THE INFLUENCE OF MEASUREMENT CONTEXT ON VETERANS' CONSISTENCY IN REPORTING POSTTRAUMATIC STRESS DISORDER AND POSTCONCUSSIVE SYMPTOMS

by

Lynnette Astrid Averill

A dissertation submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Educational Psychology

The University of Utah

August 2013

The University of Utah Graduate School

STATEMENT OF DISSERTATION APPROVAL

The dissertation of **Lynnette Astrid Averill**

has been approved by the following supervisory committee members:

John Kircher	, Chair	**5/28/2013** Date Approved
Jennifer Romesser	, Member	**5/28/2013** Date Approved
Zac Imel	, Member	**5/28/2013** Date Approved
Steven Allen	, Member	**5/28/2013** Date Approved
Patricia Kerig	, Member	**5/28/2013** Date Approved

and by **Elaine Clark** , Chair of the Department of **Educational Psychology**

and by Donna M. White, Interim Dean of The Graduate School.

ABSTRACT

Within the Veterans Affairs Health Care System, posttraumatic stress disorder (PTSD) is routinely assessed in both mental health settings, including PTSD specialty clinics, and medical settings such as polytrauma clinics. To date, no empirical studies have been published that investigate the influence of contextual factors on measures such as the PTSD Checklist (PCL) when administered in different settings on separate, distinct occasions. Further, little is known about the impact on commonly used assessment measures when traumatic brain injury (TBI) and PTSD co-occur and what, if any, influence contextual factors have on veterans' endorsement of symptoms or their consistency in reporting the shared or overlapping symptoms. The present study conducted a systematic evaluation of the influence of measurement context on self-reported postconcussive and PTSD symptoms. Specifically, analyses focused on the consistency of reported symptoms across questionnaires and settings. Additionally, the influence of measurement occasion and context on PTSD symptom reporting within medical and mental health contexts was explored.

Data from 713 Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) veterans was collected from retrospective medical chart reviews. Results indicated moderate to strong correlations between similar items measuring sleep, concentration, irritability, and loss of interest on the PCL, Neurobehavioral Symptom Inventory (NSI), and Patient Health Questionnaire (PHQ) and revealed no significant effect of context on item-level reporting. A fixed effects repeated measures ANOVA revealed no effect of measurement occasion and

a two-period cross-over analysis revealed no evidence of differential carryover (e.g., there was no context X occasion interaction). However, the influence of context was significant and accounted for 12% of the variance in PCL scores. PCL mean scores were higher in the mental health setting (63.64) than the medical setting (58.37).

This is the first study to the author's knowledge that investigated what, if any, differences are noted on PCL scores when administered in contextually different settings on distinct measurement occasions. Results suggest that self-reports of the severity of PTSD symptoms depend on whether the individual completes the PCL in a mental health (PTSD) or medical (polytrauma) context. Given the large numbers of recently returning OEF/OIF/OND veterans and the high prevalence rates of co-occurring PTSD and mild TBI, these results call for continued investigation of the reliability of commonly used assessment measures when administered in different contexts, and when diagnoses, especially those with many shared symptoms are co-occurring. Optimizing assessment protocols can help ensure accurate diagnosis and effective intervention, ultimately improving the overall quality of care for veterans.

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGMENTS

My outstanding supervisory committee, Drs. John Kircher, Jennifer Romesser, Zac Imel, Steve Allen, and Patricia Kerig, deserve my highest praise for their thoughtful guidance, constructive critiques, and unwavering support throughout the dissertation process. To John, my committee chair, my utmost appreciation for all the time you have spent providing advice, statistical wisdom and wizardry, and encouragement. You have been truly wonderful to work with and I can't thank you enough for chairing the committee and for your help in all areas of the project. To Jen, thank you for your mentorship, for entrusting me with your data, and for working with me to overcome the hurdles of data collection from states away.

To my dear friends, Brett and Katie, your ability to take my mind out of work mode so I could relax, unwind, and laugh helped me stay balanced (and probably sane) throughout this long process! I can't thank you enough for your friendship, support, encouragement, and so much more. Thank you also for being there on "D-Day" with balloons and banners, dinner and accomodation, and of course, some much-beloved pirate garb. *Aaaarrrr Mateys!*

To my family, I don't really know what to say other than thank you. There are no words to express how lucky and blessed I am to have you in my world. Your never-ending love and support have been incredible and invaluable. I am beyond grateful for you every single day and I love you all to bits.

To my husband, Christopher, there is so much I would like to say and yet I can't find any words that begin to express myself. You are everything to me, and

without you, none of the rest matters. You are my saint, my king, and truly the magic that holds the sky up. Every day, your support, encouragement, and love are more deep and meaningful than I can believe. Your help in all things, from the technical to the academic to the emotional, build me up, keep me strong and laser-focused, and ensure that even the scariest journeys will stay safe. You are ever my champion and advocate, a source of hope and happiness, and the Light in the darkness. With your hand in mine, I know I can walk any path. I love you more than words can say and I am so lucky and grateful that you have been and continue to be my very best friend and true love. I absolutely can't wait to start our next adventure together!

To my mother, who was the most persistent, determined, and courageous person I ever had the pleasure of knowing, I dedicate this project and my advanced education to you. Every day she instilled in me the value of education, the necessity of striving for excellence, never to settle for mediocrity, and to continue reaching toward my dreams no matter the obstacles that may arise. Her life was proof that all bumps in the road, whether mole hill or mountain, can be overcome with faith and determination. The warmth of her smile and her jubilant laugh live on still in my heart, reminding me that hard work and dedication to a goal must be always accompanied by love and laughter to balance the soul.

Howard Thurman once said, "Don't ask yourself what the world needs, ask yourself what makes you come alive and go and do that, because what the world needs is people who have come alive." To all of you mentioned above, and to all of those I couldn't acknowledge in this brief space. You have my most sincere appreciation for the many ways, both big and small, that you help me to 'come alive.'

INTRODUCTION

Posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI) have received unprecedented public attention and clinical focus since the start of the current wars in the Middle East. These conditions have become known as the "signature injuries" of these wars due to high prevalence rates among returning military service members and veterans (Hoge et al., 2004, Sayer et al., 2008; Tanielian & Jaycox, 2008). Despite the vast amounts of empirical literature that have accumulated in the past decade examining various aspects of PTSD and TBI, there is a notable lack of research that evaluates the utility and effectiveness of commonly used assessment measures for these conditions when they co-occur (Carlson et al., 2009; Spoont et al., 2013). The assessment of either of these disorders can be challenging due to retrospective reporting biases, recall error, potential difficulties linking symptoms to specific etiological events (Brenner, Vanderploeg, & Terrio, 2009; Carlson et al., 2011; Ulloa, Marx, Vanderploeg, & Vasterling, 2012) and the lack of a definitive method to diagnose mild TBI (mTBI) in the post-acute or chronic phase (Vanderploeg & Belanger, 2013). The challenge and complexity increases significantly when both PTSD and TBI (particularly mTBI, also referred to as concussion) are diagnostic possibilities, as the two often have considerable overlap with respect to both etiological event(s) and symptom presentation.

Determining whether or not an individual currently meets diagnostic criteria for PTSD or has a history of TBI is typically possible, although the accurate attribution of all current symptoms can be far more complicated (Bryant, 2001;

Stein & McCallister, 2009; Ulloa, Marx, Vanderploeg, & Vasterling, 2012). Current evidence-based practices to screen for PTSD, a history of mTBI, and persistent cognitive, affective, and somatic/sensory symptoms or "postconcussive" symptoms (PCS) may be less accurate or effective if and when the conditions co-occur (Carlson et al., 2009). Additionally, due to cultural differences in reporting style (Osterman & de Jong, 2007) or stigma associated with having a mental health diagnosis (e.g., Brenner, Vanderploeg, & Terrio, 2009; Hoge et al., 2004; Kilbourne, Keyser, & Pincus, 2010), it is possible that contextual factors relating to the assessment instruments and/or measurement environment in which the assessment is being conducted may influence veterans' endorsement of symptoms (Ulloa, Marx, Vanderploeg, & Vasterling, 2012).

This lack of knowledge and evidence raises concern as research suggests that the use of valid and reliable assessment measures may not, in and of itself, ensure the quality of the data obtained (Bradley et al., 2010; Hawkins et al., 2007). Potentially flawed assessment methodology and related poor quality data can have considerable consequences for veterans as the diagnoses they are given directly influence the type of treatment(s) they receive and treatment prognosis, the compensation and pension benefits they are eligible for, and their views and beliefs about themselves. Significant consequences also exist for care providers, treatment programs, payers, and other stakeholders in the service of providing care and improving outcomes for veterans (Kilbourne, Keyser, & Pincus, 2010). The present study examines the influence of context (e.g., medical or mental health setting) and overall assessment objective (e.g., seemingly medical or mental health-based questions) on veterans' consistency in reporting the, often commingled, symptoms of PTSD and PCS.

The following literature review provides a brief description of military

background; prevalence rates, definitions, and diagnostic criteria for PTSD, mTBI, and PCS; a discussion of the symptom overlap between the conditions; information regarding the VA's integration of mental health services into primary care settings and the creation of the Polytrauma System of Care; brief introductions to measurement-based care and discordance analysis; and a description of the specific research questions.

Military Background

The ongoing military operations in Iraq and Afghanistan are the first sustained ground combat undertaken by the United States since the war in Vietnam. Since October 2001, more than two million U.S. military troops have deployed to the Middle East in support of Operation Enduring Freedom (OEF; primarily in Afghanistan), Operation Iraqi Freedom (OIF; primarily in Iraq) and Operation New Dawn (OND; U.S. military involvement in Iraq since September 2010). Many of these military troops have been exposed to prolonged periods of intense combat-related stress and traumatic events and approximately 37% of these service members have been deployed two or more times (Litz & Schlenger, 2009; Tanielian & Jaycox, 2008). High rates of exposure to specific types of combat trauma are common among OEF/OIF/OND veterans. Studies suggest between 40% (Tanielian & Jaycox) and 90% (Hoge et al., 2004) of those deployed to the Middle East report exposure to dead bodies and/or receiving enemy fire, and between 50% and 80% report having a friend who was seriously injured or killed. The pace and nature of the deployments in these current conflicts is unprecedented in the history of our nation's military force (Belasco, 2007; Bruner, 2006). Not only are higher proportions of the armed forces being deployed, including Reservists and National Guard, but deployments

have been longer, redeployment to combat has been common, and breaks between deployments have been infrequent (Hosek, Kavanagh, & Miller, 2006). Further, an "urban warfare" setting like many seen across Iraq and Afghanistan can be especially stressful and present unique challenges (Hoge et al., 2004; NCPTSD, 2010; Tanielian & Jaycox, 2008). Urban warfare is notorious for complicating operational planning, command, control, and communications for numerous reasons. Combatants are harder to identify, civilians are often densely populated, increasing the risk for civilian casualties, and the urban environmental terrain is markedly different from combat in a more open and defined theater of operations (Johnson, Markel, & Shannon, 2012).

Despite extended periods of intense combat, these wars have produced significantly lower casualty rates of killed or wounded than in earlier conflicts, such as Vietnam, Korea, or the World Wars (Tanielian & Jaycox, 2008). Fewer penetrating brain, abdominal, and thoracic injuries are sustained compared to prior conflicts (Gondusky & Reiter, 2005). Significant advances in both medical technology and accessibility within a combat theater as well as protective body armor mean that more service members are surviving injurious experiences that would have been fatal in prior wars (Gawande, 2004; Regan, 2004; Warden, 2006). Additionally, there has been greater availability for rapid air evacuation in which wounded soldiers are transported to near-by military hospitals for life-saving medical procedures (Peoples, Gerlinger, Craig, & Berlingame, 2005). Despite sometimes catastrophic injuries, these advances in military medicine and response have contributed to the survival of more than 90% of the soldiers seriously wounded in OEF/OIF/OND (Gawande, 2004).

However, casualties of a different kind—"invisible wounds"—such as mental health conditions and cognitive impairments that result from deployment experiences are emerging at alarming rates (Hoge et al., 2004; Hoge et al., 2008; Kennedy et al.,

2007; Tanielian & Jaycox, 2008; Walker, Clark, & Sanders, 2010). Evidence suggests that the psychological toll of these deployments, many involving prolonged exposure to combat-related stress over multiple rotations, may be disproportionately high compared with the physical injuries of combat (Hoge et al., 2004; Tanielian & Jaycox, 2008; Walker et al., 2010).

Prevalence Rates of PTSD and mTBI

The true prevalence of PTSD and mTBI among military service members is difficult to estimate. Complications include limitations in real-time documentation of war-zone injuries and events, differences in sampling strategies and time frames, the ambiguity surrounding the operational definitions of the two conditions, and the methods by which they are assessed (Carlson et al., 2011; Vasterling, Bryant, & Keane, 2012). Further, in combat, even if the specific event leading to a TBI does not precipitate PTSD, the TBI occurs in a context of persistent and repeated exposure to extreme psychological stress and/or life threat, which further complicates the diagnostic process and accurate attribution of symptoms (Vasterling, Bryant, & Keane).

The prevalence rates of PTSD and mTBI in service members returning from OEF/OIF/OND have been reported as 13.8% and 19.5%, respectively (Tanielian & Jaycox, 2008). In addition to the occurrence of each condition when considered alone, PTSD and mTBI frequently co-occur (Hoge et al., 2008; Tanielian & Jaycox, 2008; Vasterling, Bryant, & Keane, 2012). Military personnel who experience blast exposure and report a history of mTBI are at elevated risk for developing PTSD and/or depression (Belanger, Kretzmer, Yoash-Gantz, Pickett, & Tupler, 2009; Broomhall et al., 2009). Among those veterans reporting a history of mTBI, 27- 44% also

screened positive for PTSD (Hoge et al., 2008; Tanielian & Jaycox, 2008). Similarly, even without the diagnosis of PTSD, high levels of combat stress are associated with a three- to eightfold increase in the rate of reporting of postconcussive-like symptoms (Cooper et al., 2011). Eighty-one percent of veterans presenting to a Veterans Affairs (VA) Medical Center polytrauma specialty clinic met criteria for more than one diagnosis and 42% had three co-occurring diagnoses, including pain, PTSD, depression, and PCS (Lew et al., 2009).

Posttraumatic Stress Disorder

Clinical Definition and Diagnostic Criteria

In its current conceptualization within the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) PTSD is defined by six criteria. The causal factor (criterion A) of PTSD states that an individual must have experienced a traumatic event in which there was perceived or actual serious danger or threat to self or others. The need for an external causal factor is a unique element to PTSD, not shared with any other disorder in the DSM-IV-TR. Additionally, criterion A2 states the experience must have evoked strong feelings, including intense fear, helplessness, and/or horror. The cardinal signs and symptoms of PTSD are currently broadly divided into three symptom clusters, including persistent re-experiencing of trauma (a sense of reliving traumatic events through intrusive thoughts, memories, nightmares, flashbacks, psychological and physiological distress when reminded of aspects of the trauma, etc.; criterion B); emotional numbing and avoidance of thinking or talking about past trauma and of situations that trigger memories of trauma (criterion C); and heightened arousal and hypervigilance (a heightened sense of awareness of one's surroundings, exaggerated

startle response; trouble falling or staying asleep; irritability; criterion D). The typical course of PTSD begins with the development of symptoms within 6-months of the precipitating traumatic event, although delayed onset is not uncommon. The full spectrum of symptoms must be present for more than 1 month (criterion E) and the psychological distress must cause clinically significant impairment and debilitating behavioral features such as unemployment, impulsive or violent behavior, and family discord (criterion F; American Psychiatric Association, 1994; Foa et al., 2000; Kulka et al., 1988).

The DSM-IV-TR has been undergoing revisions and the DSM-5 is slated to be released to the general public in May 2013. The DSM-5 PTSD work-group has made significant changes to the clinical definition and diagnostic criteria. They have paid greater attention to the behavioral symptoms that accompany PTSD, and have restructured and recategorized the symptom clusters to include re-experiencing, avoidance, negative cognitions and mood, and arousal (American Psychiatric Association, 2013; Friedman, Resick, Bryant, & Brewin, 2010; Miller et al., 2012).

Individuals suffering from PTSD also typically experience a diverse set of secondary symptoms. Guilt, including survivor guilt and guilt regarding acts of omission or commission (King & King, 1994; Kubany, 1994) as well as anger (Chemtob, Harnada, Roitblat, & Muraoka, 1994; Kubany, Gino, Denny, & Torigoe, 1994) are especially common among veterans. Cognitive effects such as impaired concentration and decision making, memory impairment, and confusion are also frequently reported(Bremner et al., 1992; Brenmer, Krystal, & Charney, 1995; Horowitz, 1986). Behavioral symptoms such as increased relational conflict resulting in social withdrawal, alienation, reduced relational intimacy, and impaired work and school performance are common. Finally, somatic complaints of exhaustion,

insomnia, and cardiovascular, gastrointestinal, and musculoskeletal disorders are also endorsed by many individuals with PTSD (NCPTSD, 2011).

Risk Factors

Research has shown that multiple risk factors make some individuals more prone to develop PTSD than others (APA, 2000; Foa et al., 2000; Kennedy et al, 2007). Pretraumatic risk factors include female gender, low socioeconomic status, low level of education, low level of intelligence, race (e.g., Hispanic, African American, American Indian, and Pacific Islander), abuse in childhood or other adverse childhood factors, previous traumatization, and family history of psychiatric disorders. Peri- and posttraumatic factors include (1) experience of greater stressor magnitude and intensity, unpredictability, uncontrollability, real or perceived responsibility, and betrayal; (2) being in a situation of ongoing or persistent stress and exposure to trauma (e.g., a combat theater, domestic violence relationship); (3) report of greater perceived threat or danger, suffering, upset, terror, horror and/or fear; (4) lack of social support; (5) a social environment that produces shame, guilt, stigmatization, or self-hatred; (6) young age at the time of exposure to trauma (many military service personnel enter the military at 18); (7) poor training or preparation for the traumatic event (e.g., how prepared are soldiers for what they face in combat); (8) bereavement or traumatic grief (e.g., many returning service personnel report having lost friends and comrades during their deployment; loss of self, meaning, purpose in life due to functional impairment); (9) major loss of resources (e.g., many veterans are discharged from the military and struggle to find or sustain employment; many are disabled and file for compensation and pension); (10) children in the home and/or a distressed spouse (e.g., many of the service personnel are young men and women with families; deployments,

especially multiple deployments can be very hard for the families who remain at home as can the readjustment phase postdeployment; (11) history of preexisting psychiatric diagnoses and/or substance abuse; (12) poor coping skills; and (13) predisposition due to genetic factors (APA, 2000; Foa, Keane, & Friedman, 2000; Kennedy et al., 2007).

Traumatic Brain Injury

Clinical Definition and Diagnostic Criteria

In the US, the most widely accepted criteria for TBI, and those that are supported by the VA and Department of Defense (DoD), are put forth by the American Congress of Rehabilitation Medicine (ACRM, 1993). The ACRM defines TBI as any traumatically induced structural injury and/or physiological disruption of brain function as a result of an external force that is indicated by new onset or worsening of at least one of the following clinical signs, immediately following the injurious event: any period of loss of or a decreased level of consciousness; any loss of memory or posttraumatic amnesia for events immediately before or after the injury; any alteration in mental state or alteration in consciousness at the time of the injury (confusion, disorientation, slowed thinking, etc.); neurological deficits (weakness, loss of balance, changes in vision, praxis, sensory loss, aphasia) that may or may not be transient; or intra-cranial lesion. TBI may arise from any physical damage by external blunt or penetrating trauma to the head, skull, dura, or brain or from acceleration-deceleration movement such as whiplash or coup-countercoup, resulting in tearing or shearing of nerve fibers and bruising or contusion of the brain against opposite sides of the skull (Kennedy et al., 2007; VA/DoD mTBI Clinical Practice Guidelines, 2009). Scraping of the brain across the rough bony base of the skull can cause contusions as well (Kennedy et al.).

TBI is categorized by severity into three levels: mild, moderate, and severe, based on the length of loss of consciousness, alteration of consciousness, posttraumatic amnesia, and/or the results of structural brain imaging. The present study focuses on mild TBI only. Acute severity is determined at the time of the injury, and although the severity level has prognostic value, it does not necessarily predict the individual's ultimate level of functioning or the number or severity of postconcussive symptoms they experience (VA/DoD mTBI Practice Guidelines, 2009). There is substantial evidence that the epidemiology, pathophysiology, natural history, and prognosis for mTBI are different than for moderate and severe TBI. For example, the VA/DoD mTBI Clinical Practice Guidelines (2009) note moderate and severe TBI are often associated with objective evidence of injury on brain scans or neurological examinations and objective deficits on neuropsychological testing, whereas these same evaluations are often not definitive in individuals with mTBI. The natural history and prognosis of moderate and severe TBI are more directly related to the nature and severity of the injury, whereas factors unrelated to the injury (e.g., comorbid psychiatric disorders) have been shown to be the strong predictors of symptom persistence after mTBI (Brenner, Vanderploeg, & Terrio, 2009; VA/DoD mTBI Practice Guidelines, 2009).

Blast Injuries

Research suggests that approximately 75% of combat injuries among OEF/OIF/OND soldiers result from explosive munitions (Clark et al., 2007; Owens et al., 2008; VHA Handbook 1172.1, part 2.a., p.1). Military service members are repeatedly exposed to blasts from roadside bombs, improvised explosive devices (IEDs), vehicle-born explosive devices (VBEDs), rocket propelled grenades (RPGs),

and mortar attacks, in addition to the 'usual' risk for injuries such as penetrating bullet wounds from fire fights (Owens et al., 2008; Summerall & McAllister, 2010). The consequences of blast-related injuries to the brain are controversial (Kennedy et al., 2007; Taber, Warden, & Hurley, 2006); however, the mechanism and sequelae of brain over-pressurization from blast waves are similar to those in the fluid percussion animal models of mTBI (Gurkoff, Giza, & Hovda, 2006). Studies have demonstrated that exposure to blast over-pressurization induces ultra-structural and biochemical alterations and associated cognitive deficits in rats (Cernak, Wang, Jiang, Bian, & Savic, 2001) and pigs (Capehart, 2011) and can produce fatal injuries if severe enough and in close enough proximity. The effects of primary blasts most often cause damage not only to the brain, but to air-filled organs, such as the lungs and colon, or those at air-filled interfaces, such as the tympanic membranes (eardrums) and the eyes (DePalma, Burris, Champion, & Hodgson, 2005; Ritenour & Baskin, 2008; Silver, McAllister, & Arciniegas, 2009).

In the absence of a blast wave with a magnitude sufficient to damage the internal organs or cause barotrauma associated with dynamic changes in atmospheric pressure, the effects of blasts on the brain are somewhat uncertain (DePalma, Burris, Champion, & Hodgson, 2005; Ritenour & Baskin, 2008; Silver, McAllister, & Arciniegas, 2009). Research suggests, however, that effects of blasts on the brain are the same as those involved in brain injuries incurred in other contexts. These blast effects include being struck in the head by debris and shrapnel (secondary effect) and being struck in the head when thrown into a stationary object (tertiary effect) (Warden, 2006). Quaternary effects unique to blast explosion include burns and injury due to inhalation of toxic fumes, smoke, and/or dust (Finkel, 2006). Secondary and tertiary blast effects are common mechanisms of blast-related TBI in returning

military personnel (Silver et al., 2009).

A common misconception among many military service members, their loved ones, the news media and general public, and even some treatment providers is that any exposure to a blast event means that the individual has sustained a TBI. This is inaccurate, as exposure to a blast has many potential outcomes and repercussions varying significantly in severity. For example, imagine a group of soldiers driving in a convoy. One soldier may feel a slight impact from an IED blast three humvees in front of his but not experience any injuries whatsoever, including no loss or alteration in consciousness. Another soldier two humvees up may be thrown against the side of the vehicle, strike his head, feel dazed and confused momentarily and report a headache for several hours. A third, in the humvee hit directly by the IED may sustain serious physical injuries, experience a loss of consciousness, and have to be medivaced for immediate stabilization and intensive medical care. Exposure to a blast can have different outcomes based on one's relative location to the blast, whether or not the individual was physically moved or other objects were moved toward them as a result of the blast, and whether or not they were wearing protective body armor, a helmet, etc. The VA/DoD mTBI Practice Guidelines (2009) note that not all individuals exposed to an external force, including blasts, will sustain a TBI; however, any person who has a history of such an event and meets the above ACRM diagnostic criteria may have sustained a TBI.

Risk Factors for Military Personnel

Simply being in the military increases the risk of exposure to traumatic injuries that could cause TBI given the nature of common work duties, even during peacetime (Ommaya, Ommaya, Dannenberg, & Salazar, 1996; Summerall & McAllister, 2010).

This reflects the higher-risk activities service members engage in and perhaps increased likelihood of risk-taking personality traits among those volunteering for military service (Summerall & McAllister). Further, a history of TBI is, in itself, a significant risk factor for future brain injury. Research from civilian samples has suggested that those with a single TBI are two to three times more likely to sustain a second injury, and those who sustain a second are seven to nine times more likely to sustain a third (Annegers, Grabow, Kurland, & Laws, 1980). Similar data are not yet available for military populations, although clearly, the risk for all injury, including TBI, is significantly increased during times of active combat and thus it could be expected that a similar pattern would exist (Summerall & McAllister, 2010; Warden et al., 2005).

Postconcussive Symptoms

When speaking of TBI, the term "mild" is not intended to describe the impact or severity of any persistent PCS. Rather, the term refers only to the initial injurious event and injury characteristics such as duration of lost consciousness or posttraumatic amnesia, and visibility of injury on brain scans. Although the vast majority of studies of both civilian and military populations have indicated that most individuals with a mTBI will return to baseline neuropsychological functioning within the 3 months postinjury (Alexander, 1995; Belanger, Curtiss, Demery, Lebowitz, & Vanderploeg, 2005; Belanger & Vanderploeg, 2005; Levin et al., 1987; Schretlen & Shapiro, 2003), a subset of these individuals report a persistent constellation of symptoms for many months to years after the injury (Benge, Pastorek, & Thornton, 2009; MacGregor, Dougherty, Tang, & Galarneau, 2013). It is estimated that 75-90% of all reported TBIs among U.S. military personnel are categorized as mild and that approximately

90% of these follow a predictable course where soldiers experience few, if any, persistent PCS and rarely require any specialized medical treatment. The prevalence of persistent PCS following a mTBI varies widely across studies from 18% to 64% (Belanger, Curtiss, Demery, Lebowitz, & Vanderploeg, 2005; Binder, Rohling, & Larrabee, 1997; Boake et al., 2005; Dikmen, Marhamer, Fann, & Temkin, 2010; Terrio et al., 2009; Vanderploeg, Curtiss, Luis, & Salazar, 2007). A recent study of National Guard veterans found that even after controlling for adverse deployment/ combat related stressors, such as injury and exposure to blast, those with a history of deployment-related mTBI were 2.5 times more likely to endorse multiple PCS when assessed approximately 30 months post-deployment, than those without any history of brain injury (Vanderploeg, Belanger, Horner, et al. 2012). Interestingly, these same PCS were 2.6 times higher among those with non-TBI physical injuries and 3.1 times higher among those who had experienced heavy combat, making it quite difficult to know what, if any, unique or direct causative effect mTBI has for these symptoms above and beyond that of a common stress or injurious effect (Vanderploeg et al., 2012).

Most clinicians and researchers agree that common PCS appear in three symptom clusters: cognitive, physical/somatic, and emotional/affective. Common cognitive symptoms include deficits in memory, attention, and concentration, slowed processing speed, impaired executive functioning and poor mental flexibility, problems with decision making, planning, and organization. Common physical or somatic symptoms include nausea, vomiting, blurred vision, sensitivity to light and/ or sound, fatigue, disordered sleep, dizziness, vertigo, poor balance, impaired motor skills, and headache. Common emotional or affective complaints include irritability and agitation, anxiety, impulsivity, aggression, fearfulness, worry, interpersonal

sensitivity, and depression (Brenner, Vanderploeg, & Terrio, 2009; VA/DoD mTBI Practice Guidelines, 2009).

PCS are generally nonspecific and share many characteristics with a number of preexisting or comorbid conditions including PTSD (Foa, Cashman, Jaycox, & Perry, 1997); depression (Iverson, 2006); outpatients presenting for psychological treatment (Fox, Lees-Haley, Ernest, & Dolezal-Wood, 1995); chronic pain (Gasquoine, 2000; Iverson & McCracken, 1997); outpatients with minor medical complaints (Lees-Haley & Brown, 1993); and personal injury litigants (Dunn, Lees-Haley, Brown, Williams, & English, 1995). PCS-like symptoms are common and expected among deployed soldiers as well (Hoge, 2010). Further, many healthy adults report postconcussive-like symptoms such as headaches, irritability, sleep difficulty, and memory deficits, which suggest they are relatively common in daily life (Gouvier, Uddo-Crane, & Brown, 1988; Iverson & Lange, 2003; Mittenberg, DiGiulio, Perrin, & Bass, 1992). From 35.9% to 75.7% of healthy adults report that they have experienced postconcussive-like symptoms in the past 2 weeks, and from 2.9% to 15.5% report more severe symptoms (Iverson & Lange, 2003).

Symptom Overlap

There is considerable symptom overlap between PTSD and PCS (Brenner, Vanderploeg, & Terrio, 2009; Dunn, Julian, Formolo, Green, & Chicoine, 2011; Stein & McAllister, 2009) which makes assessment conceptually and methodologically challenging when both are diagnostic possibilities (Iverson, 2012). Other commonly co-occurring diagnoses such as depression, chronic pain, and substance use further complicate the clinical presentation, assessment process, and diagnostic reliability as they too can have overlapping symptoms or serve to exacerbate

or minimize the experience of symptoms (Iverson). Anxiety, hyperarousal (e.g., sleep, poor concentration, irritability, sensitivity to noise), anhedonia, and psychogenic posttraumatic amnesia symptoms overlap with PCS (Brenner, Vanderploeg, & Terrio, 2009; Iverson). Such significant symptom overlap makes it challenging for the clinician to accurately diagnosis, especially in cases where a singular etiological event is the cause for both potential PTSD and mTBI. Due to the shared nature of many of these symptoms, a thorough assessment of symptom onset is necessary and PCS should not be attributed to brain injury if they are better explained by pre-existing conditions or other comorbid medical, neurological, or psychological causes except in cases of an immediate exacerbation of a pre-existing condition (VA/DoD mTBI Practice Guidelines, 2009).

Integrating Primary Care and Mental Health

In 2007, the Veterans Health Administration began a system-wide initiative to integrate mental health services and primary care. They noted that mental and physical health are interrelated components of overall health and are best treated in a coordinated, comprehensive care system (New Freedom Commission on Mental Health, 2003; Department of Veterans Affairs, 2004; Post & Van Stone, 2008).

It has been suggested that the placement of mental health providers in primary care clinics provides an alternative treatment access point, which may help reduce apprehension associated with candid reports of symptoms, and efforts to seek mental health treatment (Cigrang et al., 2011; Tanielian & Jaycox, 2008). Integrated care recognizes several aspects: primary care provides opportunities to screen for unrecognized disease; mental health and substance abuse conditions are common and are often treated by primary care practitioners; patients may prefer treatment in

primary care settings; an established relationship with a primary care practitioner fosters engagement in and adherence to treatment; and health conditions do not always fall neatly into "physical" and "mental health" categories (VHA Handbook 1160.01, 2008).

The Polytrauma System of Care

One of the most notable efforts to integrate medical and mental health care into a coordinated and comprehensive system came in response to the new generation of veterans that returned from the Middle East and presented with complex physical injuries and emotional trauma, and the related need for specialized medical care and comprehensive rehabilitation. The VA established the Polytrauma System of Care, which provides integrated, interdisciplinary care to veterans who present with complex clinical presentations, often including TBI and PTSD. These clinics are interdisciplinary in nature, often include providers from physical medicine and rehabilitation, psychology, psychiatry, occupational therapy, physical therapy, speech therapy, case manager, recreational therapy, and sometimes a vocational rehabilitation counselor (Walker et al., 2010) and have shown some success in this complex population (Batten & Pollack, 2008; Sayer et al., 2008). The term polytrauma has been introduced to describe these more complex, multisystem, blast-related injuries (Brenner, Vanderpoleg, & Terrio, 2009; VHA Handbook 1171.1). The Veterans Health Administration (VHA) describes complex injuries as polytrauma, defined as "...two or more injuries to physical regions or organ systems, one of which may be life threatening resulting in physical, cognitive, psychological, or psychosocial impairments and functional disability" (VHA Handbook 1172.1, part 3.i., p.3).

Measurement-based Care

The influx of attention on the psychological, cognitive, and physical consequences of war and combat has resulted in additional health assessments for both service members still in theater and those postdeployment as well as substantial efforts by the VA to expand both in- and outpatient mental health services (Bryan & Morrow, 2011; Carlson et al., 2009; Tanielian & Jaycox, 2008). The full extent to which mental health problems are being detected, accurately assessed and diagnosed, and appropriately treated in this high-risk population remains unclear. Despite the proliferation of evidence-based guidelines for the treatment of many psychiatric conditions, the quality of care and the overall effectiveness of these efforts is questionable in light of the fact that mental health problems in general, and suicide rates in particular, continue to rise (Bryan & Morrow, 2011; Department of the Army, 2010; Kilbourne, Keyser, & Pincus, 2010; Tanielian & Jaycox, 2008; Vasterling, Bryant, & Keane, 2012; Vogt, 2011).

A 2006 report by the U.S. Institute of Medicine (IOM) documented substantial gaps in evidence-based care for mental health conditions, citing poor quality assessment and detection, treatment, and follow-up care (IOM, 2006). VA Health Services Research & Development Office (HSR&D) performed a systematic review of the literature on the assessment and treatment of individuals with a history of TBI and PTSD, focusing on three critical areas, including prevalence rates, treatment considerations, and the relative accuracy of diagnostic tests used for assessing mTBI and PTSD when the two co-occur (Carlson et al., 2009). Although the majority of the findings within this report are outside the scope of the present study, one of the findings is relevant. Although there has been a spike in the literature exploring comorbid mTBI and PTSD due to their high prevalence rates

among returning service members, the group of content experts were unable to find any published studies that address the relative accuracy of screening or diagnostic tests used to assess the history of symptoms of mTBI or PTSD when the two are comorbid (Carlson et al., 2009). Further, despite general agreement among both experts and administrators that VA primary care providers should screen for PTSD and that specialty PTSD care should be provided in a primary care setting, there has been a paucity of research on the clinical utility of PTSD screening and assessment instruments in this type of setting. In addition to the movements to provide PTSD services in primary care settings, most metropolitan VAs have PTSD Clinical Teams (PCTs) that provide comprehensive care for veterans with PTSD, including individual, couples, and group psychotherapy, psychiatric assessments, PTSD-related psychological evaluations, and medication management.

It was not until January 2013 that a systematic evaluation was conducted to evaluate screening measures for PTSD commonly used in VA primary care settings (Spoont et al., 2013). They found that the PTSD Checklist (PCL; Weathers et al., 1993) is the most widely used instrument and had the relatively largest empirical base of literature when compared to other screening instruments. They identified eight studies that had investigated the validity of the instrument in a primary care setting (Spoont et al.). However, the authors noted that these studies are of limited value because the methodology was flawed, the investigators used biased sampling/recruiting procedures, and the reports failed to include relevant and important additional information (Spoont et al.). Additionally, they found that there continues to be a marked absence of literature on the validity and utility of the PCL and other assessment instruments in the presence of highly prevalent specific psychiatric comorbidities and across varying contexts/clinical settings. Further, they found that

there is limited evidence regarding potential variation in the performance of screening tools by age, gender, or race, and they provided no information about how specific psychiatric comorbidities might affect the performance of the screening tools (Spoont et al.). Importantly, it is unknown whether reports by veterans differ depending on whether they are obtained in medical or mental health settings. Given the high prevalence rates of these conditions and the high likelihood that veterans may be assessed in multiple settings, including primary care settings, polytrauma clinics, or PTSD/mental health clinics, this seems to be a striking oversight.

Research optimizing the diagnostic accuracy and clinical utility of assessment for PTSD, mTBI history, and PCS are of the utmost importance (Carlson et al., 2009; Iverson, 2012). The use of valid and reliable assessment measures may not, in and of itself, ensure the quality of the data obtained if other factors such as the setting in which the measure is administered are overlooked (Bradley et al., 2010; Hawkins et al., 2007). Potentially flawed assessment methodology and related poor-quality data can have considerable consequences for veterans as the diagnoses they are given directly influence the type of treatment(s) they receive, compensation and pension benefits, and potential self- or social stigma or stereotyping. Significant consequences exist too for care providers, treatment programs, payers, and other stakeholders in the service of providing care and improving outcomes for veterans (Kilbourne, Keyser, & Pincus, 2010).

Discordance Analysis

In recent years, the VA has enacted new policies to conduct assessments and "quality monitoring practices" more frequently for a variety of physical and mental health conditions including PTSD, major depressive disorder, and substance

disorders (Kilbourne et al., 2010). Veterans are often asked to complete the same measure in various settings at multiple time points to track symptom presentations and evaluate the type and quality of services received. Two studies have investigated the consistency or 'concordance' in veterans' reporting on identical items on an alcohol use screening measure when administered in contextually different settings and temporally different occasions (Bradley et al., 2011; Hawkins et al., 2007). Both studies found significant inconsistency or 'discordance' between veterans' responses across settings and over time. Bradley and colleagues found that almost twice as many veterans screened positive for alcohol use on a survey screen (11.1%) than on a clinical screen (5.7%). Further, of those that screened positive on the survey screen, over 60% had discordant results on the clinical screen compared to the only 1.5% who screened negative. Hawkins and colleagues found similar results with only 24.6% of veterans screening positive for alcohol misuse based on medical record reviews, while 33.4% screened positive based on mailed out surveys.

Some discordance between clinician administered and mailed survey results is expected as veterans may be more or less likely to report honestly when sitting face-to-face with a provider, depending on their level of rapport, how relevant they feel the information may be, the consequences of honest reporting, if a loved one is accompanying them to the appointment, etc. Further, some inconsistency in reporting can be due to random measurement error, regression to the mean, or actual changes in veterans' alcohol use from time one to time two (Bradley et al., 2011; Hawkins et al., 2007). However, the level of observed discordance between clinical and mailed survey alcohol screeners in these two studies was greater than what could be easily accounted for by these factors, suggesting contextual factors such as the measurement setting can influence veterans' endorsement of symptoms (Bradley et al.,

2011; Hawkins et al., 2007).

Within the VA Health Care System, PTSD is routinely assessed in both mental health clinics, including PTSD specialty clinics, and medical settings such as polytrauma clinics, yet, to date, no empirical studies have been published that investigate the relative accuracy and utility of measures such as the PCL when administered in contextually different settings on multiple measurement occasions.

Influence of Contextual Factors

Due to potential cultural differences in reporting style (Osterman & de Jong, 2007) or stigma associated with having a mental health diagnosis or brain injury (e.g., Brenner, Vanderploeg, & Terrio, 2009; Hoge et al., 2004; Kilbourne, Keyser, & Pincus, 2010), it is possible that contextual factors relating to the assessment instruments and/or measurement environment in which the assessment is being conducted may influence veterans' endorsement of symptoms (Ulloa, Marx, Vanderploeg, & Vasterling, 2012). Additionally, veterans may report symptoms differently depending on who is inquiring and the level of rapport between the veteran and provider (Iverson, Brooks, Ashton, & Lange, 2010). Veterans also may over- or under-report symptoms for financial reasons (e.g., military service-connected disability, workers compensation, personal injury litigation), to gain access to treatment services, to avoid legal/criminal consequences, or to receive recognition, validation, or honor for serving in the military (Elhai, Sweet, Breting, & Kaloupek, 2012; Iverson, 2012).

Statement of the Problem

Little is known about the accuracy of commonly used assessment measures when TBI and PTSD co-occur (Carlson et al., 2009; Spoont et al., 2013). More

specifically, to date no studies have been published that explore the influence of contextual factors on measures such as the PCL when administered in different settings on separate occasions, and what, if any, influence contextual factors have on veterans' endorsement of symptoms or their consistency in reporting the same/overlapping symptoms when PTSD and TBI co-occur (Carlson et al., Donnelly et al., 2008; Iverson, 2012; King et al., 2012). The present study tested for the influence of measurement context on self-reported postconcussive and PTSD symptoms and the consistency of OEF/OIF/OND veterans' reports of symptoms on different self-report questionnaires within and between medical and mental health contexts.

Research Questions

Question 1

Questions 1a and 1b assessed veterans' consistency in reporting symptoms across two "obviously psychological" measures administered during a single visit to a PTSD clinic. Data analysis focused on nearly identical items that assessed sleep, concentration, and loss of interest on the PCL and the Patient Health Questionnaire (PHQ), a measure of depressive symptoms.

a. Are symptoms reported consistently across measures (i.e., PCL and PHQ)?

b. Are symptoms endorsed to a greater or lesser degree based on the assessment construct (i.e., PTSD vs. depression)?

Question 2

Questions 2a and 2b assessed veterans' consistency in reporting symptoms across separate measures administered in a single visit to a polytrauma clinic. Data analysis focused on nearly identical items that assessed sleep, concentration, and irritability on the PCL, an obviously "psychological measure," and the NSI, a more

"medical measure." Specific questions are:

c. Are symptoms reported consistently across measures (i.e., the PCL and NSI)?

d. Are symptoms endorsed to a greater or lesser degree based on the type of measure (i.e., psychological vs. medical)?

Question 3

Question 3 tested whether the level of consistency in a polytrauma clinic differed from the level of consistency in a PTSD clinic.

a. Does one measurement setting demonstrate greater/lesser levels of consistency in reported symptoms than the other?

Question 4

Question 4 assessed the extent to which self-reported PTSD symptoms, as measured by the PCL, varied over measurement occasions.

a. Do self-reported PTSD symptoms vary by measurement occasion?

Question 5

Question 5 tested if self-reported PTSD symptoms depended on whether the veteran completed the PCL first in the PTSD clinic and then in the polytrauma clinic or vice versa. Stated differently, do those veterans who complete a PTSD assessment at time 1 and a polytrauma assessment at time 2 report greater/lesser levels of PTSD symptomology than those who complete polytrauma first and PTSD second?

a. Do self-reported PTSD symptoms vary by the order of administration context?

Question 6

Question 6 tested for effects of context on self-reported PTSD symptoms. Specifically, regardless of the order of measurement occasions, do veterans report greater/lesser levels of PTSD symptomology when assessed in the PTSD clinic, a "mental health" or "psychological" setting versus the polytrauma clinic, a "medical" setting?

a. Are symptoms endorsed to a greater or lesser degree when the assessment is administered in a psychological as opposed to a medical setting?

Question 7

Though the PCL is considered a diagnostic tool, it is typically used in clinical settings in tandem with a clinical diagnostic interview with both data sources contributing to the final diagnosis of PTSD. Generalizability Theory ("G Theory") was used to assess the dependability of diagnoses of PTSD based solely on the PCL.

a. Is the PCL dependable enough to make an absolute judgment (diagnosis) of PTSD based solely on its 17 items at one measurement occasion.

b. How many items and measurement occasions would be needed to make dependable diagnoses of PTSD using only the PCL.

METHODS

Participants

The present study was approved by the University of Utah Institutional Review Board and the Research Review Committee of the George E. Wahlen Veterans Affairs Medical Center in Salt Lake City, Utah. Data were obtained from three independent retrospective medical chart reviews. For the sake of clarity, these will be referred to as DS1 (for dataset1), DS2, and DS3. DS1 was an existing database created from a retrospective chart review of 144 male OEF/OIF veterans who underwent a PTSD assessment at the Salt Lake City VA. These veterans had a diagnosis of military-related PTSD substantiated in their medical records. Sixty-one of these 144 also completed a polytrauma/TBI evaluation and have a co-occurring diagnosis of military-related mTBI noted in their records. Veterans were excluded if they met criteria for a moderate or severe brain injury. For a full description of DS1, refer to the study by Romesser and colleagues (Romesser et al., 2011). DS2 was obtained from an original retrospective chart review of 58 OEF/OIF/OND veterans who underwent both PTSD and polytrauma/TBI evaluations at the Salt Lake City VA. Further description is provided below. DS3 was an existing database created from a retrospective chart review of 529 OEF/OIF veterans who underwent TBI evaluations by the polytrauma teams at two different metropolitan VA medical centers, the Salt Lake City VA and the Michael E. DeBakey VA Medical Center in Houston, Texas. These veterans were referred to the polytrauma clinic following a positive screen on the VA's TBI Clinical Reminder screening tool that was administered at an initial VA appointment.

Veterans were excluded if they met criteria for moderate or severe brain injury. For a full description of DS3, refer to the 2012 study by Romesser and colleagues (Romesser et al., 2012).

DS2 was created by locating hard copies of assessment protocols from the PTSD and polytrauma clinics and compiling this information with data obtained from the Computerized Patient Record System (CPRS), the VA's electronic medical records system. Fourteen members of the initial DS2 sample were dropped, leaving only 44 for final analyses. Four veterans were dropped due to significant missing data; 4 were dropped due to an inability to reliably interpret the assessment protocols due to multiple responses being endorsed simultaneously; 3 were dropped as a PTSD diagnosis was not substantiated in their medical records; 2 were dropped as they were classified with moderate to severe brain injury (rather than mild); and 1 was dropped from analysis as they completed both assessments on the same day and it was impossible to determine the order in which these were completed from the information available in their medical records. Of the 4 veterans with missing data, CRPS records indicated that 2 were already service connected for PTSD at the time of their evaluation and thus were not required to complete the full assessment protocol, but rather went to the PTSD assessment clinic to seek referral for treatment.

DS1 and DS2 were used to answer research question 1, DS2 and DS3 were used to answer research question 2, and all three datasets were used to answer research question 3. DS2 was used to answer research questions 4-7 as this was the only dataset that contained identical assessment protocols from the two distinct measurement occasions. Table 1 provides a summary of the characteristics of the three datasets.

Table 1. Sample Sizes, Measurement Occasions, Assessments, and Context

	Dataset 1	Dataset 2	Dataset 3
Number of Cases	144	44	529
Number of Occasions	1	2	1
Assessments Given	PCL, PHQ	PCL, PHQ, NSI	PCL, NSI
Measurement Context(s)	PTSD	PTSD & Polytrauma	Polytrauma

Measurement Contexts

PTSD Assessment Clinic

At the George E. Wahlen VA Medical Center in Salt Lake City, the PTSD Clinical Team (PCT) is an outpatient clinic specializing in the assessment, diagnosis, and treatment of PTSD and related psychiatric concerns. This clinic is housed in the outpatient mental health building on the VA campus, which is a separate building from the main medical hospital. Veterans are referred to the PTSD assessment group in a number of ways, including referral from their primary care provider or other provider/contact at the VA, referral during an inpatient psychiatric hospitalization, referral from a VA staff during their attendance at a postdeployment health re-assessment (PDHRA), by a fellow veteran, friend, family member, or by self-referral. The PTSD assessment group is held once weekly and includes a group and individual component. Veterans complete assessment protocols in a large, open room with other Veterans, also presenting for PTSD evaluation. After completing the battery of paperwork, each veteran participates in a one-on-one clinical interview. The PCL is administered as one assessment within the 14-page Veterans Affairs Military Stress Treatment Assessment (VAMSTA; Fontana et al., 2006). In addition to testing for PTSD, the VAMSTA includes measures that evaluate depression, suicide risk, drug and alcohol use, health and medical problems, sleep, religious/spiritual life,

employment status, social life, and quality of life.

Polytrauma Assessment Clinic

At the Salt Lake City VA, the polytrauma clinic is similar to the PCT in that it is an outpatient specialty clinic held one time per week; however, it differs from the PTSD clinic in many ways. This clinic is housed in the main medical hospital on the VA campus. Accessing the clinic requires that the individual walk past the entrance to the emergency department, past a primary care clinic, and the outpatient pharmacy. The clinic itself has a different feel from the PCT as it is a medical environment with private patient rooms containing medical examination tables. Referral to this clinic is limited in comparison to the PTSD clinic. Veterans are referred to this clinic only after screening positive on a brief TBI screen given in the course of a primary care or other medical or mental health appointment (including the PCT). The only group component of this clinic occurs when the maximum of four veterans in clinic are asked to gather in one room for a brief 5- to 10-minute psychoeducational presentation that describes TBI and typical recovery trajectories, common symptoms and problems following exposure to TBI, and common comorbidities.

Veterans are asked to complete a battery of self-report assessment measures focused primarily on their history of exposure to potentially injurious events (e.g., falls, blasts, accidents, etc.) and related persistent symptoms, problems with pain, and the degree to which they are bothered by these problems. This battery also includes measures of PTSD (the PCL), depression (the Beck Depression Inventory), and postconcussive symptoms (the NSI). For the remainder of the clinic, veterans stay in their private exam room and are met by multiple members of the interdisciplinary Polytrauma Team. This assessment team typically includes a provider from each of

the following specialty areas: physical medicine/rehabilitation, neuropsychology, speech therapy, occupational therapy, physical therapy, social work/case management and nursing. During the course of this 4- to 5-hour assessment, veterans participate in multiple one-on-one clinical interviews to assess for TBI and related persistent symptoms. The staff briefly evaluates mental health concerns, gains a thorough medical history and understanding of complicating medical conditions, including brief vision and hearing evaluations, explores options for medication management as appropriate, and evaluates overall functioning.

Measures

The PTSD Checklist

The PCL, developed at the National Center for PTSD, is a 17-item self-report measure of PTSD symptoms based closely on the criteria listed in the DSM-IV. Each symptom is rated in terms of severity. Respondents rate how much they were bothered by each item during the past month using a five-point scale that ranges from *not at all* (1) to *extremely* (5). Usually, a total score ranging from 17 to 85 is obtained by summing the response to each item. A total score of 50 is generally considered an appropriate cut off for making a PTSD diagnosis in treatment-seeking veterans (Forbes, Creamer, & Biddle, 2001; Weathers et al., 1993). The PCL has demonstrated high levels of diagnostic accuracy when evaluated against the gold standard structured interview measures such as the PTSD component of the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996) and the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995), both at a single time point and over the course of treatment and follow-up (Forbes et al., 2001). The PCL has demonstrated strong test-retest reliability at 2-3 days (.96) and .88 at 1 week

(Blanchard et al., 1996; Ruggiero et al., 2003) and high levels of internal consistency that range between .94 (Blanchard et al., 1996) and .97 (Weathers et al., 1993). The PCL is one of the most widely used self-report measures of PTSD and has been shown to have excellent reliability and validity for a variety of populations (e.g., Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Cordova et al., 1995; Ruggiero, Del Ben, Scotti, & Rabalais, 2003; Weathers et. al., 1993). See McDonald and Calhoun (2010) for a review of the PCL's diagnostic accuracy and Wilkins, Lang, and Norman (2011) for a summary of the PCL's psychometric properties.

The Neurobehavioral Symptom Inventory

The Neurobehavioral Symptom Inventory (NSI; Cicerone & Kalmar, 1995) is a 22-item self-report measure of postconcussive symptoms. Respondents are asked to rate how much they have been bothered during the past 2 weeks by each symptom using a five-point scale ranging from *none* (0) to *very severe* (4). The NSI includes three postconcussive symptom clusters composed of affective, somatic/sensory, and cognitive symptoms (Caplan, Ivins, Poole, Vanderploeg, Jaffee, & Schwab, 2010). These 22 items were derived from a larger structured clinical interview originally created by Levin et al. (1987) to assess common complaints subsequent to mTBI. Although the NSI is widely used within the VA Health Care System, relatively little is known about its psychometric properties. King and colleagues (2012) completed an investigation of the psychometric properties of the NSI and found that it demonstrated high internal consistency (total alpha = 0.95; subscale alpha = 0.88 to 0.92) and that subscale total scores correlated highly with the total score (r = 0.88 to 0.93). Their study found that the NSI was able to differentiate veterans with a history of TBI from those without, but was strongly influenced by variance associated with

probable PTSD, depression, and generalized anxiety. The measure is typically used as a screening tool, the results of which are reported in a qualitative manner rather than as a diagnostic tool that requires the calculation of a symptom cluster or total score indicative of the presence or absence of mTBI. Additionally, treatment providers can use the NSI as an assistive tool in clinical evaluations and interviewing as a quick snapshot of the postconcussive symptoms the veteran has endorsed, which then can be followed up on to get more information about onset, course, duration, severity, impairment, etc.

The Patient Health Questionnaire

The Patient Health Questionnaire (PHQ; Kroenke, Spitzer, & Williams, 2001) developed by Pfizer Incorporated is comprised of nine items corresponding to the diagnostic criteria for major depressive disorder described in the DSM-IV-TR (American Psychiatric Association, 2000). This self-report is completed based on the past 2 weeks and asks raters to endorse symptoms on a four-point scale that ranges from *not at all* (0) to *nearly every day* (3). The total score can range from 0-27. The authors suggest five levels of severity: minimal (total score, 0 – 4); mild (total score, 5–9); moderate (total score, 10 - 14); moderately severe (total score, 15 –19); and severe (total score, 20– 27). The PHQ-9 has demonstrated a sensitivity and specificity of 88% for major depression with scores at 10 or higher. This assessment has been found to be effective and useful in monitoring levels of severity of depression over time.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics Version 21 and the statistical package R. Veterans' consistency in reporting on nearly identical items on the PCL and PHQ or NSI was assessed through Pearson Product Moment

correlations and intraclass correlation coefficient (ICC) reliability analyses. More specifically, correlational analyses were calculated on items that measure sleep, concentration, and irritability from a single polytrauma evaluation and those items measuring sleep, concentration, and loss of interest from a single PTSD evaluation. Specific items on the PCL used in these correlational analyses include: item 13 "trouble falling or staying asleep;" item 15 "having difficulty concentrating;" item 14 "feeling irritable or having angry outbursts" and item 9 "loss of interest in activities that you used to enjoy." Items on the NSI include: item 15 "difficulty falling or staying asleep;" item 13 "poor concentration, can't pay attention, easily distracted;" and item 21 "irritability, easily annoyed." Specific items from the PHQ include: item 3 "trouble falling or staying asleep or sleeping too much;" item 7 "trouble concentrating on things, such as reading the newspaper or watching television;" and item 1 "little interest or pleasure in doing things." To determine whether there were differences between measurement occasions, homogeneity of regression slopes were calculated using multiple regression. A two-period cross-over design in a fixed effects repeated measures analysis of variance (fixed effects RMANOVA) was used to evaluate veterans' consistency in reporting on identical measures across time, measurement occasion, and the context of the measurement environment (i.e., the PTSD clinic, a "mental health" setting and the polytrauma clinic, a "medical" setting). Generalizability (G) theory is a statistical theory concerning the dependability or trustworthiness of generalization of behavioral measurements (Shavelson, Webb, & Rowley, 1989). A two-facet, fully crossed, random effects design with repeated measures ANOVA was used to evaluate the dependability of the diagnosis of PTSD based on the administration of the PCL.

RESULTS

Participants

The present study included data from 713 OEF/OIF/OND veterans with a median age of 28 years. They were predominantly male (96.5%), Caucasian (69.7%), married or partnered (53.4%), with high school diplomas or equivalent education (53.7%). DS1 did not include information regarding branch of service; however, DS2 and DS3 demographics suggest the majority of the sample served in the United States Army (Table 2 reports complete demographics). As DS2 was obtained from retrospective chart reviews for the current project, the demographic characteristics of that sample have not been reported previously. Participants in DS2 had a median age of 28 years, were exclusively male (100%), predominantly Caucasian (81.8%), married or partnered (61.4%), Army Veterans (52.3%), with high school diplomas or equivalent education (52.3%). Table 3 provides the mean total scores, standard deviations, and coefficient alphas for the PCL, NSI, and PHQ in all three datasets.

Research Questions

Research Question 1 and Research Question 2

Intraclass and Pearson Product Moment correlation coefficients were calculated for individual items on the PCL, NSI, and PHQ to assess consistency of symptom reporting across measures. Pearson Product Moment correlations provide a basic linear correlation coefficient, whereas intraclass correlations attenuated the estimates of reliability to the extent that there were differences in mean levels of reported symptom severity. As indicated in Table 4, relatively strong correlations were demonstrated for

Table 2. Demographics

	Dataset 1		Dataset 2		Dataset 3	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	30.9	7.7	29.7	7.3	31.0	8.1
	Dataset 1		Dataset 2		Dataset 3	
	n	%	*n*	%	*n*	%
Gender						
Male	144	100	44	100	504	95.3
Female	–	–	–	–	25	4.7
Race/Ethnicity						
Caucasian	118	81.9	36	81.8	342	64.7
Hispanic	15	10.4	6	13.6	91	17.2
African American	2	1.4	2	4.5	79	14.9
Native American	–	–	–	–	3	0.6
Asian	2	1.4	–	–	13	2.5
Pacific Islander	–	–	–	–	1	0.2
Other	3	2.1	–	–	–	–
Unknown	4	2.7	–	–	–	–
Marital Status						
Married / Partnered	79	54.9	27	61.4	275	51.9
Divorced / Separated	24	16.7	7	15.9	108	20.4
Single / Never Married	28	19.4	10	22.7	142	26.8
Widowed	–	–	–	–	3	0.6
Unknown	9	6.3	–	–	1	0.2
Education History						
Less than High School	–	–	–	–	3	0.6
HS Diploma / Equiv.	78	54.2	23	52.3	282	53.3
Some College / Tech	12	8.3	12	27.3	200	37.8
Bachelor's Degree	9	6.3	9	20.5	36	6.8
Some Graduate School	–	–	–	–	7	1.3
Unknown	41	28.5	–	–	1	0.2
Military Branch of Service						
Army	–	–	23	52.3	287	54.3
Air Force	–	–	4	9.1	21	4.0
Navy	–	–	4	9.1	33	6.2
Marine Corp	–	–	7	15.9	127	24.0
National Guard	–	–	6	13.6	59	11.2
Unknown	144	100	–	–	2	0.3

Table 3. Mean Scores, Standard Deviations, and Coefficient Alphas

	Dataset 1 (PTSD)	Dataset 2 (PTSD)	Dataset 2 (Polytrauma)	Dataset 3 (Polytrauma)
PCL				
Mean Score	60.64	63.89	60.31	52.00
Standard Deviation	14.85	12.67	13.61	7.00
Cronbach's Alpha	0.88	0.93	0.94	0.95
PHQ				
Mean Score	15.34	13.75	–	–
Standard Deviation	7.16	5.60	–	–
Cronbach's Alpha	0.82	0.86	–	–
NSI				
Mean Score	–	–	47.64	42.81
Standard Deviation	–	–	14.01	15.36
Cronbach's Alpha	–	–	0.92	0.93

Table 4. Correlation Results

	Dataset 1	Dataset 2	Dataset 2	Dataset 3
N	144	44	44	529
Context	PTSD	PTSD	Polytrauma	Polytrauma
Sleep				
Correlated Items [A, B, C]	A, B	A, B	A, C	A, C
ICC	0.66	0.77	0.73	0.81
Pearson	0.70	0.81	0.73	0.76
DF	137	43	43	487
P	0.000	0.000	0.000	0.000
Concentration				
Correlated Items [D, E, F]	D, E	D, E	D, F	D, F
ICC	0.62	0.56	0.75	0.66
Pearson	0.63	0.56	0.74	0.64
DF	138	43	43	488
P	0.000	0.000	0.000	0.000
Irritability				
Correlated Items [G, H]	–	–	G, H	G, H
ICC	–	–	0.76	0.71
Pearson	–	–	0.78	0.73
DF	–	–	43	506
P	–	–	0.000	0.000
Loss of Interest				
Correlated Items [I, J]	I, J	I, J	–	–
ICC	0.58	0.74	–	–
Pearson	0.58	0.75	–	–
DF	137	43	–	–
P	0.000	0.000	–	–

[A] PHQ Item 13. *"Trouble falling or staying asleep."*

[B] PHQ Item 3. "*Trouble falling or staying asleep, or sleeping too much."*

[C] NSI Item 18. *"Difficulty falling or staying asleep."*

[D] PCL Item 15. *"Having difficulty concentrating."*

[E] PHQ Item 7. *"Trouble concentrating on things, such as reading the newspaper or watching television."*

[F] NSI Item 13. *"Poor concentration, can't pay attention, easily distracted."*

[G] PCL Item 14. *"Feeling irritable or having angry outbursts."*

[H] NSI Item 21. *"Irritability, easily annoyed."*

[I] PCL Item 9. *"Loss of interest in activities that you used to enjoy."*

[J] PHQ Item 1. *"Little interest or pleasure in doing things."*

those items measuring sleep. Moderate to strong correlations were seen for those items assessing concentration, irritability, and loss of interest. Little variation was noted between the Pearson and intraclass correlations and in all cases, the level of agreement between scales measured on the same day in the same clinical context remained moderate to strong.

Research Question 3

Research Question 3 asked if the consistency of measurement in the PTSD clinic differed from the consistency of measurement in the polytrauma clinic. Separate multiple regression analyses were used to test for heterogeneity of regression or differential consistency between settings in self reports of problems sleeping and difficulties in concentration. Note, the items assessing loss of interest and irritability were not included in these analyses as they were not assessed in both settings. There were no significant differences between the mental health (PTSD) and medical (polytrauma) settings in symptom reporting on items that measured sleep ($\beta = .013$, $p = .720$) or concentration ($\beta = -.048$, $p = .184$).

Research Question 4

The repeated measures ANOVA revealed no overall effect of measurement Occasion ($F(1, 42) = 0.43$, $p = 0.52$). However, given the archival nature of the dataset, there was no control over the length of interoccasion intervals. An examination of these revealed considerable variability in the interoccasion interval. Figure 1 shows that the distribution of days between measurement occasions ranged from 1 to 1810.

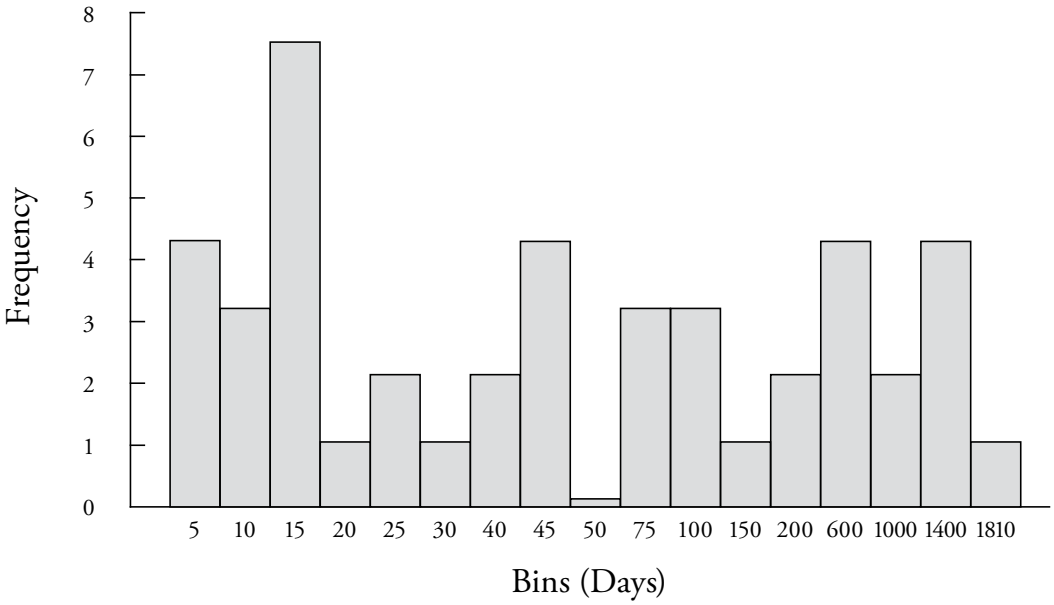

Figure 1. Distribution of Days Between Measurement Occasions

Research Question 5

A primary motivation for the present study was to determine if the severity of self-reported PTSD symptoms depends on whether the measurements are obtained in a medical or mental health context. In a two-period cross-over design, interpretation of the effect of Context requires that there be no differential carryover (Hills & Armitage, 1979). Differential carry-over is indicated when there is a between-group main effect of Order of test administration on the PCL scores (PTSD/mental health first versus polytrauma/medical first). The effect of Order was not significant (F (1, 42) = 1.42, p = 0.24), indicating that differential carryover did not complicate the interpretation of the effect of Context.

Research Question 6

The repeated measures ANOVA revealed a significant effect of Context, F (1, 42) = 5.79, p = .02, partial η^2=.12. Contrary to predictions, the severity of symptoms on the PCL was higher in the PTSD clinic (M=63.34) than the polytrauma clinic

(*M*=58.37). The results of the repeated measures ANOVA that address Research Questions 4, 5, and 6 are summarized in Table 5.

Veterans measured first in a PTSD clinic reported the highest levels of PTSD symptoms. Reports were somewhat lower for veterans measured in the PTSD clinic on the second occasion. Conversely, veterans measured first in a polytrauma clinic had the lowest level of self-reported PTSD symptoms, but the severity of symptoms increased when veterans were queried in a polytrauma clinic after they had first been evaluated in a PTSD clinic. A test of the simple effect of Context at the first measurement occasion approached the conventional level of significance, $t(43) = 1.99$, $p = .053$, partial $\eta^2 = .086$. Simple effects of measurement occasion were not significant for veterans measured first in the PTSD clinic, $F(1, 42) = 2.82$, $p = .100$, or for veterans measured first in the polytrauma clinic, $F(1, 42) = 3.23$, $p = .079$.

Research Question 7

The PCL is often used in combination with a clinical interview to determine if a veteran meets the criteria for PTSD. G Theory was used to assess the dependability of PTSD diagnoses based on the administration of the 17-item PCL on a single measurement occasion. Analyses assumed an absolute fixed cutoff for classifying veterans as either having PTSD or not. When decisions are based on a fixed cutoff,

Table 5. Effects of Measurement Occasion, Context, and Order

	Type III SS	*df*	Mean Sq.	*F*	$p < .05$	Partial η^2
Within-Subjects						
Occasion	19.32	1	19.32	0.43	0.52	–
Context	260.68	1	260.68	5.80	0.02	.12
Error	1887.90	42	44.95			
Between-Subjects						
Intercept	258597.02	1	258597.02	848.88	0.00	–
Order	430.93	1	430.93	1.415	0.24	–
Error	12794.56	42	304.63			

G Theory states that the error variance is the sum of all variances in the linear model except person variance(items, occasions, personXitems, personXoccasions, itemXoccasion, personXitemXoccasion, and error; Shavelson & Webb, 1991). The index of dependability was the ratio of person variance to the sum of person variance and error variance.

The variance components for the generalizability study are reported in Table 6. The generalizability analysis yielded a dependability (Φ) of .423. Thus, only 42.3% of the variance in PCL total scores was dependable. An interesting benefit of G theory is that it allows for "what-if" studies, in which it is possible to estimate what the dependability of a measure could be with different numbers of items or occasions. In this case, manipulations of the number of items and occasions, even up to 100,000, produced negligible improvement in dependability (Φ = .506). These manipulations had little effect on Φ because they had no effect on the residual variance component. To determine if unmodeled variance in PCL scores associated with context affected the estimates of variance components for the generalizability study, the analyses were repeated using only the larger of the two groups that first completed the PCL in the PTSD clinic (*n*=32). The effects on variance estimates were negligible.

Table 6. Variance Components

Source	Variance
Person	0.43
Item	0.11
Occasion	0.00
Person x Item	0.29
Person x Occasion	0.15
Item x Occasion	0.00
Residual	0.42

DISCUSSION

Consistency of Item-Level Symptom Endorsement

The Pearson Product Moment and intraclass correlation results from the PTSD and polytrauma clinics demonstrate moderate to strong correlations between items that assess sleep, concentration, irritability, and loss of interest. This suggests veterans endorse these symptoms similarly across measures within a single measurement occasion. The strongest correlation was found on the items measuring sleep within the polytrauma clinic (PCL 13, NSI 18, ICC = .81). This result is not necessarily surprising as these two items are the most synonymous of those being tested. It is likely that the minor difference in wording (e.g., "trouble" and "difficulty" falling or staying asleep) is negligible. Further, both assessments ask veterans to report their level of distress on a five-point scale with response anchors focused on severity and intensity of symptoms rather than frequency of symptom occurrence. It is interesting, given the high level of similarity between the PCL and NSI sleep items that the correlation is not higher.

The lowest intraclass correlation, although still moderately strong, was found on the concentration items within the PTSD clinic (PCL 15, PHQ 7, ICC = .56). Of the items being tested, these two are the most dissimilar in terms of wording. The PHQ item is more specific than the PCL item, and it includes the example, "reading a newspaper or watching television." It is possible that the added specificity of the item contributes to variance in responses between the two instruments. Additionally, unlike the PCL and NSI, the PHQ asks veterans to respond to how much they have been bothered by symptoms in terms of frequency, rather than severity. This

difference in response scales also may contribute to variance in responses to items on the PCL and PHQ. Further, sleep disturbances may be an easier construct to quantify and associate with a subjective level of distress than one's ability to concentrate. It is relatively simple to quantify the number of hours of sleep one gets each night, how long it takes them to fall asleep, and how many times they wake in the night, in comparison to trying to accurately evaluate problems with concentration such as the number of times an individual gets distracted or notices their mind wandering. Additionally, the concentration items may be more highly correlated in the polytrauma setting as veterans may associate concentration as a symptom of mTBI rather than depression or PTSD and thus may be more likely to endorse elevated concentration problems in the medical setting.

In this case, it is difficult to know what contributed to the level of overall consistency. Overall both settings demonstrated moderate to strong consistency across items, with slightly more, although not statistically significantly greater, in the medical setting. However, this result may be an artifact of the structural similarity of the PCL and NSI compared to the PCL and PHQ, rather than the measurement context itself. Given the similarity in items and the close temporal proximity in completion of the measures, it is encouraging that the results demonstrated moderate or strong correlations across measures and settings, which indicates consistency in item-level symptom endorsement.

The Influence of Measurement Occasion, Order, and Context

Interestingly, there was no main effect for measurement occasion. Since there was no control over interoccasion intervals, variance in time intervals between measurement occasions would appear as person X occasion interaction variance or error, reducing the sensitivity of the statistical test for the effects of occasions. Despite the variance in interoccasion intervals, there appeared to be some evidence

of differential regression effects. Veterans measured in the mental health setting on the first occasion had high PCL scores, whereas veterans measured in the mental health setting on the second occasion regressed downward and were less extreme. The opposite effect was observed for veterans measured in the medical setting. Those scores were relatively low on the first occasion and were elevated on the second. Thus, there was no mean effect of occasion on PCL scores, but there was evidence of negative change for some veterans and positive change for others.

It is also possible that many of the veterans in this sample were not engaged in any sort of treatment or intervention and thus may not have had significant impetus for PTSD symptoms to change in the interval between measurement occasions. Additionally, it is possible that veterans were engaged in treatment, but not necessarily a trauma-focused evidence-based therapy such as Prolonged Exposure or Cognitive Processing Therapy, which were part of VA-wide rollouts, beginning in 2007 under the direction of the VA Office of Mental Health Services. Data regarding treatment were collected as part of the retrospective chart review. Unfortunately, many of the medical records were vague and thus it was challenging to provide a clear indication of the amount of treatment veterans received, only the types of treatments. Finally, Forbes et al. (2001) compared the PCL to the CAPS at pre- and posttreatment. They found that the PCL provided a more conservative estimate of change (8.4%) than the CAPS (17.5%). In the absence of a large shift in symptoms, many veterans may report similar levels of severity on the PCL across time.

When considering the null effect of measurement occasion and the significant effect of context, it is appropriate to consider the possibility of inaccurate presentations and symptom endorsements during testing. It is also important to consider the symptoms evaluated on the PCL, some of which are non-specific in nature (e.g., sleep, concentration, loss of interest, irritability) and may be elevated due to other psychiatric or medical health concerns. Approximately 85% of the sample endorsed

PTSD symptoms at or above the recommended cut-off of 50, with many significantly elevated scores suggestive of severe PTSD symptomology. Although a large body of literature exists concerning the detection of exaggerated PTSD symptoms, self-report measures, such as the PCL, are ineffective in detecting symptom exaggeration (Guriel & Gremouw, 2003).

Related to possible symptom overreporting, the potential for new or continued secondary gain must be considered, particularly as many of these participants are recently returned veterans who will be relatively new to the VA Health Care System. For some, the PTSD or polytrauma clinics may have been their first exposure to the VA. Elements of secondary gain can include financial incentives such as service connection, access to treatment services, avoiding criminal charges and related consequences, and for some, receiving recognition for military service (Bianchini, Mathias, & Greve, 201; Elhai et al., 2012; Greiffentstein & Baker, 2008). Further, it has been argued that the service connection/disability program within the VA can have unintended consequences of creating, promoting, or even accentuating problems or illness due to the structure of the system and the requirements for receiving benefits (Howe, 2009; Mossman, 1996; Sayer, Spoont, Nelson, Clothier, & Murdoch, 2008).

Although an effect of context was predicted, the finding that reports of PTSD symptoms were higher in the mental health clinic than in the medical setting are contradictory to those hypothesized. Divergent to this result, a body of literature suggests that OEF/OIF/OND veterans are more likely to accept more medically based diagnoses such as TBI, than they are mental health diagnoses such as PTSD or depression due to cultural factors and stigma (Brenner, Vanderploeg, & Terrio, 2009; Hoge et al., 2004; Kilbourne, Keyser, & Pincus, 2010; Osterman & de Jong, 2007). Further, there may be a belief that mTBI is due to an injurious event and thus is not the fault of the individual, whereas some may view PTSD or other psychiatric concerns to be the mark of characterological flaw, weakness, or personal shortcoming.

Further anecdotal reports indicate that veterans may be more likely to follow through with treatment recommendations or referrals for TBI-related intervention (e.g., neuropsychological testing, rehabilitation services such as physical, occupational, and speech therapy, and cognitive remediation and cognitive aids) than they are for mental health services (e.g., individual or group psychotherapy, psychotropic medications; Brenner et al., 2009).

Consistent with the results from veterans in the present study who were first assessed in the medical setting, several studies have found an increase in PTSD and postconcussive symptom endorsement over time (Belanger et al., 2009; Milliken et al., 2007). Several explanations have been suggested to explain these findings. First, it has been proposed that physiological changes that persist following mTBI such as vestibular changes, hearing loss, and tinnitus may result in increased anxiety over time. Additionally, it is possible that the longer veterans are home from deployment and continue transitioning back into a civilian lifestyle, they may become more aware of symptoms (Belanger et al., 2009). Further, screening and assessment within a polytrauma clinic setting is typically remote in time from the injury event(s) and one's accuracy of reporting decreases over time (Hoge, 2010; Vanderploeg & Belanger, 2013). Of important note, mTBI is not a progressive disease; the symptoms to no worsen with time, but rather are expected to improve and typically remit within hours to months of the injury (Vanderploeg & Belanger, 2013). Given natural course of recovery from mTBI, if PCS-like symptoms exist that are chronic in nature, they are most likely unrelated to the mTBI, but rather to other factors such as PTSD or other psychiatric concerns, chronic pain, substance use, or poor sleep. Additionally, it is important to remember that some of these symptoms are non-specific in nature and are, in fact, normal and expected among postdeployment combat veterans (Hoge, 2010).

It is also quite possible that the clinical context primes veterans to be more

or less sensitive to certain types of items, even prior to their arrival at the clinic. For example, veterans who report to a PTSD clinic will know that they are attending an appointment intended to evaluate their PTSD symptoms, and they may be more prepared to endorse these sorts of symptoms. Further, if a veteran is willing to seek treatment and/or accept a referral from a treatment provider or loved one, it is likely that stigma is not a concern, or may be a concern that pales in comparison to their desire to get help for their symptoms. Relatedly, veterans who complete both PTSD and polytrauma assessments may be atypical of the majority of veterans who seek treatment at the VA. Conversely, a veteran with an appointment in a polytrauma clinic may be focused more on their cognitive and sensory/somatic complaints, or other factors such as chronic pain, than psychiatric symptoms. Depending on the severity of symptoms and other potentially complicating comorbidities, it is possible that veterans in the polytrauma clinic are preoccupied with more medical/physical complaints.

Dependability of the PCL

In clinical practice settings, the PCL is most often used as a self-report measure of PTSD symptoms to inform a clinical interview. A limitation of the current study is that the PCL was the only source of diagnostic information available for PTSD. As such, the author wanted to assess how much confidence should be placed on the PCL that it will produce the same diagnostic decisions if it were administered on any one of multiple occasions. Generalizability theory provided an opportunity to explore the effects of increasing the number of items or measurement occasions on the dependability of diagnoses based on the PCL. This exercise can provide useful information regarding the dependability of a measure and have possible implications for clinical practice.

At the outset of the present study, the dependability of the PCL for the current

sample was an interesting question. However, the current dataset was inadequate to answer the question. The present sample had a restricted range, over 85% of the total scores exceeded the recommended cutoff of 50 for a diagnosis of PTSD. Indeed, several cases were dropped from the sample because those veterans ultimately were not diagnosed with PTSD. The restriction of range precluded a reasonable assessment of the usefulness of the PCL for identifying veterans with PTSD.

Limitations and Directions for Future Research

There are several limitations to this study that require acknowledgment. The sample size used for the majority of analyses was small. Future research should include larger datasets with greater variability in test scores to ensure more generalizable results. The current data did not include service connection status at any time point. This information will be important given the literature concerning over-reporting both PTSD and postconcussive symptoms for the purposes of secondary gain. Although chart reviews included a preliminary evaluation of treatment between measurement occasions, given the considerable variance in interinterval occasions, it will be necessary to have greater control over what types and amount of treatment interventions veterans receive between measurement occasions. Romesser and colleagues tested for treatment effects by evaluating both the influence of earlier TBI treatment and the use of psychotropic medications within 30 days of the PTSD assessment and found no significant effects for either (Romesser et al., 2011). In addition to knowing the time between measurement occasions, it will be useful to note the time since injury for mTBI. The majority of the sample included in the present study have remote injuries (6 months to 1 year on average) and as there is a large body of literature on the expected resolution of symptoms and course of recovery (Belanger, Curtiss, Demery, Lebowitz, & Vanderploeg, 2005; Carroll et al., 2004; Vanderploeg & Belanger, 2013). Having a sense of the time since injury could

provide some insight into the potential severity of symptoms attributable to mTBI.

Controlling for time between interval occasions may provide useful information regarding the trajectory of veterans' self-reported PTSD and postconcussive symptoms following a single measurement occasion. It could also prove beneficial to collect additional clinical information concerning participants such as the presence (or absence) of other diagnoses, including depression, anxiety disorders, adjustment disorder, substance use disorders, and chronic pain as each of these have some similar symptoms to those of PTSD and postconcussive symptoms. Demographic, diversity, and cultural factors such as age, ethnicity, gender, and other factors should be considered. Given the high prevalence rates of military sexual trauma (MST) among returning service members and veterans, it would be interesting to evaluate, what, if any, influence the presence of MST has on the outcome of results. Chart review should also include an investigation of referral source as there may be differences among those who are self-referred for a PTSD assessment as compared to those who are referred by a physician or other treatment provider.

Conclusions

Within the VA Health Care System, PTSD is routinely assessed in both mental health settings, including PTSD specialty clinics, and medical settings, such as polytrauma clinics, yet this is the first study to the author's knowledge that investigated the reliability of the PCL when administered in mental health and medical settings on multiple measurement occasions. Research designed to optimize the diagnostic accuracy, reliability, and clinical utility of assessment for PTSD, mTBI history, and PCS are important (Carlson et al., 2009; Iverson, 2012). For veterans, diagnosis directly influences the type of treatment(s) they may receive and the compensation benefits they may be eligible for. The present study revealed significant differences between mental health and medical contexts in veterans' reports of PTSD

symptoms. Given the large numbers of recently returning OEF/OIF/OND veterans and the high prevalence rates of co-occurring PTSD and mTBI, these results call for continued investigation of the reliability of commonly used assessment measures when administered in different contexts. The optimization of assessment protocols for this new generation of veterans will provide better opportunity to ensure accurate diagnoses, and in turn, can improve the overall care these service members receive.

REFERENCES

American Psychiatric Association. (2004). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.

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

Belanger, H. G., & Vanderploeg, R. D. (2005). The neuropsychological impact of sports-related concussion: A meta-analysis. *Journal of the International Neuropsychological Society*, *11*(4), 345-357.

Belasco, A. (2007). *The cost of Iraq, Afghanistan, and other global war on terror operations since 9/11*. Washington, D.C.: Congressional Research Service.

Benge, J. F., Pastorek, N. J., & Thornton, G. M. (2009). Postconcussive symptoms in OEF-OIF veterans: Factor structure and impact of posttraumatic stress: A meta-analysis. *Rehabilitation Psychology*, *54*(3), 270-278.

Bianchini, K.J., Mathias, C.W., & Greve, K.W. (2001). Symptom validity testing: A critical review. *Clinical Neuropsychologist*, *15*, 19-45.

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., et al. (1995). The development of a Clinician-Administered PTSD Scale. *Journal of Traumatic Stress*, *8*(1), 75-90.

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). *Behavioral Research and Therapy*, *34*(8), 669-673.

Bremner, J. D., Krystal, J. H., Southwick, S. M., & Charney, D. S. (1995). Functional neuroanatomical correlates of the effects of stress on memory. *Journal of Traumatic Stress*, *8*(4), 527-553.

Bremner, J. D., Southwick, S. M., Brett, E., Fontana, A., Rosenheck, R. A., & Charney, D. S. (1992). Dissociation and posttraumatic stress disorder in Vietnam combat veterans. *American Journal of Psychiatry*, *149*, 328-332.

Brenner, L. A., Vanderploeg, R. D., & Terrio, H. (2009). Assessment and diagnosis of mild traumatic brain injury, posttraumatic stress disorder, and other polytrauma conditions: Burden of adversity hypothesis. *Rehabilitation Psychology*, *54*(3), 239-246.

Bryant, R. A. (2001). Posttraumatic stress disorder and mild brain injury: controversies, causes and consequences. *Journal of Clinical and Experimental Neuropsychology*, *23*(6), 718-728.

Chemtob, C. M., Hamada, R. S., Roitblat, H. I., & Muraoka, M. Y. (1994). Anger, impulsivity, and anger control in combat-related posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology*, *62*(4), 827-832.

Cicerone, K. D., & Kalmar, K. (1995). Persistent postconcussion syndrome: The structure of subjective complaints after mild traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *10*(3), 1-17.

Cigrang, J. A., Rauch, S. A. M., Avila, L. L., Bryan, C. J., Goodie, J. L., Hryshko-Mullen, A., et al. (2011). Treatment of active-duty military with PTSD in primary care: Early findings. *Psychological Services*, *8*(2), 104-113.

Clark, M. E., Bair, M. J., Buckenmaier, C. C., Gironda, R. J., & Walker, R. L. (2007). Pain and combat injuries in soldiers returning from Operations Enduring Freedom and Iraqi Freedom: Implications for research and practice. *Journal of Rehabilitation Research and Development, 44*, 179-194.

Committee on Treatment of Posttraumatic Stress Disorder, Institute of Medicine. (2006). *Treatment of posttraumatic stress disorder: An assessment of the evidence*. Washington, D.C.: National Academies Press.

Davidson, J. R., Hughes, D., Blazer, D. G., & George, L. K. (1991). Posttraumatic stress disorder in the community: An epidemiological study. *Psychological Medicine*, *21*(3), 713-721.

Department of Veterans Affairs, National Center for PTSD. (2010). NCPTSD Website. Retrieved October 19, 2011, from http://www.ptsd.va.gov

Department of Veterans Affairs and Department of Defense, Management of Concussion/mTBI Working Group. (2009). *VA/DoD clinical practice guideline for management of concussion/mild traumatic brain injury*. Washington DC: Author.

Elhai, J.D., Sweet, J.J., Guidotti-Breting, L.M., & Kaloupek, D. (2012). Assessment in contexts that threaten response validity. In J.J. Vasterling, R.A. Bryant, & T.M. Keane, (Eds.), *PTSD and mild traumatic brain injury* (pp. 174-198). New York: The Guilford Press.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P)*. New York: Biometrics Research, New York State Psychiatric Institute.

Foa, E. B., Keane, T. M., & Friedman, M. J. (2000). *Effective treatments for PTSD: Practice guidelines from the International Society for Traumatic Stress Studies*. New York, NY US: Guilford Press.

Forbes, D., Creamer, M., & Biddle, D. (2001). The validity of the PTSD checklist as a measure of symptomatic change in combat-related PTSD. *Behavioral Research and Therarpy*, *39*(8), 977-986.

Gawande, A. (2004). Casualties of war--military care for the wounded from Iraq and Afghanistan. *New England Journal of Medicine*, *351*(24), 2471-2475.

Gondusky, J. S., & Reiter, M. P. (2005). Protecting military convoys in Iraq: An examination of battle injuries sustained by a mechanized battalion during Operation Iraqi Freedom II. *Military Medicine*, *170*(6), 546-549.

Hills, M., & Armitage, P. (1979). The two-period cross-over clinical trial. *British Journal Of Clinical Pharmacology*, *58*(7), S703.

Hoge, C. W., Auchterlonie, J. L., & Milliken, C. S. (2006). Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *Journal of the American Medical Association, 295*(9), 1023-1032.

Hoge, C. W., Castro, C. A., Messer, S. C., McGurk, D., Cotting, D. I., & Koffman, R. L. (2004). Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *New England Journal of Medicine*, *351*(1), 13-22.

Hoge, C. W., Goldberg, H. M., & Castro, C. A. (2009). Care of war veterans with mild traumatic brain injury–flawed perspectives. *New England Journal of Medicine*, *360*(16), 1588-1591.

Hoge, C. W., Lesikar, S. E., Guevara, R., Lange, J., Brundage, J. F., Engel, C. C., Jr., et al. (2002). Mental disorders among U.S. military personnel in the 1990s: Association with high levels of health care utilization and early military attrition. *American Journal of Psychiatry*, *159*(9), 1576-1583.

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. *New England Journal of Medicine*, *358*(5), 453-463.

Hoge, C. W., Terhakopian, A., Castro, C. A., Messer, S. C., & Engel, C. C. (2007). Association of posttraumatic stress disorder with somatic symptoms, health care visits, and absenteeism among Iraq war veterans. *American Journal of Psychiatry*, *164*(1), 150-153.

Howe, L.S. (2009). Giving context to post-deployment post-concussive-like symptoms: Blast-related potential mild traumatic brain injury and comorbidities. *The Clinical Neuropsychologist*, *23*(8), 1315-1337.

Iversen, A. C., van Staden, L., Hughes, J. H., Greenberg, N., Hotopf, M., Rona, R. J., et al. (2011). The stigma of mental health problems and other barriers to care in the UK Armed Forces. *BMC Health Services Research*, *11*, 31-31.

Keane, T. M., Weathers, F. W., & Foa, E. B. (2000). Diagnosis and assessment. In E. B. Foa, T. M. Keane & M. J. Friedman (Eds.), *Effective treatments for PTSD: Practice guidelines from the International Society for Traumatic Stress Studies* (pp. 18-36). New York: Guilford Press.

Kennedy, J. E., Jaffee, M. S., Leskin, G. A., Stokes, J. W., Leal, F. O., & Fitzpatrick, P. J. (2007). Posttraumatic stress disorder and posttraumatic stress disorder-like symptoms and mild traumatic brain injury. *Journal of Rehabilitation Research and Development*, *44*(7), 895-920.

Kessler, R. C., Berglund, P. A., Bruce, M. L., Koch, J. R., Laska, E. M., Leaf, P. J., et al. (2001). The prevalence and correlates of untreated serious mental illness. *Health Services Research*, *36*(6 Pt 1), 987-1007.

King, L. A., & King, D. W. (1994). Item response theory and PTSD assessment. *PTSD Research Quarterly*, *5*(2), 6-8.

Kubany, E. S. (1994). A cognitive model of guilt topology in combat-related PTSD. *Journal of Traumatic Stress*, *7*(8), 3-19.

Kubany, E. S., Gino, A., Denny, N. R., & Torigoe, R. Y. (1994). Relationship of cynical hostility and PTSD among Vietnam veterans. *Journal of Traumatic Stress*, *7*(1), 21-31.

Levin, H. S., Mattis, S., Ruff, R. M., Eisenberg, H. M., Marshall, L. F., Tabaddor, K., et al. (1987). Neurobehavioral outcome following minor head injury: A three-center study. *Journal of Neurosurgery*, *66*(2), 234-243.

Litz, B. T., & Schlenger, W. E. (2009). PTSD in service members and new veterans of the Iraq and Afghanistan wars: A bibliography and critique. *PTSD Research Quarterly*, *20*(1), 1-7.

McAllister, T. W., & Stein, M. B. (2010). Effects of psychological and biomechanical trauma on brain and behavior. *Annals of the New York Academy of Sciences*, *1208*, 46-57.

Milliken, C. S., Auchterlonie, J. L., & Hoge, C. W. (2007). Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *Journal of the American Medical Association*, *298*(18), 2141-2148.

O'Donnell, M. L., Creamer, M., & Pattison, P. (2004). Posttraumatic stress disorder and depression following trauma: Understanding comorbidity. *American Journal of Psychiatry*, *161*(8), 1390-1396.

Possemato, K., Ouimette, P., Lantinga, L. J., Wade, M., Coolhart, D., Schohn, M., et al. (2011). Treatment of Department of Veterans Affairs primary care patients with posttraumatic stress disorder. *Psychological Services*, *8*(2), 82-93.

Romesser, J., Shen, S., Reblin, M., Kircher, J., Allen, S., Roberts, T., & Marchand, W. R. (2011). A preliminary study of the effect of a diagnosis of concussion on PTSD symptoms and other psychiatric variables at the time of treatment seeking among veterans. *Military Medicine*, *176*(3), 246-252.

Ruggiero, K. J., Del, B. K., Scotti, J. R., & Rabalais, A. E. (2003). Psychometric properties of the PTSD Checklist—Civilian Version. *Journal of Traumatic Stress*, *16*(5), 495.

Sayer, N. A., Chiros, C. E., Sigford, B., Scott, S., Clothier, B., Pickett, T., et al. (2008). Characteristics and rehabilitation outcomes among patients with blast and other injuries sustained during the Global War on Terror. *Archives of Physical Medicine and Rehabilitation*, *89*, 163-170.

Sayer, N. A., Rettmann, N. A., Carlson, K. F., Bernardy, N., Sigford, B. J., Hamblen, J. L., & Friedman, M. J. (2009). Veterans with history of mild traumatic brain injury and posttraumatic stress disorder: Challenges from provider perspective. *Journal of Rehabilitation Research and Development*, *46*(6), 703-716.

Schretlen, D. J., & Shapiro, A. M. (2003). A quantitative review of the effects of traumatic brain injury on cognitive functioning. *International Review of Psychiatry*, *15*(4), 341-349.

Shavelson, R. J., & Webb, N. M. (1991). *Generalizability theory: A primer*. Sage Publications: California.

Silver, J. M., McAllister, T. W., & Arciniegas, D. B. (2009). Depression and cognitive complaints following mild traumatic brain injury. *American Journal of Psychiatry*, *166*(6), 653-661.

Solomon, Z., Shklar, R., & Mikulincer, M. (2005). Frontline treatment of combat stress reaction: a 20-year longitudinal evaluation study. *American Journal of Psychiatry*, *162*(12), 2309-2314.

Spoont, M., Arbisi, P., Fu, S., Greer, N., Kehle-Forbes, S., Meis, L., Rutks, I., & Wilt, T.J. (2013). Screening for Posttraumatic Stress Disorder (PTSD) in primary care: A systematic review. VA-ESP Project #09-009; 2013.

Stein, M. B., & McAllister, T. W. (2009). Exploring the convergence of posttraumatic stress disorder and mild traumatic brain injury. *American Journal of Psychiatry*, *166*(7), 768-776.

Stein, M.B., McQuaid, J.R., Pedrelli, P., Lenox, R., & McCahill, M.E. (2000). Posttraumatic stress disorder in the primary care medical setting. *General Hospital Psychiatry*, *22*(4), 261-269.

Summerall, E. L., & McAllister, T. W. (2010). Comorbid posttraumatic stress disorder and traumatic brain injury in the military population. *Psychiatric Annals*, *40*(11), 563-580.

Tanielian, T., & Jaycox, L., Eds. (2008). *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery*. Santa Monica, CA: RAND Corporation.

Terrio, H., Brenner, L. A., Ivins, B. J., Cho, J. M., Helmick, K., Schwab, K., et al. (2009). Traumatic brain injury screening: Preliminary findings in a US Army Brigade Combat Team. *Journal of Head Trauma Rehabilitation*, *24*(1), 14-23.

Ulloa, E.W., Marx, B.P., Vanderploeg, R.D., & Vasterling, J.J. (2012). Assessment. In J.J. Vasterling, R.A. Bryant, & T.M. Keane (Eds.), *PTSD and mild traumatic brain injury* (pp. 174-198). New York: The Guilford Press.

Vanderploeg, R.D., & Belanger, H.G. (2013). Screening for a remote history of mild traumatic brain injury: When a good idea is bad. *Journal of Head Trauma Rehabilitation, 28*(3), 211-218.

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

Veterans Health Administration. (2006). 1172.1, Pts. 2.a., 3.b., and 3.i *VHA Handbook* (pp. 1-3). Washington, DC: Veterans Health Administration.

Walker, E.A., Newman, E., Dobie, D.J., Ciechanowski, P., & Katon, W. (2002). Validation of the PTSD Checklist in an HMO sample of women. *General Hospital Psychiatry*, *24*(6), 275-280.

Warden, D. (2006). Military TBI during the Iraq and Afghanistan Wars. *The Journal of Head Trauma Rehabilitation*, *21*(5), 398-402.

Warden, D. L., Gordon, B., McAllister, T. W., Silver, J. M., Barth, J. T., Bruns, J., et al. (2006). Guidelines for the pharmacologic treatment of neurobehavioral sequelae of traumatic brain injury. *Journal of Neurotrauma*, *23*(10), 1468-1501.

Weathers, F. W., Huska, J. A., & Keane, T. M. (1991). *PCL-M for DSM-IV*. Boston, MA: National Center for PTSD-Behavioral Sciences Division.

Weathers, F. W., Keane, T. M., & Foa, E. B. (2009). Assessment and diagnosis of adults. In E. B. Foa, T. M. Keane, M. J. Friedman, & J. A. Cohen (Eds.), *Effective treatments for PTSD: Practice guidelines from the International Society for Traumatic Stress Studies* (2nd ed., pp. 23-61). New York, NY US: Guilford Press.