"What Doesn't Kill Me, Makes Me Stronger:"

Predictors of Posttraumatic Growth Among

Traumatic Brain Injury Survivors of Motor Vehicle Accidents

by

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ABSTRACT

Decades of research and empirical studies support the belief that traumatic life events lead to a multitude of negative outcomes (Tedeschi & Calhoun, 1996), however, new research suggests that some survivors of trauma experience significant psychological growth, known as posttraumatic growth (PTG) (Tedeschi, Park, & Calhoun, 1998). The current study focused on the trauma of a traumatic brain injury (TBI) and its relation to the development of PTG. A TBI is both a psychological trauma and a type of acquired brain injury that occurs when physical injury causes damage to the brain (National Institutes of Health [NIH], 2013). Empirical studies examining TBIs and PTG are minimal. The current study focused on survivors who have sustained a TBI from a motor vehicle accident to help control for contextual factors of the injury that are known to affect outcomes. The aim of this study was to elucidate the physical, sociodemographic, contextual, and psychological factors that helped predict the development of PTG among a population of TBI survivors. In addition, another aim of this study was to gain a better understanding of the relationship between PTG and posttraumatic stress disorder (PTSD) symptomatology. Cross-sectional data from self-identified TBI survivors of motor vehicle accidents (n = 155) were used to construct a model of prediction of PTG. Preliminary analyses revealed a reliability issue with the measure that assessed participants' personality, and these variables were not used in planned analyses. Results revealed that the majority of participants were female, Caucasian, highly educated, and unemployed. Overall, the sample indicated significant injury severity, disability, and lower than average mental and physical functioning. The final model accounted for

approximately 15% of the variance in PTG and significant predictors included: gender, time since injury, and the interaction between PTSD symptoms and time since injury. The findings of this research can help inform treatment programs and rehabilitation services as well as funding that can aim to improve outcomes from survivors of TBI. Study limitations included the use of cross-sectional data, a homogenous and unrepresentative sample of TBI survivors, recruitment concerns, and low reliability observed in one of the integral measures of the study.

DEDICATION

To my husband for your unending support, love, and encouragement.

To my family for your love, patience, and confidence in me.

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INTRODUCTION

The Problem in Perspective

Decades of research and empirical studies support the notion that traumatic life events can lead to a multitude of negative physical and psychological consequences (Tedeschi & Calhoun, 1996). In general terms, trauma is defined as an event that involves either experiencing or being witness to real or potential harm to self or others that invokes intense fear or horror (American Psychiatric Association, 1994). Encouragingly, new research suggests that some survivors of trauma not only bounce back and cope successfully, but also experience significant development and growth, known as posttraumatic growth (PTG) (Tedeschi, Park, & Calhoun, 1998). Studies indicate that individuals who find a traumatic event as a catalyst for a positive change report constructive transformations in the following domains: self-perception, interpersonal relationships, and/or their philosophy on life and coping (McGrath & Linley, 2006; Tedeschi & Calhoun, 1996).

Of interest in the current study, was a particular trauma, known as a traumatic brain injury (TBI) and its relation to the development of PTG. Recently, TBI have garnered more public awareness namely because of the controversy of sport-related head injuries and injured veterans of the recent Iraq and Afghanistan wars (Centers for Disease Control and Prevention [CDC], 2015); Stein & McAllister, 2009). A TBI is a type of acquired brain injury that occurs when physical trauma causes damage to the brain, such as a head injury sustained in a motor vehicle accident (National Institutes of Health

[NIH], 2013). The severity of a TBI can range from mild, moderate, to severe depending on the physical damage to the brain, and severity is a key determinant of the long-term outcomes for a survivor (NIH, 2013). Furthermore, the cause of a TBI (i.e., sustained through non-violent versus violent circumstances) greatly affects the outcomes among survivors, such as post-injury emergence of psychological disorders (Kay et al., 1992). Research demonstrates that survivors of TBI are susceptible to a variety of negative outcomes similar to survivors of other traumas, including, but not limited to, psychological disorders, unemployment, and impaired social skills (Godfrey, & Shum, 2000; Hart et al., 2010; Satz et al., 1998). However, empirical studies regarding TBI and positive psychological constructs, such as PTG, are minimal. For instance, McGrath and Linley (2006) noted that there are "no systematic studies of posttraumatic growth in people with acquired brain injury" (p. 767). One of the myriad of reasons to study psychological growth after trauma is to aid in the effective rehabilitation of those that have suffered a TBI and to understand better what leads to potentially desirable outcomes, such as PTG.

The aim of this study was to elucidate the physical, sociodemographic, contextual, and psychological factors that predict the development of PTG among a population of TBI survivors. In addition, another aim of this study was to gain a better understanding of the relationship between PTG and posttraumatic stress disorder (PTSD) symptomatology. Utilizing the strong foundation of PTG research among other populations of trauma survivors, the following study presented a review of the literature regarding traumatic brain injuries, posttraumatic growth, and predictors of posttraumatic

growth including sociodemographic variables, personality traits, and PTSD symptoms. Traumatic brain injury was clearly defined and discussed as well as a description of level of severity of injury, cause of injury, and psychological versus physical trauma to the brain – all key dimensions in understanding TBI. To help control for contextual factors (i.e., cause of injury) that may have affected outcomes among TBI survivors, this study focused on survivors who sustained a TBI from a motor vehicle accident (MVA). Additionally, PTG, the outcome variable of this study, was described as both a conceptual process and an outcome. The predictors of PTG among traumatic brain injuries survivors were delineated, with definitions and characteristics of each. Moreover, the present study was distinct from previous research conducted because a novel array of predictors of PTG were selected and examined with prudent attention to extraneous variables, such as physical health status, not previously considered among this population.

LITERATURE REVIEW

Traumatic Brain Injury

A common type of physical trauma is a traumatic brain injury (TBI). A TBI is caused by wide variety of injuries involving a bump, blow, or jolt to the head, a fall, or a penetrating head injury (CDC, 2015; Mayo Clinic, 2014). In other words, it is a brain injury that is acquired by exogenous factors. A TBI may cause damage to the brain in any of the following forms: contusion, brain laceration, intracranial hematoma, skull fracture, or contrecoup injury (Bryant, 2001; Joseph & Masterson 1999). Furthermore, a TBI may result in the shearing of nerve fibers within the brain, and ongoing secondary

brain damage can result from hypoxia, anemia, metabolic anomalies, hydrocephalus, or intracranial hypertension, among many other conditions (Bryant, 2001). The range of symptoms that an individual may suffer following a TBI is extensive and typically depends on the severity of the TBI (discussed at length below). Symptoms of a TBI are varied and may include but are not limited to loss of memory, alterations in awareness, physical symptoms (i.e., nausea, vomiting, dizziness), and cognitive deficits (Joseph & Masterson 1999; Mayo Clinic, 2012). Table 1 provides a visual representation of the common symptoms observed following a TBI and is organized by type of symptom indicator.

In the United States alone, TBI are the third most frequent injury-related cause of death, with 1.7 million Americans sustaining a TBI each year (CDC, 2015). Further, TBI in the United States is the leading cause of death and disability in individuals aged one to 44. A TBI is most likely to occur among children aged 0 to 4, adolescents aged 15 to 19, and adults over the age of 65 (CDC, 2015). Across all ages, males are more likely than females to sustain a TBI (CDC, 2015). It is estimated that 30% of veterans have had a TBI (CDC, 2015; Mayo Clinic, 2014). The leading causes of TBI include falls (35.2%), followed by traffic accidents (17.3%), a blow or strike to the head (16.5%), and assaults (10%) (CDC, 2015).

Severity of a Traumatic Brain Injury. The impact of a TBI can vary widely as the severity of a TBI covers a vast spectrum of injury. A TBI is often classified by its severity and can range from mild to moderate to severe. In fact, the majority of empirical research regarding TBI classifies participants based on the severity of their neurological

injury (Saatman et al., 2008). Among systems that classify TBI, the Glasgow Coma Scale (GCS) is the most commonly used severity scale for adults due to the high inter-observer reliability and relatively good predictive power (Saatman et al., 2008). The GCS measures a patient's level of consciousness (LOC) following a head injury (Saatman et al., 2008). Scores can range from 3 (severe TBI) to 15 (mild TBI) and assess a patient's ability to open his/her eyes, to provide verbal responses, and to execute motor commands. Concussed patients score in a range from 14 to 15, whereas a patient in a coma scores between 3 to 8 (Bodin et al., 2012; McCullagh, Oucherlony, Protzner, Blair, & Feinstein, 2001). The GCS is not without criticism, as opponents remark that it is not a good discriminator among less severe TBI and does not take into account treatment received before arriving at a hospital (Saatman et al., 2008). In addition, the Abbreviated Injury Scale (AIS) or the Injury Severity Score (ISS) can also be utilized to measure degree of TBI severity. These scales include an assessment of injuries to other areas of the body and provide a more holistic score (Saatman et al., 2008). Other useful ways to determine severity of head trauma is by degree of posttraumatic amnesia (PTA), length of loss of consciousness (LOC), as well as overall mental status, such as level of orientation and confusion following an accident (Bodin et al., 2012). See Table 2 for a visual representation of how a TBI is classified by severity.

Due to the obvious heterogeneity observed among TBIs, the medical field has alternative methods of classifying a TBI. For example, pathoanatomic classification describes the location and anatomical features of a brain injury. This classification defines the location of the head injury, beginning with the scalp and skull down to the

axonal level of the brain (Saatman et al., 2008). Such a categorization is shown to be predictive of intracranial pressure and long-term outcomes in adults. Moreover, other classification systems exist such as classifying by pathophysiology and prognostic modeling (Saatman et al., 2008).

Given the range of debilitating symptoms associated with a TBI, it is not surprising that survivors of TBI experience negative outcomes, ranging from an inability to return to work to neuropsychological deficits (Hawley & Joseph, 2008). In spite of these findings, some researchers have examined the seemingly positive outcomes associated with a TBI and have discovered that not only was long-term adjustment sometimes achieved, in some cases a higher level of functioning was reported than that of pre-trauma (McGrath & Linley, 2006). For example, Hawley and Joseph (2008) conducted a longitudinal study of TBI survivors that considered injury severity and examined participants' adjustment after ten years. The results suggested that regardless of TBI severity participants showed evidence of long-term positive changes in outlook.

Cause of Traumatic Brain Injury. Not only does severity of a TBI greatly affect an individual's outcomes, but also the cause of the TBI is linked to survivor outcomes. In the medical field there is an etiological categorization for TBI known as "classification by physical mechanism." This system categorizes a TBI based on whether an individual's head was struck by an object (impact injury) or if an individual's brain was damaged by movement within the skull (inertial injury) (Saatman et al., 2008). Majdan et al. (2011) proclaimed there was a lack of empirical studies that consider differences in severity and outcome of TBI.

A few comparison studies have been conducted that further reveal the utility in understanding the effect cause of injury has on survivor outcomes. When comparing TBI that were acquired through violence-related incidents (e.g., assault) versus non-violent incidents (e.g., fall), research has demonstrated that the cause of injury was correlated with sociodemographic variables, history of substance abuse, severity of trauma and subsequent disability, and social integration post-injury (Dagher, Habra, Lamoureux, De Guise, & Feyz, 2010). For example, one study compared sociodemographics, medical characteristics, and acute outcomes among patients who had a moderate to severe TBI from either a motor vehicle accident (MVA) or an assault (Dagher et al., 2010). Results indicated that patients with a TBI sustained from a MVA had a higher percentage of polytrauma (injuries to other parts of their bodies), more medical complications, and higher scores on measures assessing severity of injury than did patients who had sustained a TBI from an assault. In contrast, patients who had sustained a TBI from an assault were more likely to be non-Caucasian, single males, and less educated, were more likely to have a criminal record, and have a history of unemployment and substance abuse (Dagher et al., 2010). Between the two groups, however, differences were not observed in regard to length of stay in the hospital or scores on a measure of global functioning given at discharge of initial hospital stay (Dagher et al., 2010). This study demonstrated that TBI survivors are qualitatively different, both in terms of demographic and injury characteristics, dependent on the cause of TBI.

Cause of TBI is also linked with psychological diagnoses following trauma, which can significantly affect outcomes for a TBI survivor. As an example, for those

who suffered a TBI following a MVA, estimates suggested that somewhere between 10% to 50% developed PTSD and a large percentage also exhibited symptoms of major depression (Friedland & Dawson, 2001; Hickling, Gillen, Blanchard, Buckley, & Taylor, 1998). It was postulated that the high incidence of PTSD observed among survivors of a MVA is related to loss of sense of control and the disruption to normal life often felt following a MVA (Friedland & Dawson, 2001). Thus, in studying a group of TBI survivors with an array of causes of injury, findings may be less generalizable and subject to more criticism due to lack of experimental control. Given that traffic accidents are one of the most common ways to sustain a TBI, survivors of MVA were recruited to be participants in this study.

Traumatic Brain Injury: Organic versus Psychological Trauma. In addition to severity and cause of TBI, another complication when studying TBI is distinguishing between symptoms that stem from physiological trauma to the brain and symptoms that arise from psychological and emotional distress engendered by the trauma. Kay et al. (1992) asserted there is a complex "interplay of neurological, physical, cognitive, psychological, personality, and environmental factors within the context of individual variabilities" that determines how an individual reacts and recovers following a TBI (p. 377). Thus, determining precisely how the physical severity and the organic pathology of a TBI affect recovery is quite hard to quantify. Kay et al. posited that many survivors of TBI have an underlying organic pathology that can mimic symptoms of posttraumatic stress disorder (PTSD) or post concussive syndrome (PCS), which are both psychological conditions. However, the only viable way to determine the etiology of ongoing

psychological and cognitive problems following a TBI is with neuroimaging that can detect subtle brain abnormalities. Kay et al. presented research that suggested even those who have suffered a mild TBI (Glasgow Coma Scale score of 13-15) show identifiable brain lesions. Moreover, Rao and Lyketsos (2000) emphasized that the neuropsychiatric disturbances, which include disorders of mood, cognition, or behavior that is often present following a TBI, were closely linked to the actual physical trauma to the brain. In addition, the presence of psychiatric conditions among TBI survivors is quite astonishing. For example, 25% of TBI survivors experience major depression while estimates for anxiety disorders among TBI survivors range from 11%-70% (Rao & Lyketsos, 2000). To summarize, it is exceptionally hard to distinguish between symptoms that are caused by physical trauma to the brain or by psychological distress of being confronted with severe injury or death. In fact, for the purpose of this study, psychiatric and cognitive symptoms were treated the same whether they arose from an organic pathology, psychological distress, or a combination of both.

Posttraumatic Growth

Definition of Posttraumatic Growth. Posttraumatic Growth (PTG) is both a process and an outcome (Tedeschi, et al., 1998). As a construct, PTG is conceptualized as a cognitive process that is initiated from dealing with a traumatic event and ultimately leads to incremental and positive psychological change (Tedeschi, et al., 1998). Throughout the literature, PTG has many different labels, such as finding benefits, stress-related growth, thriving, positive psychological changes, transformation of trauma, or adversarial growth (Tedeschi, & Calhoun, 2004; Zoellner, & Maercker, 2006). Tedeschi

and Calhoun (2004) coined the term posttraumatic growth, and their definition is the most widely used in the current literature: "posttraumatic growth refers to a change in people that goes beyond an ability to resist and be damaged by highly stressful circumstances; it involves a movement beyond pretrauma levels of adaptation" (p. 4). Tedeschi et al. (1998) have used the analogy of an earthquake to describe the process of PTG. They posited that a traumatic life event is like a "seismic" episode that occurs during an earthquake, which destroys buildings and communities and leaves only rubble in its wake. At first, people mourn and feel overwhelmed by the amount of work that is required to recover. Yet, the community bands together and builds stronger and sturdier structures, and people reflect on everything they have learned, accomplished, and overcome giving a new and lasting perspective (Tedeschi, et al., 1998). Tedeschi, et al. asserted that individuals recovering from a traumatic life event do initially experience psychological pain and distress but ultimately rebuild their life in a way that is superior to life before the trauma – just as in the earthquake analogy. These individuals are thought to create new psychological constructs for themselves that incorporate the possibility of a trauma and ways to cope (Tedeschi, et al., 1998).

Multiple studies suggest that PTG typically manifests itself differently across individuals but within three broad domains including positive change in perception of self, improved interpersonal relationships, and a new philosophy on life (McGrath & Linley, 2006). Interestingly, PTG is different from other seemingly similar constructs such as resilience, hardiness, optimism, or coping, as these mainly refer to the endurance of stress or a return to pre-trauma functioning (Tedeschi, et al., 1998; Tedeschi, &

Calhoun, 2004). In addition, a debate exists regarding the relationship between PTG and posttraumatic stress disorder (PTSD), and this relationship is an integral aspect in understanding the conceptualization of PTG. Some postulate that PTSD and PTG are constructs that are viewed as *not* residing on either end of the same continuum (Zoellner & Maercker, 2006). This notion suggests that growth and distress can coexist within one individual at the same time (the relationship between PTG and PTSD is discussed at length below) (Zoellner, & Maercker, 2006).

Measuring Posttraumatic Growth. In the early conceptualization of PTG, measurement of the construct varied amongst empirical studies (Cohen, Hettler, & Pane, 1998). Different definitions and connotations of PTG originally produced an array of measurement techniques and instruments. Notably, early studies assessed PTG by either interviewing survivors of trauma or using non-standardized self-report, paper-and-pencil measures (Cohen et al., 1998). These initial measurements of PTG were heavily criticized as they assessed a priori dimensions of PTG and did not provide a theoretical reasoning for the conceptualization of PTG that was linked across empirical findings (Cohen et al., 1998). With an awareness of the methodological problems in the assessment of PTG, Tedeschi and Calhoun (1996) were motivated to create an empirically based instrument of PTG. Tedeschi and Calhoun developed the Posttraumatic Growth Inventory (PTGI), which is now the most widely known and used measure of PTG. Cohen et al. (1998) asserted that the PTGI, while not perfect, is "the state of the art in PTG assessment" (p. 27).

In creating their measure, Tedeschi and Calhoun (1996) extensively examined the

PTG literature in order to develop evidence-based test items. They found that prior studies that had examined growth among trauma survivors most commonly noted positive changes in three domains. First, survivors of trauma often reported a positive change in perception of themselves. For instance, trauma survivors indicated they felt more "self-assured," "stronger," "self-reliant" and "assertive" (Tedeschi & Calhoun, 1996, p. 456). Second, a subset of trauma survivors reported a positive change in their relationships with others. Survivors indicated that this positive change manifested by developing deeper bonds with family members or fostering a greater appreciation for loved ones. Finally, survivors of trauma reported a beneficial change in their philosophy on life. This change was reported as a greater appreciation for living, a better understanding of life priorities, or a strengthening of religious and/or spiritual beliefs (Tedeschi & Calhoun, 1996).

Armed with the commonly perceived benefits survivors of trauma report, Tedeschi and Calhoun (1996) created test items for their PTG measure. Initially, 34 test items were generated that were believed to capture the most commonly reported positive changes following a traumatic event. A 6-point Likert response format was used that ranged from 0 (I did not experience this change as a result of my crisis) to 5 (I experienced this change to a very great degree as a result of my crisis). An initial study of the measure's items using a principal components analysis with a varimax rotation revealed the PTGI assessed five different dimensions of PTG (Tedeschi, & Calhoun, 1996). Based on the findings from the first factor analysis, Tedeschi and Calhoun selected 21 test items and performed a factor analysis that revealed five interpretable

factors with eigenvalues greater than one. These were explained as: 1) *Relating to Others*, 2) *New Possibilities* 3) *Personal Strength* 4) *Spiritual Change* and 5) *Appreciation of Life* (listed in respective order of variance accounted for). These factors accounted for 62% of the common variance in the PTGI. Tedeschi and Calhoun conducted several studies that demonstrated good internal consistency (α = .90) and acceptable test-retest reliability (r = .71) of the measure. Not only is the PTGI the most commonly used measure of PTG, it has greatly furthered the definition and understanding of the construct.

Time Since Trauma. For individuals who do experience growth after trauma, it is logical to assume that PTG would not emerge immediately following a traumatic experience. In addition, it was originally suggested that PTG is a slow process that gradually unfolds over time as survivors of trauma establish new and positive perspectives that helped them cope (Tedeschi & Calhoun, 1998). Therefore, a variable that is often considered when measuring PTG is the length of time elapsed between a traumatic event and the measurement of growth (Prati & Pietrantoni, 2009). Views regarding the point PTG develops following a trauma have been somewhat varied, with longitudinal studies suggesting that the greatest increase in PTG is observed two weeks to two months following an incident. Cross-sectional studies conversely report that PTG takes much longer, even years, to develop (Silva, Ownsworth, Shields, & Fleming, 2011).

A study conducted in Japan examined the relationship between the PTGI and time since trauma (Taku et al., 2007). Interestingly, it was found that the composite score and the scores on the subscales of the PTGI did not have a significant correlation with the time since trauma (Taku et al., 2007). In addition, empirical studies have assessed PTG

as early as one month following a trauma to as long as 52 years post-trauma (Helgeson, Reynolds, & Tomich, 2006). This suggested it may be appropriate to measure PTG at any point in the stage of recovery, as long as it is recognized that this may alter the relationship between PTG and other studied variables.

Time since trauma has also been examined as a moderator of PTG. A meta-analytic review that surveyed 77 studies examined moderators of "benefit finding" following trauma (Helgeson et al., 2006). Specifically, Helgeson et al. (2006) examined the average time since the trauma occurred (*Mdn* = 30 months) as a moderator variable of different outcomes, including PTG. Results indicated that time since trauma was a significant predictor for a variety of variables including positive well-being, a term used to represent constructs such as PTG ($\beta = .62$, $p < .001$). Moreover, the average effect size for the positive well-being variable among the studies included in the meta-analysis was statistically significant ($R^2 = .22$, $p < .05$). In the domain of brain injury, Gangstad, Norman, and Barton (2009) investigated the extent to which time since a stroke (a form of acquired brain injury) moderated the relationship between PTG and anxiety/depression. It was found that as length of time since stroke increased, the relationship between PTG and anxiety/depression became significant and more negative. These findings implied that PTG, although still present early in recovery post-trauma, becomes greater as time since incident increases (Gangstad et al., 2009).

Posttraumatic Growth and Traumatic Brain Injury. There has been some uncertainty in the literature about studying PTG among survivors of TBI, because it was hypothesized that the devastating injury to the brain and consequently the reduction in

cognitive capacities could prevent the PTG process from occurring or at least make it difficult to assess (McGrath & Linley, 2006). However, McGrath and Linley (2006) examined the degree, nature, and course of positive psychological change among individuals with a severe traumatic brain injury. The study used two matched samples of survivors of severe TBI, with one sample early in their injury recovery (M = 7 months) and the other for whom a significant amount of time had passed since injury (M = 10 years). Participants were given the PTGI, a measure of sense of coherence, and a measure of depression and anxiety. The late time sample reported significantly higher levels of PTG suggesting that positive change does take time to develop. The researchers noted that the participants' scores on the PTGI were comparable, or even higher, than other groups of trauma survivors providing evidence that PTG does exist among TBI survivors (McGrath& Linley, 2006). In addition, participants who scored higher on the anxiety and depression measure also scored higher on the PTGI. The researchers postulated that individuals who develop PTG do not suffer from denial or a lack of awareness and can simultaneously report depression and anxiety as well as psychological growth.

Predictors of Posttraumatic Growth

It is clear that PTG is a relevant and understudied construct in the realm of survivors of TBI. This sentiment is shared by McGrath and Linley (2006) as they stated "there is a need for exploratory research to begin to establish whether or not people may experience posttraumatic growth following brain injury, as well as to delineate some of the variables that may be associated with reports of posttraumatic growth" (p. 768).

Empirical studies have shown a wide array of factors to be associated with PTG amongst many populations of trauma survivors, including sociodemographic variables, specifics of the trauma (Wang, Wang, Wang, Wu, & Liu, 2013), individual coping styles and perspectives, (Schuettler & Boals, 2011), world assumptions, and social support (Dekel, Mandl, & Solomon, 2011).

From recent scholarly articles, Schuettler and Boals (2011) amassed factors that have been demonstrated to be either positively or negatively correlated with PTG. Factors that were consistently positively correlated with PTG included being female, having a minority race status, younger age, intrusive/avoidant thought patterns, severity of trauma, optimism, problem-focused coping, positive religious coping, and social support. In contrast, factors that were consistently negatively correlated with PTG included negative affect, negative religious coping, and alcohol use (Schuettler & Boals, 2011). Finally, several factors yielded either inconsistent associations or have been understudied in regards to PTG and included personality dimensions, resilience, self-efficacy, emotion-focused coping, avoidant coping, and intelligence (Schuettler & Boals, 2011). In sum, understanding the how, why, and ways in which PTG develops, especially in regard to a specific type of trauma, is largely unknown. A clearer understanding of predictors of PTG may aid in psychological treatment by identifying positive resources and offering alternative coping skills or perspectives that lead to positive outcomes (Wang et al., 2013).

While there is limited research regarding predictors of PTG among TBI survivors, predictors of PTG regarding other types of traumas have been extensively examined. In a

study conducted in Mainland China, researchers studied the prevalence and predictors of PTG among accidentally injured patients (n = 180) during the convalescence stage of recovery (Wang et al., 2013). Wang et al. (2013) collected a wide array of information using instruments to measure the following key variables: demographics; subjective distress; severity of trauma; personality (Big Five Inventory); symptoms of PTSD; and coping style. Using correlation analyses to examine the relationship between PTG and demographics, it was found that higher levels of PTG were associated with married and more educated patients. Unlike other studies, age, gender, and time since accident were not related to levels of PTG. The researchers reported that different combinations of their chosen predictors (demographics, personality, accident injury variables, and PTSD) accounted for a 21.4% of the variance observed in PTG. The demographic variables (5.8%), personality (5.6%), and PTSD symptoms (5.3%) accounted for a significant amount of the variance observed in PTG. More specifically, analyses revealed that marital status (β = .169, p < .05), educational level (β = .184, p < .05), Openness as a personality trait (β = .260, p < .01), avoidance of PTSD symptoms (β = .255, p < .05), and positive coping (β = .204, p < .05) styles were all significant predictors of PTG in the accidentally injured Chinese patients (Wang et al., 2013). Such results are promising in offering a better understanding of PTG and a basis for examining PTG among TBI survivors. Yet, the researchers warned that the results might only be generalizable to the Chinese population, as there are unique characteristics of coping and personality in Chinese culture (Wang et al., 2013).

A substantial amount of PTG research have been conducted among survivors of

cancer since there is a longstanding recognition, namely through qualitative and descriptive findings, that the experience of cancer can lead to positive psychological growth (Widows, Jacobsen, Booth-Jones, & Fields, 2005). For example, breast cancer survivors often report beneficial changes in relationships, a greater appreciation of life, and changes in their priorities (Bellizzi & Blank, 2006). Unfortunately, Widows et al. (2005) noted that few studies have examined, in a systematic and theory-driven way, the individual differences that predict PTG among cancer survivors, which is similar to what is currently observed in the literature regarding TBI survivors. Bellizzi and Blank (2006) conducted a cross-sectional study that examined predictors of the different facets of PTG (growth in relationships, growth in new possibilities, and growth in appreciation of life) among breast cancer survivors (n = 224). Participants included women who had either undergone a mastectomy or lumpectomy and were at least one year post-treatment but no more than 4 years post-treatment. Information was gathered regarding their contextual and disease related variables, and participants' optimism and hope, coping strategy, intensity and emotional impact of their cancer, and PTG were assessed. A series of hierarchical regressions were conducted, and it was found that the chosen predictors, contextual factors, personality, temporal factors (i.e., time since diagnosis, type of cancer, type of treatment, emotional impact, and coping style) accounted for between 28-35% of the variance of PTG. One regression model, which examined PTG in relationships, indicated that marital status (β = .19, p < .01), education (β = -.18, p < .05), employment (β = .17, p < .01), current age (β = -.23, p < .05), perceived intensity of disease (β = .28, p < .001), and coping style (β = .39, p < .001), accounted for a significant amount of

variance in PTG in relationships with others (a subscale of the PTGI). Moreover, the study revealed there were different patterns of prediction between the other subscales in the PTGI, but differences were slight and only observed with marital status, education, and type of cancer (Bellizzi & Blank, 2006). The above studies demonstrate that there are some consistent predictors of PTG among specific groups of trauma survivors. Furthermore, since PTG is most often examined in relation to a specific group of trauma survivors, the predictors of PTG among TBI survivors may be unique and, therefore, need to be examined.

Personality. Tennen and Afflect (1998) stated, "many survivors of adversity do not experience positive consequences from their plight, and these individuals could well differ from their growth-experiencing counterparts in general or specific personality characteristics" (p. 67). This begs a fundamental but difficult question: is personality predictive of growth after trauma? In addition, a unique characteristic to consider when examining personality and PTG among TBI survivors is that the nature of their trauma adds the component of physical damage to the brain. Thus, to a large degree, it is unknown how personality characteristics are affected due to the trauma itself. A substantial body of research demonstrates that personality is typically stable among non-brain-injured adults (Graham & Lachman, 2012). Research regarding personality and PTG has been examined among what Tennen and Affleck (1998) called the "usual suspects" in personality research, which include dispositional optimism, cognitive complexity, dispositional hope, and the "Big Five." Empirical research exhibits the most support for a relationship among the "Big Five" and PTG.

Five Factor Model. McCrae and Costa's (1999) Five Factor Model (FFM) has been examined in relation to PTG. The FFM is an "empirical generalization about the covariation of personality traits" (p. 139). The five factors have an immense amount of research supporting their existence and have been studied dating back to as early as the 1940s (John & Srivastava, 1999). Essentially, the Five Factors have repeatedly emerged when researchers examine the dimensional structure of trait ratings (John & Srivastava, 1999). When psychologists and researchers use the term "personality," they are largely referring to the Five Factors (McCrae & Costa, 1999). The Five Factors are Extraversion (E), Agreeableness (A), Conscientiousness (C), Neuroticism (N), and Openness (O). The Five Factors have been shown to be empirically relevant cross-culturally, especially among cultures in which Germanic languages are spoken (John & Srivastava, 1999).

Moreover, research has demonstrated that the Five Factors account for a significant amount of the variance in participants' scores when positive or negative outcomes were investigated following a traumatic event (Shakespeare-Finch, Gow, & Smith, 2005). For example, Extraversion has been associated with positive post-trauma perceptions and rational action, positive thinking, substitution, and restraint as coping mechanisms (Shakespeare-Finch et al., 2005; Wilson & Boden, 2008). Moreover, in a study of soldiers who had been deployed to Iraq, a higher Extraversion score on the Eysenck Personality Questionnaire was associated with a higher level of PTG following their deployment (Engelhard, Lommen, & Sijbrandij, 2014). Both Agreeableness and Conscientiousness have been linked to individuals being able to perceive positive changes in their life following a trauma (Shakespeare-Finch et al., 2005). Openness has

been linked with the capacity to use effective coping strategies, such as the use of humor, in response to adverse circumstances (Shakespeare-Finch et al., 2005; Wilson & Boden, 2008). In contrast, Neuroticism was related to maladjustment and was as the strongest predictor of negative outcomes post-trauma (Shakespeare-Finch, Gow, & Smith, 2005). Neuroticism was also associated with passive and withdrawn and behavior, increased uses of hostile reaction, escapist fantasy, passivity, and indecisiveness (Wilson & Boden, 2008).

In fact, there appears to be a direct relationship between personality and PTG as evidenced during the creation of the PTGI. During the scale's validation study conducted by Tedeschi and Calhoun (1996), participants were given the NEO Personality Inventory (n = 325), and it was discovered that several relationships existed among the PTG factors and personality dimensions. As hypothesized, all personality factors, excluding neuroticism, were significantly positively correlated (all correlations significant at $p < .01$ or greater) with PTG (Tedeschi & Calhoun, 1996). What was particularly intriguing about this study was the relationship of the personality factors to the PTG factors. For instance, Extraversion had a positive correlation to Relating to Others (r = .28), and Openness had a positive correlation with New Possibilities (r = .25). These relationships show the value in using not only Big Five factors as general predictors of PTG but also as predictors of the different facets of PTG.

In a more recent study conducted by Shakespeare-Finch et al. (2005), personality factors and coping style were studied in relation to PTG among emergency ambulance personnel (n = 526). It was hypothesized that higher levels of the Five Factors,

excluding Neuroticism, would predict PTG and that participants' coping style would be a mediating variable within this relationship. A short form of the NEO (NEO-FFI), a measure of coping, and the PTGI were used. Correlations demonstrated that the four aforementioned factors were associated with higher levels of PTG, and a multiple regression analysis revealed that the Five Factors were significantly predictive of PTG, $F(5, 500) = 10.58$, $p < .001$ (R^2 was not reported in this study). More specifically, Extraversion ($r = .22$, $p < .001$) and Openness ($r = .22$, $p < .001$) were found to be the most highly correlated with the composite PTGI score, followed by Agreeableness ($r = .14$, $p < .01$) and Conscientiousness ($r = .14$, $p < .01$). Neuroticism was shown to have neither a positive nor negative correlation to PTG. These results further validate previous findings that personality is predictive of PTG and show the value in better understanding personality in relation to PTG among specific populations.

In the previously discussed study conducted by Wang et al. (2013), the relationship between the Five Factors, as measured by the BFI, and the PTGI subscales was also examined along with other predictors of PTG. Several significant relationships were observed among the PTGI subscales and the Five Factors, including a significant relationship between: *Relating to Others* and Openness ($r = .159$, $p < .05$), *New Possibilities* and Openness ($r = .194$, $p < .01$), *Personal Strength* and Extraversion ($r = .166$, $p < .001$) and Openness ($r = .231$, $p < .01$), *Appreciation of Life* and Agreeableness ($r = .149$, $p < .05$), Conscientiousness ($r = .188$, $p < .05$), and Openness ($r = .160$, $p < .05$). However, the composite score of the PTGI was significantly correlated only with Openness ($r = .250$, $p < .01$). Wang et al. asserted that the relationship between the

personality factors and PTG was consistent with other findings and solidified this association. In addition, Wang et al. proposed that Openness was significantly correlated to a participant's overall PTGI score (recall this study used accidentally injured individuals), as this trait made them more able face an uncertain future.

Trauma and Personality Change. Due to the physical injury to the brain, assessing personality dimensions in relation to PTG among TBI survivors does pose difficulties. A study conducted with US war veterans examined personality changes following either a blast-TBI or a blunt-TBI (Mendez, Owens, Jimenez, Peppers, & Licht, 2013). In this study, participants were heavily screened for inclusion; in so much as they must have had a TBI uncomplicated by other factors, and not have met criteria for PTSD, depression, or other psychological issues. The sample consisted of 24 veterans, 12 in each group, in addition to each participant having a significant other informant who completed some measures. It was hypothesized that negativistic personality changes would occur among the veterans, specifically those from the Blast Group due to the specific type of physical trauma sustained. The study included a measure of psychopathology, interpersonal relationships, a questionnaire relating to damage to the frontal lobe, and the Big Five Inventory (completed by significant other informant). The results indicated that there were changes in personality among veterans surviving a TBI, particularly among the Blast Group, which had higher ratings of Neuroticism and also higher ratings on the other four factors. T-tests demonstrated that the significant other informant ratings confirmed that when compared to participants' pre-TBI personality, the Blast Group changed to be more cold-hearted, aloof, introverted, and apathetic. Mendez

et al. asserted that it is unclear as to why personality changes were seen, and it must be noted that there was no way to draw a clear distinction between the biomechanical trauma and the psychological trauma endured (this is a sentiment that was echoed in the previous discussion regarding organic trauma versus psychological trauma). However, Mendez, et al. postulated that the blast-TBI survivors experienced greater personality change due to the diffuse axonal injury that occurred as compared to a more isolated injury observed in the blunt group. In sum, the study is evidence that investigating personality among TBI survivors is complicated by not only a TBI but also by the type and cause of TBI. Therefore, understanding how personality affects PTG among TBI survivors is a basic necessity in undertaking research with this population, and this present study aimed to bridge this gap.

Posttraumatic Stress Disorder. The literature demonstrates a remarkable relationship between posttraumatic stress disorder (PTSD) and PTG. For instance, it has been suggested that certain hallmarks of PTSD may be complexly related to a survivor's level of PTG. PTSD is a diagnosis that is delineated in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) (American Psychiatric Association, 2013). Recently, the diagnostic criteria of PTSD was changed with the publication of the DSM-5 and PTSD is currently classified as a "trauma and stressor related disorder" (American Psychiatric Association, 2013). Overall, the symptoms and diagnostic criteria of PTSD have remained largely the same in the DSM-5 as compared to the DSM-IV (U.S. Department of Veterans Affairs, 2014). Recognition of the differences between the new DSM-5 criteria and the DSM-IV criteria are important, as the vast majority of validated

measures and assessments of PTSD are derived from the DSM-IV criteria. The DSM-5 criteria changes include: a modification in the clustering of symptoms; the addition of three new symptoms (persistent and distorted blame, persistent negative emotional state, and reckless or destructive behavior); a clarification of symptom expression; added clinical subtypes; and separate diagnostic criteria for children under the age of six (U.S. Department of Veterans Affairs, 2014). Given that extensive research and measurement have been conducted with the DSM-IV diagnostic definition, this criterion was utilized in the present study, as the purpose was not to diagnosis PTSD but rather to understand what aspects of PTSD symptomatology are associated with PTG.

The DSM-IV criteria state that for an individual to be diagnosed with PTSD he/she must: (a) have experienced, witnessed, or been confronted with actual or threatened death, injury, or threat to physical integrity and they responded with intense fear, helplessness or horror; (b) persistently re-experience the traumatic event; (c) engage in effortful avoidance of distressing trauma related stimuli and have a numbing of general responsiveness; (d) experience symptoms of increased arousal; (e) have persistence of symptoms for more than one month; (f) endure persistence of symptoms that cause distress or functional impairment (American Psychiatric Association, 1994). The National Center for PTSD estimated that only 7-8% of Americans experience PTSD throughout the course of their lives (U.S. Department of Veterans Affairs, 2014). However, 50-60% of Americans are likely to endure at least one traumatic event in their lifetime, which suggests that most Americans who experience a traumatic event will not qualify for a diagnosis of PTSD (U.S. Department of Veterans Affairs, 2014). However,

simply because an individual does not meet all the criteria for PTSD does not imply that they do not express posttraumatic stress (PTS) symptomatology following a traumatic incident.

Posttraumatic Stress Disorder and Posttraumatic Growth. In some respects, PTG cannot be considered or measured without appropriate attention paid to the literature regarding the multifaceted relationship between PTSD symptoms and PTG. Empirical evidence indicates that there are several ways in which to conceptualize the linear relationship between PTSD and PTG (Knust, 2012). First, the belief that PTG emerges through the process of extreme distress suggests that PTSD symptoms are likely to be positively related to PTG. Similarly, it was proposed that higher levels of PTG are associated with higher levels of PTSD symptoms because perceived growth may be indicative of a maladaptive coping process that involves self-deception (Engelhard, Lommen, & Sijbrandij, 2014). Finally, there is the assertion that a negative association exists between perceived growth and PTSD because PTG is considered an adaptive outcome that is defined as successful coping without the presence of negative psychological impact (Knust, 2012). Unfortunately, Knust (2012) reported that there is not currently enough convincing evidence to support any one of these views. In fact, research suggests that the relationship between PTG and PSTD symptoms may be more complex, with some affirming that a linear positive association exists (Engelhard et al., 2014) and others attesting that curvilinear relationship is present between the two constructs (Kleim & Ehlers, 2009).

Kleim and Ehlers (2009) investigated the association between PSTD and PTG to

determine whether a curvilinear relationship among these variables was present among a population of assault survivors. Measures assessing PTG, PTSD, depression, peritraumatic emotions, and response styles were used. First, it was found that higher scores on the PTGI were associated with greater PTSD symptomatology ($r = .35$, $p < .01$). A hierarchical regression was conducted to examine whether a quadratic component of the relationship between PTG and PTSD symptoms existed. The results suggested that there was a significant quadratic effect of PTGI scores in prediction of PTSD symptoms severity. Kleim and Ehlers reported that these results indicated that the shape of relationship (curvilinear) suggested that moderate growth was associated with greater levels of PTSD symptom severity and that both low and high levels of growth were associated with lower levels of PTSD symptom severity. Kleim and Ehler concluded that the findings of their study point to the possibility of a nonlinear relationship between PTG and PTSD symptomatology.

Posttraumatic Stress Disorder and Traumatic Brain Injury. Suffering a TBI is both a physically and psychologically traumatic event, however, the prevalence of comorbid TBI and PTSD is not well understood or frequently documented (Vasterling & Dikmen, 2012). Furthermore, due to the lack of research it is unknown as to what the clinical consequences may be for those who suffer both a TBI and a PTSD diagnosis (Vasterling & Dikmen, 2012). For instance, does the co-occurrence of a TBI and PTSD translate to more negative outcomes (i.e., slower recovery times) or the possibility of seemingly positive outcomes (i.e., PTG)? Furthermore, a controversy exists regarding whether PTSD and TBI can even co-exist among head injury survivors. Bryant (2001)

argued that PTSD cannot develop following a TBI because the individual experiences significantly impaired cognitive capacity, especially in the case of severe TBI, and this prevents the encoding of the traumatic event. Empirical evidence recently suggested that the latter may not be the case, but that PTSD symptoms are sometimes not easily distinguished from TBI symptoms, as both conditions can lead to episodes of dissociation, re-experiencing, and hyperarousal (Bryant, 2001). For example, one study investigated whether a TBI impacted the development of PTSD among motor vehicle accident (MVA) survivors (Hickling, Gillen, Blanchard, Buckley, & Taylor, 1998). More specifically, the researchers were interested in whether MVA survivors who reported loss of consciousness (LOC) at the time of the accident demonstrated lower rates of PTSD than individuals who reported no LOC at the time of their accident (Hickling et al., 1998). Remarkably, results indicated that individuals who experienced an LOC at the time of accident were just as likely to experience PTSD as those who did not experience an LOC. The individuals who reported LOC at time of accident also reported little to no recall of the event yet 40% of them still met the criteria for PTSD. Hickling et al. (1998) affirmed that such findings refute the conviction that those who lose consciousness at time of accident cannot develop PTSD.

The Current Study

At this time, the understanding of PTG among TBI survivors is analogous to that of an intricate, unfinished puzzle – the pieces of the puzzle exist and are laid out for viewing but the precise way in which the pieces fit together and the ultimate completed product of the puzzle remains unclear. To help complete more of this puzzle, the

previously discussed findings detailed in the literature review ultimately drove the research questions and hypotheses of the current study. The literature review underscored the frequency of TBI and the importance of understanding positive outcomes, such as PTG, following a trauma. It was also established that conducting studies with survivors of TBI is complicated by the severity and cause of the trauma as well as the organic versus psychological pathology. Based on the known complexities of working with TBI survivors, it was determined that the current study will focus on survivors who have sustained a TBI from a MVA in order to help control for contextual factors of the injury that are known to affect outcomes. The construct of PTG, a variable that measures growth following a trauma, was introduced and the importance of understanding this variable among various populations of trauma survivors was discussed. PTG is typically examined as an outcome variable, and much of what is known about PTG is derived from the development of the PTGI. The primary dimensions of PTG, as measured by PTGI, include relating to others, new possibilities, personal strength, spiritual change, and appreciation of life. When measuring PTG as an outcome variable, research demonstrates that time since trauma may act as a moderating variable. In addition, the literature revealed that PTG among TBI survivors is an understudied topic. However, research with an array of trauma survivor populations demonstrates that there are consistent factors associated with the development of PTG. Numerous factors have been shown to be predictive of PTG and range from gender to different facets of personality. Informed by the literature regarding factors commonly associated with PTG, a model of prediction of PTG among TBI survivors was created.

The first component of the model included sociodemographic and contextual variables of TBI survivors that are related to PTG. The second component of the model included personality, and more specifically personality dimensions known as the "Big Five." Factors related to the brain injury event, such as TBI severity and time since injury, were also considered as part of the prediction model. Another element of the model comprised symptoms of PTSD, a psychological disorder sometimes present after experiencing a trauma. Lastly, the interaction between time since injury and symptoms of PTSD was part of the prediction model, as time since trauma was established a moderator of PTG.

The purpose of this study was to better identify the physical, sociodemographic, contextual, and psychological factors that predict the development of PTG among a population of TBI survivors. A more definitive understanding of the associated factors in the development of PTG can inform psychologists and the medical field alike in effectively assisting survivors of TBI. For the current study, five research questions and eight corresponding hypotheses were derived and developed from the current literature and theory.

Research Questions and Hypotheses

Q1: What is the bivariate relationship between sociodemographic and contextual variables of TBI survivors (gender, race, age, marital status, education, employment, income, and current physical health status) and PTG, without considering any other variables that will be entered into the multiple regression model?

H1: Gender, race, age, marital status, education, employment, income, and current physical health status will be significantly related to PTG among TBI survivors.

Q2: What is the relationship between the Big Five dimensions of personality and PTG among TBI survivors?

H2: The personality factors Openness, Extraversion, Agreeableness, and Conscientiousness will be related positively to PTG.

H3: The factor of Neuroticism will be negatively related to PTG.

Q3: What additional contributions do variables associated with the brain injury event make to the prediction of PTG among TBI survivors above and beyond survivors' sociodemographic and contextual variables, and dimensions of personality?

H5: The degree of TBI severity will be negatively associated with PTG after controlling for survivors' sociodemographic and contextual factors, and dimensions of personality.

H6: Time since injury will be positively associated with PTG after controlling for survivors' sociodemographic and contextual factors, dimensions of personality, and degree of TBI severity.

Q4: What additional contributions do PTSD symptoms make to the prediction of PTG among TBI survivors above and beyond survivors' sociodemographic and contextual variables, dimensions of personality, and variables associated with the brain injury event?

H7: PTSD symptoms will be negatively associated with PTG after controlling for survivors' sociodemographic and contextual factors, dimensions of personality, degree of TBI severity, and time since injury.

Q5: Does time since injury affect the predictive relationship between PTSD symptoms and PTG?

H8: Time since injury will moderate the relationship between PTSD and PTG, such that PTG will be more strongly associated with less PTSD symptoms as time since injury increases.

METHOD

Participants

The final sample for this study included 155 self-identified TBI survivors, and 154 after an outlier was removed. In total, 193 participants began the survey, however, out of these participants, 157 completed the survey in its entirety. To be retained for analysis, a participant must have successfully completed the Demographic Questionnaire (Appendix E), indicated they were a survivor of a MVA, and sustained a TBI specifically from this trauma. Recall, a MVA (also described as a car accident or traffic collision) was defined as an incident where at least one vehicle collides with another vehicle, pedestrian, cyclist, animal, road debris, or other stationary object. To determine the occurrence of a brain injury from a MVA, participants' responses on the TBI History and Severity measure were assessed. Item 1 asked if the respondent had sustained a head injury from a car accident. Item 7 was a qualitative item, which asked respondents to briefly describe how they had sustained their head injury. Responses to these two items were crosschecked to ensure the respondent had in fact been involved in a MVA that resulted in a TBI. Any respondent that indicated they (1) never sustained a TBI or (2) did sustain a TBI but not from a MVA was removed from the study (n = 1). Other exclusion criteria included participants who sustained their injury before the age of 18 (n = 13), participants who did not include the age at which they sustained their injury (n = 21), and

participants who did not complete the Demographic Questionnaire (n = 3). The surveys from individuals who met the above exclusion criteria were removed from the study, totaling 20.21% (n = 38) cases removed.

After these exclusions, data for n = 155 participants were examined. The majority, 80.31%, of survey attempts provided usable data for analyses. Possible explanations for unfinished surveys may have included: internet disruptions or other technical difficulties, time required to complete the survey (participants were not able to save the survey and complete it at a later time), and/or participant inability to meet the cognitive demands of completing the survey.

The majority of the final sample (n = 155) was Caucasian (n = 142, 91.6%) and female (n = 86, 55.5%). The mean age was 34.69 years (SD = 13.20). Over four fifths of the sample reported attending at least some college (n = 127, 82%). A large proportion of participants reported being unemployed due to disability (n = 67, 43.2%), however, yearly combined income varied considerably. Almost half the sample reported being married (n = 68, 43.9%) followed by about a fourth who reported they were single and never married (n = 43, n = 27.7%). See Table 3 for additional information on the demographic characteristics of the participants.

Recruitment

After Institutional Review Board approval (Appendix B), brain injury non-profit organizations, online support groups, and social media outlets were contacted and invited to share the study's recruitment script (Appendix C) with members. As two examples of the recruitment that occurred, a large non-profit organization posted the recruitment script

on their Facebook page while a group leader of a local support group handed out the recruitment script to members. The consent form and survey instruments were completed entirely online and the survey was hosted by surveymonkey.com. The recruitment script included a password to access the study, as the SF-12v2® Health Survey is under copyright. Permission from the test creators, Optum, Inc., had been granted prior to data collection. The landing page for the survey presented potential participants with the informed consent letter (Appendix D). The consent form explained the purpose of the study and told participants the survey was both anonymous and voluntary. Participating individuals were self-identified TBI survivors of a MVA. Recruitment and data collection occurred from January to March 2015.

Procedure

An online survey research design was chosen for several reasons. First, a sample of MVA and TBI survivors may have been difficult to access if limited by a specific geographic region. Second, use of an internet based survey was cost efficient, allowing resources, both time and money, to be directed to other aspects of the study. For instance, this allowed monetary resources to be used for the participant prize lottery versus the cost of printed materials and mailing expenses.

ASU Institutional Review Board approval was obtained on January 22, 2015. All information collected from participants was self-report survey data. Participants were able to complete the online survey from any computer of their choice. Combined, the measures totaled 58 questions and took approximately 10-15 minutes for participants to complete. There was no request for long-term follow-up with any of the participants, and

participants were not contacted with the exception of those who won the prize lottery. The informed consent letter was on the opening page of the online survey. A signature for each participant was not obtained and filling out of the survey served as informed consent to participate. No personally identifying information was requested on the consent form or on the survey. The consent form told participants that survey questions were anonymous and that filling out the survey was their informed consent to participate in the study. Lastly, this study did not include any non-English speaking participants, minors, or any other individuals unable to consent.

Upon survey completion, participants were asked if they would like to provide their e-mail address to be entered in a prize lottery. Participants were informed that their e-mail address would not be linked to their survey responses. From their e-mail address, five participants were randomly selected to receive a $50 electronic Amazon gift card. An electronic gift card was sent via using only the winner's e-mail and further identifying information was not needed to redeem the gift card (i.e., full name or address). The drawing was completed once all data had been collected.

There were no known risks to completing this survey specifically, although it was possible that answering questions may have presented some issues that are often associated with participation in survey research. First, recalling the traumatic accident associated with their head injury and sustaining a head injury may have been a distressing activity and could have caused some psychological discomfort for participants. In the informed consent letter provided at the beginning of the survey, participants were given information about obtaining counseling. Second, the loss of time associated with

participating may have been a discomfort or inconvenience to participants. Third, this survey may have felt like an invasion of privacy to participants as they were asked about their health history, personality, age, income, and other demographic information, which may have caused some psychological unease. There were not any legal, social, or economic risks related to this research study.

Measures

The survey contained only self-report instruments, which captured participants' demographics and assessed history and severity of TBI, personality, symptoms of posttraumatic stress, current mental and physical functioning, and posttraumatic growth.

Demographic Questionnaire. This 7-item measure asked basic demographic questions (Appendix E). The items that comprised this measure were based on demographic variables that previous studies had shown to be associated with posttraumatic growth. For example, one question asked what "describes your current relationship status?" as studies have consistently demonstrated that marital status is associated with a greater posttraumatic growth (Bellizzi & Blank, 2006).

Severity of Self-Reported TBI. The severity of participants' TBI was measured by a self-report questionnaire created specifically for this study (Appendix F). This measure gathered information about the participants' TBI history and severity, such as age of injury and context of injury. Participants were asked to report in what month and year they sustained their injury in order for time post-injury could be calculated. The measure also included an open-ended essay item that asked participants to describe the incident surrounding their head injury.

Additionally, this measure allowed participants to be classified as mild, moderate, or severe TBI survivors. The questions that assessed severity were based on a study conducted by Williams, Cordan, Mewse, Tonks, and Burgess, (2010) which used a self-report measure to classify TBI. Williams et al. (2010) asked participants about the loss of consciousness (LOC) associated with their TBI, as this is a criterion used to classify TBI severity in a medical setting. Thus, the first item that assessed TBI severity asked, "Estimate the amount of time you experienced a loss of consciousness (i.e., blacked out) from this injury." Responses were based on a 4-point Likert scale in which respondents indicated duration of loss of consciousness, which ranged from 1 ("I did not lose consciousness") to 2 ("more than 24 hours"). Additionally, an item concerning duration of posttraumatic amnesia (PTA) was included, as empirical evidence indicates this is helpful in TBI classification as well. The second item that assessed TBI severity stated, "Estimate the amount of memory loss associated with this injury." Responses were based on a 4-point Likert scale in which respondents indicated amount of memory loss, which ranged from 1 ("I didn't experience any memory loss") to (" I have trouble remembering things that happened within 24 hours of the injury and the following days and/or weeks and/or months"). The scaled responses for both items were based on the literature and ways in which TBI are commonly classified among medical professionals and health organizations, such as the World Health Organization and American Congress of Rehabilitation Medicine (Bodin, Yeates, & Klamar, 2012).

Following data collection, participants were placed into three categories based on their responses (*1 = mild, 2 = moderate, 3 = severe*). Participants were categorized

based on their most severe response to LOC and PTA questions (Table 4). For instance, if participants indicated they had no loss of consciousness following a TBI but reported more than a day of posttraumatic amnesia, they were placed in the severe TBI category. In other words, the worst symptom reported by the participants determined their level of severity. This determination was based on the assertion of Bodin, Yeates, and Klamar (2012), who recognized that not all TBI fall neatly into one classification, however, stated that medical grading systems of TBI use the most severe symptom to classify the injury.

Big Five Inventory - 10 (BFI-10). Personality was assessed by a well-known measure of personality, a version of the Big Five Inventory (Appendix G). The original version of the BFI was first constructed in the late 1980s and consisted of 44 items. The item stems contained in the BFI are trait adjectives known to be reliable markers of the Big Five (John & Srivastava, 1999). The BFI – 44 scales range from eight to ten items and are believed to represent each factor thoroughly. The internal consistency of each subscale ranges from .70 to .95 and the test-retest reliabilities range from .80 to .90 (John & Srivastava, 1999).

In the current study, the BFI-10 was utilized, and as the name denotes, the instrument is comprised of ten items with two items per subscale (Rammstedt & John, 2007). Item stems asked participants to evaluate different dimensions of their personality: "I tend to see myself as someone who is reserved." The 5-point Likert scale responses ranged from 1 ("strongly disagree") to 5 ("agree strongly"). While the measure is short, the scale has historically been shown to generalize to the full scale well (Rammstedt & John, 2007). In fact, when Rammstedt and John (2007) conducted a

validation study of the BFI-10 they proclaimed, "although the BFI-10 scales include less than 25% of the full BFI-44 scales, they predicted almost 70% of the variance of the full scales" (p. 206). In addition, their study further exemplified that BFI-10 retains significant levels of reliability and validity. Thus, the short version of this measure was chosen for time efficiency and to reduce the cognitive demands needed to complete this study. In the current study, the BFI – 10 demonstrated exceptionally low reliability with the Cronbach's alpha at $\alpha = .10$, which indicated very poor internal consistency (Gliem & Gliem, 2003). The two-item BFI – 10 subscales' reliabilities were also remarkably low. The subscale reliabilities were as follows: Neuroticism ($\alpha = .64$), Conscientiousness ($\alpha = .51$), Extraversion ($\alpha = .48$), Agreeableness ($\alpha = .38$), and Openness ($\alpha = .30$). Given the extremely low reliability coefficients for the BFI-10 subscales, the influence of personality was not explored as planned, and the personality scales were not included in the regression analyses. An exploratory factor analysis (EFA) was conducted as a follow-up analysis to explore the possible scale structure for the BFI-10 items in the current sample of TBI patients.

The Posttraumatic Stress Disorder Checklist – Civilian Version (PCL-C). Participants' posttraumatic stress (PTS) symptomatology was assessed by this 17-item self-report instrument (Appendix H). The PCL-C is one of two versions of the PCL that exists, with the PCL-M being created for PTS that is specific to military trauma (Weathers, Litz, Huska, & Keane, 1994). Derived from the military version, the test creators noted that the PCL-C may be applied to any traumatic event. The PCL-C is a 5-point Likert scale in which respondents indicate how much, 1 ("not at all") to 5

("extremely"), a PTS symptom had bothered them over the past month. For example, participants were asked if they experienced,"Trouble remembering important parts of a stressful experience from the past?" All items were summed for a composite score, which can range from 17 to 85, with lower scores representing fewer PTS symptoms. Further, a threshold score of 44 is indicative of a PTSD diagnosis among members of the general population (Weathers et al., 1994). In this study, the Cronbach's alpha was $\alpha = .93$.

SF-12v2® Health Survey. To measure each participant's current level of functional health and well-being, the SF-12v2® was used (instrument not included in Appendix to protect Copyright). The SF-12v2® was a brief but comprehensive 12-item measure that assessed health status (Maruish & Turner-Bowker, 2009). For example, one of the items simply asked participants to rank the following statement: "In general, would you say your health is…" from 1 ("Excellent") to 5 ("Poor"). The scale included eight subscales of everyday functioning (physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, mental health), which can be interpreted individually or used to create the two component summary measures: physical component summary (PCS) and mental component summary (MCS) (Maruish & Turner-Bowker, 2009). Only the PCS and MCS were utilized for present study and were scored using copyrighted software provided by Optum, Inc. For the two component summary measures, higher scores represent a more favorable health status, with a mean score of 50 and a standard deviation of 10 in the general population (Fleishman, Alfredo, Selim, & Kazis, 2010). More specifically, low scores on the PCS suggested "limitations in physical functioning, role participation due to physical problems, a high degree of bodily

pain, and poor general health" while low scores on the MCS indicated "frequent psychological distress, social and role disability due to emotional problems, and poor general health" (Maruish & Turner-Bowker, 2009, p. 16).

Reliability and validity evidence for this measure was assessed in several ways. First, Maruish and Turner-Bowker (2009) suggested checking the item internal consistency. This was conducted by examining the correlations between all test items and was considered satisfactory when 90% of the hypothesized item-scale correlations are $r = .40$ or higher (Maruish & Turner-Bowker, 2009). In the present study's sample, 83.33% of the correlations were greater than $r = .40$. Secondly, item discriminant validity was also assessed, which was done by observing whether items were more correlated with their related scale than they were with the other scales on the measure. This was satisfactory if 80% of correlations are higher for the related scale than other scales. In present study, 75% of the correlations were more correlated with their related scale than the other scales, which is slightly below the deemed cutoff. Finally, overall scale reliability as measured by coefficient alpha was assessed and Maruish and Turner-Bowker (2009) stated a satisfactory value for interpreting results for this measure is Cronbach's $\alpha \geq .70$. In present study's sample, $\alpha = .70$.

Posttraumatic Growth Inventory – Short Form (PTGI-SF). Level of PTG was assessed by the PTGI (Appendix I), which was developed by Tedeschi and Calhoun (1996) based on a review of literature on responses to trauma, interviews with trauma survivors, and analysis of these findings (See section Measuring Posttraumatic Growth for more information on the development and history of this measure). It was a 10-item

measure, which assessed five domains of PTG on 6-point Likert-type scale (Tedeschi, & Calhoun, 1996). For example, the scale asked participants to rate the following statement from 1 ("I *did not* experience this change as a result of my crisis" to 6 ("I experienced this change to a *very great degree* as a result of my crisis"): I have a greater appreciation for the value of my own life. Moreover, the PTGI subscales include: Relating to Others, New Possibilities, Personal Strength, Spiritual Change, and Appreciation of Life. A composite score was calculated by summing responses to all items and ranges from 0 to 50. Only the composite score was used in the current study, as the subscales on the short form have not been deemed reliable. The PTGI has excellent internal consistency (α = .90) and acceptable test-retest (r = .71) (Cann et al., 2010). In this study, the Cronbach's alpha was α = .90.

RESULTS

Preliminary Analyses

Data management and analyses were conducted using SPSS, version 22 software (IBM Corp., 2013). Overall, missingness was low and on any given survey item was less than 8%. Moreover, of the included 155 participants, there were 37 participants (23.87%) who were missing at least one item on any given measure. To handle missingness, data were analyzed using pairwise deletion methods. This means that for any given analysis, cases (sets of participant responses) were used if they included responses to the variables in that particular analysis. If a case (response set for a certain participant) was missing (the individual did not respond) for one or more of the items in that analysis, the case was removed from that particular analysis. Case deletion was

chosen because of the method's simplicity and the assumption that missing data in the dataset was missing at random (Schafer & Graham, 2002).

Sample Characteristics. Overall, the results indicated that this sample had high levels of trauma, both physically and mentally, and low levels of growth. The final sample included 154 participants after an outlier was removed. Out of the 155 participants, 144 completed the two items required to classify the severity of their TBI. The majority of participants had sustained a severe TBI (n = 107, 69%), followed by participants that had sustained a mild TBI (n = 30, 19.4%). Few participants reported having sustained a moderate TBI (n = 7, 4.5%). Most participants provided the month and year of their head injury (n = 124) and the time since injury was calculated by computing the time between the reported TBI and the date the survey was taken. On average, it had been approximately 5 years and 11 months of time since injury (M = 67.52 months, Mdn = 42.00 months, SD = 75.03 months), with the most recent injury reported to have occured only less than one month prior to completing the survey and the most distant injury reported to have occured 42 years prior to completion of the survey (Figure 1).

On the PCLC-C, the measure of posttrumatic stress, 62.70% of participants had a score of 44 or greater, indicating that the majority of participants met the criteria for a PTSD diagnosis. Regarding current health status as measured by the SF-12v2®, the mean PCS score was 42.67 while the mean MCS score was 41.69, both below the normed average (Figure 2). Additionally, 61% of participants fell below the average on the PCS and 68% of the participants fell below the average when compared to the general

population (norms provided by Optum, Inc.). Finally, on the PTGI, the sample mean of the composite score was 22.68, which is considerably low as the highest score for this measure is 50. Scores on this measure ranged from 0 to 49. See Table 5 for the means and standard deviations of all scales with an outlier removed.

Concerning responses to the qualitative item that asked participants to describe the incident surrounding their head injury, responses echoed the level of severity that was captured with the quantitative items. Most participants chose to answer this item with at least a few words (n = 154), and the majority of participants elected to provide details of the incident surrounding their TBI. See Table 6 for some examples of responses to this item, which were selected at random.

Exploratory Factor Analysis. Examination of reliability of the study's measures revealed a considerable problem with one of the instruments: the BFI – 10. It was determined that given the poor reliability statistic, the variables from the BFI – 10 could not be used in the study's planned hierarchical multiple regression analyses. To investigate the large discrepancy between the BFI – 10's reliability presented in the literature and the reliability found here (α = .10), an exploratory factor analysis (EFA) was conducted prior to commencing the planned regression to examine the scale's unique factor solution.

The EFA consisted of a principal axis factoring using oblique rotation via the direct oblimin method. Costello and Osborne (2005) stated that best practices when interpreting an EFA include not only retaining factors with an eigenvalue of 1.0 or greater but also conducting a scree test. A scree test involves examining the graph of the

eigenvalues and identifying a natural bend where the curve begins to flatten. The present study's analysis yielded a 3-factor solution, however, the eigenvalues decreased significantly after the first factor. The natural bend in the scree plot occurred after the first factor in the plot (Figure 3), as the first factor accounted for a large proportion of the variance (25.37%). In total the three factors, accounted for 50.81% of the variance. While the rotated pattern matrix revealed distinct factors with only moderate cross-loadings, there was no clear replication of any of the Big Five factors (Table 7). It was determined that the identified factors were significantly different than what has been detailed in the literature. Thus, the BFI – 10 did not appear to be a useable measure of personality among this sample of survivors of TBI and therefore was dropped from further analysis in this study.

Crosstabulation by TBI Severity. Given that the sample appeared to be clearly divided among TBI severity groups, a crosstabulation of TBI severity by employment status and income was examined (Table 8 and Table 9). Employment status and income were chosen as these demographic variables might have reflected severity of TBI. For example, those who reported a severe TBI theoretically were likely to have also reported a disabled work status. Indeed, a large proportion (50.94%) of participants who identified as having a severe TBI also reported being disabled and unable to work. Interestingly, reported income among participants who identified as having a severe TBI was rather diverse. Moreover, about half of participants (56.67%) who identified as having a mild TBI reported working either full-time or part-time. Thus, it appeared employment status was associated with TBI severity, and to a lesser degree, income.

The crosstabulation by TBI severity was also used to further examine the lack of reliability of the BFI – 10. It was conjectured that the low reliability of the BFI – 10 was related to the high TBI severity of the sample. In other words, if the items of the BFI – 10 were examined for only the mild TBI group, the reliability of the measure might have increased. Thus, the reliability of the BFI – 10 was examined by each TBI severity group. The reliability of the BFI – 10 among the mild TBI group was of interest, as this sample (n = 30) was closest to a non-injured population. It was found that the measure was still unreliable with Cronbach's alpha at $\alpha = -.16$. A negative alpha value indicated the mean of all the inter-item correlations among the scale items was weak and/or negative.

Predicting Posttraumatic Growth Among TBI Survivors of Motor Vehicle Accidents

For present study, hierarchical multiple regression was utilized, as this analysis allowed for the testing of theoretical assumptions and examination of the influence of several predictors in a specific sequential order (Petrocelli, 2003). Furthermore, with this type of analysis each predictor was judged on the basis of how much it added to the prediction of the outcome, above and beyond what was be accounted for by the other preceding predictors (Petrocelli, 2003). In other words, hierarchical multiple regression analyses were conducted based on the study's research questions to examine the direct effects of various classes of factors on the prediction of PTG among TBI survivors. The reasoning for entering each block in this sequential order was an attempt to capture factors that were part of the process in TBI survivors developing PTG following a motor vehicle accident. However before proceeding with the analysis, the data were examined

to determine if it met the assumptions necessary to conduct a hierarchical multiple regression analysis.

Testing the Assumptions of Hierarchical Multiple Regression. There are several assumptions that must be met when conducting a hierarchical multiple regression analysis. The first is to ensure that sample size is adequate. Power analyses were conducted using G*Power to determine the appropriate sample size for the proposed analyses. Based on a power analysis for linear multiple regression with an effect size of .15, alpha set at .05, and a power of .95 that included 7 predictor variables, approximately 154 participants were needed. In addition, a power analysis for correlation with an effect size of .30, two-tailed, and a power of .95, indicated that approximately 134 participants were needed. A sample size of between 135-160 participants was deemed necessary for adequate power.

The second assumption that must be assessed is multicollinearity, which occurs when two or more predictor variables entered in a hierarchical multiple regression analysis are highly correlated. In the current sample, the variance inflation factor (VIF) for predictors ranged from 1.052 to 10.564, indicating multicollinearity was generally not an issue. O'Brien (2007) stated that a VIF of 10 or less suggests that multicollinearity was not a serious concern. However, a VIF greater than 10, which was observed in two values in the present analysis, does not necessarily mean that eliminating that variable is warranted (O'Brien, 2007). O'Brien suggested considering the context in which the variables are highly correlated. For this present study, all predictor variables were

retained with an understanding that the relationship between some of the predictors may have led to a slight change in the regression coefficients.

Third, the data were examined for outliers. Outlier analysis identified one extreme value that was determined to influence the results of the hierarchical multiple regression. Analyses were rerun without this participant and the findings were different. Therefore, this participant was dropped from the data set. With the removal of the outlier the sample size was 154 participants. Despite this one extreme score, overall the data were dispersed and centered around zero. All further analyses were conducted without this outlier. See Figure 4 for a scatterplot of the data depicting the outlier.

Lastly, tests of linearity, normality, and homoscedasticity were conducted. Examination of several data plots indicated that the relationship between the outcome variable and the predictor variables was linear as well as homoscedastic. Results of the normality tests for this data set indicated that the data set was not meaningfully skewed. There was a slight negative skew with more responses that occurred at the higher end of the distribution; however, the skewness was not enough that it violated the assumption of normality. In sum, with the outlier removed, it was determined that the data set met the necessary assumptions needed to conduct a hierarchical multiple regression analysis.

The Hierarchical Multiple Regression Analysis. First, to reduce the number of possible variables in the regression, some categorical variables were split into dichotomous variables via dummy coding. The following were the dummy coding schemes utilized: Race: "1" White (n = 141), and "0" non-white (Black or African American, American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific

Islander, from multiple races (n = 13). Marital status: "1" married (n = 87), in a domestic partnership, or cohabitating, and "0" single never married, divorced, widowed, or separated (n = 67). Education: "1" graduate degree, bachelor degree, or associates degree (n = 58) and "0" not a college graduate (less than high school degree, high school degree or equivalent, some college but no degree (n = 95). Employment: "1" works full-time or part-time (n = 53), and "0" does not work (not employed and looking for work, not employed and not looking for work, retired, disabled (n = 101). Income: "1" above $50,000 ($n$ = 42) and "0" below $50,000 ($n$ = 109).

Next, the relationship between the sociodemographic and contextual variables of TBI survivors and PTG was examined. It was hypothesized that gender, race, age, marital status, education, employment, income, and current physical health status would be significantly related to PTG among TBI survivors. To test this hypothesis the correlations between the predictor variables and outcome variable were examined. These sociodemographic and contextual variables were considered as potential predictor variables in the hierarchical multiple regression model because they were identified as variables that prior studies had shown to be predictive of PTG (discussed in section titled Predictors of Posttraumatic Growth). This examination was to determine if the outcome variable, PTG, had a significant correlation with any of the sociodemographic and contextual variables and if these variables would need to be treated as covariates in the hierarchical multiple regression analysis (Wei et al., 2010). Cohen, Cohen, West, and Aiken (2003) indicated that the absence of a correlation implies the absence of a causal relationship between variables within the context of hierarchical multiple regression.

Thus, when building a hierarchical multiple regression model a researcher should select variables that are both bolstered by theory and are shown to be statistically relevant. Of these aforementioned variables, only gender ($r = .23$, $p < .01$) was significantly and positively correlated with PTG. These results revealed that females had higher scores on the PTGI following a TBI. Contrary to what was hypothesized, the sociodemographic and contextual variables of race, age, marital status, education, employment, income, and current physical health status were not significantly correlated with PTG. Therefore, these variables were not entered into the hierarchical multiple regression model. See Table 10 for correlations between all potential predictor variables and PTG.

Finally, all other predictor variables were entered as steps in the hierarchical multiple regression analysis, which was based on the study's hypotheses. In Step 1 of the hierarchical multiple regression, gender was entered as a covariate. In Step 2, TBI severity was entered to examine its main effect on PTG after controlling for gender. In Step 3, time since injury was entered to examine its main effect on PTG after controlling for gender and TBI severity. In Step 4, symptoms of PTSD were entered to examine their main effect on PTG after controlling for gender, TBI severity, and time since injury. Lastly in Step 5, the interaction variable between time since injury and symptoms of PTSD was entered to examine the effect of this interaction on PTG after controlling for gender, TBI severity, time since injury, and symptoms of PTSD. Recall that variables from the BFI – 10 were not considered for inclusion in the hierarchical regression because, as previously discussed, this measure was not believed to be valid with the study's sample.

In Step 1 of the hierarchical multiple regression analysis, gender accounted for 5.4% of the variance in PTG ($\Delta R^2 = .054$, $p < .05$) (See Table 11). This indicated that gender helped predict PTG, with females being more likely to report growth, $\beta = .233$, $t = 2.51$, $p < .05$. In Step 2, adding TBI severity did not add a significant increment in the ability of the model to predict PTG ($\Delta R^2 = .029$, $p > .05$) above and beyond gender. Gender remained a significant predictor ($\beta = .224$, $p < .05$), but TBI severity was not a significant predictor ($\beta = .169$, $p > .05$). Thus, the results of Step 2 did not support the hypothesis that the degree of TBI severity would be negatively associated with PTG. In Step 3, time since injury also did not add a significant increment in predicting PTG ($\Delta R^2 = .003$, $p = > .05$), above and beyond gender and TBI severity. Gender remained a significant predictor ($\beta = .222$, $p < .05$), but neither TBI severity ($\beta = .160$, $p > .05$) nor time since injury ($\beta = .058$, $p > .05$) was found to be a significant predictor in the model. The results of Step 3 did not support the hypothesis that time since injury was positively associated with PTG. In other words, variables associated with the brain injury event were not shown to significantly predict PTG in TBI survivors of motor vehicle accidents. In Step 4, symptoms of PTSD also did not add a significant increment in predicting PTG ($\Delta R^2 = .015$, $p > .05$), above and beyond gender, TBI severity, and time since injury. In this model, gender continued to be significant predictor ($\beta = .236$, $p < .05$), TBI severity was now a significant predictor ($\beta = .198$, $p < .05$), and time since injury ($\beta = .035$, $p > .05$) and PTSD symptoms ($\beta = -.132$, $p > .05$) were not significant predictors. The results of Step 4 did not support the hypothesis that symptoms of PTSD were negatively associated with PTG. Lastly, in Step 5, the variable representing the interaction between

time since injury and symptoms of PTSD did account for additional variance observed in PTG ($\Delta R^2 = .046$, $p < .05$). The results of Step 5 supported the hypothesis that time since injury moderated the relationship between PTSD and PTG. Overall the final model accounted for approximately 15% of the variance in PTG ($R^2 = .147$, $p < .05$), and the significant predictors included: gender ($\beta = .199$, $p < .05$), time since injury ($\beta = .837$, $p < .05$), and the interaction between PTSD symptoms and time since injury ($\beta = -.829$, $p < .05$).

DISCUSSION

The primary goal of this dissertation was to investigate predictors of posttraumatic growth following a TBI from a motor vehicle accident. Further understanding of the positive psychological construct of posttraumatic growth among this population can aid psychologists and other mental health professionals with treatment and rehabilitation after the devastating occurrence of a TBI. The data analyses, however, illuminated complexities of studying a population of TBI survivors. Thus, the discussion focuses not only on the interpretation and implications of results but also the issues that arose with studying a population of predominantly severe TBI survivors. In addition, the limitations of this study and directions for future research are addressed.

Injury Severity, Disability, and Mental and Physical Functioning of Sample

This study's sample reported higher severity, disability, and lower functioning on measures than anticipated. First, the degree of injury, which was assessed by self-reported TBI severity, revealed a sample of significantly injured individuals. The majority of participants, 69%, were classified as having had a severe TBI, which was

higher than anticipated as most brain injuries that occur are mild. The self-reported TBI severity was qualitatively corroborated with participants' responses to an open-ended question about the circumstances under which they sustained their TBI. For instance, one participant stated, "…hit my head...knocked me out, woke up in hospital 2 days later." Based on their self-report, this participant was classified as a having had a severe TBI, which was consistent with having been unconscious for several days. Thus, it did not seem that participants were falsely identifying as having had a severe TBI; rather, it appeared that the sample was truly comprised of individuals that had sustained a severe TBI from a motor vehicle accident. The severity of the study's population was consistent with results from Dagher et al.'s study (2010), which indicated that patients with a TBI sustained from a MVA had a higher percentage of polytrauma, more medical complications, and higher scores on measures that assessed severity of injury than patients who sustained a TBI from a different type of trauma.

The majority of participants reported being unemployed due to disability. An examination of the crosstabulation between TBI severity and employment status revealed that most individuals with a severe TBI were also unemployed. This finding was consistent with the TBI literature that examines the construct known as return to work (RTW). RTW is often used as an outcome measure for the TBI population (Yasuda et al., 2002). Operationally, RTW is considered achieved if the individual works either full-time (at least 40 hours a week) or part-time (at least 10 hours a week) in addition to being subjectively "capable of competitive employment" (McMordie, 1990, p. 59). The literature estimated that, sadly, less than a third of TBI patients will ever reenter the

competitive workforce (Yasuda et al., 2002). In addition, those who returned to work often spend less time at work, have lower wages, and experience higher job turnovers when compared to their non-injured counterparts (Hart et al., 2010). Employers and family members typically noted that emotional problems largely affected the chance for employment, although cognitive issues, like memory, also played a role (Yasuda et al., 2002). When McMordie et al. (1990) surveyed 177 TBI patients over the age of 19, it was found that only 19.2% of the TBI patients actually met the criteria for RTW. This was consistent with the present study's finding, which found that only 25% of participants who had sustained a severe TBI were working full-time or part-time. Furthermore, McMordie et al. (1990) found that individuals were less likely to RTW if they had experienced extended loss of consciousness and prolonged hospital stays. This finding was also congruent with our sample since the vast majority of those classified as severe reported at least some loss of consciousness at the time of their injury.

The prevalence of posttraumatic stress in the sample also underscored the severity of psychological symptoms of the sample. Over 50% of the participants qualified for a clinical diagnosis of PTSD and an even higher proportion of the sample reported at least some symptoms of posttraumatic stress. Even among this traumatized population, the presence of PTSD and associated symptoms was higher than anticipated, as the estimated occurrence of PTSD in the general population is between 7 to 8% (Vasterling & Dikmen, 2012). Unfortunately, the prevalence of comorbid TBI and PTSD is not well understood or frequently documented (Vasterling & Dikmen, 2012). An issue that complicates the understanding of PTSD among a sample of TBI survivors is the fact that posttraumatic

stress symptoms are often not easily distinguished from TBI symptoms. In fact, both conditions have similar indicators, such as difficulty concentrating (Bryant, 2001). While the sample had a high report of PTSD symptoms, it was considered that perhaps the measure of PTSD was actually capturing symptoms of a TBI and lead to false positives of PTSD diagnoses. On the other hand, the sample may have been experiencing high levels of posttraumatic stress, which played a role in understanding some of the other findings and implications for treatment.

On two other measures of functioning, physical and mental, assessed by a well-validated health survey, the participants scored lower than the general population. Scores that are below the general population norms are indicative of a group that has the following characteristics: limitations in physical functioning, lack of role participation related to physical problems, significant bodily pain, frequent psychological distress, social and role disability due to emotional problems, and poor general health (Maruish & Turner-Bowker, 2009). Additionally, the norms of this measure indicated that approximately 20% of the general population has a positive screening of depression. In this study, 51% of participants had a positive depression screen. In addition to above average levels of PTSD, this population also had an above average presence of depression. These findings were consistent with past research of SF-12v2® and the TBI population. For example, Findler et al. (2000) found that a sample of TBI survivors who completed a longer version of the SF-12v2® reported significantly more health problems than the general population and they concluded this measure as a reliable differentiator between individuals with TBI and those without a disability.

Essentially, the sample was more representative of those who have had a severe TBI and less representative of those who have sustained a mild or moderate TBI (i.e. concussion). The high level of trauma and high degree of injury reported by the sample likely impacted the usability of at least one of the study's measures, which affected the planned analyses, and also provided a context for interpreting some of the other findings.

Personality and Traumatic Brain Injury

A major intention of this study was to understand personality among TBI survivors and how dimensions of personality help predict posttraumatic growth. Preliminary analyses, however, revealed that the chosen measure of personality was not reliable with the sample and therefore was not used in the planned analyses. Not only was reliability for the measure extraordinarily low, but it also was discrepant from what has been observed when this measure was previously used in uninjured populations. Moreover, the five-factor structure of personality did not emerge among the sample of TBI survivors when an exploratory factor analysis was conducted. There are several explanations as to why this measure was essentially unusable and the five factors were not detected.

One concern was that the measure was simply too short and the sample of participants too small to capture the five-factor structure of personality. The short version, comprised of 10 items, was chosen to reduce the cognitive load to participants. Although less commonly used, the BFI-10 had shown promise in terms of reliability (Rammstedt & John, 2007). The test creators have conducted several investigative studies and asserted "that the BFI-10 possesses psychometric properties that are

comparable in size and structure to those of the full-scale BFI" (Rammstedt & John, 2007, p. 207). Yet, a recent study conducted by Hirschfeld, Brachel, and Thielsch, (2014) examined the number of participants needed to yield stable loading patterns for versions of the BFI. Using factor analysis and bootstrapping techniques, they found that factor loadings were highly variable in smaller samples ($n < 500$). For example, primary factor loadings only stabilized in very large samples and then revealed a pattern consistent with the five-factor structure of personality. Hirschfeld et al. asserted that most studies do not have enough participants, unless over 1,000, to yield stable factor loadings on versions of the BFI. In light of these findings, there was a clearer understanding as to why reliability for this measure was low. With a relatively small number of participants ($n = 155$) it was not possible to conclude whether the five-factor structure of personality did or did not exist in this sample of TBI survivors. It was posited that perhaps the low reliability observed in the BFI – 10 was related to the severity of the sample. However, the reliability for the mild TBI group ($n = 30$), a group closest to the average population, was even lower. Considering the aforementioned findings, it seems that personality was unable to be successfully measured by the BFI – 10 due to an inadequate sample size.

Another important point was that the Big-Five may be not as universal as often proclaimed, and in certain populations it may not be appropriate to measure personality in this way. In a study that used the BFI to determine the universality of the Big Five in different cultural groups, the researchers ran into similar issues. Their exploratory factor analysis, regardless of rotation, yielded "a personality structure that is largely distinct

from the Big Five" (Gurven, von Rueden, Massenkoff, Kaplan, & Lero Vie, 2013, p. 365). The results of Gurven et al.'s (2013) study also exhibited factors that appeared "largely distinct" from the Big Five, with, at best, three factors. Interestingly, research has demonstrated that trauma and brain injuries are related to changes in personality. Although, no conclusions were drawn from the results of this study, it must also be considered that the inability to replicate the Big Five was related to latent changes in personality associated with a TBI.

Predicting Posttraumatic Growth Among TBI Survivors

This study was largely undertaken in the hopes to better understand predictors of posttraumatic growth among a group of TBI survivors. Early in data analyses, it became apparent that many of the sociodemographic and contextual variables of TBI survivors that were considered as predictors of PTG were not significantly correlated with participants' scores on the PTGI. Thus, the model of prediction was built using only gender of the sociodemographic and contextual variables and the other hypothesized predictors including: TBI severity, time since injury, symptoms of PTSD, and the interaction between symptoms of PTSD and time since injury. It was found that gender, time since injury, and the interaction between PTSD symptoms and time since injury were significant predictors of PTG.

First, results indicated that gender helped predict PTG, with females being more likely to report growth. This was consistent with findings presented in the literature. For example, gender differences in self-reported posttraumatic growth have been frequently documented. A meta-analysis of 70 studies conducted by Vishnevsky et al. (2010)

revealed a small to moderate gender difference in posttraumatic growth, with women reporting more posttraumatic growth than men. The meta-analysis did not explicitly investigate the underlying processes as to why women report more posttraumatic growth, but a few explanations were posited. First, Vishnevsky et al. contended that there is a tendency for women to have more ruminative thought than men. This includes the propensity for women to ruminate on constructive issues as well as damaging issues. In regards to posttraumatic growth, woman may ruminate constructively about their trauma, which can lead to an increased awareness of personal strengths and/or an appreciation of the importance of social connections (Vishnevsky et al., 2010, p. 117). Other studies offered different theories to explain the gender differences observed in posttraumatic growth. For instance, Swickert and Hittner (2009) concluded that social support is a mediator in the relationship between gender and posttraumatic growth. They asserted that females were more likely to seek others during times of stress and trauma, which in turn promoted posttraumatic growth. Furthermore, research has demonstrated that men are less likely to seek out mental health services and have less positive attitudes towards mental health services than women (Mackenzie, Gekoski, & Knox, 2006). Perhaps, participation in mental health services may engender or spark posttraumatic growth. One thing does seem to be consistent, however, regardless of the specific trauma population, women tended to report higher levels of posttraumatic growth than did males. This finding was further bolstered with results from this study, as being female was a significant predictor of posttraumatic growth in the sample. The above explanations may be true for TBI survivors but future research with this population should explore gender

differences in posttraumatic growth.

Results suggested that TBI severity alone did not add a significant increment in predicting posttraumatic growth in the model; however, the direction of the relationship was positive indicating that the more severe a TBI the higher the self-reported level of posttraumatic growth. In addition, TBI severity did become a significant predictor when the predictor of when symptoms of PTSD were added into the model. One explanation for this was there was a significant correlation between PTSD symptoms and TBI, thus the change in the model could have been related to multicollinearity. Understanding this finding was less straightforward, especially as the measure that assessed TBI severity was first used in this study. Research on injury and trauma reveals that often individuals with more severe injuries experience less distress than individuals with mild injuries, and this appears to hold true for those that have suffered a TBI. For example, Findler et al. (2000) reported that contrary to the predictions in their study, individuals with moderate-to-severe TBI reported less distress and health problems than individuals with a mild TBI. Moreover, Findler et al. asserted their findings were consistent with previously reported results, which concluded that individuals with mild TBI were likely to report more distress and lower quality of life than individuals with moderate-to-severe TBI. It is unclear why those who have sustained a severe TBI report more posttraumatic growth and well-being. The understanding of this finding may have two opposing explanations. On the one hand, perhaps individuals with a severe TBI lack the cognitive ability to process the effects of their brain injury and the resulting loss of ability and functions. In contrast, maybe enduring a severe TBI is more likely to trigger a revaluation of one's life

and priorities to trauma. Lower levels of trauma, and therefore mild-to-moderate injury severity, may not stimulate individuals to reconsider and reevaluate important facets of their lives. Future research with this population should explore TBI severity and the underlying processes that increase the likelihood of posttraumatic growth with increased injury severity. Finally, as a new self-report measure of TBI severity was implemented in this study, future studies should attempt to replicate these findings with more power to determine if TBI severity may truly be predictive of posttraumatic growth.

Results also suggested that symptoms of PTSD alone did not significantly predict posttraumatic growth in the model. A variety of reasons may explain why significance was not found, including small sample size, a highly injured sample unable to correctly complete the measures, and/or simply that a significant relationship did not exist between these two constructs. Unfortunately, it was hard to draw any certain inferences from this result and points to the need for further research. It was helpful to look to another recent study that may provide some further insight into the relationship between PTSD and posttraumatic growth, although with a different population of trauma survivors. Engelhard, Lommen, and Sijbrandij (2014) conducted a longitudinal study of American soldiers who had been deployed to Iraq to investigate the relationship between perceived growth and PTSD symptoms. They wanted to determine whether more perceived posttraumatic growth predicted increased or decreased PTSD symptoms among the soldiers. Participants were soldiers who had been deployed to Iraq and were assessed prior to deployment (Time 1), 5 months after returning home (Time 2), and 15 months after returning home (Time 3). Their results indicated that higher levels of posttraumatic

growth at Time 2 predicted higher scores on the PTSD symptom measure at Time 3 and PTSD symptom scores at Time 2 did not predict posttraumatic growth at Time 3. Engelhard et al. believed these findings should lead future researchers to also consider the maladaptive-significance theory, which stated that PTG reflected denial of adverse effects of traumatic experiences. In sum, emerging research may support a positive relationship between the two variables but further research among a TBI population is indicated. In addition, Cerdá (2014) asserted there is a need to examine the long-term effect of posttraumatic growth and whether it truly reflects an adaptive process with long-lasting benefits or an illusory type of posttraumatic response.

Furthermore, the results suggested that variable of time since injury alone did not significantly predict posttraumatic growth in the model; however, time since injury became a significant predictor in the final step of the model. Tedeschi and Calhoun (1998), who were among the founders of the construct of posttraumatic growth, suggested that posttraumatic growth is a slow process that gradually unfolds over time as survivors of trauma establish new perspectives on how to cope. Thus, it was expected that as time since injury increased so would the level of posttraumatic growth. Interestingly, the current sample represented a range in regards to time since injury, with the most recent injury reported to have occurred less than one month before completing the survey and the most distant injury reported to have occurred 42 years prior to completion of the survey. Although Tedeschi and Calhoun proposed that time since injury was an important factor in the development of posttraumatic growth, empirical evidence provided mixed findings. For example, another study conducted in Japan

examined the relationship between the PTGI and time since trauma (Taku et al., 2007). It was found that the scores on the PTGI did not have a significant relationship with the time since trauma. Future research should continue to investigate the time since injury and the development of posttraumatic growth.

Finally, the variable that represented the interaction between time since injury and symptoms of PTSD, did account for additional variance observed in posttraumatic growth. This indicated that posttraumatic growth was more strongly associated with less PTSD symptoms as time since injury increased. This finding was consistent with what has been observed in the literature, as time since trauma has been established as a moderator of posttraumatic growth (Helgeson et al., 2006). Gangstad, Norman, and Barton (2009) investigated the extent to which time since an acquired brain injury moderated the relationship between PTG and negative psychological outcomes, such as anxiety/depression. Consistent with findings from the current study, Gangstad et al. (2009) found that as time since injury increased, the relationship between PTG and negative psychological outcomes became significant and more negative. This recurrent finding implied that posttraumatic growth not only takes time to develop as Tedeschi and Calhoun (1998) originally proposed, but as posttraumatic growth continues to develop over time it is also associated with less negative psychological outcomes (i.e., posttraumatic growth) (Gangstad et al., 2009). This ultimately tied back to Tedeschi and Calhoun's (1998) belief that posttraumatic growth is engendered through a slow process of psychological recovery and is linked to positive psychological outcomes (i.e., less symptoms of PTSD). Lastly, a strength of this current study was that overall the sample

reported a substantial amount of time had passed since injury (M = 67.52 months) whereas in Gangstad et al.'s (2009) sample reported about half as much time had passed since injury (M = 32.03 months). Thus, this study added new information to the literature that time since injury moderated the relationship between negative psychological outcomes and posttraumatic growth even as time since injury increased.

While the model in the current study accounted for 15% of the variance in PTG for TBI survivors of motor vehicle accidents, there are still an innumerable number of variables that can predict posttraumatic growth. Forthcoming research should continue to explore variables that may be useful in predicting posttraumatic growth, both unique to this population as well as universal to survivors of any type of trauma.

Limitations

There were several limitations to this study. First there were some limitations surrounding recruitment. The majority of participants was Caucasian, highly educated, reported having a severe TBI, and reported high levels of posttraumatic stress. The results were likely based on a homogenous and unrepresentative sample of the larger population of TBI survivors. Therefore, it would not be appropriate to generalize results to other ethnic, socioeconomic, or severity groups. The unrepresentativeness of the sample was probably a function of the methods used for recruitment. Most participants were recruited via online social media groups, which restricted the sample to individuals who had access to the internet. It was less clear why the sample included a large proportion of individuals who had a severe TBI and significant levels of posttraumatic stress. One explanation was that individuals with a severe TBI were more likely to

identify with groups created for survivors. For example, participants were recruited from TBI survivor support groups on Facebook. Another explanation may be that individuals who incur brain injuries from MVA were more likely to have severe TBI. This speculation has not been explicitly reported in the literature, but is a key point for further investigation. Similar to most voluntary survey studies, the convenience sample probably left out certain groups of TBI survivors of motor vehicle accidents. For instance, individuals who chose not to participate could represent a group of TBI survivors who were not impacted very much by their injury or were impacted in a very deleterious way by their injury. If this is the case, it may have lead to an overrepresentation of growth in this population. Finally, the findings were a result of cross-sectional data, which prevented making any statements about causal effects. Despite these limitations, the study was designed to investigate predictors of posttraumatic growth and the results offered preliminary ideas for significant predictors among survivors of TBI of motor vehicle accidents.

Implications

This research study provided new and potentially useful information on the conceptualization of posttraumatic growth among TBI survivors. Some of the most remarkable and far-reaching findings included: the high incidence of PTSD, the significant level of mental and physical distress, and high occurrence of unemployment in this sample of participants. The findings of this research can help inform treatment programs and rehabilitation services as well as funding that can aim to improve outcomes from survivors of TBI. For example, TBI survivors need appropriate and adequate

treatment for PTSD, as untreated symptoms of PTSD may lead to other negative outcomes. Future studies should continue to explore posttraumatic growth among this complex population in an effort to help survivors reach a positive change originating from their trauma.

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APPENDIX A

TABLES AND FIGURES

Table 1

Common Signs and Symptoms of TBI

Thinking/Remembering	Physical	Emotional/Mood	Sleep
Difficulty thinking clearly	Headache	Irritability	Hypersomnia
Feeling slowed down, dazed, confused, or disoriented	Fuzzy or blurred vision	Sadness or Depression	Hyposomnia
Difficulty concentrating	Nausea/vomiting	Difficulty with emotional regulation	Difficulty falling asleep
Difficulty remembering new information	Dizziness	Nervousness	Feelings of Drowsiness
Loss of consciousness	Sensitivity to noise or light	Anxiety	Inability to wake from sleep
Memory loss and amnesia	Balance problems/ loss of coordination	Combativeness	
	Lethargy	Agitation	
	Loss of smell or taste		
	Slurred speech		
	Weakness/numbness in finger and toes		
	Convulsions/seizures		
	Dilation of pupils		
	Clear fluid draining from nose or ears		

Note. Adapted from Centers for Disease Control and Prevention and Mayo Clinic.

Table 2

Severity of a TBI

	Mild	Moderate	Severe
GCS	13 – 15	9 – 12	≤ 8
PTA	≤ 1 hr	1 – 24 hrs	> 1 day
LOC	< 30 min	30 min – 24 hrs	> 24 hrs

Note. GCS - Glasgow Coma Scale; PTA - length of posttraumatic amnesia; LOC - length of loss of consciousness.

Table 3

Demographic Characteristics of Participants (N = 155)

Characteristics	*n*	*%*
Age		
18 – 20	4	2.6
21 – 29	31	20.0
30 – 39	44	28.4
40 – 49	34	21.9
50 – 59	28	18.1
60+	14	9.0
Gender		
Male	69	44.5
Female	86	55.5
Relationship Status		
Married	68	43.9
Windowed	1	0.6
Divorced	20	12.9
Separated	3	1.9
In a Domestic Partnership or Civil Union	6	3.9
Single, but Cohabitating	14	9.0
Single, Never Married	43	27.7
Race		
White	142	91.6
Black or African American	2	1.3
American Indian or Alaskan Native	1	0.6
Asian	1	0.6
Native Hawaiian or Pacific Islander	2	1.3
Hispanic	3	1.9
Multi-Racial	4	2.6
Education		
< High School Degree	4	2.6
High School Degree or Equivalent	23	14.9
Some College	51	33.1
Associate Degree	17	11.0
Bachelor Degree	39	25.3
Graduate Degree	20	13.0
Employment		
Employed, Working Full-Time	38	24.5
Employed, Working Part-Time	16	10.3
Not Employed, Looking for Work	14	9.0
Not Employed, Not Looking for Work	15	9.7
Retired	5	3.2
Disabled, Not Able to Work	67	43.2

Yearly Combined Income		
< $20,000	29	19.2
$20,000 – $34,999	26	17.2
$35,000 – $49,999	23	15.2
$50,000 – $74,999	30	19.9
$75,000 – $99,999	12	7.9
$100,000 – $149,999	16	10.6
$150,000+	15	9.9

Table 4

Combinations of Item Responses that Determine Categorization of TBI Severity

Length of Loss of Consciousness		*Amount of Posttraumatic Amnesia*
Mild		
Did not lose consciousness OR Less than 30 minutes	AND	Did not experience any memory loss OR Trouble remembering things that happened within an hour of injury
Moderate		
Did not lose consciousness OR Less than 30 minutes OR 30 minutes to 24 hours	AND	Trouble remembering things that happened within 24 hours of injury Did not experience any memory loss OR Trouble remembering things that happened within an hour of injury OR Trouble remembering things that happened within 24 hours of injury
Severe		
Did not lose consciousness OR Less than 30 minutes OR	AND	Trouble remembering things that happened within 24 hours of injury and following days and/or weeks and/or months

30 minutes to 24 hours		
More than 24 hours	AND	Did not experience any memory loss OR Trouble remembering things that happened within an hour of injury OR Trouble remembering things that happened within 24 hours of injury OR Trouble remembering things that happened within 24 hours of injury and following days and/or weeks and/or months

Table 5

Overall Means and Standard Deviations for Scales (n = 154)

Variable	*M*	*SD*
TBI Severity	2.53	.82
PCL – C	49.72	16.08
SF-12v2® - PCS	42.59	12.93
SF-12v2® - MCS	41.65	6.47
PTGI – SF	22.68	12.85

Note. Each scale has different potential maximum score: TBI Severity = 3, PCL-C = 85, PCS = 80, MCS = 80, PTGI = 50).

Table 6

Examples of Responses to Item, "Briefly describe how you got your head injury."

Participant A	"Car accident received a concussion and neck injury and it's been 9 months and I'm still suffering from post concussive syndrome."
Participant B	"Driving on ice while working. Slid off the road attempting to stop. Hit head at least once on driver's side window or seatbelt mechanism."
Participant C	"Hit by a speeding taxi that struck my driver's side door, my head went through the driver's window. I was driving."
Participant D	"Coming down highway, 18 wheeler didn't stop for stop sign and hit my side of Toyota. Hit my head...knocked me out, woke up in hospital 2 days later."
Participant E	"I was driving with a friend on the passenger side of my car. The young man who hit me was 19 at the time. The accident happened because he failed to yield while turning left. He had a passenger as well. The young man said he didn't see me but his passenger did. Out of the four individuals in the accident I was the only person hurt. The accident happened in New York. My parents packed up everything and moved me to California so I could get the help I needed because my doctors in New York told my parents to put me in a nursing home because I would never do anything of the things I can do now."
Participant G	"While I was riding a bicycle, an F550 flatbed going the other direction cut a corner, crossed the center line and lane on my side and hit me head on. I hit the front bumper and took off the driver's mirror. The truck left the scene leaving me on the side of the road unconscious, bleeding and with poly trauma."
Participant H	"I was walking my dog across a crosswalk and I was hit. I cracked my skull and fractured my ankle in three different places."
Participant I	"Head on collision. I was the passenger. Multiple facial fractures, several other injuries to my body, severe traumatic brain injury. I was in an induced coma for over two weeks."

Note. Any identifying information has been changed.

Table 7

Factor Loadings for BFI – 10 items (N = 155)

Item	*Factor 1*	*Factor 2*	*Factor 3*
tends to be lazy (C)	.525		
does a thorough job (C)	.434		
is outgoing, sociable (E)	.429	.324	
is generally trusting (A)	.423		
tends to find fault with others (A)	.391		
gets nervous easily (N)	-.526		
is relaxed, handles stress well (N)	-.556		.334
is reserved (E)		.946	
has few artistic interests (O)			-.268
has an active imagination (O)			-.649

Note. C = Conscientiousness, E = Extraversion, A = Agreeableness, N = Neuroticism, O = Openness.

Table 8

*Employment Status*TBI Severity Crosstabulation (n = 154)*

Employment Status	Severity		
	Mild (*n* = 30)	Moderate (*n* = 7)	Severe (*n* = 107)
Employed, Working Full-Time	14 (46.67%)	3 (42.86%)	16 (15.09%)
Employed, Working Part-Time	3 (10%)	1 (14.29%)	10 (9.43%)
Not Employed, Looking for Work	4 (13.33%)	0 (0%)	9 (8.49%)
Not Employed, Not Looking for Work	2 (6.67%)	0 (0%)	13 (12.26%)
Retired	0 (0%)	1 (14.29%)	4 (3.77%)
Disabled, Not Able to Work	7 (23.33%)	2 (28.57%)	54 (50.94%)

Table 9

*Income*TBI Severity Crosstabulation (n = 154)*

Income	Severity		
	Mild (*n* = 30)	Moderate (*n* = 7)	Severe (*n* = 106)
< $20,000	6 (20%)	0 (0%)	20 (19.42%)
$20,000 – $34,999	3 (10%)	2 (28.57%)	17 (16.50%)
$35,000 – $49,999	3 (10%)	1 (14.29%)	18 (17.46%)
$50,000 – $74,999	5 (16.67%)	2 (28.57%)	22 (21.36%)
$75,000 – $99,999	5 (16.67%)	1 (14.29%)	6 (5.83%)
$100,000 – $149,999	1 (3.33%)	1 (14.29%)	12 (11.65%)
$150,000+	7 (23.33%)	0 (0%)	8 (7.77%)

Table 10

Correlations Between Potential Predictor Variables and PTG (n = 154)

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1 Age	1											
2 Gender	.21*	1										
3 Relationship Status	.26**	.26	1									
4 Race	.14	.06	.21*	1								
5 Education	.23**	.14	.17*	.09	1							
6 Employment	-.17*	.23**	-.05	-.12	.01	1						
7 Income	.24**	.09	.23**	.02	.04	.13	1					
8 Physical Health Status	-.14	-.29**	-.11	-.23**	.01	.43**	.02	1				
9 Time Since Injury	.20*	.04	-.07	.06	-.03	.03	.00	.08	1			
10 TBI Severity	.18*	.05	.03	.06	-.20*	-.29**	-.06	-.20*	.16	1		
11 PTSD	-.12	.11	.13	.02	-.11	-.18*	-.005	.38***	-.12	.27**	1	
12 PTG	.05	.23**	-.02	-.08	-.06	-.07	.01	-.03	.09	.18*	-.06	1

Note. * = $p < .05$, ** = $p < .01$, *** = $p < .001$

Table 11

Hierarchical Multiple Regression Analysis Predicting PTG Among TBI Survivors (n = 154)

Step and predictor variable	*B*	*SE B*	β	R^2	ΔR^2
Step 1:				.054*	.054
Gender	6.011*	2.400	.233		
Step 2:				.083	.029
Gender	5.781*	2.378	.224		
TBI severity	2.649	1.446	.169		
Step 3:				.086	.003
Gender	5.733*	2.386	.222		
TBI severity	2.504	1.469	.160		
Time since injury	.010	.016	.058		
Step 4:				.102	.015
Gender	6.077*	2.391	.236		
TBI severity	3.100*	1.529	.198		
Time since injury	.006	.016	.035		
PTSD Symptoms	-.105	.078	-.132		
Step 5:				.147*	.046
Gender	5.127*	2.374	.199		
TBI severity	2.643	1.509	.169		
Time since injury	.143*	.060	.837		
PTSD Symptoms	.092	.113	.115		
Time since injury X PTSD Symptoms	-.002*	.001	-.829		

Note. * = $p < .05$, ** = $p < .01$, *** = $p < .001$

Figure 1. Histogram of Freqencies of Time in Months Since Injury

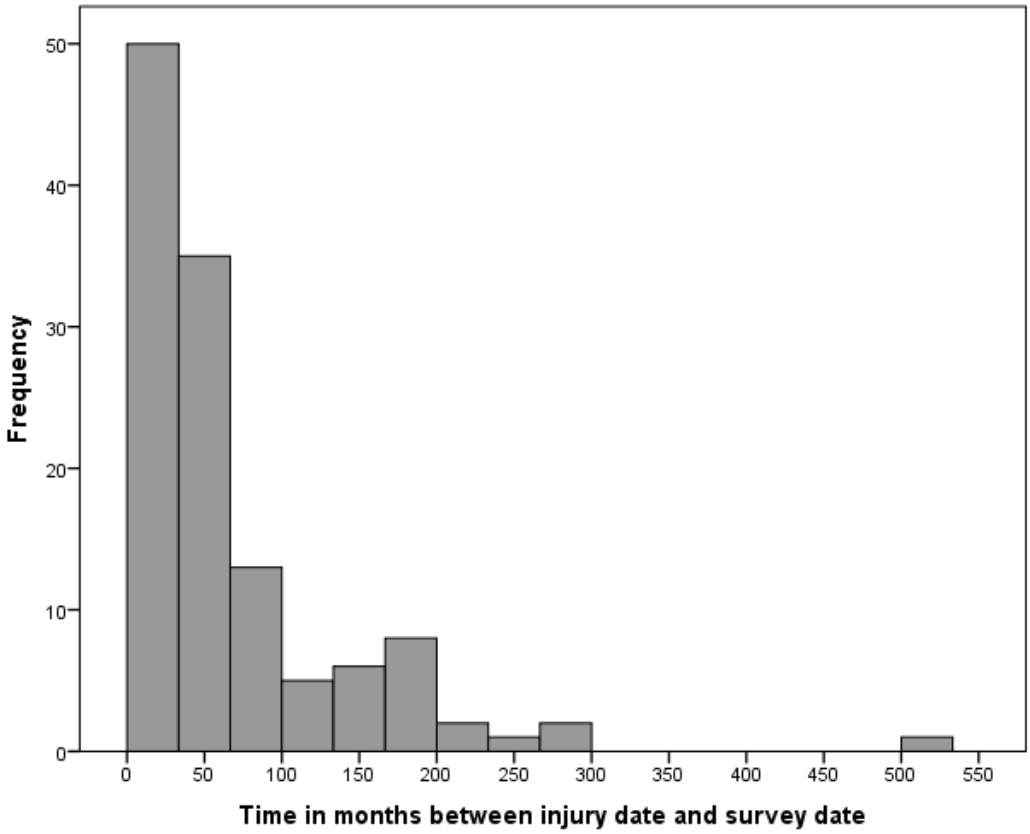
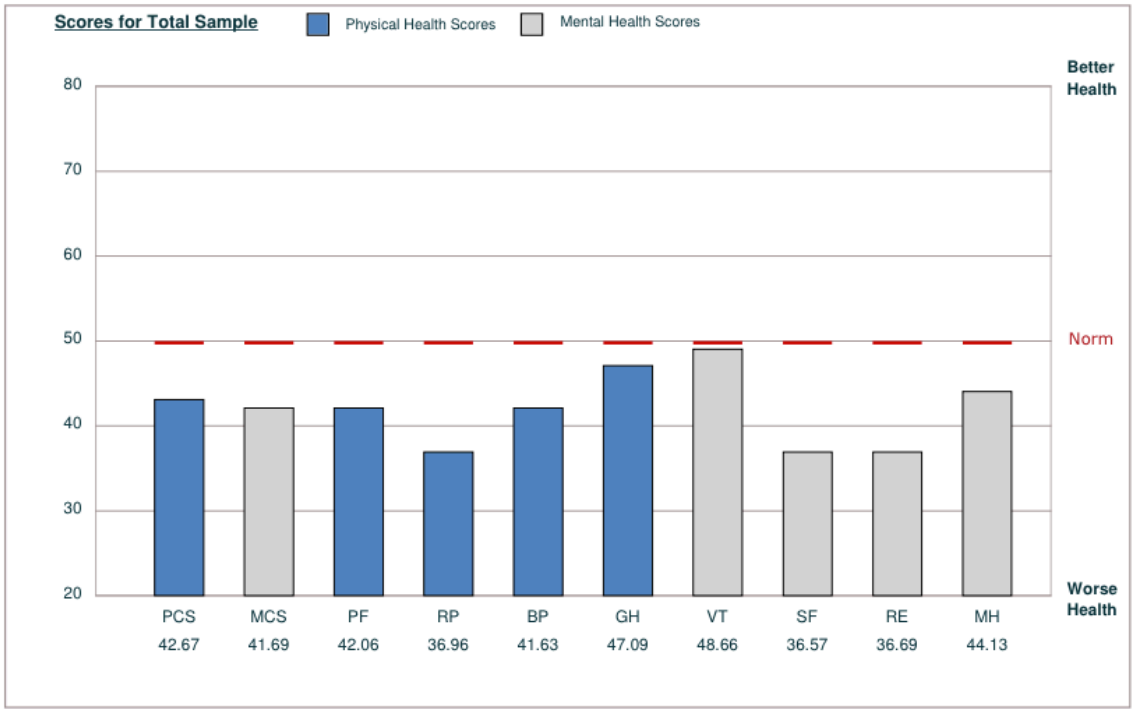


Figure 2. Participant Scores on the SF-12v2® Scales Depicting Below Average Mental and Physical Functioning



Abbreviation
PCS = Physical Component Summary
MCS = Mental Component Summary
PF = Physical Functioning
RP = Role Physical
GH = General Health
BP = Bodily Pain
VT = Vitality
SF = Social Functioning
RE = Role Emotional
MH = Mental Health

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Figure 3. Exploratory Factor Analysis of BFI – 10 Items

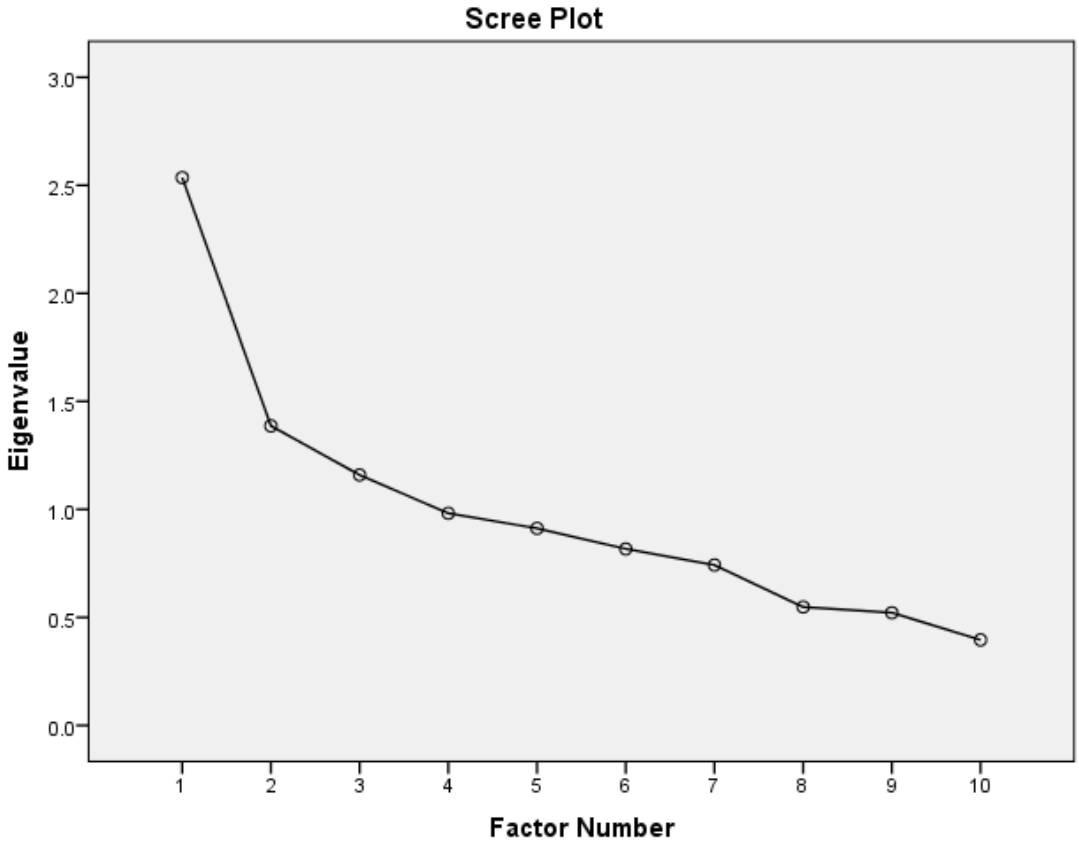
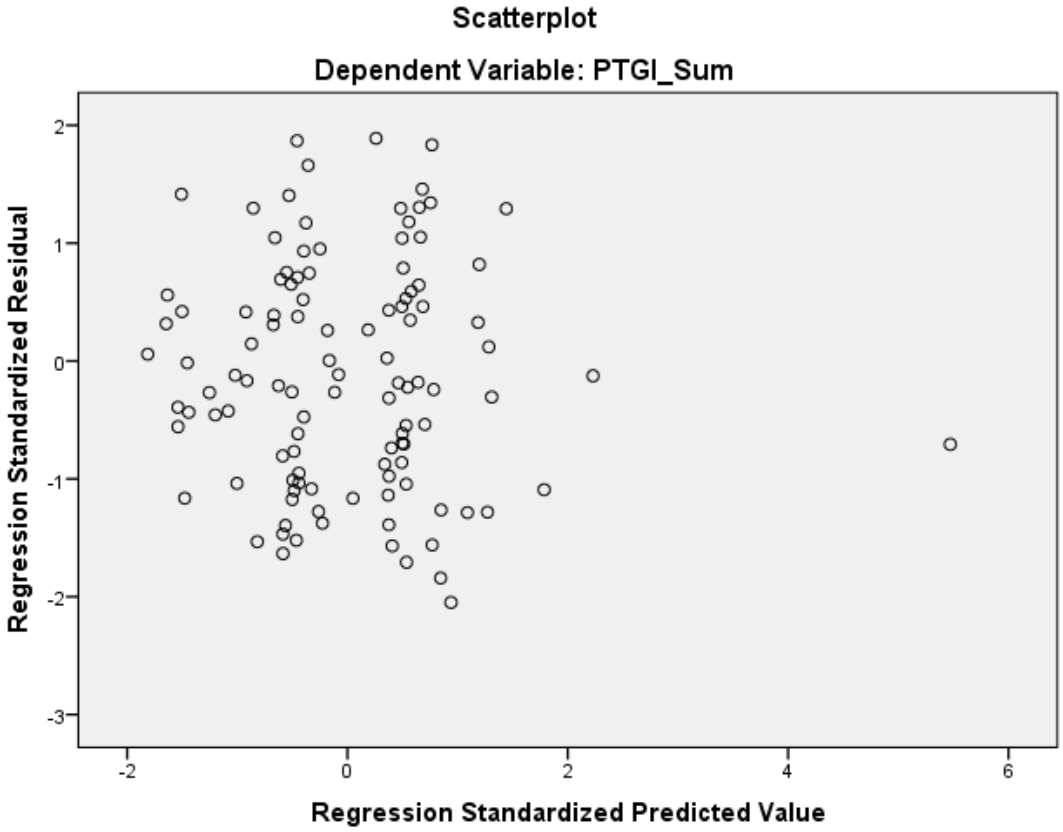


Figure 4. Scatterplot Depicting Outlier



APPENDIX B

INSTITUTIONAL REVIEW BOARD EXEMPTION NOTIFICATION

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Bianca Bernstein
CLS - Counseling and Counseling Psychology
480/965-2920
bbernstein@asu.edu

Dear Bianca Bernstein:

On 1/22/2015 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	"What Doesn't Kill Me, Makes Me Stronger:" Predictors of Posttraumatic Growth Among Traumatic Brain Injury Survivors of Motor Vehicle Accidents
Investigator:	Bianca Bernstein
IRB ID:	STUDY00002130
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• HRP-503a_GILDAR1.docx, Category: IRB Protocol; • InformedConsent_GILDAR1 (5).pdf, Category: Consent Form; • Measures, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Recruitment_GILDAR1.pdf, Category: Recruitment Materials;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 1/22/2015.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Natalie Gildar
Natalie Gildar

APPENDIX C

PARTICIPANT RECRUITMENT SCRIPT

Dear Participant:

I am Natalie Gildar, a doctoral student in the Counseling Psychology program at Arizona State University. Under the direction of my advisor, Dr. Bianca Bernstein, we are conducting a research study that examines the different ways people deal with the effects of a traumatic brain injury. I am recruiting individuals who sustained a head injury from a car accident as an adult (18 years or older).

To qualify for this study you must have sustained a head injury from a car accident. A head injury can range from a minor concussion to coma. A car accident is any incident where a vehicle collides with another vehicle, pedestrian, cyclist, animal, road debris, or other stationary object.

The survey will take approximately 10-15 minutes to complete. Your participation is voluntary. If you have any questions concerning the research study, please contact me at ngildar@asu.edu. The information letter and survey can be accessed at the link below. The link is password protected.

https://www.surveymonkey.com/s/TBIMVA
Password: thankyou

If you would like to be entered to win a $50 Amazon electronic gift card after you have completed of the survey, you will be instructed to submit your email address after completing the study. Five participants will be randomly selected for these prizes. Providing your e-mail address is entirely voluntary and will not be linked to your survey results at any time.

Thank you!

Natalie Gildar

Natalie J. Gildar, M.A.
Doctoral Candidate
Counseling Psychology
Arizona State University
ngildar@asu.edu

APPENDIX D

INFORMED CONSENT LETTER

Dear Participant:

I am Natalie Gildar, a doctoral student in the Counseling Psychology program at Arizona State University. Along with my advisor, Dr. Bianca Bernstein, we are studying the different ways people deal with the effects of a traumatic brain injury following a car accident.

To qualify for this study you must have sustained a head injury from a car accident as an adult (18 years or older). A head injury can range from a minor concussion to a coma. A car accident is any incident where a vehicle collides with another vehicle, pedestrian, cyclist, animal, road debris, or other stationary object.

We would like to invite you to participate, which would involve your filling out an online survey that will take approximately 1015 minutes. Participation is voluntary. You can leave the research at any time and it will not be held against you. We expect about 200 people will participate in this research study.

If you would like to be entered to win a $50 Amazon electronic gift card after you have completed of the survey, you will be instructed to submit your email address after completing the study. Five participants will be randomly selected for these prizes. Providing your email address is entirely voluntary and will not be linked to your survey results at any time.

There are no known risks to completing the survey, although it is possible that answering questions about your head injury may cause some distress. You may call a national Crisis Line at 1800273TALK (8255), if you feel upset at anytime. We cannot promise any benefits to you or others from your taking part in this research, however, we hope the results of the study may be used to help provide better rehabilitation and counseling services to survivors of traumatic brain injuries.

Efforts will be made to limit the use and disclosure of your personal information, including research study records, to people who have a need to review this information. We cannot promise complete secrecy. The results of this study may be used in reports, presentations or publications but your name will not be used. Filling out this survey will be your informed consent to participate.

If you have questions, concerns, or complaints, talk to the research team at ngildar@asu.edu. To contact the Principal Investigator, please contact Bianca Bernstein at bbernstein@asu.edu or 4809652920.

This research has been reviewed and approved by the Social Behavioral IRB. You may talk to them at (480) 9656788 or by email at research.integrity@asu.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.

- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Thank you for considering participation in our study!

APPENDIX E

DEMOGRAPHIC QUESTIONNAIRE

1. What is your age?

- 18-20
- 21-29
- 30-39
- 40-49
- 50-59
- 60 or older

2. Are you male or female?

- Male
- Female
- Other (please specify)

3. Which of the following best describes your current relationship status?

- Married
- Widowed
- Divorced
- Separated
- In a domestic partnership or civil union
- Single, but cohabiting with a significant other
- Single, never married

4. Are you White, Black or African-American, American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific islander, or some other race?

- White
- Black or African-American
- American Indian or Alaskan Native
- Asian
- Native Hawaiian or other Pacific Islander
- From multiple races

Some other race (please specify)

5. What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school degree or equivalent (e.g., GED)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree

6. Which of the following categories best describes your employment status?

- Employed, working full-time
- Employed, working part-time
- Not employed, looking for work
- Not employed, NOT looking for work
- Retired
- Disabled, not able to work

7. How much total combined money did all members of your HOUSEHOLD earn in 2014? This includes money from jobs; net income from business, farm, or rent; pensions; dividends; interest; social security payments; and any other money income received by members of your HOUSEHOLD that are EIGHTEEN (18) years of age or older. Please report the total amount of money earned - do not subtract the amount you paid in taxes or any deductions listed on your tax return.

- Less than $20,000
- $20,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 or More

APPENDIX F

SEVERITY OF SELF-REPORTED TBI QUESTIONNAIRE

1. Have you ever experienced a blow or injury to the head from a car accident that caused you to be knocked out, and/or dazed and confused?

- ○ Yes
- ○ No

2. How many times have you experienced a blow or injury to the head that caused you to be knocked out, and/or dazed and confused?

If you have experienced more than one head injury, think of your most severe head injury to answer the following questions.

3. Estimate the amount of time you experienced a loss of consciousness (i.e. blacked out) from this injury.

- ○ I did not lose consciousness
- ○ Less than 30 minutes
- ○ 30 minutes to 24 hours
- ○ More than 24 hours

4. Estimate the amount of memory loss associated with this injury.

- ○ I didn't experience any memory loss
- ○ I have trouble remembering things that happened within an hour of the injury
- ○ I have trouble remembering things that happened within 24 hours of the injury
- ○ I have trouble remembering things that happened within 24 hours of the injury and the following days and/or weeks and/or months

5. How old were you when this injury occurred (if you've had more than one injury, indicate the age of each injury).

6. In what month and year did you have this injury?

7. Briefly describe how you got your head injury.

APPENDIX G

BIG FIVE INVENTORY – 10

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please select a number next to each statement to indicate the extent to which you agree or disagree with that statement.

I see myself as someone who...

1. is reserved

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

2. is generally trusting

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

3. tends to be lazy

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

4. is relaxed, handles stress well

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

5. has few artistic interests

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

6. is outgoing, sociable

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

7. tends to find fault with others

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

8. does a thorough job

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

9. gets nervous easily

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

10. has an active imagination

Disagree Strongly (1)	Disagree a Little (2)	Neither Agree nor Disagree (3)	Agree a Little (4)	Agree Strongly (5)
○	○	○	○	○

APPENDIX H

THE POSTTRAUMATIC STRESS DISORDER CHECKLIST – CIVILIAN VERSION

Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully, then select one of the numbers to indicate how much you have been bothered by that problem in *the past month*.

1. Repeated, disturbing *memories, thoughts, or images* of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

2. Repeated, disturbing *dreams* of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

3. Suddenly *acting* or *feeling* as if a stressful experience *were happening again* (as if you were reliving it)?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

4. Feeling *very upset* when something *reminded* you of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

5. Having *physical reactions* (e.g., heart pounding, trouble breathing, sweating) when*something reminded you* of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

6. Avoiding *thinking about* or *talking about* a stressful experience from the past or avoiding*having feelings* related to it?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

7. Avoiding *activities* or *situations* because *they reminded you* of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

8. Trouble *remembering important parts* of a stressful experience from the past?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

9. *Loss of interest* in activities that you used to enjoy?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

10. Feeling *distant* or *cut off* from other people?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

11. Feeling *emotionally numb* or being unable to have loving feelings for those close to you?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

12. Feeling as if your *future* will somehow be *cut short?*

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

13. Trouble *falling* or *staying* asleep?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

14. Feeling *irritable* or having *angry outbursts?*

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

15. Having *difficulty concentrating?*

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

16. Being *"super-alert"* or watchful or on guard?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

17. Feeling *jumpy* or easily startled?

Not true at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
○	○	○	○	○

APPENDIX I

POSTTRAUMATIC GROWTH INVENTORY – SHORT FORM

Please indicate the degree to which the change reflected in each of the following statements is true in your life as a result of this crisis.

1. I changed my priorities about what is important in life.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

2. I have a greater appreciation for the value of my own life.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

3. I am able to do better things with my life.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

4. I have a better understanding of spiritual matters.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

5. I have a greater sense of closeness with others.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

6. I established a new path for my life.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

7. I know better that I can handle difficulties.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

8. I have a stronger religious faith.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

9. I discovered that I'm stronger than I thought I was.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○

10. I learned a great deal about how wonderful people are.

I *did not* experience this change as a result of my crisis.	I experienced this change to a *very small degree* as a result of my crisis.	I experienced this change to a *small degree* as a result of my crisis.	I experienced this change to a *moderate degree* as a result of my crisis.	I experienced this change to a *great degree* as a result of my crisis.	I experienced this change to a *very great degree* as a result of my crisis.
○	○	○	○	○	○