-402. doi: 10.1097/00001199-200609000-00004

Warriner, E.M., Rourke, B.P., Velikonja, D., & Metham, L. (2003). Subtypes of emotional and behavioral sequelae in patients with traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology*, *25*(7), 904-917. doi: 10.1076/jcen.25.7.904.16494

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale—Revised*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1997). *Manual for the Wechsler Adult Intelligence Scale- Third Edition.* San Antonio, TX: Harcourt Assessment.

Wilk, J. E., Thomas, J. L., McGurk, D. M., Riviere, L. A., Castro, C. A., & Hoge, C. W. (2010). Mild traumatic brain injury (concussion) during combat: Lack of association of blast mechanism with persistent postconcussive symptoms. *The Journal of Head Trauma Rehabilitation*, *25*(1), 9-14. doi: 10.1097/HTR.0b013e3181bd090f

Whitcomb, S., & Merrell, K. W. (2013). *Behavioral, social, and emotional assessment of children and adolescents*. (4th ed., p. 223). New York, NY: Routledge.

Whiteside, D., Clinton, C., Diamonti, C., Stroemel, J., White, C., Zimberoff, A., & Waters, D. (2010). Relationship between suboptimal cognitive effort and the clinical scales of the Personality Assessment Inventory. *The Clinical Neuropsychologist*, *24*(2), 315-325. doi: 10.1080/13854040903482822

Whiteside, D. M., Dunbar-Mayer, P., & Waters, D. P. (2009). Relationship between TOMM performance and PAI validity scales in a mixed clinical sample. *The Clinical Neuropsychologist*, *23*(3), 523-533. doi: 10.1080/13854040802389169

World Health Organization. (2008). *International statistical classification of diseases and related health problems* (10th ed.). Geneva, Switzerland: World Health Organization.

Young, S., Bramham, J., Gray, K., & Rose, E. (2008). The experience of receiving a diagnosis and treatment of ADHD in adulthood: A qualitative study of clinically referred patients using interpretative phenomenological analysis. *Journal of Attention Disorders, 11* (4), 493-503. doi: 10.1177/1087054707305172

Youngjohn, J.R., Burrows, L., & Erdal, K. (1995). Brain damage or compensation neurosis? The controversial post-concussion syndrome. *The Clinical Neuropsychologist*, *9*, 112-123. doi: 10.1080/13854049508401593

Youngjohn, J. R., Davis, D., & Wolf, I. (1997). Head injury and the MMPI-2: Paradoxical severity effects and the influence of litigation. *Psychological Assessment*, *9*(3), 177-184. doi: 10.1037/1040-3590.9.3.177

Zhang, A.Y., and Snowden, L.R. (1999). Ethnic characteristics of mental disorders in five U.S. communities. *Cultural Diversity and Ethnic Minority Psychology, 5*(2), 134-146. doi: 10.1037/1099-9809.5.2.134

Appendix A

Personality Assessment Inventory Clinical Scale & Subscale Abbreviations

Clinical Scale	Abbr.	Clinical Subscale	Abbr.
Somatic Complaints	SOM		
		SOM- Conversion	SOM-C
		SOM- Somatization	SOM-S
		SOM- Health Concerns	SOM-H
Anxiety	ANX		
		ANX- Cognitive	ANX-C
		ANX- Affective	ANX-A
		ANX- Physiological	ANX-P
Anxiety-Related Disorders	ARD		
		ARD- Obsessive-Compulsive	ARD-O
		ARD- Phobias	ARD-P
		ARD- Traumatic Stress	ARD-T
Depression	DEP		
		DEP- Cognitive	DEP-C
		DEP- Affective	DEP-A
		DEP- Physiological	DEP-P
Mania	MAN		
		MAN- Activity Level	MAN-A
		MAN- Grandiosity	MAN-G
		MAN- Irritability	MAN-I
Paranoia	PAR		
		PAR- Resentment	PAR-R
		PAR- Hypervigilance	PAR-H
		PAR- Persecution	PAR-P
Schizophrenia	SCZ		
		SCZ- Psychotic Experiences	SCZ-P
		SCZ- Social Detachment	SCZ-S
		SCZ- Thought Disorder	SCZ-T
Borderline Features	BOR		
		BOR- Affective Instability	BOR-A
		BOR- Identity Problems	BOR-I
		BOR- Negative Relationships	BOR-N
		BOR- Self-Harm	BOR-S
Antisocial Features	ANT		
		ANT- Antisocial Behaviors	ANT-A
		ANT- Egocentricity	ANT-E
		ANT- Stimulus-Seeking	ANT-S
Alcohol Problems	ALC		
Drug Problems	DRG		

Table 1

Correlations Between PAI Scales and Number of CVTs Failed

			Number of CVTs Failed		
PAI Scales	*n*	*m*	r_s	*df*	*p*
SOM	72	68.4	.44	70	<.001
SOM-C	71	69	.45	69	<.001
SOM-H	71	62.9	.19	69	.11
SOM-S	71	67.3	.49	69	<.001
ARD-T	71	71	.39	69	.001
DEP	72	69	.50	70	<.001
DEP-A	71	65	.47	69	<.001
DEP-C	71	63.4	.38	69	.001
DEP-P	71	69	.47	69	<.001
SCZ-T	71	71	.34	69	.004

Table 2

Ethnic Group Differences on PAI Scales/Subscales

	PAI Scales/Subscales														
		SOM			SOM-C			DEP			SCZ-T			PAR-P	
Ethnic Comparison	*df*	*t*	*p*	*df*	*t*	*p*	*df*	*t*	*p*	*df*	*t*	*p*	*df*	*t*	*p*
AA v C	51	.84	.403	51	1.47	.147	-	-	-	-	-	-	51	1.64	.107
H v C	44	.14	.890	44	.48	.632	-	-	-	44	.01	.99	-	-	-
C v AA	-	-	-	-	-	-	51	.72	.475	-	-	-	-	-	-
H v AA	-	-	-	-	-	-	15	-.07	.949	15	1.24	.233	-	-	-

Note. C = Caucasian, AA = African American, and H = Hispanic.

Table 3

Number of CVTs Failed by Ethnicity and MEB/PEB Involvement

	Ethnic Group			Involved in MEB/PEB	
CVTs failed	Caucasian	African American	Hispanic	Yes	No
0	32 (69.6%)	8 (44.4%)	8 (66.7%)	21	25
1	10 (21.7%)	6 (33.3%)	2 (16.7%)	7	9
2	4 (8.7%)	4 (22.2%)	2 (16.7%)	5	5