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CROSS-VALIDATION OF THE VALIDITY-10 SUBSCALE OF THE NEUROBEHAVIORAL SYMPTOM INVENTORY

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CROSS-VALIDATION OF THE VALIDITY-10 SUBSCALE OF THE NEUROBEHAVIORAL SYMPTOM INVENTORY

DISSERTATION

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
College of Arts and Sciences
at the University of Kentucky

By
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ABSTRACT OF DISSERTATION

CROSS-VALIDATION OF THE VALIDITY-10 SUBSCALE OF THE NEUROBEHAVIORAL SYMPTOM INVENTORY

The present study is a cross-validation of the Validity-10 embedded symptom validity indicator from the Neurobehavioral Symptom Inventory (NSI) for the detection of questionable response validity during evaluation for mild traumatic brain injury (TBI).

The sample and data derived from a three-site Veterans Affairs (VA) parent study to validate the TBI Clinical Reminder, a routine set of questions asked of all recently returned veterans at VA facilities to screen for history of TBI. In the parent study, veterans recently returned from Iraq and Afghanistan underwent an evaluation for TBI with a physician and completed an assessment battery including neuropsychological tests of cognitive performance and indicators of symptom and performance validity, psychiatric assessment measures, a structured interview for post-traumatic stress disorder (PTSD), and various behavioral health questionnaires. The present study estimated the test operating characteristics of Validity-10, using NSI results gathered during the physician evaluation to compute Validity-10 scores, and using results on several other measures of symptom and performance validity from the assessment battery as criteria for questionable response validity. Only individuals who had positive screen results for TBI on the TBI Clinical Reminder prior to full evaluation were included in the present sample.

Sensitivity of Validity-10 to questionable validity was moderately high (.60 - .70) to excellent (.90 - 1.00) at high levels of specificity (> .80). Effects of different base rates of and different criteria for questionable validity on the utility of Validity-10 were explored as well. Chi-square analyses to determine the effect of PTSD symptoms on the utility of Validity-10 demonstrated overall classification accuracy in general, and false positive rate in particular, were relatively poorer when used with individuals who reported significant PTSD symptoms. Overall, these findings support the use of Validity-10 (at cut score Validity-10 ≥ 19) to identify those veterans being evaluation for mild TBI in the VA system who should be referred for comprehensive secondary evaluation by a clinical neuropsychologist using multiple forms of symptom and performance validity

testing. Further studies of the effects of PTSD symptoms on the accuracy of Validity-10 for this purpose are recommended.

KEYWORDS: Neuropsychological Assessment, Traumatic Brain Injury, Validity Testing, Neurobehavioral Symptom Inventory, Veterans

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July 17, 2017_____

CROSS-VALIDATION OF THE VALIDITY-10 SUBSCALE OF THE NEUROBEHAVIORAL SYMPTOM INVENTORY

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Chapter 1—Introduction

This dissertation describes the cross-validation of an embedded symptom validity subscale of the Neurobehavioral Symptom Inventory (NSI; Cicerone and Kalmar, 1995). The present introduction outlines the structure of the document and presents the basic argument justifying the study in brief. Each point is further explained and supported in the literature review below. The methods section describes the provenance of the data analyzed, the instruments and scores used for measurement, and the analytic procedure used to answer the research questions. The results section presents the results of the analyses interpreted in answer to the research questions. Finally, the discussion section relates the study findings to the broader literature and current clinical practices, presents limitations of the present study and methodological issues pertinent to the area of study, and summarizes primary conclusions drawn from the study.

Numerous veterans seek treatment through the United States Veterans Health Administration (VHA), and the wars of the past two decades have increased the numbers of veterans seeking evaluation for traumatic brain injury (TBI). Indeed, because of its high prevalence among returning veterans, TBI has been called the "signature injury" of the Operation Iraqi Freedom and Operation Enduring Freedom (OIF/OEF) conflicts in Iraq and Afghanistan (Taneilian and Jaycox, 2008). VHA has instituted a screening process for TBI to facilitate the appropriate referral of veterans such that all individuals at risk for TBI are examined by a physician first and that those in need of further assessment are evaluated by a comprehensive team including a clinical neuropsychologist. Three major complications threaten appropriate diagnosis and referral in this context. First, the vast majority of TBIs experienced in civilian life and combat are of mild severity, and the

diagnosis of mild TBI relies a great deal on the presence of symptoms that are often vague, nonspecific, or unverifiable. Second, the validity of symptom reporting and performance on neuropsychological measures is known to be more questionable in the presence of the possibility of secondary gain. That is, in settings wherein financial or other external incentives to feign or exaggerate symptoms of mild TBI are present, the base rate of feigning and exaggeration rises. Evaluation within VHA is clearly such a setting, because veterans are often awarded disability compensation if evaluators conclude that a given disability is "service-connected"—that it exists due to combat experience. Third, as combat veterans, most of those evaluated by VHA for mild TBI are at risk for posttraumatic stress disorder (PTSD) due to combat stress. PTSD, unfortunately, shares many of the vague, nonspecific, and often unverifiable symptoms associated with mild TBI.

Considering these three complications, it would be desirable for VHA to have an objective indicator of questionable validity of symptom presentation for mild TBI, and it would as well be desirable to know how the operating characteristics of that indicator are affected by the presence of combat PTSD. Moreover, it would be ideal to have this indicator available at the time of TBI evaluation by the physician, so that individuals with an indicator of questionable validity may be referred for further evaluation by the clinical neuropsychologist rather than be referred to TBI support services or to receive compensation based on self-reported information alone. Researchers have recently identified that one measure administered during all VHA medical TBI evaluations, the Neurobehavioral Symptom Inventory (NSI), contains items that have potential for use as an embedded validity scale. Preliminary work has found this scale, dubbed "Validity-10,"

to be useful for classifying test-taker responses as valid or invalid. The present dissertation replicates these findings in an independent sample of veterans using multiple symptom validity and performance validity tests as criterion measures.

Chapter 2—Literature Review

Mild Traumatic Brain Injury

Traumatic brain injury (TBI) is damage to the tissue of the brain due to blunt force trauma or violent rotational forces. The presentation and course of TBI varies by severity of the injury. Severity of TBI is diagnosed based on the length of loss of consciousness; the duration of a delirium-like state of confusion called post-traumatic amnesia (PTA); and impairment of ocular, motor, and vocal responsiveness, often assessed using the Glasgow Coma Scale (Teasdale & Jennett, 1974). Recommended rules for classifying TBI severity according to these measures vary across organizations, though many are similar in practice. Table 1 presents a typical classification system, developed by the World Health Organization Collaborating Centre Task Force of Mild Traumatic Brain Injury and endorsed by the National Academy of Neuropsychology (Ruff et al., 2009). Moderate or severe TBI typically results in loss of consciousness followed by a period of retrograde and anterograde PTA, which may resolve, leaving residual deficits in cognitive function. Severe TBI may result in protracted coma or death, longer duration of PTA, and more pronounced disability.

Emergency departments in the United States see roughly 1.1 million visits for TBI annually, only 15% of which fall in the moderate to severe range (Corrigan, Selassie, and Orman, 2010). The remaining majority would be considered mild TBIs (mTBIs), wherein there is little to no loss of consciousness or PTA. Moreover, an unknown number of mTBIs are never evaluated or treated. It is common practice to differentiate between mild and "complicated mild" TBI, the latter of which applies when there is detectable injury on emergency CT imaging (Williams, Levin, and Eisenberg, 1990).

The distinction is useful because complicated mild TBIs are more similar in course to moderate TBI than to mild TBI. Often, complicated mild TBIs are excluded from research studies. Certain organizations, such as the U.S. Departments of Defense (DoD) and Veterans Affairs (VA), prefer to classify such injuries as moderate because of that similarity (Department of Veterans Affairs and Department of Defense, 2009). In all other respects, the VA/DoD guidelines for TBI severity are virtually identical to those presented in Table 2.1.

Neuropathological studies identify traumatic axonal injury, including stretching, swelling, and degeneration, as the primary structural determinant of brain damage severity in mTBI (see Biasca & Maxwell, 2007; Bigler & Maxwell, 2011; Saatman, Serbst, & Burkhardt, 2009). Processing speed, attention, and memory are the cognitive domains most typically affected, but the symptom picture varies by etiology and the locus of any focal injury. The course of mTBI is a subject of debate among brain injury researchers and clinicians. Whereas it is clear that moderate to severe TBI often results in permanent cognitive impairment, the long-term cognitive sequelae of mTBI are less easily characterized. It is well established that the majority of individuals who report mTBI symptoms return to baseline cognitive function within months post-injury (Levin et al., 1987). Meta-analytic studies of the overall impact of mTBI on neuropsychological function have found that initial cognitive impairment may be pronounced—about one standard deviation below expectation—but, on average, resolves to minimal effect sizes after about one week, further improving over the following 3-6 months (Belanger & Vanderploeg, 2005; Broglio & Puetz, 2008; Karr, Areshenkoff, and Garcia-Barrera, 2014; Schretlen & Shapiro, 2003).

It is also well recognized that a small minority of individuals report symptoms, produce impaired scores on neuropsychological testing, and have poor psychosocial outcomes long after their mTBI sequelae would be expected to have resolved (Kay, Newman, & Cavallo, 1997). Reported symptoms may include headaches, dizziness, malaise, fatigue, noise intolerance, mood disturbance, difficulty with memory or concentration, insomnia, alcohol intolerance, apathy, or social inappropriateness (Cicerone & Kalmar, 1995). Both the WHO and the American Psychiatric Association have proposed research criteria for a postconcussional syndrome/disorder (PCS), but the designation has not been widely adopted for several reasons. Healthy adults meet PCS criteria at rates similar to those with a history of mTBI (Iverson & Lange, 2003). Moreover, high rates of PCS symptoms are associated with outpatient psychological treatment, outpatient medical treatment, personal injury litigation, orthopedic injury, chronic pain, and posttraumatic stress disorder.

Some researchers are satisfied that there are no lasting cognitive effects of mTBI. On this view, the differences found after 6 months in the small minority of cases noted above are attributable to situational factors, such as motivation level and testing conditions, and are not due to injury to brain tissue. One meta-analytic study found that residual effects of mTBI on neuropsychological testing were very small in research samples, whereas effects in clinical and forensic samples were large (Belanger et al., 2005). Meta-analysis also revealed that persistent differences in neuropsychological test scores after mTBI have an effect size of $g = -0.07$, which translates to a negligible clinical difference (Rohling et al., 2011). Others have argued that there may indeed be credible cognitive sequelae of mTBI that persist well outside the normal range. On this view, the

group mean differences reported in studies of mTBI course apply to the majority of the group and are largely unaffected by the performance of the small minority with persistent damage to the brain, which is a low base rate condition (Pertab, James, & Bigler, 2009; Iverson, 2010; but see Rohling, Larrabee, and Millis, 2012, for a rebuttal of the methodological argument and Bigler et al., 2013, for further discussion). Bigler & Maxwell (2011) reviewed mounting evidence from neuroscience and neuroimaging studies that there is indeed altered brain function in some persons with mTBI, including changes in various biomarkers of structural damage, inflammatory response, evidence of traumatic injury detectable with specialized imaging techniques, neuropathologic differences on autopsy after mTBI, and in vivo changes in neurotransmitter levels. Iverson (2012) reviewed evidence that factors such as resilience, multiple bouts of depression, other psychiatric illness, and poor social adjustment have reciprocal relationships with cognitive function, and he proposed a biopsychosocial model of outcome from mTBI. Neuropsychological studies continue to emerge that either find or fail to find late cognitive effects of mTBI, and there is no clear consensus regarding the possibility of persistent cognitive sequelae of mTBI, especially under stressful conditions.

Combat TBI. War presents numerous opportunities for injury to the head and brain, including projectile trauma, falls, hand-to-hand assaults, and exposure to concussive blasts from explosive devices. With the abundance of improvised explosive devices (IEDs) in the Iraq and Afghanistan wars, blast exposure has gained research attention as a cause of injury. As in the general population, mTBIs represent most TBIs experienced by soldiers in combat. The U.S. Department of Defense (U.S. DoD; 2012) reported that from the year 2000 to November 2012, just over 262,000 members (11.3%)

of the U.S. Armed Forces were given medical diagnoses of TBI, over three-fourths of which were acquired during active duty. Mild TBI accounted for 76.4% of these diagnoses. These DoD figures and others based on real-time surveillance of reported events fall below estimates based on post-deployment assessment, which range from 11.2% to 22.8% (Mental Health Advisory Team V, 2008; Schwab et al., 2007; Tanielian & Jaycox, 2008; Hoge et al., 2008; Schneiderman, 2008; Terrio et al., 2009).

Both mid-deployment and post-deployment estimates face methodological challenges: in-theater assessment personnel may be relatively untrained or under stress; the in-theater assessment setting may be suboptimal; post-deployment assessments are often designed for screening purposes, allowing for many false positives; post-deployment assessment introduces the fallibility of retrospective report; and situational incentives to distort one's presentation abound, such as a desire to remain of use or to escape danger, the potential to collect disability benefits, or mistrust of the uses to which one's health information may be put. The DoD and VA both screen returning veterans for possible TBI and refer those who with a positive result for more thorough assessment and, where appropriate, rehabilitation services. Given the difficulties in assessing presence and outcome of mTBI in veterans, research support for unique effects of mTBI are scant for this population, and much of current research and clinical work applies knowledge gained from civilian populations to this unique group.

Test Validity

Given the presence of numerous incentives to distort one's responses to psychological measures, it is important to be able to identify whether the results of a given evaluation are valid for interpretation. To accomplish this task, psychologists have

developed validity tests that are sensitive to response distortion and relatively insensitive to clinical conditions. Instruments developed to detect response distortion on self-report measures of symptoms are called "symptom validity tests" (SVTs), and those designed to detect response distortion on performance-based tests of ability are called "performance validity tests" (PVTs; Larrabee, 2012). A further distinction is drawn between validity tests that are embedded within other clinical measures ("embedded validity tests") and those that are administered with the single dedicated purpose of assessing response validity ("standalone validity tests"; Berry and Schipper, 2008; Rogers, 2008a). The various forms of response distortion include providing random responses, minimization of problems ("faking good") and feigning or exaggeration of problems ("faking bad"; Rogers, 2008c).

Strategies for detecting faking bad generally involve either identification of unlikely presentations or identification of excessive impairment (Rogers, 2008b). An unlikely presentation may be identified through examination of the magnitude of errors, the discordance of errors with item difficulty, the discordance of errors with known learning principles (e.g. recognition memory scores lower than free recall scores), or the pattern of scores across cognitive measures with reference to expected patterns of impairment. Strategies to detect excessive impairment focus instead on the extent of impairment rather than on the qualitative nature of impairment. These strategies include identification of deficits on tasks measuring cognitive functions that tend to be preserved in neurological impairment; performance significantly below chance expectations; or deficient performance as compared with that of samples of individuals with neurological disorders and no identified incentive to feign.

SVTs and PVTs are ideally submitted to two complementary forms of validation study, the simulation design and the known-groups design (Berry and Schipper, 2008; Rogers 2008c). The simulation design is an analogue study comparing honestly-responding individuals who have clinical conditions to individuals without clinical conditions who have been instructed and incentivized to feign or exaggerate symptoms. It has the benefit of high internal validity, such that variability in outcomes may be attributed to experimental manipulation of factors such as instructions, coaching, and incentives. The simulation design has relatively weak external validity, in that results may not be generalizable to the analogized real-world situations. The known-groups design classifies real-world individuals into groups according to criterion evidence of malingering and compares the performance of those unlikely to be malingering to those likely to be malingering. The known-groups design has the benefit of high external validity, in that its results are drawn from a real-world context and are likely to generalize. Internal validity is relatively weak because the investigator has little ability to manipulate variables, which complicates inferences of causation. Tests that exhibit satisfactory operating characteristics under both paradigms benefit from the strengths of each whereas weaknesses are mitigated.

Test operating characteristics are summarized with various indices of diagnostic classification accuracy. Suppose there is a study population, some portion of which has a condition of interest. That proportion is the *base rate* (*BR*) of the condition in that population. Further suppose that there is a test for the condition of interest that assigns a positive or negative test sign to each individual depending on whether that person produced a score above or below a given *cut score*. To summarize the classification

accuracy of the test using that cut score, one may calculate hit rate, sensitivity, specificity, positive and negative predictive values, as follows. *Sensitivity* is the proportion of those with the condition who received a positive test sign. *Specificity* is the proportion of those without the condition who received a negative test sign. Sensitivity and specificity are intrinsic to the use of a test at a particular cut score in a particular population; they do not vary with changes in the base rate of the condition. The predictive values supply converse indices of classification accuracy that take into account the base rate and answer the pressing clinical question: "Given that a person produces a particular test sign, what is the probability that the person has or does not have the condition?" Specifically, the *positive predictive value* (*PPV*) is the proportion of individuals with a positive test sign who do have the condition; the *negative predictive value* (*NPV*) is the proportion of individuals with a negative test sign in which the condition is absent. Like sensitivity, specificity, and hit rate, the predictive values depend upon the particular test, the particular cut score, and the particular population; unlike the others, predictive values vary with changes in the base rate.

Posttraumatic Stress Disorder

Posttraumatic stress disorder (PTSD) is a syndrome of persistent, impairing symptoms following psychological trauma involving the threat or occurrence of injury, death, or loss of physical integrity to the individual or to someone close to the individual (American Psychiatric Association, 2013). Persistent symptoms involve (a) reexperiencing of the traumatic incident, such as flashback memories, recurrent dreams, or intense psychological or physiological reaction to reminders of the event; (b) avoidance of reminders of the incident, such as thoughts, feelings, conversations, people,

or places, inability to recall important aspects of the event, or emotional numbness, such as decreased ability to feel emotions like love, happiness, or connection with others, or a sense that one's future will be cut short; and (c) hyperarousal, such as an inability to fall or stay asleep, increased startle response, hypervigilance to threat, irritability, outbursts of anger, or difficulty concentrating. Occurrence of the syndrome within 30 days of the event is considered an acute stress disorder (ASD), and an ASD that persists beyond 30 days after the event is revised to a diagnosis of PTSD. Moreover, symptoms must cause significant impairment in social or work functioning, or in other important domains of function. PTSD may be specified as "chronic" if symptoms persist from more than 6 months post-trauma or as "delayed onset" if symptoms first arise more than one month post-trauma. Lifetime prevalence of PTSD was estimated at 7.8% in the National Comorbidity Survey, with two-thirds of diagnoses eventually remitting (Kessler et al., 1995).

Most symptoms listed in the diagnostic criteria for PTSD are affective or behavioral, but the mention of difficulty concentrating is a recognition of cognitive complaints among those with the disorder. Indeed, meta-analysis has revealed that combat veterans with PTSD tend to perform worse than combat veterans without PTSD on neuropsychological tests of verbal and visual memory, with medium to large effect sizes (Johnsen & Asbjornsen, 2008; Brewin, Kleiner, Vasterling, & Field, 2007). Individual studies have found similar effects on measures of executive functions (Hart et al, 2008; Jenkins et al., 2000; Beckham et al., 1998). Methodological strength is variable across studies, and the presence of such confounding factors as IQ, substance use disorders, and incentive to overreport was rarely addressed in early studies. Recent

studies that controlled or screened for differences on these factors replicated the expected neuropsychological differences (Geuze, Vermetten, de Kloet, Hijman, & Westenberg, 2009; Samuelson et al., 2006), as did the examination by Shandera-Ochsner et al. (2013) of a single-site subsample of the multi-site VA study sample to be examined in the current project.

Combat PTSD. Magruder et al. (2004) used a telephone-administered structured interview to estimate the prevalence of PTSD at 10% among veterans known to the VA medical system. Hoge et al. (2004; 2007) reported a slightly higher range, from 13-17% among veterans. The traumatic events that meet Criterion A of the DSM-5 diagnosis include prolonged exposure to threat of death in a combat zone, injury to the individual, and witnessed injury or death of other soldiers or civilians, among others. Assessment of combat-related PTSD is complicated by possible delayed onset of symptoms; adjustment to a stark change of environment and demands from a combat zone to home, including available social support and norms for social interaction; lack of prior information regarding premorbid functioning, psychiatric and otherwise; the time demand involved in making a systematic assessment of onset and severity of a wide range of symptoms; the need for clinical judgment in determining whether a given symptom is connected to the traumatic event; and a context of assessment that may incentivize over- or under-reporting of symptoms, as described above regarding mTBI diagnosis. Also like mTBI, the military and VA screen all returning veterans for PTSD symptoms, make referrals for more focused assessment, and provide or refer the veteran to appropriate services, including well validated interventions such as Prolonged Exposure Therapy (Foa, Hembree, & Rothbaum, 2007) and Cognitive Processing Therapy (Resick et al., 2006).

Mild TBI and Combat PTSD

Carlson et al. (2011) performed a systematic review of evidence regarding prevalence estimates, diagnostic accuracy, and treatment approaches for mTBI and PTSD in combination. The studies examined varied widely in specific aims and study design, etiology of trauma, sample size, and measures employed. Only 9 of the 38 studies that met criteria for inclusion examined U.S. military samples. Prevalence estimates for comorbid mTBI and PTSD were highly variable across studies, but three large-scale studies of OIF/OEF veterans estimated the prevalence of probable comorbidity at 5-7% (Hoge et al., 2008; Schneiderman et al., 2008; Tanielian & Jaycox, 2008). For veterans with probable mTBI, the estimated prevalence of comorbid PTSD ranged from 33-39%.

Current Practice and Research

The Veterans Health Administration (VHA) continues to evaluate numerous OIF/OEF veterans each year for traumatic brain injury. The need to include symptom validity testing and performance validity testing in evaluations for mTBI is well established, both in civilian and veteran populations. As noted earlier, VHA policy is to ask every returning veteran a set of questions (the TBI Clinical Reminder) to screen the individual for possible TBI history and refer those with positive results to further evaluation by a TBI physician (the Comprehensive TBI Evaluation, or CTE). The CTE includes a physical examination, interview, and completion of self-report symptom measures, including the NSI. The CTE physician evaluates the likelihood of brain injury involvement, and if TBI is likely, the individual is referred for a secondary TBI evaluation, which includes neuropsychological assessment. The neuropsychological

evaluation is the first context in which the validity of the individual's symptom report and behavioral performance is formally evaluated.

It would be beneficial to have a formal test of invalid responding "upstream" from the neuropsychological evaluation because such a test would provide symptom validity information gathered at a different time point, in a different context, and by a different clinician than the bulk of the test data available to the neuropsychologist. Thus, the neuropsychologist, who is the clinician best equipped to interpret symptom validity test data in the context of other test data, would have the benefit of repeated observation, varied setting, and varied tester when making the final judgment as to symptom and performance validity. Should the NSI, which is completed as part of the CTE before neuropsychological evaluation, yield a valid and useful measure of symptom validity, the VHA need not change procedure except to refer individuals with positive test signs on the measure embedded in the NSI for neuropsychological evaluation. Hence, recent research has focused on identifying embedded measures of symptom validity within the NSI (Lange et al., 2013b; Vanderploeg et al., 2014; Lange et al., 2015, 2016).

Lange et al. (2013b) first developed a five-item measure called the Mild Brain Injury Atypical Symptoms Scale (mBIAS) for use in conjunction with the NSI and the PTSD Checklist—Civilian (PCL-C) to detect symptom feigning among veterans being evaluated for postconcussional disorder (PCD) and PTSD. This initial simulation study employed a sample of 85 Australian undergraduate students assigned to perform honestly (n = 24), feign PCD (n = 29), or feign PTSD (n = 32). The group identified cutoff scores for "probable exaggeration" (mBIAS score ≥ 8), which had a low sensitivity of .34 and excellent specificity of 1.0, and for "possible exaggeration" (mBIAS ≥ 6), which had

good sensitivity of .74 and good specificity of .88. They recommended further study of the mBIAS using veteran clinical samples.

Vanderploeg et al. (2014) identified NSI items to form a subscale for clinically atypical or bizarre symptoms (NIM5), a subscale of items endorsed with very low frequency (LOW6), and a combined scale of non-overlapping items in NIM5 and LOW6 (Validity-10). Three clinical samples were used to identify items for the scales: a sample of consecutive referrals to an outpatient military brain injury clinic ($N = 443$), all VHA patients who had completed the CTE and showed evidence of brain injury ($N = 36{,}655$), and respondents to a Florida National Guard survey who had probable deployment related TBI ($N = 146$). A fourth sample used for cross-validation included 206 veterans presenting to military TBI clinics for neuropsychological evaluation. All participants in this latter sample completed the Personality Assessment Inventory (PAI) and were classified as valid ($n = 161$) or invalid responders ($n = 45$) based on the cut score of 75 or higher on the PAI Negative Impression Management (PAI NIM) scale. Of the three developed NSI subscales, Validity-10 best classified participants overall, with moderately high sensitivity of .61 and high specificity of .85 at a cut score of greater than 22.

Lange et al. (2015) performed a head-to-head comparison of Validity-10 and the mBIAS in a prospective study of 63 combat veterans diagnosed with mTBI. Participants were placed in criterion groups of SVT-pass ($n = 39$) and SVT-fail ($n = 24$) based on 8 of the 10 validity scales of the Minnesota Multiphasic Personality Inventory – Restructured Form (MMPI-2-RF). Participants were excluded based on high Cannot Say scores and VRIN-r/TRIN-r scores. The mBIAS produced an optimal cut score of ≥ 8 and showed poor sensitivity of .17 and excellent specificity of 1.0. Validity-10 produced an optimal

cut score of ≥ 13, which showed moderately high sensitivity of .63 and excellent specificity of .97. The group (which had developed the mBIAS) rejected the mBIAS in favor of Validity-10. Lange et al. (2016) replicated the cross-validation study of Vanderploeg et al. (2014) in a sample of 272 U.S. military veterans with mild, moderate, or severe TBI. Using the cut score of PAI NIM ≥ 75 to create criterion groups, the study found Validity-10 to best classify participants at a cut score of ≥ 19, having moderately high sensitivity of .59 and very high specificity at .89.

The present study would seek to replicate and extend the validity information obtained by prior studies by employing NSI data obtained directly from the VHA CTE process, multiple measures of symptom and performance validity, and a direct analysis of the extent to which PTSD symptoms may affect the test operating characteristics of Validity-10.

Aim & Objectives

The aim of this study is to examine the test validity of the Validity-10 subscale (Vanderploeg, 2014) of the Neurobehavioral Symptom Inventory (NSI; Cicerone & Kalmar, 1995) for detecting invalid responses during evaluation of veterans for mild traumatic brain injury (mTBI). The objectives of the study are:

(1) to estimate the sensitivity and specificity of Validity-10 at the recommended cut scores for identifying questionably valid test profiles as determined by tests of cognitive symptom validity and performance validity;

(2) to estimate the sensitivity and specificity of Validity-10 at the recommended cut scores for identifying questionably valid test profiles as determined by tests of psychiatric symptom validity;

(3) to estimate the sensitivity and specificity of Validity-10 at the recommended cut score for identifying questionably valid test profiles determined by failure of SVTs or PVTs, regardless of cognitive or psychiatric domain;

(4) to characterize the clinical utility of Validity-10 by calculating its test operating characteristics in a representative sample at several realistic benchmark base rates of invalid responding; and

(5) to determine the extent to which the presence of PTSD symptoms affects the test operating characteristics of Validity-10.

Table 2.1: WHO Classification of Traumatic Brain Injury Severity

Severity	Duration of LOC	GCS Score	Duration of PTA
Mild	< 30 m	13-15	< 24 h
Moderate	30 m - 24 h	9-12	1-7 d
Severe	> 24 h	3-8	> 7 d

Note. GCS score is the lowest score obtained 30 minutes or longer after injury. LOC = loss of consciousness; GCS = Glasgow Coma Scale; PTA = post-traumatic amnesia; d = days; h = hours; m = minutes.

Chapter 3—Methods

Parent Study

Data for the proposed study were obtained as part of a multi-site VA study ("Evaluation of VA's TBI Clinical Reminder and Comprehensive TBI Evaluation"; Babcock-Parziale, Pape, High, Smith, Evans, and McKnight, 2010). The objectives of the parent study were (1) to develop an Experts' Diagnostic Assessment Battery, including a neuropsychological battery and clinical diagnostic criteria, for combat mTBI and PTSD; (2) to evaluate test operating characteristics of the VA TBI Clinical Reminder (TCR) screening tool and the physician-administered Comprehensive TBI Evaluation (CTE) with respect to the EDAB; (3) to examine the concordance of the neuropsychological battery (measuring objective cognitive symptoms) with the NSI and the validity of both the neuropsychological battery and the NSI for predicting outcome on the CTE; (4) to examine the relation between CTE results and functional outcomes as measure by self-report inventories of sleep, general health, disability, and community participation; (5) examine the concurrent validity of EDAB classification with respect to functional impairment measures; and (6) to determine the one-week test-retest reliability of the TCR and CTE. In pursuit of those aims, the research team collected from a sizable sample of recent veterans a wealth of objective and self-report data pertinent to risk factors, diagnosis, and cognitive, affective, somatic, and other functional outcomes of combat PTSD and mTBI. This section will describe the participants, procedures, and measures included in the parent study, with particular attention to those most pertinent to the proposed project.

Parent study participants. Veterans of OEF/OIF were recruited by letter or clinical contact from three VA Polytrauma Network Sites (Southern Arizona VA Health Care System in Tucson, AZ, Hines VAMC in Chicago, IL, and Lexington VAMC in Lexington, KY). Following receipt of a HIPAA waiver, OEF/OIF program managers were contacted for a list of OEF/OIF veterans in each of the three catchment areas. Investigators were also notified of new enrollments in VA Polytrauma services at each site. The research team sent a letter to each veteran to allow the individual to opt out of a follow-up recruitment telephone call. Those for whom an opt-out response was not received within three weeks were contacted by study staff to complete a telephone screening. Study recruitment brochures were also distributed to community-based outpatient clinics affiliated with each site to invite potential participants to contact study staff. Potential recruits were excluded from participation who (1) were enrolled in another research study, the principal investigator of which would not approve concurrent this concurrent enrollment; (2) had been treated for concussion within the last 30 days; (3) had been diagnosed with moderate or severe TBI; or (4) were unable to read and respond in English, the only language for which all study instruments were validated. Participants demonstrated understanding that the study was to evaluate the VAs assessments for mTBI; that participants must be OEF/OIF veterans; that this was not a treatment study; that the study would require the participant to visit a VA site for 8 hours of assessments (including breaks), that the participant would be asked about deployment experiences, health, and wellbeing; and the participant would receive up to $160 for participation in the study. These details were reiterated during further informed consent procedures on the day of testing.

Procedures. The initial selection of measures and diagnostic criteria for inclusion in the Expert Diagnostic Assessment Battery (EDAB) was a result of an expert panel under the online Delphi paradigm. Two panels of eight VA and non-VA clinicians treating mTBI patients were assembled based on peer-reviewed publications and experience diagnosing and treating persons with mTBI. The first panel included physiatrists, behavioral neurologists, clinical neuropsychologists, neuropsychiatrists, nurse practitioners, and speech pathologists and was responsible for selecting clinical diagnostic criteria for mTBI. The second panel included only clinical neuropsychologists and was responsible for selecting a battery of neuropsychological tests with utility for evaluation of mTBI. Research team members assembled an updated review of the research on mTBI diagnosis, which was provided to the expert panel members for briefing (Pape et al., 2013). Under the Delphi paradigm, panel members were independently asked for ratings of the utility of different questions and instruments for diagnosing mTBI. Ratings were compiled and iteratively distributed to panel members for consideration and follow-up rating until consensus was reached. The result was the EDAB, a battery of neuropsychological tests and clinical criteria selected by expert consensus to serve as a proxy "gold standard" for diagnosis of mTBI in the absence of a generally accepted "gold standard."

To briefly review VA policy: all returning OIF/OEF veterans complete the TBI Clinical Reminder screening questionnaire upon contact with the VA health system. Those who screen negative for combat TBI continue with VA care as usual. Those who screen positive undergo a CTE administered by a VA Polytrauma physician. Results of the TBI Clinical Reminder and the physician-administered CTE are recorded in the VA

electronic medical record. The NSI is administered during the CTE. Participants in the parent study who received a positive TBI Clinical Reminder screening result completed the study measures within 30 days of completing the CTE. To ensure that all study participants completed the same measures, participants who received a negative TBI Clinical Reminder screening result underwent a CTE with a physician on the research team on the day of research testing. On the day of research testing, all participants completed the EDAB, which included neuropsychological testing, standalone performance validity testing (Letter Memory Test), embedded symptom validity testing (MMPI-2-RF validity scales), and a structured interview for TBI diagnosis; the Clinician Administered PTSD Scale, which is a structured interview for PTSD diagnosis; and a set of self-report questionnaires to collect demographic, mood, and functional outcome data.

Measures Relevant to Present Study

TBI Clinical Reminder. The TBI Clinical Reminder is a set of four self-report questions administered by oral interview of veterans by VHA healthcare professionals (Belanger, Uomoto, and Vanderploeg, 2009). It serves as a screening measure to rule out a history of traumatic brain injury. Respondents with a positive answer on all four of the items are referred to a TBI physician for more thorough evaluation in the Comprehensive TBI Examination. The four questions are as follows: (1) Did you have any injury(ies) during your deployment from any of the following? (check all that apply: fragment, bullet, explosion, etc), (2) Did any injury you received while deployed result in any of the following? (check all that apply: head injury, feeling dazed, not remembering the injury, etc.), (3) Did any of these begin or get worse afterward? (check all that apply: problems with balance, memory, sleep, etc.), and (4) In the past week, have you had any of the

above symptoms? (check all that apply: problems with dizziness, memory, etc.). Belanger et al. (2012) examined the evidence for utility of the TBI Clinical Reminder using results of the secondary TBI evaluation as a criterion measure. Sensitivity (*SN* = 0.87 - 0.90) and negative predictive value at an estimated base rate of 15% (*NPV* = 0.89) were very good. Specificity (*SP* = 0.13 – 0.18) and positive predictive value (*PPV* = 0.16) were extremely poor, limiting acceptable use of the TBI Clinical Reminder to screening situations alone.

Neurobehavioral Symptom Inventory. The Neurobehavioral Symptom Inventory (NSI; Cicerone and Kalmar, 1995) is a self-report questionnaire that assesses the presence and severity of 22 nonspecific sequelae of TBI. The test taker rates on a five-point scale how much each symptom has disturbed him or her in the past month. Domains assessed include cognitive, affective, physical, and pain symptoms. The NSI is administered as part of the VHA Comprehensive TBI Examination, so the data are available for veterans who screen positive on the TBI Clinical Reminder before the physician determines the need for a referral to more intensive "secondary TBI evaluation" by a multidisciplinary team including a clinical neuropsychologist. Meterko et al. (2012) conducted a confirmatory factor analysis of NSI responses in a large sample of VHA patients and found support for a four-factor model ("Somatosensory," "Cognitive," "Affective," and "Vestibular"). Vanderploeg et al. (2015) confirmed this four-factor model in two large VHA and DOD samples of veterans. The same group presented normative data for NSI in this population (Soble et al., 2014). Psychometric studies of the Validity-10 subscale of the NSI were detailed above, in the "Current Practice and Research" section of the literature review. The Validity-10 includes 10 items relating to hearing problems, noise sensitivity, change in taste or smell, difficulty making

decisions, slowed thinking, dizziness, balance problems, coordination difficulties, nausea, and vision problems.

Letter Memory Test. The Letter Memory Test (LMT; Inman et al., 1998) is a stand-alone, forced-choice performance validity test designed to be insensitive to neurological compromise while retaining face validity as a test of memory. In reality, success on the task relies upon recognition memory, which is relatively preserved in most neurological disorders. Test duration is about 15-20 minutes. The test taker is presented with a string of letters, then a 5-second delay, and then a set of options from which to select the presented string. Over the course of the test, the number of multiple-choice options increases from two, to three, and finally to four, and the string length increases from three letters, to four, to five, giving the impression of increasing difficulty. The recommended cut score for detecting invalid responding is a total percentage correct below 93%. Under both simulation and known-groups designs, the LMT has consistently demonstrated excellent specificity and moderate to high sensitivity to feigned sequelae of TBI (Inman et al., 1998; Greub and Suhr 2006; Vagnini et al., 2006, Schipper, Berry, Coen, and Clark, 2008; Sollman and Berry, 2011).

California Verbal Learning Test—Second Edition. The California Verbal Learning Test—Second Edition (CVLT-II; Delis, Kramer, Kaplan, and Ober, 2000) consists of a five-trial verbal list-learning task, followed by immediate and delayed recall trials, a recognition task of target words among distraction items, and a forced choice recall trial included as a performance validity index. The parent study did not include the forced choice recall trial, which would have been ideal for inclusion as an embedded performance validity index; however, the Total from the learning trials (Trials 1-5) and

Recognition Discriminability (d') scores from the recognition trial have performed well as embedded validity measure in the prior edition of the test (Millis, Putnam, Adams, and Ricker, 1995; Sweet et al., 2000; Demakis, 2004), and the d' score from the current revision has been included as a useful index in logistic regression-based formulas for detecting invalid performance (Wolfe et al., 2010). The present study will employ cut scores of CVLT-II Total ≤ 34 and CVLT-II $d' \leq 0.81$ as indices of questionable performance validity. These are empirically derived cut scores on the original CVLT (Millis, Putnam, Adams, and Ricker, 1995) and may be applied to the CVLT-II because the two tasks have nearly identical demands. The d' score is essentially a proportion of errors a (sum of misses and false positives divided by total items); it is by definition scaled to the total number of task items, so interpretation of the score should be nearly identical under either task.

Minnesota Multiphasic Personality Inventory—2—Restructured Form. The Minnesota Multiphasic Personality Inventory—2—Restructured Form (MMPI-2-RF; Tellegen and Ben-Porath, 2008; Ben-Porath, 2012) is a 338-item, true-or-false, self-report questionnaire designed to assess personality and psychopathology symptoms. Test duration is about 30-45 minutes. Test items were extracted from the MMPI-2 based on a factor analysis and used to construct ten factor-specific clinical scales and three higher-order clinical scales. The test includes several embedded validity scales designed to detect content-nonresponsive feigning (VRIN-r, TRIN-r) and both faking bad (F-r, Fp-r, Fs, FBS-r) and faking good (L-r and K-r) response styles. The faking bad scales in particular have demonstrated large effect sizes for identifying overreporting in civil forensic settings (Wygant et al., 2011). Because there is no well-validated alternative cut

score for overreported TBI the present study will use the recommended cut scores of F-r ≥ 120, Fp-r ≥ 100, Fs ≥ 100, and FBS-r ≥ 100 from the test manual to determine questionable validity according to the MMPI-2-RF. Specifically, Fp-r and Fs will be used as indicators of psychiatric symptom validity, whereas F-r and FBS-r will be used as indicators of cognitive symptom validity, in accordance with prior research (Gervais, Wygant, Sellbom, and Ben-Porath, 2011; Rogers, Gillard, Berry, and Granacher, 2011).

Miller Forensic Assessment of Symptoms Test. The Miller Forensic Assessment of Symptoms Test (M-FAST; Miller, 2001) is a structured interview designed to detect malingered psychiatric presentations. The 25 items were selected to represent the various approaches to psychiatric malingering described by Rogers (1997). The M-FAST has been validated extensively for use in legal contexts. The cutoff score recommended in the manual demonstrated good specificity (greater than 0.80) and excellent sensitivity (greater than 0.90) in initial validation studies (Miller, 2001). The present study will employ the cutoff score of Total ≥ 6 recommended in the test manual as an indicator of questionable psychiatric symptom validity.

Clinician-Administered PTSD Schedule. The Clinician-Administered PTSD Schedule (CAPS; Blake et al., 1995) is a structured interview for posttraumatic stress disorder, widely considered to be the "gold standard" for PTSD diagnosis. The CAPS first uses a questionnaire to screen for whether the test taker meets Criterion A of the DSM-IV PTSD diagnostic criteria. Test takers who meet Criterion A are interviewed regarding the frequency, intensity, and event-relatedness of symptoms relevant to Criteria B, C, and D of the diagnosis. Final interview questions assess Criterion E (duration of symptoms), Criterion F (functional impairment due to symptoms), and Specifiers

(delayed-onset, chronic, acute) for the diagnosis. Weathers, Ruscio, and Keane (1999) evaluated nine different scoring rules for the CAPS and found all nine rules to demonstrate very good to excellent reliability in two independent administrations. The researchers recommended that the scoring rules, which varied by leniency, be selected and defended according to the clinical or research task at hand. To err on the side of inclusivity because of the possible presence of disruptive, subclinical posttraumatic stress symptoms in the population, the present study will employ the "lenient scoring rule" (frequency ≥ 1 and intensity ≥ 2) to determine the presence of self-reported PTSD symptoms sufficient for a diagnosis.

Analytic Procedure

Pape et al. (2016) reported on the utility of a diagnostic algorithm generated as a part of the parent study. The report did include a brief comparison of two cut scores of the NSI Validity-10 and their effects on performance of the algorithm. The report did not, though, examine the test operating characteristics of the NSI Validity-10 in sufficient detail to cross-validate its use among veterans who screened positive in the TBI clinical reminder. The sample for the present study includes only participants who screened positive for TBI follow-up using the TBI Clinical Reminder. Participants with invalid MMPI-2-RF profiles due to content nonresponsive feigning (VRIN-r ≥ 80 or TRIN -r ≥ 80) were excluded from analyses. For each participant, a Validity-10 score was computed based on NSI data. Test signs on SVTs and PVTs were tallied using the cut scores noted above. For each participant, the number of positive SVT/PVT signs was then totaled within the cognitive symptom/performance domain and within the psychiatric symptom

domain. The number of positive SVT/PVT test signs overall, regardless of domain, was also totaled.

For the first three study objectives, sensitivity and specificity of Validity-10 was computed for the previously studied cut scores of ≥13, ≥19, and >22. These analyses were performed using six different criterion rules to determine questionable validity (QV): production of "one or more" positive test signs in the cognitive domain only, in the psychiatric domain only, or irrespective of domain, and production of "two or more" positive test signs in the cognitive domain only, in the psychiatric domain only, or irrespective of domain. Results were used to select an "optimal" Validity-10 cut score for further analyses. For the fourth study objective, positive and negative predictive values of the optimal Validity-10 cut score were computed under each criterion rule at three realistic benchmark base rates of invalid responding in the population. For the fifth and final study objective, participants were classified by PTSD diagnosis based on self-reported symptoms per the Clinician Administered PTSD Scale (CAPS). Overall accuracy, false positive rate, and false negative rate of the Validity-10 optimal cut score were calculated within PTSD status group under both the "any one" or "any two" rule for QV. To test the statistical significance of differences between these rates across PTSD status, participants were cross-tabulated according to PTSD diagnosis and accurate or inaccurate classification by the optimal Validity-10 cut score under both the "any one" or "any two" positive test sign criterion rules. For each cross-tabulation, a chi-square test was performed to examine the association between reported PTSD symptoms and classification accuracy of Validity-10.

Chapter 4—Results

From the parent study sample of 438 participants, 22 were excluded for content non-responsive feigning indicated by elevation of the VRIN-r or TRIN-r scale of the MMPI-2-RF. One additional participant was excluded for having incomplete neuropsychological data, and a further two participants were excluded for having NSI data entirely missing. Nine participants had missing data for no more than 1 of the 22 NSI items, and those data points were converted to zero to retain the bulk of the data for those individuals while reflecting the lack of endorsement of symptoms for which data were missing. Of the remaining 413 participants, only the 177 who screened positive for TBI using the TBI Clinical Reminder were included in the present analyses, unless otherwise indicated.

The sample (N = 177) was predominantly male (93.8%), with a median age of 27.0 years (M = 30.0; SD = 8.03) and a bimodal distribution of education level, with peaks at 12 years and 14 years (M = 13.5; SD = 1.54). The reported racial/ethnic makeup of the sample was 72.3% white (not Hispanic or Latino), 20.9% Hispanic or Latino, 8.5% Black or African American, 10.2% more than one race/ethnicity, and 9.1% other or unspecified. The mean estimated WAIS-III Full Scale IQ, based on the WTAR, was 102.6 (SD = 8.30).

Table 4.1 shows the computed base rates of questionable validity in the sample as measured by production of either one or two positive test signs on indicators in the cognitive domain, the psychiatric domain, or either/both domains. Across domains, the measured base rate was higher using the laxer criterion of "one or more positive test sign" rather than the more stringent criterion of "two or more positive test signs."

Conversely, regardless of the number of positive test signs chosen, the measured base rate was higher when considering both the cognitive and psychiatric domains together rather than separately. These trends are in line with expectations given the relative stringencies of the criteria employed. For the interested reader, cross-tabulations of single SVT/PVT test signs are provided in Appendix 1.

Table 4.2 displays the computed sensitivity and specificity of each of three proposed Validity-10 cut scores for detecting questionable validity as measured by the various criteria presented above. As expected, a lower cut score generally exhibited higher sensitivity and lower specificity, whereas the reverse was true of a higher cut score. Also as expected, regardless of the cut score, Validity-10 was more sensitive to questionable validity as measured by more stringent criteria. Specificity did not appear to be affected notably by stringency of the criteria for questionably validity. Using the criterion of one or more positive test sign, a cut score of Validity-10 > 22 resulted in excellent specificity and poor sensitivity across domains. A cut-score of Validity-10 ≥ 19 demonstrated high specificity and moderate sensitivity across domains, with sensitivity notably higher for questionable validity in the cognitive domain. A cut-score of Validity-10 ≥ 13 resulted in quite high sensitivity but unacceptably low specificity. Using the more stringent criterion of two or more positive test signs, specificity followed a similar pattern across domains, but sensitivity was higher overall. Sensitivity at a high level of specificity was optimal for a cut score of Validity-10 ≥ 19 overall, reaching a moderately high range of about .55-.60 in the psychiatric and combined domains and nearly perfect range in the cognitive domain.

As explained in the Methods section above, predictive values answer the clinical question of how likely the test result is to give a correct classification. Unlike sensitivity and specificity, predictive values vary along with the base rate. Table 4.3 displays the positive and negative predictive values (PPV and NPV) of the optimal cut score (Validity-10 ≥ 19) at several benchmark base rates of the various criteria for questionable validity. The salient trend is that under all criteria of questionable validity, PPV improved from moderate to moderately high as the benchmark base rates increased toward 50%. NPV diminished slightly from very high to moderately high as base rate increased. The one exception is that NPV for QV defined as two or more positive test signs in the cognitive domain remained excellent across base rates. Predictive values were similar across number of positive test signs required for questionable validity. Predictive values were slightly better for QV in the cognitive domain than those for QV in the combined domains, which in turn were slightly better than those for QV in the psychiatric domain. For the interested reader, cross-tabulations of single SVT/PVT results by Validity-10 test sign (using the cut score Validity-10 ≥ 19) are provided in Appendix 2.

In order to determine whether reported presence of PTSD symptoms influences the test operating characteristics of Validity-10, several accuracy indices were computed separately for those participants who met the lenient CAPS criterion for PTSD and for those who did not. These accuracy indices, presented in Table 4.4, were computed for the optimal Validity-10 cut score (Validity-10 ≥ 19) under both the "Any 1" and "Any 2" criterion rules for QV. Visual examination of these values suggests that the Validity-10 may be more accurate overall and have a lower false positive rate among those without significant reported PTSD symptoms than among those who do report a significant level

of PTSD symptoms. The reverse appears to be true, however, regarding false negative rate. The effects appeared to stand whether using failure of "one or more positive SVT/PVT test sign" or "two or more positive SVT/PVT test signs" as criteria for questionable validity. Overall accuracy and false negative rate did appear to improve somewhat under the more stringent "two or more" criterion.

To test the statistical significance of these between-groups differences follow-up cross-tabulations and Bonferroni-corrected Pearson chi-square tests were performed, treating overall classification errors, false positives, and false negatives separately. Examination of these results in Table 4.5 further clarifies the effects. The differences across PTSD group in total classification accuracy and false positive rate were found to be significant at the $p < .05$ level, even after adjusting for multiple tests. The difference in false negative rate across PTSD groups was not found to be significant at the $p < .05$ level. These results suggest that Validity-10 does perform more poorly among those who report more significant PTSD symptoms, particularly because more false positives for QV are generated in that population. On the other hand, PTSD diagnosed by structured interview did not significantly increase the risk of false negative Validity-10 results, at least among this sample of veterans referred due to a positive TBI screen. The same pattern of effects appeared regardless of whether the "one or more" or "two or more" PVT/SVT failure rule was used to determine QV.

Table 4.1: Base rates of questionable validity by domain and number of positive test signs

Criterion	Base Rate (%)
At least 1 positive:	
Cognitive PVT/SVT	24.3
Psychiatric SVT	24.3
Cognitive or Psychiatric PVT/SVT	34.5
At least 2 positive:	
Cognitive PVTs/SVTs	7.34
Psychiatric SVTs	6.78
Cognitive or Psychiatric PVT/SVT	18.6

Note. The table displays the base rates of questionable response validity found in the study sample using several different criteria for questionable response validity. PVT = performance validity test; SVT = symptom validity test.

Table 4.2: Sensitivity and specificity of Validity-10 by cut score and criterion

	Validity-10 ≥ 13		Validity-10 ≥ 19		Validity-10 > 22	
	SENS	SPEC	SENS	SPEC	SENS	SPEC
At least 1 positive:						
Cognitive PVT/SVT	76.7	63.4	55.8	86.6	23.3	94.8
Psychiatric SVT	65.1	59.7	41.9	82.1	20.9	94.0
Cognitive or Psychiatric PVT/SVT	70.5	66.4	44.3	87.1	19.7	95.7
At least 2 positive:						
Cognitive PVT/SVT	100	57.9	92.3	81.7	46.2	93.3
Psychiatric SVT	91.7	57.0	58.3	78.8	33.3	92.1
Cognitive or Psychiatric PVT/SVT	78.8	61.1	57.6	84.0	30.3	95.1

Note. Sensitivity and specificity are reported as percentages. SENS = sensitivity; SPEC = specificity. PVT = performance validity test; SVT = symptom validity test.

Table 4.3: Predictive values of Validity-10 (≥ 19) at varying base rates

	Base Rate = .20		Base Rate = .30		Base Rate = .40	
	PPV	NPV	PPV	NPV	PPV	NPV
At least 1 positive:						
Cognitive PVT/SVT	51.0	88.7	64.0	82.1	73.5	74.6
Psychiatric SVT	36.9	86.0	50.0	76.7	60.9	67.9
Cognitive or Psychiatric PVT/SVT	46.1	86.2	59.5	78.5	69.5	70.1
At least 2 positive:						
Cognitive PVT/SVT	55.8	97.7	68.4	96.1	77.1	94.1
Psychiatric SVT	40.7	88.3	54.1	81.5	64.7	73.9
Cognitive or Psychiatric PVT/SVT	47.4	88.8	60.7	82.2	70.6	74.8

Note. Predictive values are reported as percentages. PPV = positive predictive value; NPV = negative predictive value; PVT = performance validity test; SVT = symptom validity test.

Table 4.4, Panels a-b: Validity-10 accuracy rates by PTSD status

(a) Validity-10 accuracy rates by PTSD status using "Any 1" QV criterion

	Overall Accuracy	False Positive Rate	False Negative Rate
No PTSD	84.62	3.64	80.00
PTSD	65.17	21.31	50.98
Total	72.31	12.93	55.74

(b) Validity-10 accuracy rates by PTSD status using "Any 2" QV criterion

	Overall Accuracy	False Positive Rate	False Negative Rate
No PTSD	93.85	3.28	50.00
PTSD	70.54	25.30	41.38
Total	79.10	15.97	42.42

Note. '"Any 1" rule' denotes use of one or more positive test sign on symptom validity and performance validity tests as the criterion for questionable response validity. '"Any 2" rule' denotes use of two or more positive test signs on symptom validity and performance validity tests as the criterion for questionable response validity. PTSD = post-traumatic stress disorder criteria met per CAPS lenient criterion.

Table 4.5, Panels a-f: Cross-tabulations and tests of Validity-10 accuracy by PTSD status

(a) Validity-10 overall accuracy ("Any 1" rule) by PTSD status

	Validity-10 and Criterion Concordant	Validity-10 and Criterion Discrepant	Totals	χ^2	*p* value
No PTSD	55	10	65		
PTSD	73	39	112		
Totals	128	49	177		
				7.76	.005*

(b) Validity-10 overall accuracy ("Any 2" rule) by PTSD status

	Validity-10 and Criterion Concordant	Validity-10 and Criterion Discrepant	Totals	χ^2	*p* value
No PTSD	61	4	65		
PTSD	79	33	112		
Totals	140	37	177		
				13.52	< .001*

(c) Validity-10 false positives by PTSD status among non-QV participants ("Any 1" rule)

	Validity-10 True Negative	Validity-10 False Positive	Totals	χ^2	*p* value
No PTSD	53	2	55		
PTSD	48	13	61		
Totals	101	15	116		
				8.03	.005 *

Table 4.5, Panels a-f (Continued)

(d) Validity-10 false positives by PTSD status among non-QV participants ("Any 2" rule)

	Validity-10 True Negative	Validity-10 False Positive	Totals	χ^2	*p* value
No PTSD	59	2	61		
PTSD	62	21	83		
Totals	121	23	144		
				12.71	< .001 *

(e) Validity-10 false negatives by PTSD status among QV participants ("Any 1" rule)

	Validity-10 True Positive	Validity-10 False Negative	Totals	χ^2	*p* value
No PTSD	2	8	10		
PTSD	25	26	51		
Totals	27	34	61		
				2.85	.091

(f) Validity-10 false negatives by PTSD status among QV participants ("Any 2" rule)

	Validity-10 True Positive	Validity-10 False Negative	Totals	χ^2	*p* value
No PTSD	2	2	4		
PTSD	17	12	29		
Totals	19	14	33		
				.017	.744

Note. '"Any 1" rule' denotes use of one or more positive test sign on symptom validity and performance validity tests as the criterion for questionable response validity. '"Any 2" rule' denotes use of two or more positive test signs on symptom validity and performance validity tests as the criterion for questionable response validity. PTSD = post-traumatic stress disorder criteria met per CAPS lenient criterion. *significant at $p <$ .05, one-tailed, Bonferroni-corrected for familywise error across six tests.

Chapter 5—Discussion

Primary Findings

The present study employed a modified known-groups design and a clinically relevant sample of veterans in the VHA system to cross-validate the Validity-10 for detecting questionable response validity (QV) among veterans being evaluated for mild TBI. Primarily, the study sought to estimate the sensitivity and specificity of Validity-10 to QV at several suggested cut scores and, in turn, to estimate the positive and negative predictive values of the best performing cut score under several realistic benchmark base rates. Results suggested that under more stringent criteria for questionable validity, a cut score of Validity-10 ≥ 19 exhibited good specificity and moderate to moderately high sensitivity for QV regardless of whether psychiatric or cognitive symptom report or performance were invalid. Predictive values demonstrated that use of the Validity-10 ≥ 19 cut score at several realistic benchmark base rates presented a modest improvement in negative predictive value and a substantial improvement in positive predictive value, versus simply assuming valid performance and symptom report (i.e., "going with the base rate").

Broadly speaking, these findings are in line with the growing consensus that Validity-10 performs well as an SVT (Vanderploeg et al., 2014; Lange et al., 2015; Lange et al., 2016). At a finer level of detail, the present findings differ from prior research in notable ways. First, Vanderploeg et al. (2014) recommended a cut score of Validity-10 > 22, which in that study exhibited moderately high sensitivity and high specificity. That cut score indeed showed excellent specificity in the present study, but sensitivity was unacceptably low (.20 - .30) in most domains. Vanderploeg et al. (2014)

employed only one criterion measure (Personality Assessment Inventory – Negative Impression Management; PAI-NIM), which was primarily a psychiatric SVT. Lange et al. (2015) reported moderately high sensitivity and excellent specificity, albeit for a cut score of Validity-10 ≥ 13, using 8 of the 10 MMPI-2-RF validity scales as criterion measures. That cut score exhibited quite high sensitivity in the present study (> .65), but specificity was unacceptably low (.55 - .70). The criterion measures employed in that study were representative of both the psychiatric and cognitive symptom domains but were limited to the MMPI-2-RF and included no stand-alone SVT-PVTs. Finally, Lange et al. (2016) replicated the Vanderploeg et al. (2014) study in a sample of veterans, using the PAI-NIM as the sole criterion measure and recommended a cut score of Validity-10 ≥ 19, which displayed moderately high sensitivity and very high specificity. The present findings nearly exactly replicate that recommended cut score and its operating characteristics, with the added benefit of multiple SVT/PVT modalities in both the cognitive and psychiatric domains.

Moreover, the present study found that utility of the Validity-10 was highest (sensitivity nearly perfect) for QV cognitive symptoms and performance, whereas sensitivity to QV psychiatric symptoms was more moderate. This disparity does not appear to have been identified or studied before the present study. Although one study (Lange et al., 2015) did include criterion measures of both psychiatric and cognitive symptom validity, the analyses did not distinguish between psychiatric and cognitive QV. The other two studies (Vanderploeg et al., 2014; Lange et al., 2016) relied only upon a measure of psychiatric symptom validity as a criterion measure. Unfortunately, there are no prior results with which to compare the present finding of surprisingly good

performance of Validity-10 for detecting strictly cognitive QV. If that effect is non-spurious, future validation studies will only be able to replicate it if care is taken to distinguish between cognitive and psychiatric QV. Be that as it may, even the relatively weaker predictive values for QV psychiatric symptoms in the present findings did indicate a modest improvement over assuming valid psychiatric symptom report, suggesting that use of Validity-10 where only the authenticity of psychiatric symptoms is in question would be preferable to—and would at least cause no more harm than—"going with the base rate." Indeed, perhaps unintentionally, detection of psychiatric QV has the strongest research support in the current Validity-10 literature.

Given that within the VHA system there is often a question of comorbid PTSD symptomatology during evaluations for mild TBI, the present study sought to determine whether such symptoms might affect the utility of Validity-10 in those evaluations. The findings suggest that regardless of the stringency of criteria for QV, the presence of PTSD symptoms was associated with an increase in false positive identification by Validity-10. These findings suggest that individuals who report significant traumatic stress symptoms are more likely to produce a positive SVT/PVT sign. There exists the possibility that production of positive test signs represents "false positive" activity in which SVT/PVTs are unduly sensitive to genuine symptoms. Conversely, there exists the alternative possibility that those who report PTSD symptoms do fake bad, and do so in such a manner that they are more difficult to detect with SVT/PVTs. The present study does not allow for conclusion in one direction more than the other. Perhaps both phenomena are at work. Nonetheless, the present findings suggest that the presence of reported PTSD symptoms can affect the test operating characteristics of Validity-10, and

further studies would be required to better characterize the effect. If the latter case is true—that individuals reporting more PTSD symptoms are more likely faking bad—then future studies should explore using more sensitive SVT/PVTs (or more sensitive cut scores) as criterion indicators for QV. To date, no validation study of Validity-10 has attempted to measure the effect of PTSD symptoms on test operating characteristics.

Limitations

Use of a known groups design in this study raises concerns about internal validity. There was no experimental manipulation of participants' response styles, thus there can be no comparison of performance before and after a manipulation, nor across groups who performed under only one experimental condition. The observational nature instead limits us to an approximation of response style as a quasi-experimental "condition" identified using post-hoc criteria. The trade-off in using a known groups design is the gain in external validity. The participants are part of the real-world population under study. They do not simulate response styles; they merely have them. Where the simulation design introduces an additional assumption in asking participants to take on a response style to better control the experimental condition, the known groups design elects to take advantage of real-world expression of response styles, introducing the assumption of accurate identification of those response styles down the line. Still, the criticism carries weight. Thus, best practice for validation of SVT/PVTs is to perform both types of study and to critically evaluate the results at a meta-analytic level. Validation of the NSI Validity-10 would benefit from further studies following a clinically enhanced simulation design, in which the performance of honest performers with mild TBI diagnoses is

compared with the performance of participants without mild TBI instructed to simulate mild TBI symptoms.

The present study was an attempt to improve on past studies by including as criterion measures several SVT/PVTs in both the cognitive and psychiatric domains. On this front, though, the study would have been improved had the criterion SVT/PVTs been more standard and better validated. Because the data for the study were drawn from a pre-existing clinical research study, the choice of criterion measures was limited to instruments administered in the parent study. Moreover, the present study fell prey to a practical problem often found in secondary data analysis—that despite more ideal measures having been administered (e.g. CVLT-II Forced Choice), the data from those measures were not available in the database simply because they were not of primary interest in the parent study. Original records were inaccessible due to variable information security practices across the multiple VA sites, and so substitute measures were identified. On one hand, it is true that a prospective study designed from scratch to answer the research questions would have been ideal; on the other hand, accepting some trade-offs allowed examination of test operating characteristics in a highly relevant clinical sample. To abandon the analysis because of an unwillingness to adapt would have been an opportunity lost. Such is the reality of secondary data analysis in clinical research.

Another limitation of the present study is that the choice of the "lenient" criteria for PTSD diagnosis on the CAPS was somewhat arbitrary. This is both true and unavoidable. A trivial point is that neither the "moderate" nor the "strict" criteria would have been less arbitrary. The rationale behind employing the lenient criteria was that the

presence of considerable traumatic stress symptoms, even if PTSD criteria were not fully met, may affect the results on tests sensitive to mild TBI symptoms. If that is the case, it would be prudent to err on the side of including those subclinical cases. The balance is that the traumatic stress reported must have been "considerable" and exist across symptom domains in the first place to meet even the lenient criterion. The decision admittedly leaves the researcher in the unenviable position of inheriting the designation of "diagnosed PTSD" from the research instrument. To be entirely clear, in the present study, the "PTSD symptoms present" group was not intended to represent individuals who would meet criteria for a PTSD diagnosis after thorough interview. Indeed, the high base rate of "PTSD symptoms present" in the study sample is evidence that the criteria are too lenient for use in clinical diagnosis. For use in the present research context, they suffice.

Recommendations

The present study was from the beginning intended to address a specific clinical need. Evaluation for mild TBI within the VHA should include symptom and performance validity testing both because of the often vague and nonspecific nature of mild TBI symptoms and because of the unique incentive structure that very nearly guarantees the presence of an opportunity for secondary gain. Currently in the VHA, SVT/PVTs are only administered during neuropsychological evaluation, which itself only occurs based on a secondary referral from a TBI physician or as a part of the compensation and pension process. Thus, there is no process for early identification of questionable response validity that would generate a referral to a neuropsychologist for clarification. Based on the present findings, we recommend the use of the Validity-10, at a cut score of

greater than or equal to 19, to generate a referral for neuropsychological testing (including SVT/PVTs) to clarify whether the response style is invalid or valid. Implementation of the recommendation would require the TBI physician or medical staff to total the Validity-10 items from the NSI, which is already completed at the TBI physician evaluation. It is critical, to reduce prejudicial treatment of veterans who screen positive for questionable response validity on the Validity-10, that all providers involved be properly educated such that a positive result is not equated with malingering or "gaming the system," but is instead treated as an inconclusive test result referred out for clarificatory testing.

The present study generated several recommendations for research as well. Based on an equivocal effect of reported PTSD symptoms on the false positive rate of the Validity-10, future studies may better characterize the effect in various ways. For example, using well validated psychiatric SVTs or more rigorous diagnostic procedures may help determine whether the symptoms that drive the effect are genuine. If the effects do appear to be genuine, then perhaps some honing of the SVT/PVTs used in the present study may be in order. It is further recommended, based on the strong performance of Validity-10 for detecting cognitive QV, that future validation studies distinguish between cognitive and psychiatric domains of response validity, so that any true effect may be replicated. Finally, though the initial validation of the NSI Validity-10 has now been replicated by independent research teams in independent samples, there is still much validation work left to be done. For example, prior validation studies relied either on too few criterion SVTs or on wholly psychiatric-domain criterion SVTs. None included PVTs. Though the present study represents a step forward in more comprehensively

validating the measure, it would be ideal to replicate and extend the findings with a variety of criterion measures across domains and modalities.

Chapter 6—Conclusion

This dissertation presented a cross-validation of the Validity-10 embedded symptom validity indicator from the Neurobehavioral Symptom Inventory (NSI) for the detection of questionable response validity during evaluation for mild traumatic brain injury (TBI). Secondary analysis based on a multi-site, parent study estimated the test operating characteristics of Validity-10, using NSI results gathered during the VHA TBI evaluation, and using results on several other measures of symptom and performance validity from a clinical research battery as criteria for questionable response validity. Sensitivity of Validity-10 to questionable validity was moderately high (.60 - .70) to excellent (.90 - 1.00) at high levels of specificity (> .80). Examination of predictive value at different base rates of and using different criteria for questionable validity supported a recommendation to use a cut score of Validity-10 ≥ 19 to generate clarificatory referral to VHA neuropsychologists. Chi-square analyses to determine the effect of PTSD symptoms on the utility of Validity-10 demonstrated classification accuracy in general, and false positive rate in particular, is relatively poorer when used with individuals who reported significant PTSD symptoms. Overall, these findings support the use of Validity-10 (at cut score Validity-10 ≥ 19) to identify those veterans being evaluation for mild TBI in the VA system who should be referred for comprehensive secondary evaluation by a clinical neuropsychologist using multiple forms of symptom and performance validity testing. Also recommended were further studies of the effects of PTSD symptoms on the accuracy of Validity-10 and studies of the differential performance for detecting questionable response validity in the cognitive domain.

Appendix 1: Cross-tabulations of criterion SVT/PVT test signs

	CVLT-II Recog (-)	CVLT-II Recog (+)	Totals
LMT (-)	149	3	152
LMT (+)	22	3	25
Totals	171	6	177

	CVLT-II 1-5 (-)	CVLT-II 1-5 (+)	Totals
LMT (-)	143	9	152
LMT (+)	19	6	25
Totals	162	15	177

	MMPI-2-RF F-r (-)	MMPI-2-RF F-r (+)	Totals
LMT (-)	145	7	152
LMT (+)	21	4	25
Totals	166	11	177

	MMPI-2-RF FBS (-)	MMPI-2-RF FBS (+)	Totals
LMT (-)	150	2	152
LMT (+)	23	2	25
Totals	173	4	177

	MMPI-2-RF Fp-r (-)	MMPI-2-RF Fp-r (+)	Totals
LMT (-)	144	8	152
LMT (+)	20	5	25
Totals	164	13	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
LMT (-)	144	8	152
LMT (+)	20	5	25
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
LMT (-)	131	21	152
LMT (+)	15	10	25
Totals	146	31	177

	CVLT-II 1-5 (-)	CVLT-II 1-5 (+)	Totals
CVLT-II Recog (-)	143	9	152
CVLT-II Recog (+)	19	6	25
Totals	162	15	177

	MMPI-2-RF F-r (-)	MMPI-2-RF F-r (+)	Totals
CVLT-II Recog (-)	145	7	152
CVLT-II Recog (+)	21	4	25
Totals	166	11	177

	MMPI-2-RF FBS (-)	MMPI-2-RF FBS (+)	Totals
CVLT-II Recog (-)	150	2	152
CVLT-II Recog (+)	23	2	25
Totals	173	4	177

	MMPI-2-RF Fp-r (-)	MMPI-2-RF Fp-r (+)	Totals
CVLT-II Recog (-)	144	8	152
CVLT-II Recog (+)	20	5	25
Totals	164	13	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
CVLT-II Recog (-)	162	9	171
CVLT-II Recog (+)	2	4	6
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
CVLT-II Recog (-)	131	21	152
CVLT-II Recog (+)	15	10	25
Totals	146	31	177

	MMPI-2-RF F-r (-)	MMPI-2-RF F-r (+)	Totals
CVLT-II 1-5 (-)	152	10	162
CVLT-II 1-5 (+)	14	1	15
Totals	166	11	177

	MMPI-2-RF FBS (-)	MMPI-2-RF FBS (+)	Totals
CVLT-II 1-5 (-)	159	3	162
CVLT-II 1-5 (+)	14	1	15
Totals	173	4	177

	MMPI-2-RF Fp-r (-)	MMPI-2-RF Fp-r (+)	Totals
CVLT-II 1-5 (-)	150	12	162
CVLT-II 1-5 (+)	14	1	15
Totals	164	13	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
CVLT-II 1-5 (-)	153	9	162
CVLT-II 1-5 (+)	11	4	15
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
CVLT-II 1-5 (-)	138	24	162
CVLT-II 1-5 (+)	8	7	15
Totals	146	31	177

	MMPI-2-RF FBS (-)	MMPI-2-RF FBS (+)	Totals
MMPI-2-RF F-r (-)	163	3	166
MMPI-2-RF F-r (+)	10	1	11
Totals	173	4	177

	MMPI-2-RF Fp-r (-)	MMPI-2-RF Fp-r (+)	Totals
MMPI-2-RF F-r (-)	160	6	166
MMPI-2-RF F-r (+)	4	7	11
Totals	164	13	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
MMPI-2-RF F-r (-)	159	7	166
MMPI-2-RF F-r (+)	5	6	11
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
MMPI-2-RF F-r (-)	141	25	166
MMPI-2-RF F-r (+)	5	6	11
Totals	146	31	177

	MMPI-2-RF Fp-r (-)	MMPI-2-RF Fp-r (+)	Totals
MMPI-2-RF FBS (-)	160	13	173
MMPI-2-RF FBS (+)	4	0	4
Totals	164	13	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
MMPI-2-RF FBS (-)	161	12	173
MMPI-2-RF FBS (+)	3	1	4
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
MMPI-2-RF FBS (-)	143	30	173
MMPI-2-RF FBS (+)	3	1	4
Totals	146	31	177

	MMPI-2-RF Fs-r (-)	MMPI-2-RF Fs-r (+)	Totals
MMPI-2-RF Fp-r (-)	159	9	164
MMPI-2-RF Fp-r (+)	9	4	13
Totals	164	13	177

	M-FAST (-)	M-FAST (+)	Totals
MMPI-2-RF Fp-r (-)	140	24	164
MMPI-2-RF Fp-r (+)	6	7	13
Totals	146	31	177

	M-FAST (-)	M-FAST (+)	Totals
MMPI-2-RF Fs-r (-)	138	26	164
MMPI-2-RF Fs-r (+)	8	5	13
Totals	146	31	177

Appendix 2: Cross-tabulation of SVT/PVT test signs by Validity-10 test signs

	Validity-10 (-)	Validity-10 (+)	Totals
LMT (-)	125	27	152
LMT (+)	10	15	25
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
CVLT-II Recog (-)	134	37	171
CVLT-II Recog (+)	1	5	6
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
CVLT-II 1-5 (-)	130	32	162
CVLT-II 1-5 (+)	5	10	15
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
MMPI-2-RF F-r (-)	132	34	166
MMPI-2-RF F-r (+)	3	8	11
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
MMPI-2-RF FBS (-)	133	40	173
MMPI-2-RF FBS (+)	2	2	4
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
MMPI-2-RF Fp-r (-)	128	36	164
MMPI-2-RF Fp-r (+)	7	6	13
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
MMPI-2-RF Fs-r (-)	131	33	164
MMPI-2-RF Fs-r (+)	4	9	13
Totals	135	42	177

	Validity-10 (-)	Validity-10 (+)	Totals
M-FAST (-)	116	30	146
M-FAST (+)	19	12	31
Totals	135	42	177

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VITA

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Prior Education

2010	**M.S.**	Clinical Psychology Concentration: Clinical Neuropsychology	University of Kentucky Cumulative GPA 4.0/4.0
2007	**B.A.**	Philosophy Diploma awarded *magna cum laude* and with honors	DePauw University Cumulative GPA 3.8/4.0

Professional Positions

Jul 2015—
Jun 2017

University of Kentucky Internship Consortium — Lexington, KY

Department of Psychology, University of Kentucky
106-B Kastle Hall
(859)-323-8487
Position: **Clinical Psychology Intern**
Rotations: **Eastern State Hospital** (Jan-Jun 2017), **UK Orofacial Pain Clinic** (Jul-Dec 2016), **UK Counseling Center** (Jan-Jun 2016), **Cardinal Hill Rehabilitation Hospital** (Jul-Dec 2015)

Jul 2013—
May 2015

Center on Drug and Alcohol Research — Lexington, KY

University of Kentucky College of Medicine
(859) 323-5000
Position: **Research Assistant**

Jul 2013—
Jun 2014

Kentucky Neuroscience Institute — Lexington, KY

Departments of Neurology/Neurosurgery
University of Kentucky Chandler Hospital
(859) 257-1000
Position: **Neuropsychology Extern**

Aug 2012—
Oct 2012

Eastern State Hospital — Lexington, KY

627 W 4th Street
(859) 246-7000
Position: **Psychology Extern**

Jul 2011—
Jun 2012

Jesse G. Harris, Jr. Psychological Services Center — Lexington, KY

University of Kentucky
644 Maxwelton Court
(859) 257-6853
Positions: **Assistant Director, Therapist** (Aug 2009—Dec 2013)

May 2009—
Jun 2011

Veterans Affairs Medical Center — Lexington, KY

Clinical Neuropsychology Service
Polytrauma Department
1101 Veterans Drive

(859) 281-4927
Position: **Neuropsychology Research Assistant**

May 2009— Jun 2011 & Sep 2007— Aug 2008 **Univ. of Kentucky Dept. of Physical Medicine & Rehab.** Lexington, KY
Cardinal Hill Rehabilitation Hospital
2050 Versailles Road
(859) 254-5701
Position: **Neuropsychology Extern and Research Assistant**

Scholastic and Professional Honors

2014	Recipient of the Jesse G. Harris, Jr. Dissertation Award, Department of Psychology, University of Kentucky, for outstanding dissertation proposal in the clinical psychology doctoral program ($1000).
2013	Recipient of the Excellence in Clinical Performance Award, Department of Psychology, University of Kentucky, for more than 300 hours of service at the Jesse G. Harris, Jr. Psychological Services Center.
2012	Recipient of the Outstanding Scientist-Practitioner Award, Department of Psychology, University of Kentucky, for commitment to empirically supported treatment, leadership, productivity, and professionalism as a doctoral student in the clinical psychology program.
2010	Phi Kappa Phi honor society, nominated member.
2008 – 2011	Recipient of the Daniel R. Reedy Quality Achievement Fellowship Award, University of Kentucky Graduate School ($3000, renewable).
2007 – curr.	Phi Beta Kappa honor society, nominated member, Indiana Alpha chapter.
2007	Diplomate of the Media Fellows Program, DePauw University.
2007	Diplomate of the Information Technology Associates Program, DePauw University.
2007	Diplomate of the Honor Scholar Program, DePauw University.
2003 – 2007	Recipient of Rector Scholarship, DePauw University (full tuition, 4 years).
2003 – 2007	Recipient of Robert C. Byrd Honors Scholarship. US. Department of Education ($1500, renewable).

Professional Publications

Berry, D.T.R., **Harp**, J.P., Mason, L.H., & Combs, H.L. (2017). Applying diagnostic accuracy standards to performance validity tests (Invited book chapter). In Bowden (ed.), *Neuropsychological Assessment in the Age of Evidence-Based Practice*. Oxford.

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Shandera, A.L., Berry, D.T.R., Clark, J.A., Schipper, L.J., Graue, L.O., and **Harp**, J.P. (2010). Detection of malingered mental retardation. *Psychological Assessment*, *22*(1), 50-56.