RESILIENCE FOLLOWING TRAUMA: EVIDENCE FROM A LEVEL 1 TRAUMA CENTER

A Dissertation

by

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Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

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August 2015

Major Subject: Counseling Psychology

ABSTRACT

The purpose of this study was to examine longitudinally the trajectories of depression and post-traumatic stress disorder (PTSD) in individuals who survived a potentially traumatic event (PTE) and were admitted to a Level 1 trauma center and explore covariate prediction of classes using mild traumatic brain injury (TBI) status, demographic, and health related quality of life variables. Data were analyzed using latent growth mixture modeling. Participants consists of patients consecutively admitted to a Level 1 trauma center that were approached to complete assessments while hospitalized and then at three, six and 12 months post-discharge. The Patient Health Questionnaire-8 (PHQ-8) and the Primary Care Posttraumatic Stress Disorder Screen (PC-PTSD) were used in the present study to identify the classes of adjustment. The sample (n = 406) was predominantly male, European-American, and high school or less educated. The results indicated that a five-class model was the best fit for the depression data, which included a resilient, a delayed, a recovering, a chronic, and a chronic-worsening class. A three-class model was the best fit for the PTSD data, which included a resilient, a chronic, and a stable, moderately distressed class. Lower pain interference and greater psychological well-being while hospitalized was associated with significantly decreased odds of being in a non-resilient class compared to the resilient class. The resilient class reported the fewest symptoms of depression and PTSD and reported the lowest levels of pain interference and greater psychological well-being than the other classes. In conclusion, a five-class model of depression and a three-class model of PTSD best described the data. The results indicate that most survivors following a PTE experienced minor and

transient symptoms of depression and PTSD (i.e., resiliency). This pattern provides additional evidence that resiliency may be the most likely outcome following a PTE. In addition, greater psychological well-being and less pain interference soon after a trauma may be protective factors against the development of depression and PTSD following a PTE. Mild TBI, cause of injury, education, or gender did not predict class membership. Despite surviving a PTE, a large percentage of the sample reported low levels of distress. Clinical and research implications of the results are offered.

DEDICATION

I dedicate my dissertation work to my family, many friends, and college professors. A special feeling of gratitude to my loving mother, Marvis Harlin, whose words of encouragement and push for tenacity ring in my ears. She has given me the drive and discipline to tackle any task with determination. I owe a deep gratitude to my college mentor Dr. Kim-Phuong L. Vu, who opened my eyes to academic research and the possibility of earning a PhD. She has been a friend, guide, and teacher. I also dedicate this dissertation to Dr. Chi-Ah Chun and Dr. John Jung for strengthening my research and critical thinking skills. To my sister Arious McMichael, thank you for taking the time proofread my work time and time again. A special dedication to Dr. Timothy Elliott and Dr. Charles Ridley. These individuals provided open and honest feedback that enhanced my academic experience, further developed my research acumen, and shared the knowledge and skills that enhanced my competence as a professional. Without you all, I would not be where I am today. Thank you for your unwavering support and confidence over the years.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Elliott, and my committee members, Dr. Ridley, Dr. Brossart, Dr. Luo, and Dr. Schlegel, for their guidance and support throughout the course of this research.

Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience. I also want to extend my gratitude to the Baylor Research Institute, which provided the data, and to all the participants who were willing to participate in the study.

Finally, thanks to my mother and sister, aunts and uncles for their encouragement understanding, and support. A special thanks to my uncle, Leonard Harlin, Jr. and Aunt, Andrette Harlin for opening your home and providing a quiet place to work.

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

TABLE

CHAPTER I

INTRODUCTION

Traumatic injuries are one of the most prevalent injury types experienced by people in America with approximately two million people experiencing a potentially traumatic event (PTE) each year (Faul, Xu, Wald, & Coronado, 2010). A PTE is any event (e.g., traffic accident, assault, gunshot wound, falling, etc.) that could meet Criterion A for posttraumatic stress disorder (PTSD), in which a person is exposed to "death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence" (American Psychiatric Association, 2013). The exposure can be through direct experience, through repeated exposure to aversive events, by being a witness, or by learning that a family member or friend was exposed to a PTE (American Psychiatric Association, 2013). The percentage of people experiencing a PTE is staggering. In a representative survey of a large metropolitan city, 90% of the respondents reported experiencing PTE (Breslau et al., 1998). Other studies reported incident rates of PTEs around 50% (Alim, Graves, Meilman, Aigbogun, Gray et al., 2006; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Roberts, Gilman, J. Breslau, N. Breslau, & Koenen, 2011).

Experiencing a discrete PTE can negatively influence mental and physical functioning as well as incur great societal costs. One of the most common and costly mental health disorders related to PTEs is PTSD (Davidson, Stein, Shalev, & Yehuda, 2002). The rates of developing PTSD following a PTE vary and depend on the type of trauma experienced. Rates range between two percent and 30%. This indicates that each

year there are over 200,000 new cases of PTSD resulting from a PTE (O'Donnell, Bryant, Creamer, & Carty, 2008). At any given time, between one and eight percent of the U.S. population meets criteria for PTSD (Davison et al., 2002; Wittchen, 2002). The top two causes of PTSD are motor vehicle crashes and physical assaults (Galea, Ahern, Tracy, Hubbard, Cerda et al., 2008).

Problems associated with PTSD include difficulties maintaining gainful employment, reduction in work productivity, thoughts of suicide, reduced quality of life, strained interpersonal relationships, alcohol and drug abuse, hypervigilance, avoidant behaviors, alterations in cognitions and mood, and emotional numbing. However, less than 25% of people with PTSD seek help from a mental health professional (Eaton, Martins, Nestadt, Bienvenu, Clarke et al., 2008) even though their symptoms persists for years after the PTE (Maercker, Gäbler, O'Neil, Schützwohl, & Müller, 2013).

Major depressive disorder (MDD) is another disorder closely associated with PTEs. Rates of major depression following a PTE range between six and 42% (O'Donnell et al., 2008). The prevalence rate of MDD in the United States is estimated to be between three and seven percent (Andrews, Sanderson Slade, & Isskidis, 2000; Wittchen, 2002). Some symptoms associated with MDD include depressed mood, anhedonia, insomnia, and poor concentration (APA, 2013). In a systematic review of disease burden from around the world, Eaton et al. (2008) described mental health problems as the third most burdensome disease following infectious diseases and heart disease in terms of premature death or negative impacts on health. An alarming statistic describes MDD as the most burdensome mental health disorder (Mathers, Lopez, &

Murray, 2006). Like PTSD, MDD is a disorder that persists long after the trauma and the physical wounds have healed.

In addition to PTSD and MDD being both physically and mentally costly, they also co-occur in about 33% of cases (Campbell et al., 2007; O'Donnell et al., 2008). Thus, when people develop PTSD following a PTE there is about a one in three chance they will also develop MDD. For instance, in one study in which participants were admitted to a level 1 trauma center and followed for six months, all the participants meeting criteria for PTSD at the six-month follow-up also met criteria for MDD (Warren, Foreman, Bennett, Petrey, Reynolds et al., 2014).

The cost of mental health problems on the U.S. and world economies is astounding. Worldwide, MDD cost 97.3 billion dollars annually (Eaton et al., 2008). This study did not include the cost of PTSD, but PTSD was described as having the largest negative impact on participants' lives due to usage of hospitals, physicians, and mental health professionals (Greenberg, Sisitsky, Kessler, Finkelstein, Berndt et al., 1999). In terms of worker productivity, individuals with MDD and generalized anxiety disorder averaged eight and 10 days of impaired work every 30 days (Eaton et al., 2008). In 1990, it cost American employers at least $256.00 per employee with an anxiety disorder and it cost the person with the disorder $1,542.00 per year (Greenberg et al., 1999).

Another health concern associated with PTEs is traumatic brain injury (TBI). A TBI is an insult to the brain caused by an external force including blunt force trauma (Bryant, 2011) Annually, one and half million individuals incur a TBI that ranges from

mild to moderate to severe (Gerberding & Binder, 2003). However, a recent report shows that the number of people incurring a TBI is increasing (Faul, et al., 2010). The costs associated with TBIs now exceed 50 billion dollars per year (Finkelstein, Corso, & Miller, 2006), with the vast majority of new cases (75%) being mild TBIs (Bigler & Maxwell, 2012). The primary cause of a TBI is motor vehicle accidents (MVA; Faul et al., 2010), which is also the top cause for PTSD (Faul et al., 2010; Galea et al., 2008). Like the co-occurrence between PTSD and MDD, TBI co-occurs with PTSD and MDD (Bryant, Allison, & Harvey, 1998; Underhill, Lobello, Stroud, Terry, Devivo et al., 2003). For example, about 40% and 25% of veterans with a TBI screened positive for PTSD and MDD respectively (Hoge, Goldberg, & Castro, 2009). The combination of a TBI and PTSD or MDD impedes recovery from a mild TBI (McCauley, Wilde, Miller, Frisby, Garza et al., 2013) and increases psychological distress (Bombardier, Fann, Temkin, Esselman, Barber et al., 2010; Bryant et al., 1998).

This study focuses on mild TBI because people who have mild TBI with a co-occurring psychiatric condition are an understudied population (Stein & McAllister, 2009). In addition, mild TBIs are associated with a greater risk of developing PTSD and have the highest incident rates of PTSD when compared to moderate or severe TBIs (Zatzick, Rivara, Jurkovich, Hoge, Wang et al., 2010). Mental health providers are also more likely to treat patients with a mild TBI and co-occurring PTSD or MDD than a patient with a moderate or severe TBI with a co-occurring disorder.

The areas of the brain that trigger a PTSD response are the same areas damaged in a mild TBI (Vesterline et al., 2012). Not only do the causes of PTSD and mild TBI

overlap, the brain regions affected by these conditions overlap as well. Mild TBI, PTSD, and MDD also share similar symptoms including poor concentration, alteration in mood and cognitions, irritability, and emotional numbing (Bryan, 2011). Unfortunately, information on TBIs is incomplete because up to 25% of individuals with a TBI, mostly those with a mild TBI, fail to seek medical advice (Faul et al., 2010).

Given the high incidence rates of PTEs, and the likelihood of individuals who experience PTEs developing PTSD, MDD, acquiring a mild TBI or a combination of the aforementioned, research is warranted to understand the intersection of mild TBI, PTSD, and MDD (Vasterline, Bryant, Keane, 2012). One way to explore this intersection is by investigating the influence of mild TBI and other factors (e.g., gender, pain, psychological well-being) in the development of PTSD and MDD. Understanding these relationships will increase our ability to identify patients at risk for developing PTSD or MDD following a PTE.

Research has been conducted on how individuals recover and adjust following a variety of PTEs, including spinal cord injury (Dorstyn, Mathias, & Denson, 2009), TBI (Soberg, Roe, Anke, Arango-Lasprilla, Skandsen et al., 2013), subarachnoid hemorrhage (Navi, Kamel, Hemphill, & Smith, 2012), multiple severe physical traumas (Soberg, Bautz-Holter, Roise, & Finset, 2010), and critical illnesses (Myhren, Ekeberg, Toien, Karlsson, & Stoklan, 2010). From this research, we are learning that PTEs are associated with TBI, PTSD, MDD and mental health variables (e.g., pain, psychological well-being, injury severity). In addition, the results of these studies indicate that the majority of people who experience a PTE appear to respond in a resilient fashion, in which the

negative effects of the PTE are temporary and transient (Bonanno, 2004; Bonanno, Westphal, & Mancini, 2011). Resilient survivors maintain their previous level of functioning and display few problems immediately following the PTE. The majority of people emerge from a PTE psychologically stable (Bonanno et al., 2011; Bonanno, Rennicke, & Dekel, 2005; Skogstad, Toien, Hem, Ranhoff, Sandvik et al., 2012; Zatzick, Rivara, Nathens, Jurkovich, Wang et al., 2007).

Bonanno et al. (2011) developed a process model of adjustment, arguing for a heterogeneous conceptualization of adjustment to a PTE. His model contains four prototypical pathways representing the ways of recovery from a PTE (i.e., resilient, chronic, delayed, recovering). The "resilient" class is characterized by individuals showing minimal distress in the aftermath of a PTE, returning to premorbid functioning within days or weeks following a PTE or maintaining their previous level of functionality. The "chronic" class is characterized by individuals showing an immediate negative psychological reaction to a PTE. Following a PTE, they report clinically significant levels of PTSD and MDD symptoms, which remain elevated. One to two years after a PTE, they continue to report clinically significant levels of psychological distress. The "delayed" class is characterized by individuals showing elevated, but subclinical symptoms of PTSD and MDD immediately following a PTE. However, levels of psychological distress then increase over time to clinically significant levels. The "recovering" class is characterized by individuals reporting subclinical to clinically significant levels of PTSD and MDD symptoms immediately following a PTE. The

symptoms then steadily decrease over time and the levels of psychological distress return to pre-PTE levels within a month to two years post PTE.

The four prototypical pathways or similar classes have been documented in individuals recovering from multiple traumas (Quale & Schanke, 2010), spinal cord injuries (SCI; Bonanno, Kennedy, Galatzer-Levy, Lude, & Elfstrom, 2012), among police officers (Galatzer-Levy Brown, Henn-Haase, Metzler, Neylan, Marmar et al., 2013), former prisoners of war (Maercker et al., 2012), U.S. military service members (Bonanno, Mancini, Horton, Powell, LeardMann et al., 2012), terrorist attack survivors (Pietrzak, Feder, Singh, Schechter, Bromet, et al., 2013), grieving parents and spouses (Bonanno, Moskowitz, Papa, & Folkman, 2005) and caregivers of individuals with severe TBI (Pielmaier, Milek, Nussbeck, Walder, & Maercker, 2012). However, few studies to date have conducted a longitudinal study investigating how the occurrence of mild TBI may affect recovery from a PTE.

These studies also reveal gaps in our knowledge. Previous studies focused primarily on individuals discharged from the hospital to rehabilitation or outpatient facilities to receive additional care. Individuals discharged home are included in these studies, but in small numbers. The authors assume that individuals discharged home are similar to those receiving post-acute services. This assumption is not well founded because approximately eight out of ten people experiencing a PTE are sent home after being discharged from the hospital (Brooks, Lindstrom, McCray, & Whiteneck, 1995). The majority of studies have a majority of their sample receiving post-acute care, but the majority of PTE survivors do not receive post-acute care. There is limited research on

individuals who did not receive post-acute care following a PTE and their levels of functioning (Labi, Brentjens, Coad, Flynn, & Zielezny, 2003).

In one of the first studies of its kind, Mellick, Gerhart, and Whiteneck (2003) using the Colorado Traumatic Brain Injury Registry and Follow-up System database, investigated discharge pathways of participants with a TBI and their functioning one-year post-discharge. The authors created a database of 1,802 individuals charting six different pathways individuals took following discharge from a hospital. The six pathways are: 1) discharging to their community with no community outpatient services; 2) discharging to their community with community outpatient services; 3) discharging to a rehabilitation facility, then to their community without community outpatient services; 4) discharging to a rehabilitation facility, then to a long term care facility; 5) discharging to a rehabilitation facility, then to their community with community outpatient services; and 6) discharging to a long-term care facility.

The largest discharge pathway (64.5%) saw participants discharged to their community with no community outpatient services. Almost two/thirds of the participants did not receive any post-acute care after suffering a TBI. An additional 13% obtained only community outpatient services. Of the participants who had a severe TBI, 23% were discharged to their community, and 25% received post-acute rehabilitation care before returning to their community. This means 54 individuals with a severe TBI returned home after discharging from the hospital, while 58 other individuals with a severe TBI received additional care at rehabilitation facilities. It is unknown how the 54

individuals discharged home were functioning or the problems they experienced. For individuals with a moderate TBI, 54% were discharged to their community.

Overall, 1,162 out of the 1,802 participants did not receive any follow up services after incurring a TBI. The authors found that the participants discharged home had poorer quality of life, less social participation, and were at risk for unemployment. Although the individuals discharged back to their communities were less impaired, they stillexperienced difficulties related to their TBI more than a year later.

Cuthbert, Corrigan, Harrison-Felix, Coronado, Dijkers et al. (2011) studied three national databases on moderate to severe TBI and found between 57% and 65% of people were discharged home. They also found between 13% and 29% of people received rehabilitative services after discharging from a hospital. Annually, there are close to 116,000 people who incur a TBI without receiving post-acute care (Corrigan, Cuthbert, Whiteneck, Dijkers, Coronado et al., 2012). Therefore, for every one person who incurred a TBI and were discharged to a rehabilitation facility, three others were sent home.

Studies using Bonanno et al.'s (2011) process model of resiliency have omitted or excluded individuals with mild TBI (deRoon-Cassini, Mancini, Rusch, & Bonanno, 2010). When TBI was not an exclusion criteria, the influence of TBI status on class membership was not examined (Myhren et al., 2010). There is a dearth of information examining the psychological and physical health of people following a PTE when the PTE is a single event, the injuries requires admittance to a Level 1 trauma center, the majority of survivors discharge home, and a subset of the sample has a mild TBI. The

current study sought to provide initial evidence concerning the levels of functioning and mental health status of this population.

Understanding how these individuals adjust over time is critical to detecting those who will not develop mental health problems and those who are at risk for poor adjustment following a PTE. This can be accomplished by identifying key variables associated with resiliency or dysfunction (e.g., mild TBI, PTSD, MDD). This study will help to uncover the mechanisms related to the different pathways of adjustment following a PTE.

The current study aimed to reproduce the four prototypical pathways or classes (i.e., resilient, chronic, delayed, and recovering) in a community sample of individuals admitted to a Level 1 trauma center. In addition, the study explored whether mild TBI, demographic variables (i.e., age, gender, education, race/ethnicity), health related quality of life variables (i.e., psychological well-being, pain interference), a physical health variable (i.e., injury severity), and mechanism of injury (i.e., accidental or intentional) predicted class membership. A second aim was to extend the results of the deRoon-Cassini et al. (2010) study, by following the sample for up to 12 months post-discharge. Over the 12 months, participants were assessed four at data points (i.e., when hospitalized, three, six, 12 months post-discharge). The data were analyzed using latent growth modeling techniques and multinomial logistic regressions.

Based on the findings of deRoon-Cassini et al. (2010) and using to Bonanno's process model (Bonanno et al., 2011), it was hypothesized that the four prototypical classes would be reproduced in a mixed sample of individuals who incurred a PTE and

received treatment at a Level 1 trauma center. It was expected that the majority of the sample would show mild symptoms of depression or PTSD. These individuals were categorized as resilient (35% - 65%). The second largest class was expected to be the chronic class (5% - 30%); the third largest class was expected to be the recovering class (15% - 20%), and the smallest class was expected be the delayed class (0% - 15%; Bonanno et al., 2005; deRoon-Cassini et al., 2010; Galatzer-Levy & Bonanno, 2012).

It was also hypothesized that greater levels of psychological well-being, less pain interference (higher pain interference score), male gender, and greater education would predict the resilient class. Female gender, less education, greater injury severity, intentionally caused injuries, and mild TBI would predict a non-resilient class (Bonanno et al., 2011; deRoon-Cassini et al., 2010; Bonanno, Galea, Bucciarelli, & Vlahov, 2006). Age and race/ethnicity also were explored as predictors of class membership.

The third goal of the study was to explore within and between-group differences associated with the classes over time. Based on Bonanno et al.'s (2011) estimation of variability in levels of depression and PTSD longitudinally, the resilient and chronic classes were hypothesized to report statistically nonsignificant changes in levels of depression and PTSD between the initial assessment (i.e., while hospitalized) and the 12-month follow-up. The recovering class was hypothesized to report statistically significant decreases in depression and PTSD between the initial assessment (i.e., while hospitalized) and the 12-month follow-up. The delayed class was hypothesized to report statistically significant increases in levels of depression and PTSD between the initial assessment (i.e., while hospitalized) and the 12-month follow-up. While hospitalized, the

resilient class was hypothesized to report significantly fewer symptoms of depression and PTSD than the chronic, recovering, and delayed classes. At 12 months post-discharge, it was hypothesized that the resilient class would report significantly fewer symptoms of depression and PTSD than the chronic and delayed classes.

CHAPTER II

LITERATURE REVIEW

Experiences of trauma were once thought of as rare; however, evidence shows that traumatic events are common (Breslau, Davis, Andreski, & Peterson, 1991). It is likely that every person will experience at least one event in their life that will meet the criteria for a traumatic event as defined by Criterion A for post-traumatic stress disorder (PTSD) in the DSM-V. Criterion A describes a traumatic event as an event where a person was "exposed to: death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence" (American Psychiatric Association, 2013).

An extreme event is characterized as potentially traumatic event (PTE) because it is the response that determines if an event is traumatic (Bonanno, Brewin, Kaniasty, & La Greca, 2010). Many people experience a life altering PTE, but only a minority of individuals will go on to develop mental health problems such as PTSD or MDD (Ozer, Best, Lipsey, & Weiss, 2003). The terrorist attack on September 11, 2001 in New York City is an example of a PTE. Generally, the responses involved intense fear, a deep sense helplessness, and terror due to serious threats to physical safety as well as the physical safety of friends and family. In response to the worst act of terrorism on U.S. soil, some individuals showed high levels of psychological distress, while others reported subclinical levels of distress (Bonanno et al., 2005a). PTE will be used throughout this paper because the term recognizes individual differences in response to an extreme event.

George Bonanno has developed a process model of adjustment in which there are prototypical pathways or classes of adjustment (i.e., resilient, chronic, recovering, delayed) and proposed variables that predict membership in each class that are discernible from longitudinal data (Bonanno, 2004; Bonanno et al., 2011). According to this model, outcomes following a PTE will fall into one of these four classes with demographic, psychological, and physical health variables used as predictors. The development of Bonanno's process model of recovery began by reviewing developmental literature.

Developmental literature

Developmental psychologists have studied the nature of resiliency since the 1970's (Luthar, 2006). Research began by studying resiliency in children as a way to understand how they persevered and continued to meet educational and social milestones, while being raised in less than optimal environments. Resiliency has been found in a subsample of children, despite living in environments with community violence, poverty, harsh or inconsistent parenting, and/or parental mental illness (Luthar, 1991; Luthar, Cicchetti, & Baker, 2000; Werner, 1995; Werner, 1997). Resiliency in this context means meeting social milestones, progressing appropriately in school, maintaining physical health and developing into well-adjusted adults. The resilient children showed several adaptive characteristics such as an internal locus of control, socially expressiveness and assertiveness, social relationships with peers, and at least one supportive relationship with a parent, a family member, a teacher, a mentor or clergy member (Luthar, 2006). Resiliency is not a unitary construct, but a process in which

protective and risk factors combine to produce a resilient outcome for children growing up in stressful environments (Luthar, Dorenberger, & Zigler, 1993).

The children in these studies developed long-term strategies to minimize the negative effects of their environment. These children used internal and external factors to assist them in becoming resilient. Bonanno and colleagues hypothesized that if children can demonstrate resiliency in the face of chronic stressors, adults exposed to a sudden, acute, intense and generally short lived, but potentially disruptive PTE can demonstrate resilience as well. In addition, these investigators sought to understand the factors that supported this type of recovery (Bonanno & Mancini, 2008).

Bonanno's theory of resilience

Bonanno's process model posits that there are distinct pathways of adjustment following a PTE such that the process should be viewed as heterogeneous. He suggests there are prototypical pathways of adjustment (i.e., resilient, chronic, delayed, recovering) that can be extracted from longitudinal data (Bonanno et al., 2011) and that reactions to a PTE fall into one of these four classes.

A resilient pathway or class is one in which individuals exposed to a PTE show minimal disruptions in their psychological functioning over time. This does not discount any of their symptoms resulting from the PTE. For the resilient class, the symptoms tend to be mild and do not affect their ability to move forward with their lives. The effects are temporary: within one to two months, people in the resilient class show small differences from their pre-PTE levels of functioning. For example, the levels of depression and anxiety for resilient bereaved spouses increased minimally throughout the first 18

months post-loss (Bonanno, Wortman, Lehman, Tweed, Haring et al., 2002). The widows and widowers experienced transient symptoms such as difficulty sleeping or intrusive thoughts about the person they lost, but these issues did not prevent them from carrying out their normal daily functions. As one survivor of a PTE explained, "My family expected me to stay home for a while. I think my friends did, too. But I couldn't see it. People at work need me. That is what I do. I couldn't let those people down. That's who I am. It's my job and I need to do it. I wouldn't be me otherwise" (Mancini & Bonanno, 2006, p. 980).

In contrast, individuals in the chronic class immediately following a PTE report clinically significant levels of emotional distress which generally meets criteria for MDD and/or PTSD (Bonanno et al., 2012; Bonanno et al., 2012) and persist for years (Maercker et al., 2013). For example, survivors of the 9/11 terrorist attacks with the highest levels of distress in the immediate aftermath continued to report psychological and physical distress 18 months later (Bonanno et al., 2005). These individuals also reported disruptions in their daily lives, social support systems, their work, and economic resources.

Individuals in the delayed class report subclinical to clinical levels of distress immediately following a PTE, but over time, their symptoms increase to levels seen in the chronic class. The pattern of distress reflected in this class was similar to those with delayed PTSD (Carty, O'Donnell, & Creamer, 2006).

The recovering class is the pathway considered by many to be the most common way individuals adjust to a PTE (Wortman & Boerner, 2011). Individuals in the

recovering class report moderate to clinically significant levels of distress following a PTE. It wanes over time and within two years, these individuals return to pre-PTE levels of functioning.

Bonanno's process model of recovery also makes specific claims about the resilient class (Bonanno, 2004; Bonanno et al., 2011). First, resiliency is the most common pathway, and most survivors of a PTE will only experience minor disruptions in their lives. Therefore, resilience is not a superhuman trait, but potentially an inherent ability most people have. Second, resilient people are not pathological, abnormal, maladjusted, dysfunctional, or superficially adjusting to a PTE. They exhibit a healthy and genuine reaction to a PTE that is enduring (Lam, Shing, Bonanno, Mancini, & Fielding, 2012). Third, resiliency is not merely the absence of negative emotions, but also the expression of positive emotions (Galatzer-Levy, Brown, Henn-Haase, Metzler, Neylan et al., 2013).

Fourth, there is no one resilient type; there are multiple pathways taken to achieve resiliency. Resilient individuals possess characteristics that work in an additive and interactive way to buffer the effects of a PTE (Luthar, 1991; Werner, 1995; Werner, 1997). Resiliency is a balancing act between risk and protective factors (e.g., gender, injury severity, age, education). For example, participants with a spinal cord injury who displayed the resilient pathway were rated high in fighting spirit, used adaptive coping strategies, and minimized reliance on others and behavioral disengagement (Bonanno et al., 2012). In another study, resiliency was associated with optimism, positive affect, social support, and low negative affect (Quale & Schanke, 2010). Combinations of

variables will determine whether someone will be resilient towards the deleterious effects of a PTE.

Variables that influence outcomes following a PTE include personality factors, demographics, social-support, economic resources, past and current stressors and the ability to experience and express emotions (Bonanno et al., 2011). Personality factors play a role in adjustment to a PTE, but personality factors only account for about 10% of the variance in how people behave across time (Mischel, 1969). Demographics, on the other hand, are a major factor in explaining resiliency. As people get older and become more educated, the odds of being in the resilient class increase (Bonanno et al., 2011). Social support and economic resources are other factors that improve adjustment to a PTE (Bonanno et al., 2010). A person with a stable social support system will have a better outcome following a PTE than those without social support (Bonanno et al., 2005; Cohen &Wills, 1985). Previous experiences with PTEs resulting in high levels of distress increase the chance of having a negative reaction to future a PTE (Bonanno et al., 2011). The probability of developing PTSD increases as the number of prior PTEs increases (Breslau et al., 1998). The ability to express positive and negative emotions following a PTE is an indicator of a resilient outcome (Galatzer-Levy et al., 2013). These variables represent some risk and protective factors associated with a resilient or dysfunctional outcome following a PTE.

Resiliency is the capacity to continue functioning at a normal level in the face of adversity; it also means functioning despite feeling down, disoriented, or feeing psychological or physical pain. Resiliency reflects adaptation to an out-of-the-ordinary

experience (Bonanno & Mancini, 2010). Finally, in his process model, Bonanno (2004) differentiates resiliency from recovery (Bonanno, 2004). Resiliency is "… the ability of adults in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event such as the death of a close relation or a violent or life-threatening situation to maintain relatively stable, healthy levels of psychological and physical functioning" and have "… the capacity for generative experiences and positive emotions" (Bonanno, 2004, p. 20 – 21). On the other hand, recovery is a "… response to a PTE characterized by acute distress, moderate to severe levels of initial symptoms, and some difficulties meeting role obligations. Over time, these difficulties abate, and the person returns to his or her baseline level of functioning, usually within one to two years after the PTE" (Bonanno et al., 2011, p. 515). However, despite taking different pathways, these two classes share in common the same end point which is the same level of functioning.

Bonanno's process model departs from traditional models of adjustment following a PTE, which traditionally have focused on negative adjustment. Instead, Bonanno focuses on positive adjustments, with a specific emphasis on resiliency and the variables characterizing those with low levels of psychological distress. Bonanno and colleagues reported how the size of the resilient (35% - 60%), the chronic (5% - 30%), the recovering (15% - 25%), and the delayed (0% - 15%) classes were stable across samples (Bonanno, 2004; Bonanno et al., 2011).

Methodological approaches to the measurements of resiliency

Psychopathological and event approach. Traditionally, two methods have dominated the measurement of responses to a PTE. The psychopathological approach makes comparisons between two groups. One group meets criteria for a psychological disorder such as PTSD or MDD, and the other group does not, even though both groups endured the same PTE. For example, comparing people with firsthand experience of the 9/11 terrorist attacks with and without PTSD. The event approach examines the adjustment of one group recovering from a PTE to a group that did not experience a PTE.

For example, the study by Bonanno et al. (2005) used the event approach to compare bereaving spouses and parents to a matched sample of non-bereaving married individuals. One group experienced a death while the other group did not. The assessment between the bereaved and non-bereaved groups occurred at four and 18 months post-loss. At four and 18 months post-loss, the bereaved spouses and parents reported significantly higher levels of depression and had greater impairment in their functioning than the non-bereaved group.

In a subsequent analysis, the authors divided the bereaved group into a resilient and a non-resilient group. The bereaved individuals who reported depression scores within one standard deviation of the non-bereaved group at four and 18 months post-loss were classified as being resilient. Over 50% of the bereaved sample had low levels of depression (i.e., resiliency), and an additional nine percent reported experiencing less distress over time (i.e., recovering). When the authors compared the bereaved and non-

bereaved groups, the bereaved group was more depressed. However, when the resilient, bereaved group was compared to the non-bereaved group, there were no differences in the levels of depression or overall functioning. This study shows importance of identifying subgroups within a group purported to be homogenous. The information from the resilient, bereaved group would have been lost if the authors did not look for subgroups.

Latent growth mixture modeling. Newer methods of measuring adjustments to a PTE involve advanced growth-modeling techniques, where the modeling of data occurs through empirical exploration (Heck, 2001). One advanced method is latent growth mixture modeling (LGMM), where the observed variables are continuous, the variance and covariance vary and a latent categorical classification variable is created. LGMM is used to identify divergent patterns of change over time, and in this process, it provides information about the relative prevalence of different patterns.

The advantage of LGMM is the relaxation of the assumption that all individuals within a sample are from the same population (Jung & Wickrama, 2008). Specifically, LGMM assumes that a single growth curve will not accurately represent the data. LGMM assumes there are unobserved, heterogeneous classes within the sample, where each class has its own set of growth parameters (i.e., slope, intercept), variances and functional shape (Preacher, Wichman, MacCallum, Briggs, 2008). LGMM is able to model multiple growth curves to reflect the heterogeneity of the data. It is also similar to exploratory factor analysis in that the choices made at each step of the analysis

influences the results. The analyses are data driven, but subjective rationale determines the number of classes to retain (Ram & Grimm, 2009).

Jung and Wickrama (2008) cogently describe the way LGMM works. LGMM begins with repeatedly measured variables and the creation of a univariate growth curve, linear or nonlinear. Using matrix algebra and the application of different algorithms, latent growth parameters estimate the latent categorical variable containing the distinct classes. Theoretical justifications, parsimony, interpretability, and fit indices (e.g., entropy, Lo-Mendell-Rubin test, bootstrap likelihood ratio test) are then used to guide selection of the best model (deRoon-Cassini et al., 2010).

Determining the optimal number of latent classes requires testing several models. Each model tests a different number of latent classes nested within the categorical latent variable. Previous studies tested at least five different LGMM models ranging from one class to five classes (Bonanno et al., 2012). Each model tested has its own estimated growth parameters and latent categorical variable. After determining the optimal number of classes, the next step is to add covariates to improve model fit. An iterative process determines which covariates to add to the model. Adding covariates is a necessary step because they account for variance not accounted for by the observed variables; not including covariates could lead to model misidentification and inaccurate results (Jackson, 2010).

Another advantage of LGMM is its flexibility (Jackson, 2010). Normally, the intervals between measurements have to be constant, but LGMM can model data even when the intervals between measurements are not equidistant. For example, if data

collection takes place when the participants are still in the hospital, then at three, six, and 12 months post-discharge, LGMM can model the growth pathways. A third advantage is that time varying and time invariant variables can be included in the growth model (Curran Obeidat, & Losardo, 2010). That is, LGMM can model variables that change over time (e.g., physical health, depression symptoms) and variables that remain stable over time (e.g., gender, race) or are measured at one point (e.g., educational level, or marital status) and are thought of as being constant.

Resilience literature

Death of a loved one. The death of a loved one is one of the most stressful events people will face in their lives (Bonanno et al., 2005). Bereavement theorists posit a normative pathway of initial distress followed by steady decreases over time (Wortman & Boerner, 2011). The process is described as gradual, and as taking about one to two years before there is a return to normal functioning. However, research shows that the majority of individuals are actually able to retain their current set point of functioning, despite mourning the loss of a loved one.

In a study investigating caregiver's adjustments to the death of a partner, a sample of men self-identifying as gay or bisexual completed assessments before and after their partner died (Bonanno et al., 2005). Many of the surviving spouses were caregivers for a partner diagnosed with AIDS. The authors followed the men from eight months pre-loss to eight months post-loss. On average, the surviving spouses were most depressed immediately following the loss of their partner. At eight months pre-loss, nearly 50% of the men reported clinically significant levels of depression, but by eight

months post-loss, only 40% of caregivers reported elevated levels of depression. Although a high percentage of caregivers experienced symptoms of depression in the months before and after their partner died, the majority of caregivers reported subclinical levels of depression.

To investigate whether the bereaved caregivers showed resiliency, the authors partitioned the participants into four classes of adjustment. The authors used participant's pre-loss and post-loss data to create four classes of adjustment. For example, the bereaved caregivers were classified as low distress (i.e., resilient class) if they had subclinical levels depression eight months prior to the death of their partner and their levels of depression deviated less than one standard deviation during the first eight months post-loss. The high distress group (i.e., chronic class) had clinically significant levels of depression at eight months pre-loss and reported high levels of depressive symptoms during the first eight months post-loss. A third group was classified as experiencing decreasing distress (i.e., recovering class) if they had clinically significant levels of depression eight months pre-loss and sustained a one standard deviation decrease in depression symptoms during the first eight months post-loss. The fourth class demonstrated a grief reaction. These participants reported subclinical levels of depression pre-loss, but then reported depression symptoms that were one standard deviation or higher during the first eight months post-loss.

Three of Bonanno et al.'s (2011) four prototypical classes of adjustment were reproduced in a sample of gay men caring for spouses who died. The resilient class made up the largest group comprising 27% of the sample, the chronic class consisted of 25%,

and the recovering class was nine percent of the sample. The grief reaction class comprised 25 % the sample. The resilient class in this study did not comprise the majority of the sample, but this class did return to its pre-loss levels within in one month as predicted by Bonanno et al. (2011). The results demonstrate the variability in responses to the death of a loved one. Some people experience transient symptoms and return to their normal level of functioning while others remain highly distressed.

In another study, Bonanno et al. (2002) investigated reactions to the death of a partner in individuals 65 years or older. Data collection occurred before their partner's death and again at six and 18 months post-loss. Scores on the Center for Epidemiologic Studies Depression Scale and a measure of grief symptoms formed the classes of adjustment. By analyzing how participant's scores changed over time, the author's extracted the resilient, delayed, chronic and recovering classes. The resilient class made up 46% of the sample. The recovering, chronic, and delayed groups made up 12, seven, and four percent of the sample, respectively. Experiencing the loss of a loved one is a very traumatic event, but half of this sample in the face of such adversity was resilient and able to maintain current level of functioning. There was a belief that a display of resiliency after a loved one's death was because the survivor had a poor relationship with the person they loss (Wortman & Silver, 1989). However, in the Bonanno et al. (2002) study, the resilient class reported significantly more positive evaluations and fewer complaints about their relationship than the recovering or chronic classes. In addition, attachment styles did not differ between any of the classes.

With the use of modern statistical modeling techniques, Bonanno and colleagues reanalyzed the data from Bonanno et al. (2002) using Latent Class Growth Analysis (LCGA), which is similar to LGMM (Galatzer-Levy & Bonanno, 2012). Instead of looking at how participant's depression scores changed over time and assigning them to a group, group assignments were made using LCGA. In the reanalysis, data collection occurred across four assessment periods instead of three, (i.e., pre-loss, six, 18, 48 months). The results showed that 66% of the sample had low levels of distress (inductive of resiliency). Two/thirds of the adults mourning the loss of a loved one reported low levels of depression from around the time of their spouse's death through 48 months post-loss. The chronic, delayed and recovering classes comprised 14, nine, and ten percent of the participants, respectively. The rates of each class were different from what Bonanno et al. (2002) found, but across both studies, the largest group was the resilient class. This study supports the assertion that the most common outcome following a PTE is resiliency, in which most individuals experience only temporary symptoms and return relatively quickly to their normal levels of functioning (Bonanno, 2004).

Spinal cord injury. Distinct classes of adjustment have also been reported in individuals who survived a spinal cord injury (SCI; Post & van Leeuwen, 2012). Van Leeuwen, Hoekstra, van Koppenhagen, de Groot, and Post (2012) followed 206 SCI survivors during the first five years after their accident. Assessment of survivors occurred upon entering an inpatient rehabilitation program, and then at three, 12, 24, and 60 months (i.e., 5 years) post-discharge. Statistical analyses examined participants' total

score on the Mental Health Index questionnaire, a brief measure of overall mental health. LGMM was used to determine the number of latent classes of adjustment.

The results revealed five pathways. Over 50% of survivors maintained high levels of mental health from the occurrence of the SCI through five years post-discharge, (i.e., resilient class). Four percent of survivors had severely low level of mental health throughout the study, (i.e., chronic class). Thirteen percent of participants showed significant increases in mental health scores from the start of the rehabilitation program through the first three months post-discharge and by five years post-discharge their scores were similar to the resilient class, (i.e., recovering class). The fourth group was the smallest containing only two percent of the sample. These SCI survivors showed deteriorating mental health. In the first three months, they reported positive mental health growth. However, at every follow-up assessment thereafter, their overall mental health declined reaching levels worse than the chronic class. The fifth group, which made up 29% of the participants, had an intermediate level of mental health that slowly improved over time. Although the classes did not confirm to Bonanno's four-class model, the majority of SCI survivors demonstrated resiliency and showed that resiliency is more than the absence of psychopathology (Bonanno et al., 2011).

A recent and relevant study investigated 80 participants with severe physical injuries, (i.e., SCI or multiple traumas) while completing a rehabilitation program (Quale & Schanke, 2010). Assessment of the participants occurred after admission to the rehabilitation program and again one week before discharging. The aim of the study was to figure out if the resilient class is the most common adjustment pathway in a

rehabilitation hospital. Participants' reported their levels of anxiety, depression, PTSD, and positive and negative affect. Through examining participant's scores from admittance to discharge three separate classes were formed including a resilient class (54%), a recovering class (25%), and a chronic class (21%). None of the participants showed a delayed reaction. These results provide support for the prototypical pathways of adjustment described by Bonanno et al. (2011) and for resiliency as the most common pathway of adjustment.

Membership in the resilient class meant reporting normative scores on all of the measures used to assess adjustment (Quale & Schanke, 2010). That is, in a mixed PTE sample, the resilient class reported subclinical levels of depression, anxiety, and PTSD and reported high levels of positive affect and low levels of negative affect. These results showed that resiliency also entails the presence of positive emotions and an optimistic outlook.

Cancer survivors. Variability in adjustment was studied in survivors of cancer. Receiving a diagnosis of and undergoing surgery for breast cancer is a scary experience familiar to many women (Siggel, Naishadham, & Jemal, 2013). In a study of 285 Chinese women diagnosed with early stage breast cancer, Lam, Bonanno, Mancini, Ho, Chan et al. (2010) replicated Bonanno's four prototypical pathways using LGMM. Assessment of the patients' level of psychological distress occurred at one, four, and eight months after surgery to remove cancerous tissue. The resilient class represented 66% the survivors. The chronic, recovering, and delayed classes represented 15, 12, and seven percent of the sample, respectively.

After facing a potentially life threatening illness in which there is a 10 to 20% chance of death over the next five years (Howlader, Noone, Krapcho, Garshell, Neyman et al., 2012), the majority of the patients exhibited low levels of post-operative distress and preserved their psychological health in the first eight months. The size of the resilient class was larger than what Bonanno et al. (2011) theorized. Previous research showed that older age predicted the resilient class (Bonanno, Galea, Bucciarelli, & Vlahov, 2007), and the mean age of this sample was 50. The age of sample could explain the larger than expected resilient class.

In a continuation of the Lam et al. (2010) study, Lam et al., (2012) reassessed 199 out the 285 participants at six year post-diagnosis and grouped them based on their class assignment from the previous study. The authors reassessed participants' levels of depression, anxiety, and PTSD symptoms (i.e., intrusive thoughts, avoidant behavior, hyperarousal), and their levels of social adjustment (i.e., self-image, family, appearance, sexuality). The resilient class had the best outcome eight months after surgery, and six years later the resilient class still showed the best outcome with fewer depressive and PTSD symptoms, less anxiety, and greater social adjustment when compared to the chronic class. The chronic class exhibited high levels of psychological distress eight months after their surgery, and the same pattern continued six years later. Resiliency is not a short-term response to a PTE, but a long-term outcome. Early positive adjustment appears to facilitate long-term adjustment.

Helgeson, Snyder, and Seltman (2004) followed 287 breast cancer survivors for five-years with over 90% completing all follow-up assessments. The authors analyzed

the data using a technique similar to LGMM called TRAJ. Instead of using a measure of PTSD or depression to create the latent classes, the authors used the participants' mental health (MCS) and physical health (PCS) composite scores derived from the SF-36, a measure of health-related quality of life. The results produced four pathways for the MSC and PHC data. The extracted classes differed from Bonanno's four prototypical pathways. From the scores on the MSC and PHC, the resilient and recovering classes were produced, but the data did not produce a chronic or delayed class. They were replaced by a deterioration and a stable class. The scores for the deterioration class decreased progressively over time without leveling off. The scores for the stable class were at an intermediate level of mental and physical health across all assessment occasions. Even though Bonanno's process model may represent prototypical pathways of adjustment there is enormous variability in adjusting to a PTE. It is likely there are more than four pathways of recovery from a PTE. Yet, the crux of Bonanno's process model remains true; resiliency is common and represents how a majority of people respond to an out-of-the-ordinary event with the potential to cause harm (Bonanno et al., 2011).

Traumatic experiences. Being a prisoner of war or imprisoned because of political beliefs is another type PTE that people experience, unfortunately. For example, during the existence of East Germany people lived through imprisonment while suffering physical and psychological torture. Maercker and colleagues interviewed 86 former East Germany prisoners about their previous and current psychiatric symptoms 24 years after recovering their freedom and then re-interviewed the participants 14 years

later. The aims of the study were to retrospectively assess whether the former prisoners met criteria for PTSD upon their release, assess for current symptoms of PTSD, and replicate Bonanno's prototypical classes of adjustment.

The authors reproduced Bonanno's four classes of adjustment across the three assessment points using latent class growth modeling. The percentage for the resilient group did not coincide with previous research (Bonanno et al., 2011). The resilient class, which is usually the largest group, only made up 26% of the sample. The chronic class had the largest percentage of participants at 36% of the sample. The recovering class and the delayed classes constituted 25% and 11% of the sample, respectively. The former prisoners' endured on average three years of imprisonment and reported experiences of physical and psychological abuse. In the face of such adversity, a quarter of the survivors still displayed resiliency decades after the event.

When examining variables that predicted class membership, the prisoners that sought out treatment were almost three times more likely to be in the chronic class compared to the resilient class. In this study, seeking help was associated with a more traumatic recovery process. As an adaptive strategy or "coping ugly," the resilient class avoided talking about their trauma, which is counter to current theories of recovery from a PTE (Brewin, Dalgleish, & Joseph, 1996). This study also showed that some people may never fully recover from a PTE and that people with low levels of distress generally maintain those levels of functioning over time (Pollard & Kennedy, 2007).

Law enforcement is a career that places individuals in positions to experience a PTE. Being a police officer is portrayed as one of the most stressful jobs (Miller, 2000).

Galatzer-Levy et al. (2013) followed 285 police officers from officer training through their first 48 months of active duty. The authors assessed the officers once every year. The results of a latent class growth analysis using the Global Severity Index of the Symptoms Checklist-90 revealed a four-class model that differed from Bonanno et al.'s (2011) process model. The participants knew there was a better than average chance they would experience a PTE, and after 48 months, 91% of officers reported experiencing a life-threatening event. On average, the police officers experienced 12 life-threatening situations in their first 48 months of active duty. Of those experiencing a PTE, 97% met Criterion A for PTSD (American Psychiatric Association, 2013).

Three out of the four pathways differed from Bonanno's prototypical classes. The only class that represented a pathway previously described by Bonanno was a stable low distress class that made up 75% of the sample. In a sample in which participants faced both discrete and chronic PTEs, the modal response to these PTEs was low levels of distress. According to the authors, the resilient class displayed an ability to adapt to the stresses of being a police officer. As the process model indicates, resiliency is more than the absence of negative symptoms. This study suggests that psychological flexibility promotes resiliency (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004).

In a longitudinal study investigating the effects of deployment on US military personnel, 7,787 soldiers out of a larger sample were assessed to uncover the levels of PTSD of personnel deployed once versus those deployed multiple times (Bonanno et al., 2012b). The participants were enrolled in the Millennium Cohort Study. The first assessment took place before deployment and then approximately three and six years

after their pre-deployment assessment. The results revealed two different sets of pathways. In the group deployed once there was a resilient class (83%), a chronic class (2%), a recovering class (8%) and a chronic-worsening class (7%). The chronic-worsening class showed increasing levels of PTSD over time. In the group deployed multiple times there was a resilient class (85%), a recovering class (8%), a chronic-worsening class (4%) and a high distress-improving class (3%). The high distress-improving class exhibited high levels of PTSD during pre-deployment, but exhibited a steady decline at the second and third follow-up assessment.

Most soldiers responded to the stresses of war in a resilient manner. Among those deployed a single time, the resilient soldiers consumed significantly less alcohol and had less combat exposure than the other classes. Among those deployed multiple times, the resilient soldiers also had significantly less combat exposure. In this sample as a whole, greater combat exposure increased the odds of soldiers experiencing PTSD symptoms and having a non-resilient outcome. In a military sample, where exposure to a PTE is expected, the overwhelming majority of soldiers demonstrated resiliency.

In an attempt to test the limits of Bonanno's model of adjustments, survivors of sexual assault were assessed (Steenkamp, Dickstein, Salters-Pedneault, Hofmann, & Litz, 2012). One hundred nineteen women rated their levels of PTSD symptoms at one, two, three, and four months following a sexual assault via online surveys.

The results of the latent class growth modeling analysis did not replicate Bonanno's process model. The authors found a stable, chronically high distress group (7%) and a stable, moderately high distress group (16%). They also found a moderate

recovery group (48%), in which the participants had moderately high levels of distress that decreased over time, but their levels of distress remained in the clinically significant range. The only class that represented one of the four prototypical classes described by Bonanno et al. (2011) was a recovering class (29%), in which the participants initially reported clinically significant levels of PTSD, but reported subclinical levels at the four-month follow-up.

There was no resilient group in this sample, but this study was limited by only observing the participants during the first four months following a PTE and using a self-selected sample. It is unclear what the pathways would look like if the authors studied the participants for one or two years. Moreover, sample bias could have altered the results in which women with low distress decided not to participate. This was the first study to investigate the applicability of Bonanno's process model to victims of sexual assault. The nature of sexual assault may be so traumatizing that the normal response is to experience clinically significant levels of psychological distress even if it is temporary (Steenkamp et al., 2012).

In summary, resiliency has been examined in a number of clinical scenarios including the death of a loved one, spinal cord injuries, cancer, interpersonal violence, and traumatic accidents. Multiple methods were used to examine reactions to a traumatic event including inspection of means and sophisticated latent growth modeling techniques. Of these methods, LGM provided the most specificity in terms of individual responses to a PTE. The literature indicated there are multiple ways in which people respond or adjust to a PTE that extends beyond those identified by Bonanno et al.

(2011). As researchers continue to investigate responses to trauma, additional clinically relevant classes of adjustment are being discovered (e.g., chronic-worsening, stable moderate distress).

The results of these studies make it clear that adjustment to a PTE is a heterogeneous process. Although several studies failed to replicate Bonanno's model, the core aspects of his process model remains intact: resiliency is common, resiliency is different from the recovering pathway, and resiliency is not a temporary state, but a true response. Individuals classified as resilient are not immune to the effects of a PTE; they report symptoms of distress, just at low levels. They seem to possess more protective factors than risk factors, which helps them minimize the negative effects of a PTE. Individuals that respond to a PTE with high levels of psychological distress are individuals that have protective factors that are unable to compensate for their risk factors. Moreover, researchers and professional treating survivors need to have a better understanding of what allows a person to flexible adjust to a PTE and need to understand what prevents or stalls the recovery process. In the next section, potential risk and protective factors are discussed.

Risk and protective factors. Individuals characterized as resilient possess sets of risk and protective factor in which the protective factors outweigh the risk factors to help them to maintain their equilibrium in the aftermath of a PTE (Bonanno & Mancini, 2010). Research on adjustment following a PTE has examined a wide variety of variables to elucidate which variables convey potential risks of recovering slowly or having a delayed or chronic reaction and which variables provide passage towards a

resilient reaction. When there is a better understanding of these risk and protective factors, screeners and protocols can be developed to identify those at risk for a non-resilient outcome and identify those who should be left alone to recover on their own. Although limited, researchers have identified age, gender, ethnicity, education, etiology (non-intentional vs. intentional), injury severity, pain, and psychological well-being as potential risk and protective factors in the battle to preserve set point level of psychological functioning (Bonanno et al., 2011). However, previous research has omitted mild TBI status as a potential risk or protective factor despite the likelihood of sustaining a TBI following a PTE. One of the goals of the current study was to explore which variables predict class membership using a measure of PTSD and depression. Research on different risk and protective factors is discussed below. See Table 1 for predicted direction of influence.

Traumatic brain injuries are a significant health problem in the U.S. There are about 500,000 hospital visits each year related to TBI with up to 75% being cases of mild TBI (Faul et al., 2010), but the effects are not mild (Gerberding & Binder, 2003). Symptoms of mild TBI include memory problems, social impairment, emotion dysregulation, executive dysfunction, and inability to return to work (Stein & Mcallister, 2009). Symptoms associated with mild TBI generally decrease and disappear within 3 months of the injury, but a subset (up to 30%) of individuals will experience persistent symptoms (Lamberty, Nelson, & Yamada, 2013). Unfortunately, the information on the natural history of TBI is incomplete because researchers have conducted few longitudinal studies investigating how TBI affects pathways of adjustment following a PTE. Another reason why it is important to consider the impact of mild TBI on recovery from a PTE is the strong relationship between mild TBI and psychiatric conditions such as depression and PTSD (Iverson, 2012; Vasterling, Bryant, & Keane, 2012).

Table 1
Predicted Direction of Risk and Protective Factors

Variable	Role: Risk or Protective Factor for a Resilient Outcome
Mild TBI	Mild TBI is a risk factor for a non-resilient outcome.
Age	Unknown.
Gender	Male gender is a protective factor for a resilient outcome; female gender is a risk factor for a non-resilient outcome.
Race/ethnicity	Unknown.
Education	Higher education (some college or more) is a protective factor for a resilient outcome; lower education (high school or less) is risk factor for a non-resilient outcome.
Etiology	Intention injuries are a risk factor for a non-resilient outcome.
Injury severity	High injury severity is a risk factor for non-resilient outcome.
Pain interference	Greater pain interference (lower pain interference score) is a risk factor for a non-resilient outcome; less pain interference (higher pain interference score) is a protective factor for a resilient outcome.
Psychology well-being	Lower psychological well-being is a risk for a non-resilient outcome; higher psychological wellbeing is a protective factor for a resilient outcome.

Note. TBI = traumatic brain injury; injury severity = Injury Severity Scale; pain interference = Veterans Rand Health Survey item 5; psychological well-being = Veterans Rand Health Survey items 6a and 6c

In veterans who served in Iraq and Afghanistan, those with a probable mild TBI reported higher levels of PTSD symptoms than those without a history of mild TBI (Holland, Lisman, & Currier, 2013). Veterans with comorbid mild TBI and PTSD also had higher levels of PTSD, depression, post concussive symptoms, and a poorer quality of life than veterans with either mild TBI or PTSD (Polusny, Kehle, Nelson, Erbes, Arbisi et al., 2011). In addition, when compared to individuals recovering from an orthopedic injury, individuals with mild TBI were more anxious, depressed and experienced more post concussive symptoms (McCauley et al., 2013). When compared to individuals with minor injuries, a mild TBI group reported more anxiety, depression, and PTSD symptoms, and poorer mental and physical health (Ponsford, Cameron, Fitzgerald, Grant, & Mikocka-Walus, 2011). In general, mild TBI is associated with more severe psychiatric symptoms compared to those who have not sustained a mild TBI.

Although there are significant negative effects associated with TBI, research shows that a sizeable percent of TBI survivors will experience only transient symptoms (indicative of resiliency; Bigler & Maxwell, 2012). In a longitudinal study, researchers gauged the level of depression in 66 TBI survivors during the first 12 months after sustaining their TBI, and found that only 28 survivors met criteria for major depression across three assessment points (i.e., 3, 6, 12 months post-injury; Jorge, Robinson, Arndt, Starkstein, Forrester et al., 1993). In other words, during the first year of adjusting to a TBI, 58% (n = 38) of survivors reported subclinical levels of depression. Similar results were found in a sample of TBI survivors admitted to a Level 1 trauma center

(Bombardier et al., 2010). These authors followed 559 survivors, collecting data on depression, anxiety, and quality of life nine times over the first year post-injury. Forty-seven percent of the sample reported low levels of distress after incurring a TBI (indicative of resiliency). Moreover, the TBI survivors with low levels of distress were less likely to experience high levels of anxiety and more likely to experience greater life satisfaction.

To date, no study has attempted to produce the four pathways of adjustment in a sample of people recovering from a TBI. The closest researchers have come is assessing the caregivers of people suffering a TBI. In an innovative study, investigators attempted to reproduce Bonanno's prototypical pathways among 135 caregivers of individuals living with a severe TBI (Pielmaier, Milek, Nussbeck, Walder, & Maercker, 2013). Assessment of the caregivers occurred during their first year of being a caregiver (i.e., 3, 6, 12 months). The caregivers rated their levels of PTSD symptoms using the Impact Event Scale-Revised (IES-R).

The authors used LGMM to analyze the three subscales of the IES-R (i.e., intrusive thoughts, avoidant behaviors, hyperarousal). Bonanno's four-class model was not replicated. A two-class solution was the best fit for the data. The longitudinal data from the intrusive thoughts, avoidant behaviors, and hyperarousal subscales showed that 70, 87 and 92% of the sample, respectively, displayed a resilient pathway. In the first year of being a caregiver for a person with a severe TBI, the majority of caregivers experienced subclinical levels of PTSD symptoms and maintained their normal levels of functioning. Research needs to explore how the individuals with TBI adjust.

Although there is evidence indicating that mild TBI exacerbates other conditions, there is data showing that PTSD may be a more important variable than mild TBI in adjustment to a PTE. Polusny et al. (2011) reported that individuals with comorbid PTSD and mild TBI were the most distress, but the differences between the comorbid group and a control group were no longer significant when PTSD symptoms were controlled. It is not clear how important a factor TBI is in the process of adjusting to a PTE because of the limited longitudinal research. Given the relationship between mild TBI and psychiatric conditions, mild TBI is viewed as a risk factor for a non-resilient outcome.

In general, male gender predicts low distress more often than female gender (Bonanno & Mancini, 2008; Bonanno et al., 2011; Bonanno et al., 2006). In addition, the probability of women experiencing PTSD or acute distress symptoms after a PTE is greater than men (Breslau et al., 1991). In an urban environment, women following a PTE were more than two times as likely to develop PTSD and depression as compared to men (Ghofoori, Barragan, & Palinkas, 2013). For example, researchers conducted a national phone survey after the 9/11 terrorist attacks and after controlling for variables like exposure and distance from the attacks, women were one and a half times more likely to experience high acute stress when compared to men (Silver, Poulin, Holman, McIntosh, Gilrivas, & Pizarro, 2004). In two studies detailing adjustment following the 9/11 terrorist attacks, women were half as likely to be in the resilient group compared to men (Bonanno et al., 2006; Bonanno et al., 2007).

Although the research indicates that women are more susceptible to PTSD and are less likely to exhibit resiliency, there are studies that do not show gender differences (Galatzer-Levy et al., 2013). For example, Zatzick et al. (2007) in a nationwide study looking at the risk of developing PTSD found that the rates of PTSD did not differ between men and women. Moreover, in a sample of 60 participants rehabbing a SCI, the resilient group did not differ by gender (Kilic, Dorstyn, & Guiver, 2013). Among surgical patients, gender did not predict PTSD symptoms at a one-year follow-up (Myhren et al., 2010). Even though the literature is mixed, a greater percentage of men will exhibit low levels of psychological distress following a PTE (Brewin, Andrews, & Valentine, 2000). Male gender is a protective factor for a resilient outcome.

Education is a consistently used demographic variable in studies investigating how people respond to a PTE. The results are also inconsistent. Generally, there is a trend, where higher education is associated with a better outcome following a PTE (Bonanno & Mancini, 2008; Bonanno et al., 2010; Bonanno, 2004). However, some studies found that higher education did not predict less psychology distress (Lam et al., 2010; Powers et al., 2014). What is consistent is that when education significantly predicts outcome, higher education was associated with less psychological distress. For example, deRoon-Cassini et al. (2010) found that PTE survivors with less education were more likely to experience a non-resilient outcome. Following a physical injury, individuals with less education had higher levels of psychological distress (Skogstad et al., 2012). Among individuals recovering from a SCI, greater levels of mental health was associated with higher levels of education (van Leeuwen et al., 2012).

In first responders to the 9/11 terrorist attacks, education was a protective factor against PTSD (Pietrzak et al., 2013). Moreover, witnesses to the 9/11 terrorist attacks with higher education experienced fewer symptoms of PTSD and less distress (Silver et al., 2004). The resilient class was also more likely to have individuals with at least some college experience than the non-resilient classes (Quale & Schanke, 2010). Soldiers with a high school education or less were more like to experience high levels of psychological distress following a PTE (Bonanno et al., 2012). As participant's education increased, the probability of being in the resilient class increased (Agaibi & Wilson, 2005; Brewin et al., 2000). Although there are mixed results, greater education is a protective factor against the destructive effects of a PTE.

The etiology or cause of a PTE is an important variable. When a PTE is intentionally caused, the victim experiences greater distress. For example, the resilient class was absent from a study of a sexual assault survivors (Steenkamp et al., 2012). Intentional injuries were also associated with the chronic class (deRoon-Cassini et al., 2010) and placed the victims at a greater risk of developing PTSD (Zatzick, et al., 2007). In a systematic review of longitudinal studies tracking the prevalence and pathways of PTSD between 1998 and 2010, intentionally caused injuries showed an increase and non-intentional injuries showed a decline in rates of PTSD (Santiago, Ursano, Gray, Pynoos, Spiegel et al., 2013). However, the authors recognized that other variables like severity of injury, idiosyncratic variables, and social support played a role in recovery. For example, in a longitudinal study, researchers showed that being a victim of physical violence (e.g., aggravated assault), having low self-efficacy, and low levels of social

support were predictive of higher levels of PTSD (Johansen, Wahl, Eilertsen, & Weisaeth, 2007).

In general, intentional injuries cause more harm and produce a worse outcome compared to non-intentional injuries. However, this literature is incomplete because those who suffer an intentional PTE (e.g., assault, gunshot wound, stabbing) are less likely to participate in research (Joy et al., 2000). In addition, the number of individuals experiencing an intentional PTE is often too small for comparisons (Skogstad et al., 2012). An intentionally caused PTE is a risk factor for having a suboptimal outcome following a PTE.

Injury severity is another variable where the literature is mixed on its ability to predict distress. For example, injury severity did not predict depression (Krause, Kemp, & Coker, 2000), psychological well-being (deRoon-Cassini, Aubin, Valvano, Hastings, & Horn, 2009), or functional health (Vassend, Quale, Røise & Schanke, 2011) with individuals adjusting to a SCI or multiple traumas. With people recovering from an assault, injury severity had a non-significant relationship with quality of life (Johansen, Wahl, Eilertsen, Weisaeth, & Hanestad, 2007). In individuals recovering from a TBI, injury severity was not predictive of community reintegration or level of disability (Novack, Bush, Methaler, & Canupp, 2001). In patients admitted to a Level 1 trauma center, injury severity did not differentiate between those with and without PTSD (Warren et al., 2014) or depression (Bombardier et al., 2010).

On the other hand, research also shows that injury severity is predictive of psychological distress. For example, in a study investigating acute physical injuries, in

which injury severity ranged from minor to critical injuries, greater injury severity predicted psychological distress. More specifically, participants with severe injuries were at least two and a half times more likely to experience depressive symptoms one year after their PTE. In a sample that experienced orthopedic traumas, greater levels of injury severity were predictive of a slower recovery time (Clay, Devlin, & Kerr, 2013). When a sample of severely injured individuals was divided into the four prototypical classes (i.e., resilient, chronic, delayed, recovering), the resilient class had the lowest injury severity levels, but the differences were not statistically significant (Quale & Schanke, 2010).

Injury severity does not always have to be high in order to predict negative outcomes. Joy et al. (2000) showed that less severe injuries were associated with psychological distress in the form of anxiety, depression, and PTSD. Although there is evidence on both sides of the argument, greater levels of injury severity are a risk factor for experiencing a non-resilient outcome.

Pain is another variable used by researcher to better understand how people adjust to a PTE (Baranyi, Leithgob, Kreiner, Tanzer, Ehrlich et al., 2007). In individuals recovering from whiplash, greater levels of pain were associated with more severe PTSD symptoms (Sullivan, Thibault, Simmonds, Milioto, Cantin et al., 2009). In individuals with multiple physical injuries, levels of pain differentiated the low distress from the high distress group (Quale & Schanke, 2010), and greater levels of pain differentiated those with and without PTSD (Soberg et al., 2010). Among patients admitted to an intensive care unit, pain at three months post-discharge was predictive of anxiety and

depression nine months later (Toien et al., 2010). Karoly and Ruehlman (2006), in a national sample, formed two groups of individuals suffering from chronic pain in which one group was identified as a resilient group and the other group was identified as a distressed group. Both groups experienced high levels of pain, but the resilient group did not let the pain interfere with their lives or burden them. The distressed group, on the other hand, described their pain as burdensome and interfering with their lives. The results also showed that the resilient group had greater adaptive coping abilities and a better attitude about their pain. Both groups experienced a similar amount of pain, but the resilient group had protective factors to help them manage their pain. Greater pain is a risk factor for a non-resilient outcome.

The constructs of psychological well-being, life satisfaction, or quality of life revolves around how people evaluate their lives. Psychological well-being is a multifaceted and complex construct and is measured in a variety of ways. Psychological well-being can be measured as the outcome, where the actions of a person such as working on goals, hobbies, completing a challenging task causes higher level of psychological well-being. On the other hand, psychological well-being can be viewed as a dynamic system that helps produce a positive mental framework that allows individuals to withstand the hostility of the world with minimal disruptions to their lives (Shomotkin, 2005). However viewed, greater levels of psychological well-being are a protective factor for resiliency (Diener & Ryan, 2009).

Mancini, Bonanno, and Clark (2011) using a single question to measure psychological well-being were able to identify different classes of adjustment following

the death of a loved one, divorce, or marriage. Participants were followed for four years prior to and four years following the death of a loved one, divorce, or marriage. The levels of psychological well-being for 60% of the sample that lost a loved one remained stable. Among participants that divorced, 72% reported stable levels of psychological well-being. For participants who got married, which was a happy experience, 80% reported that their levels of psychological well-being remained stable. In the first four years following each life event, the majority of participants reported stable levels psychological well-being.

Other studies show the regulating effects of psychological well-being. In a sample recovering from a TBI, low psychological well-being was related to major depression above and beyond other predictors of major depression (Bombardier, 2010). Participants in a rehabilitation facility for spinal cord injuries reported a positive correlation between psychological well-being and resiliency and a negative correlation between psychological well-being and depression (White, Driver, & Warren, 2010). When examining psychological well-being longitudinally with people who survived multiple physical traumas, higher psychological well-being was related to fewer PTSD symptoms one and two years post-injury (Soberg et al., 2010). Among military personnel exposed to a single PTE, there was an inverse relationship between psychological well-being and PTSD over the first year (Johnsen, Eid, Laberg, & Thayer, 2002). Evan after the 9/11 terrorist attacks, resilient individuals reported higher psychological well-being than non-resilient individuals; however, this relationship was mediated by positive emotions (Fredrickson, Tugade, Waugh, & Larkin, 2003). In all,

low levels of psychological well-being convey a risk of developing potentially debilitating psychiatric conditions whether in the first few months post-injury or years later. Higher psychological well-being is protective factor for a resilient outcome.

Age is a variable used by researchers to understand how people adjust to a PTE. Yet, the literature is mixed on whether age is an important factor to consider when recovering from a PTE and whether older or younger age is predictive of a better outcome (Brewin et al., 2000). Some studies showed age as a non-significant predictor of anxiety (McCauley et al., 2013; Skogstad, et al., 2012), PTSD (Myhren et al., 2010; Joy, Probert, Bisson, & Sheperd, 2000; Skogstad et al., 2012), general distress (Galatzer-Levy et al., 2013; van Leeuwen et al., 2012), and depression (Galatzer-Levy & Bonanno, 2012).

However, in other studies age predicted PTSD (Powers, Warren, Rosenfield, Foreman, Bennett et al., 2014; Silver et al., 2004; Warren et al., 2014) and positive outcomes following a PTE (Bombardier et al., 2010). In responders to the 9/11 terrorist attacks, older age was a significant predictor of the non-resilient classes (Pietrzak et al., 2013). In a study of military service members deployed multiple times, younger age was predictive of the non-resilient classes (Bonanno et al., 2012b). With women recovering from breast cancer, younger age was predictive of the resilient class (Helgeson, et al., 2004). Through a phone survey approximately 6 months after the 9/11 terrorist attacks, Bonanno and colleagues found that older age was predictive of the resilient class (Bonanno et al., 2007). The results of these studies are confusing because depending on the sample and type of PTE, the effects of age vacillated.

The inconsistent results may be due to the fact that adjustment following a PTE is multifaceted, where age, in addition to other factors, influence adjustment including, previous experience with PTEs, premorbid psychiatric conditions, substance use, employment status, and whether the PTE event was acute and time limited like the 9/11 terrorist attacks or protracted like recovering from breast cancer (Bonanno et al., 2011). It is clear that age is an important variable, but its importance may come from how it interacts with other variables. If age predicts class membership it is unclear if older or younger age will facilitate a better outcome. The role of age will be explored.

The influence of race/ethnicity is not well understood in the resiliency literature. The research on race/ethnicity is limited because the majority of participants are European-American (Bonanno et al., 2005; deRoon-Cassini et al., 2010). The current research on race/ethnicity as a variable that predicts class membership is mixed. For example, in one study European-Americans were more likely to be in the resilient class than other ethnic groups (Bonanno et al., 2006).

Yet, in another study, Asian-Americans were two times more likely to exhibit resiliency compared to European-Americans and other ethnic groups (Bonanno et al., 2007). For patients recovering from a SCI, ethnic minorities were more prone to depression compared to European-Americans. In a meta-analysis, minority status was a risk factor for developing PTSD (Brewin et al., 2000). Studies also found that race/ethnicity did not predict class membership (Pietrzak & Southwick, 2011).

Given these mixed results, it is important to be cautious when making interpretation about the relative influence of an individual's race/ethnicity on adjustment

to a PTE because race/ethnicity is often confounded with socioeconomics, education and/or income (Bonanno et al., 2010). Given the research in this area, it is unknown whether race/ethnicity is a protective or risk factor or neither. The role of race/ethnicity will be explored.

There are several conclusions drawn from this review of risk and protective factors related to adjustments to a PTE. First, this research is still in an early stage. Limited research has been completed on mild TBI and Bonanno et al.'s (2011) process model. There are few variables that have overwhelming support in one particular direction. It is clear that these variables at different levels can be a risk or a protective factor. For example, low levels psychological well-being is risk factor for poor adjustment, whereas high levels of psychological well-being is a protective factor and is an aid in the process of adjusting to a PTE.

The review also indicates that it is unknown the direction of influence for age and race/ethnicity. Research to date suggests that male gender, higher education, higher psychological well-being, less pain, and less severe injuries, will be predictive of the resilient class. In addition, research suggests that mild TBI, female gender, lower education, lower psychological well-being, greater levels of pain, more severe injuries, and intentionally caused injuries will be predictive of a non-resilient class. As the research knowledge increases, we will be able to isolate the most important variables in predicting who will be resilient in the face of adversity, who will show early signs of psychopathology, but then recover, and who will need professional help in order to regain control of their lives. This research is important. Once we are able to reliably

predict who will and will not need help recovering from a PTE we will be able to apply that knowledge to help reduce the psychological distress people experience.

CHAPTER III

METHOD

Overview

This chapter provides descriptions of the data collection procedures, statistical analysis and measures used in this study. The data used in this study are a part of a larger project. Data were collected during four separate occasions (i.e., during hospitalization, 3, 6, and 12 months post-discharge). To analyze the data, LGMM will be employed. The aim is to reproduce the four prototypical classes of adjustment (i.e., resilient, chronic, recovering, delayed) described by deRoon-Cassini et al. (2010) and others. LGMM will be employed on a measure of PTSD and depression to reproduce the prototypical classes. The PTSD and depression scores are the indicator variables. They are the variables that will determine which classes are produced. In addition, multinomial logistic regressions will be conducted to investigate whether covariates (e.g., demographics, substance use, health related quality of life, or TBI status) predict class membership (e.g., resilient, chronic, recovering, and delayed).

Procedures

This study utilized data collected from the Baylor Trauma Outcome Project: Phase I. The data are available through a data sharing agreement with the Baylor Research Institute in Dallas, Texas, and Texas A&M University. This study was approved by the Institutional Review Board (IRB) of Texas A&M University and the Baylor Research Institute. The data are collected from individuals admitted to the Level 1 Trauma Center at the Baylor University Medical Center (BUMC), in Dallas, Texas.

Patients who entered the medical center and were admitted to the Trauma and/or Ortho-Trauma Services were approached about participating in the study.

Inclusion criteria were: 1) the patient was admitted to the trauma services within 24 hours of sustaining their injury; 2) the patient was 18 years or older; 3) the patient was able to provide at least one telephone number to be used for follow-up assessments at three, six, and 12 months. Exclusion criteria were: 1) patient experienced a traumatic brain injury and/or had existing cognitive deficits that precluded them from giving informed consent and 2) patient was unable to understand spoken English or Spanish.

Potential participants were located through the Trauma and Ortho-Trauma Services admission records and through bi-weekly rounds. The research team attempted to enroll each patient that met inclusion criteria. Patients were first approached about the study when they were medically stable. The research team informed the patient about the aim of the study, the requirement of completing questionnaires while hospitalized and then at three, six, and 12 months post-discharge. Invitations to participate were sent to interested patient who were provided and signed an informed consent form. A total of 479 individuals met criteria and consented to participate in the study.

The first assessment period occurred while the patients were still hospitalized. It included questionnaires on health related quality of life, depression, PTSD, and pain. Demographic variables (i.e., age at injury, gender, ethnicity, educational level, income) and injury-related variables (i.e., injury severity, etiology of injury, mild TBI) were obtained through the trauma services admission records.

Participants were contacted via telephone to complete the follow-up assessments. For participants with an email address or a physical address, a reminder email or letter was sent about the upcoming assessment date. The research team attempted to contact participants during a four-week window around the assessment dates. For example, beginning two weeks before and continuing two weeks after the three-month assessment date, attempts were made to contact participants. When a participant was contacted, they were reminded about informed consent and were read an IRB-approved script.

During follow-up assessments, the questionnaires were read to the participants and a clinical research assistant recorded the participant's responses. Participants were assessed using the same measures. The completed measures were maintained in the study chart assigned to the participant. An Excel spreadsheet was created to manage the quantitative data and the demographic and injury variables.

Participants

Of the 479 individuals that consented to participate, 406 (84.34 % response rate) completed the assessment battery while hospitalized, 288 (60.13 % response rate) completed the assessment battery at three months post-discharge, 213 (44.47 % response rate) completed the assessment battery at six months post-discharge and 160 (33.40 % response rate) completed the assessment battery at 12 months post-discharge. Even though the response rates at six and 12 months post-discharge were lower in the current study, the response rates were comparable to other published studies investigating responses to a PTE (deRoon-Cassini et al., 2010). The dropout rate between the first and

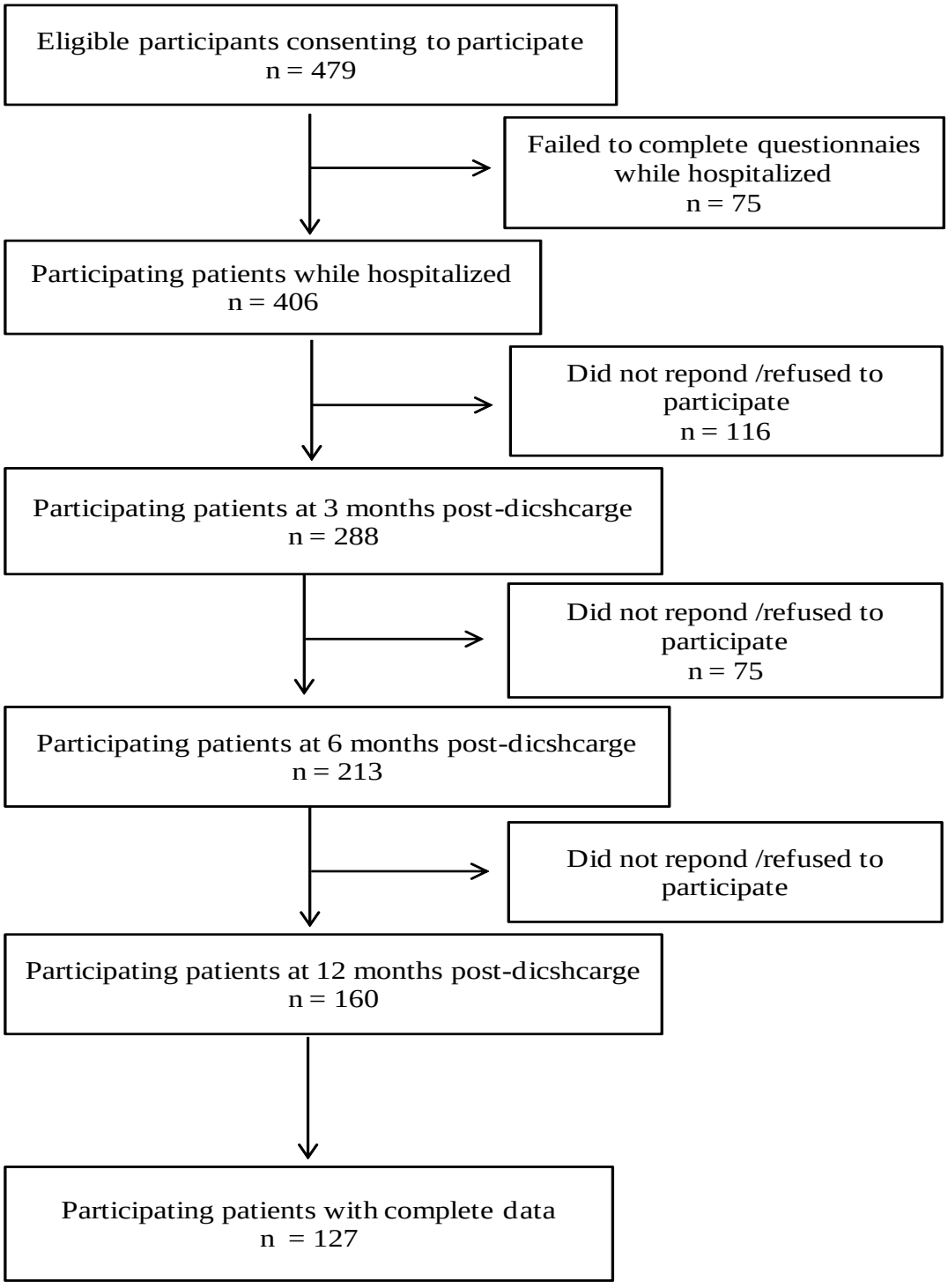

Figure 1. Flow chart of patient inclusion.

second, the second and third, and the third and fourth follow-up assessments were 24, 16, and 11%, respectively. See figure 1 for patient flow data.

The mean age of the sample was 43.31 (*SD* = 16.81). The ages of the sample ranged between 18 and 92 years old. The majority of the sample was male (62.28%) and European-American (63.23 %). Twenty-three percent of the sample was African-American, all other groups (i.e., American Indian or Alaska Native, Asian, Native Hawaiian or unobtainable) accounted for 7.26% of the sample, and about one percent of the sample had missing data on this variable. Twenty-three percent of the sample did not graduate high school, 37.26% had a high school diploma and 38.29% had at least some college education. The majority of the participants were injured by a motor vehicle or motorcycle accident (33.17%). Other causes of injury included fall (24.80%), gunshot wound (9.89%), pedestrian struck by car (5.85%), aggravated assault (5.58%), other (3.10%), animal attack (2.46%), stab (2.18%), machine accident (1.87%), bicycle accident (1.19%), and dive accident (0.29%). Fourteen percent of the injuries were identified as intentional (e.g., aggravated assault), 58.80% of the injuries were identified as non-intentional (e.g., car accident), and 36.72% met criteria for a mild TBI.

Measures

The measures used in this study are part of the larger Baylor Trauma Outcome Project. Only the measures relevant to the current study will be described. Due to the complexity of the analyses in the current study, measures were subdivided as indicator variables or covariates. Unless stated otherwise, measures were administered during each assessment point (i.e., while hospitalized, 3, 6, 12 months).

Indicator variables. The indicator variables were the variables used to create the latent classes in the LGMM.

Primary care posttraumatic stress disorder screen (PC-PTSD; Prins et al., 2003). The PC-PTSD is a four-item screener designed to detect the presence or absence of PTSD in a primary care setting. This is the first PTSD screener developed within a primary care setting. The instructions of the PC-PTSD asks respondents, "in your life, have you ever had any experience that was so frightening, horrible, or upsetting that, in the past month, you …," for example, "had nightmares about it or thought about it when you did not want to?" The response options utilize a yes or no response format. The PC-PTSD is psychometrically sound in identifying possible cases of PTSD (Prins et al., 2003). In a sample from a Veteran Administration Hospital, the PC-PTSD showed greater specificity (87%), sensitivity (78%), and efficiency (85%) than the PTSD checklist (79%, 46%, 71%, respectively) another valid PTSD screener (Prins et al., 2003). Furthermore, when the PC-PTSD was compared to the gold standard for diagnosing PTSD, the Clinician Administered Scale for PTSD, there was a 69% percent overlap in variance. Within a primary care setting, the PC-PTSD was the most effective screener in terms of specificity (82%), sensitivity (85%), efficiency (84%), and brevity (Freedy, Steenkamp, Magruder, Yeager, Zoller et al., 2010).

The test-retest reliability of the PC-PTSD was excellent (r = .83; Prins et al., 2003). In a Level 1 trauma center, the PC-PTSD was compared to the PTSD checklist and both identified a similar number of possible PTSD cases (17.22% vs. 16.10%; Hanley, deRoon-Cassini, & Brasel, 2013). The PC-PTSD has also been used as a

screening tool in a longitudinal study promoting early detection of PTSD (Milliken, Auchterlonie, & Hoge, 2007).

In the current study, the Cronbach alpha coefficient for the PC-PTSD was .77 at hospitalization, .76 at three months post-discharge, .78 at six months post-discharge, and .75 at 12 months post-discharge. A cutoff score of three indicates a case of probable PTSD. The test-retest reliability ranged from 26.73 % to 61.15% (*p*'s < .05). The skewness and kurtosis were within the acceptable range of values (-2 to +2), however, the Kolmogorov-Smirnov test of normality at each assessment was not normally distributed.

Patient health questionnaire-8 (PHQ-8; Kroenke, Strine, Spitzer, Williams, Berry et al., 2009). The PHQ-8 is the shorten version of Patient Health Questionnaire-9 (PHQ-9). Both measures are brief, self-report screeners for major depression. The PHQ-8 measures eight of the nine symptoms of major depression as outlined in the DSM-V and it provides a provisional diagnosis for a major depressive disorder. The item about self-harm or suicide is omitted because in a general population it is the least endorsed item and researchers would not be able to provide adequate support via telephone if participants endorsed this item (Kroenke & Spitzer, 2002).

The instructions ask participants, "Over the last 2 weeks, how often have you been bothered by any of the following problems?" The symptoms are rated on a four-point scale from "not at all" to "nearly every day." Higher scores represent a greater number and severity of symptoms. A score of 10 or more indicates a probable diagnosis

of major depression (Kroenke, et al., 2009) and a five-point increase or decrease qualifies as a clinically significant change (Kroenke & Spitzer, 2002).

Using data from the validation studies of the PHQ-9, Kroenke and Spitzer (2002) compared the PHQ-8 to the PHQ-9 and found the two measures were comparable. Furthermore, both measures had equal sensitivity and specificity when using a cutoff point of 10. In a sample with over 198,678 respondents from the Behavioral Risk Factor Surveillance Survey, the PHQ-8 had a sensitivity of 100% and a specificity of 95% for identifying cases of major depressive disorder with a cutoff point of 10 (Kroenke et al., 2009). The test-retest reliability of the PHQ-9 was excellent in participants whose depression status changed (r = .81) and remained the same (r = .96; Löwe, Unutzer, Callahan, Perkins, & Kroenke, 2004). Furthermore, the PHQ-8 was previously used to measure major depression in community (Fann, Bombardier, Dikmen, Esselman, Warms et al., 2005) and SCI samples (Bombardier, Kalpakjian, Graves, Dyer, Tate et al., 2012).

In the current study, the Cronbach alpha coefficient for the PHQ-8 was .85 at hospitalization, .87 at three months post-discharge, .90 at six months post-discharge, and .90 at 12 months post-discharge. The test-retest reliability ranged from 20.61% to 58.83% (p's < .05). The skewness and kurtosis for the items and total scores were within the acceptable range of values (-2 to +2). However, the Kolmogorov-Smirnov test of normality, for each assessment point was not normally distributed.

Covariates. The covariates were the variables used to predict class membership.

Demographics. Demographic information was collected through the trauma services admission records and includes age at injury, gender, ethnicity, income, and

educational level. Each categorical demographic variable was reduced to dichotomous variables. Ethnicity was reduced to European-American and ethnic minorities. Income was reduced to participants making less than $50,000.00 and those making more than $50,000.00 a year. Education level was collapsed into two groups: participants with a high school diploma or less and those with at least some college. The demographic variables were converted to dichotomous variables to facilitate exploration of their predictive ability in a multinomial logistic regression.

Traumatic brain injury status. Classification of mild TBI was based on the International Classifications of Diseases, 9th Edition coding (ICD-9). A participant was considered positive for mild TBI if a review of their medical chart showed ICD-9 codes for mild TBI (e.g., open or closed head injury, with or without loss of consciousness). The codes were obtained through the trauma registry.

Etiology. The cause of the PTE was coded in one of 12 categories (e.g., fall, machine, stab, bicycle, etc.). The 12 categories were then reduced to two indicating whether the cause of the injury was intentional (i.e., stab, gunshot wound, aggravated assault) or unintentional (e.g., motor vehicle collision, diving accident, bicycle accident). This information was collected during admission.

Injury severity. Injury severity was assessed using the Injury Severity Score (ISS; Baker, O'Neil, Haddon, & Long, 1974). The ISS determines the overall level of injury severity for patients with multiple injuries. The calculation of injury severity begins with the Abbreviated Injury Scale (MacKenzie, Shapiro, & Eastham, 1985). The Abbreviated Injury Scale rates the magnitude of injuries in six body regions on a six-

point scale from “minor” to “non-survivable.” After the magnitude of injuries across the body regions are scored, the three highest scoring body regions are squared and summed. The final number represents the ISS. Scores range from zero to 75. A score of 75 is given if any region is rated non-survivable.

The ISS is a popular method for determining injury severity with trauma survivors. (Skogstad et al., 2012). The ISS is an improvement over the Abbreviated Injury Scale because it accounts for a greater percent of the variance between injury severity and outcome variables. For example, the Abbreviated Injury Scale accounted for about 25% of the variance between injury severity and mortality, while the ISS accounted for 49% of the variance (Baker et al., 1974). Independent raters of the ISS also displayed a high level of agreement (MacKenzie et al., 1985). Injury severity was obtained while the participants were hospitalized.

Psychological well-being and pain interference. The participant’s level of psychological well-being and pain was assessed using the Veterans RAND 12-Item Health Survey (VR-12) items on general mental health and pain interference (Kazis, Selim, Rogers, Ren, Lee, et al., 2006). The VR-12 is a well-validated measure of health related quality of life with veterans (Kazis, Miller, Clark, Skinner, Lee, Rogers et al., 1998) and community (Selim, Rogers, Fleishman, Qian, Fincke et al., 2009) samples. The VR-12 is derived from the Short Form-36 Health Survey (Ware & Kosinski, 2001).

Psychological well-being was assessed by asking participants, “How much of the time during the past 4 weeks: Have you felt calm and peaceful?” and “Have you felt downhearted and blue?” Responses were made using a 6-point scale from, “all of the

time" to "none of the time." To assess pain interference, participants were asked, "During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and house work)?" Responses were made using a 5-point scale from, "not at all" to "extremely." Each response on the VR-12 represented a weighted score and a scoring algorithm converted the responses to a scale where the scores ranged between zero and 100. Higher psychological well-being scores reflected higher levels of psychological well-being. Higher pain interference scores indicated that the participant experienced less pain interference. Psychological well-being scores from the initial assessment (i.e., while hospitalized) and at three and six months post-discharge were used in the current study.

The VR-36 was validated in a sample with 9,000 patients from six different Veterans Administration Hospitals and produced an internal consistency that ranged from .80 to .95 (Jones, Kazis, Lee, Roger, Skinner et al., 2001). When compared to the VR-36, the VR-12 reliably accounted for 90% of the variance in the VR-36 albeit with one third of the questions.

The internal consistency for the psychological well-being subscale in the current study was .67 at hospitalization, .74 at three months post-discharge, .80 at six months post-discharge and .74 at 12 months post-discharge. The test-retest reliability for the psychological well-being subscale ranged from 14.14% to 57% (p's < .05). The skewness and kurtosis for the psychological well-being items and total score were within the acceptable range of values (-2 to +2).

Cronbach's alpha was not calculated for pain interference because it contains only one item. The test-retest reliability for the pain interference subscale ranged from 6.15% to 56.85% (*p*'s < .05). The skewness and kurtosis for the pain interference item and total score were within the acceptable range of values (-2 to +2). The Kolmogorov-Smirnov test of normality for the psychological well-being and pain interference subscales were not normally distributed at any of the assessment points.

Statistical analysis

Primary statistical analysis used latent growth mixture modeling to identify latent classes within the longitudinally collected PHQ-8 and PC-PTSD data across two separate analyses. The aim was to determine whether individuals admitted to a Level 1 trauma center were able to reproduce and be classified into the four prototypical latent classes described by Bonanno and colleagues (Bonanno et al., 2011; deRoon-Cassini et al., 2010). Multiple data analytic methods were tested including the one recommended by Ram and Grimm (2009). However, only a random intercept, fixed slope model produced an identifiable model. In this model, the means were allowed to vary and were freely estimated, the residuals (error terms) were uncorrelated and the residual variances were estimated freely. Except for fixing the slope to zero, the model retained the default settings of Mplus because the models produced were not very stable and changing the parameters produced non-identifiable models. To determine the best model fit, the current study utilized the same fit indices used in the deRoon-Cassini et al. (2010) study. We examined the Bayesian information criterion (BIC), the sample-size adjusted Bayesian (SSBIC), the Akaike information criterion (AIC), entropy values, the Lo-

Mendell-Rubin likelihood ratio test (LRT: Lo, Mendell, & Rubin, 2001) and the bootstrapped parametric likelihood ratio test (BLRT; McLachlan & Peel, 2000). The best model fit was determined by theory, parsimony, interpretability, and by a combination of lower values for the information criterion (i.e., BIC, SSBIC, and AIC), higher entropy values, and significant *p* values for the LRT and BLRT.

The analysis was conducted in six steps. First, a simple growth model was estimated (i.e., linear or quadratic), which resulted in the selection of a linear growth model for depression and PTSD data (see Table 2). The quadric models for the depression and PTSD data did not converge. Second, using the linear growth model, five latent growth models were compared containing, one, two, three, four and five latent classes. In the third step, the best model was selected using the selection criteria described above (i.e., fit indices, theory, interpretability). In the fourth step, the model was improved by adding covariates using an iterative process, but only a subset of the covariates were added to the model because having too many or too few covariates negatively affects model convergence (deRoon-Cassini et al., 2010).

Each conditional model (i.e., model with covariates) was compared to the unconditional model (i.e., model without covariates) and the other conditional models. The same selection criteria used to establish the unconditional model were used to determine the best conditional model. During the selection of covariates, attention was paid to improving model fit, while maintaining the highest *n* possible. This was important because several of the covariates contained high levels of missing data and inclusion of those variables (e.g., cause of injury, mild TBI) reduced the sample size by

25% and changed the model. In the fifth step, multinomial logistic regressions were conducted using the covariates included in the conditional model to predict latent class membership. In the sixth step, a second set of multinomial logistic regressions were conducted using the covariates excluded from the conditional model to determine if they predicted class membership. The pseudo-class method was used for the depression data and the R3step method was used for the PTSD data to determine if the covariates not included in the conditional model predicted class membership. The pseudo-class method was used with the depression data because the R3step method produced uninterpretable results.

The latent growth models were estimated in Mplus Version 7 (Muthén & Muthén, 1998-2012) using a linear growth model pooled from 10 imputed data sets, with restricted ranges, 200 random starting values, and 50 final model optimizations. Once an identifiable latent growth model was established, an optimal seed value was used to estimate the model again. Time was coded zero, three, six, and 12 (i.e., when hospitalized, months since injury).

To assess for differences within and between-classes on the indicator variables, IBM SPSS version 22 was used to run Pearson chi-square, mixed-design ANOVA, one-way repeated measures ANOVAs, and one-way ANOVAs (IBM® SPSS® Statistics, Chicago, IL, USA). The Pearson chi-square was used to analyze differences between dichotomous variables. All within and between group analyses were run using the composite data set generated from the ten imputed data sets.

Table 2
Model Fit Statistics for the PHQ-8 and PC-PTSD Linear Growth Models

	PHQ-8	PC-PTSD
Model Fit Statistics	Linear Growth Model	Linear Growth Model
RMSEA	0.09	0.09
CFI	0.96	0.96
TLI	0.95	0.95
SRMR	0.06	0.04

Note. PHQ-8 = Patient Health Questionnaire; PC-PTSD = Primary Care PTSD. RMESA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Residual.

The first step in the analysis of differences within and between class differences was to conduct mixed-design repeated measures ANOVA to determine if there was an overall effect of time and class membership. A 5 x 4 mixed-design ANOVA was run for on the depression data and a 3 x 4 mixed-design ANOVA was run on the PTSD data. As a post hoc analysis, one-way repeated measures ANOVAs were run with each class to isolate within-class differences. One-way ANOVAs were conducted to isolate between class differences. To reduce the chance of a Type 1 error due to multiple comparisons, all post hoc analyses used the Scheffe correction at a $p < .01$ level.

Missing data analysis

The purpose of the missing data analysis was to understand the amount of missing data, the pattern of missing data and finally, the mechanism of the missing data. Four hundred and seventy-nine participants consented to participate in the current study, but 73 participants did not participate. The only data obtained from these 73 participants were their ISS scores. There were no differences in injury severity. These 73 participants were excluded from the study leaving a final sample size of 406.

Out of the 406 participants with data, 127 (31.28%) had complete data for each time point, 88 participants (21.67%) had complete data for 3 time points, 94 participants (23.15%) had complete data for two time points, 97 participants (23.89%) had complete data for one time point. The percentages of missing data were as follows: 15.00% while hospitalized, 22.91% at three months post-discharge, 48.50% at six months post-discharge, and 61.33% at 12 months post-discharge.

When viewing a histogram of the missing data, one clear pattern emerged. Data were missing by occasion. Missing data were dispersed across the different assessment occasions, but it was often the case that participants with missing data had missing data for multiple measures. For example, if responses from the PHQ-8 were missing then responses from the PC-PTSD and the VR-12 pain interference and psychological well-being subscales were also missing.

Although the data set contains missing data, the covariance coverage among the outcome variables (e.g., PC-PTSD, PHQ-8) were above the minimum of .10 and allowed the models to be estimated (Muthén & Muthén, 1998-2012). According to the Little's missing completely at random test, the current data were either missing at random (MAR) or missing not at random (MNAR). Based on logic, amount, and patterns of the missing data (see Table 3), it is assumed that the mechanism of missing data are MAR. That is, the missing data is associated with available data, presumably because of an inability to contact participants for the follow-up assessments. Moreover, the rate of participation is similar to other studies using latent growth techniques (Bonanno et al., 2012; Galatzer-Levy et al., 2013; deRoon-Cassini, 2010). Additionally, the data are assumed to be MAR because estimators claiming to model data MNAR have very strict assumptions that are "untestable … [and] go beyond the missing data mechanism," (Ender, 2011, p. 7) and because MAR model estimators have been promoted over NMAR model estimators (Schafer & Graham, 2002). Intensive follow-up was practiced for non-responders, in which research assistant(s) made 12 attempts to contact

participants per assessment period to reduce the amount of missing data. To correct for the MAR data, a composite data set was used from 10 imputed data sets.

Table 3
Comparison of Participants with Complete and Missing Data on Study Variables

	Complete Data			Incomplete Data				
Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*F*	*p value*
Age at injury	127	49.22	17.66	279	40.62	15.72	24.12	< .001[a]
Injury severity	122	12.47	8.76	268	11.89	8.28	.39	.53[a]
PHQ-8 (T1)	127	6.98	5.93	279	8.21	6.09	3.65	.06[a]
PHQ-8 (T2)	127	6.75	6.02	160	8.71	6.82	6.46	.01[a]
PHQ-8 (T3)	127	6.80	6.45	85	7.68	7.35	.82	.37[a]
PHQ-8 (T4)	127	6.47	6.32	33	8.15	7.63	1.69	.19[a]
PC-PTSD (T1)	127	1.42	1.46	279	1.69	1.52	2.90	.09[a]
PC-PTSD (T2)	127	1.38	1.45	158	1.77	1.53	98.50	< .001[a]
PC-PTSD (T3)	127	1.59	1.53	82	1.63	1.55	303.72	< .001[a]
PC-PTSD (T4)	127	1.49	1.46	30	1.83	1.49	1055.89	< .001[a]
Pain interference (T1)	127	83.27	28.53	277	75.54	33.51	5.07	.02[a]
Pain interference (T2)	127	51.18	31.94	162	45.22	33.03	2.39	.12[a]
Pain interference (T3)	127	57.48	33.53	86	52.62	37.58	.978	.32[a]
Pain interference (T4)	127	59.84	36.21	33	61.36	30.68	.049	.82[a]
Psychological well-being (T1)	127	60.54	17.33	277	57.18	18.53	2.96	.07[a]
Psychological well-being (T2)	127	54.99	19.54	161	47.30	23.19	8.94	.003[a]
Psychological well-being (T3)	127	53.92	20.41	86	50.05	23.93	1.61	.21[a]
	n	%		*n*	%		*Test*	*p* value
TBI status								
Negative for TBI	82	0.65		111	0.62		.27	.63[b]
Positive for TBI	45	0.35		69	0.38			
Gender								
Female	56	0.44		84	0.30		7.56	.01[b]
Male	71	0.56		195	0.70			

Table 3 Continued

	Complete Data		Incomplete Data			
	n	%	*n*	%	*Test*	*p* value
Education level						
High School or less	60	0.50	173	0.69	11.85	< .01 [b]
Some College or more	59	0.50	78	0.31		
Income						
≤ 49k	40	0.40	116	0.62	11.73	< .01 [b]
≥ 50k	61	0.60	71	0.38		
Cause of injury						
Accident	113	0.90	133	0.74	11.00	< .01 [b]
Intentional	13	0.10	47	0.26		
Ethnicity						
Caucasian/White	91	0.76	179	0.68	2.39	.15 [b]
Ethnic minorities	29	0.24	84	0.32		

Note. [a] = One-way ANOVA; [b] = Fisher's exact test. PHQ-8 = Patient Health Questionnaire; PC-PTSD = Primary Care PTSD. Pain interference = Veterans Rand Health Survey item 5; Psychological well-being = Veterans Rand Health Survey items 6a and 6c. TBI = traumatic brain injury; T1= while hospitalized; T2 = three months post-discharge; T3 = six months post-discharge; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation.

CHAPTER IV

RESULTS

Preliminarily analyses

Preliminarily analyses were conducted on the study sample (n = 406) to investigate potential differences between participants with and without missing data. For continuous variables, data were assessed using a one-way ANOVA and for categorical variables (e.g., gender, TBI status), differences were assessed using Fisher's exact test (See Table 3). To calculate Fisher's exact test, categorical variables containing more than two levels (i.e., education, income, ethnicity) were collapsed into binary categories. Two education categories were constructed consisting of participants with a high school education or less and participants with at least some college. Income was split between participants who reported earning less than $50,000.00 and those who reported earning more than $50,000.00. Ethnicity was reduced to two categories: European-Americans and ethnic minorities.

There were multiple significant differences between participants with and without missing data. Several variables were significantly associated with missing data including age, PHQ-8 and PC-PTSD total scores, pain interference scores, psychological well-being scores, gender, education, income, and cause of injury. Results from separate analyses indicated that participants with missing data reported significantly higher PHQ-8 scores at three months post-discharge, mean difference (*MD*) = 1.96, and marginally higher PHQ-8 scores while hospitalized (*MD* = 0.88). Participants with missing data reported significantly higher PC-PTSD scores at three (*MD* = 0.39), six (*MD* = 0.04),

and 12 months post-discharge (*MD* = 0.34) compared to participants with complete data. Thus, individuals with missing data reported significantly higher depression and PTSD scores at two of the four measurement occasions compared to those with complete data.

Participants with missing data reported significantly lower pain interference scores (indicating more pain interference) while hospitalized (*MD* = -7.73) and reported significantly lower psychological well-being scores at three months post-discharge (*MD* = -7.69), and marginally lower psychological well-being scores while hospitalized (*MD* = 3.36) compared to participants with complete data. Participants with missing data were also significantly younger (*MD* = -8.60) than participants with complete data.

There was a significant relationship between missing data and gender. Women were overrepresented among participants with complete data (standardized residuals = 1.84) and men were underrepresented among participants with complete data (standardized residuals = -1.34). However, no single cell(s) accounted for the significance. There was a significant relationship between missing data and education. Participants with a high school diploma or less were underrepresented among participants with complete data (standardized residual = -1.73). However, the significance can be attributed to participants with at least some college education being overrepresented among participants with complete data (standardized residuals = 2.25). There was a significant relationship between missing data and income. The significance can be attributed to the overrepresentation of participants making more than $50,000.00 with complete data (standardized residuals = 2.16) and the underrepresentation of those making less than $50,000.00 with complete data (standardized residuals = -1.99).

There was also a significant relationship between missing data and cause of injury. The significance can be attributed to the underrepresentation of intentionally injured participants among participants with complete data (standardized residuals = -2.36) and an overrepresentation among participants with missing data (standardized residuals = 1.97).

Although there were significant differences between participants with complete and incomplete data, the correlation between these variables were small (Phi's = .01 - .21). There were no significant differences between participants with or without missing data on injury severity, PHQ-8 at six and 12 months post-discharge, PC-PTSD while hospitalized, pain interference at three, six, and 12 months post-discharge, psychological well-being at six months post-discharge, TBI status, and ethnicity.

Results of the LGMM

Separate LGMMs were conducted on the total scores of the PHQ-8 and PC-PTSD at each of the measurement occasions using a linear growth estimates (i.e., slope, intercept). For each measure, five different models were tested ranging from a one-class model to a five-class model. Covariates were then added to the unconditional model to improve model fit. To explore which variables predicted latent class membership, multinomial logistic regressions were conducted using the covariates included in the conditional model and the covariates not included in the conditional model.

Depression. After comparing the five latent class models, the selection of the best unconditional model was between the four and five-class models. The four-class model had a lower BIC value, a significant BPLRT *p* value, but a nonsignificant LRT *p*

value. The five-class model had lower AIC and SSBIC values, higher entropy and significant LRT and BPLRT *p* values (see Table 4). Although the differences between the four and five-class models were minor, the five-class model was selected as the best unconditional model because of the lower information criterion, higher entropy, significant LRT and BPLRT *p* values, and interpretability.

Table 4

Fit Indices for the Unconditional Depression (PHQ-8) Latent Growth Mixture Models Testing One to Five Classes

Latent Growth Mixture Models					
Fit Indices	1 Class	2 Classes	3 classes	4 Classes	5 Classes
AIC	9903.79	9812.16	9787.41	9745.40	9735.04
BIC	9931.85	9852.25	9839.52	9809.54	9811.21
SSBIC	9909.64	9820.52	9798.27	9758.77	9750.92
Entropy	-	0.752	0.792	0.800	0.810
LRT *p* value	-	0.057	0.0605	0.0761	0.0070
BPLRT *p* value	-	< 0.001	< 0.001	< 0.001	< 0.001

Note. $n = 406$. PHQ-8 = Patient Health Questionnaire-8. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSBIC = Sample Size Adjusted Bayesian Information Criterion; LRT = Lo-Mendell-Rubin Test; BLRT = Bootstrapped Parametric Likelihood Ratio Test.

Table 5 contains the parameter estimates for the unconditional and conditional five-class depression model. Table 6 lists the fit indices for the unconditional model and the conditional model with pain interference and psychological well-being at

hospitalization included as covariates. The addition of the covariates improved model fit and produced a conditional model with lower AIC, BIC, and SSBIC values, higher entropy, and significant LRT and BPLRT *p* values compared to the unconditional model.

The conditional five-class depression model produced a solution containing a resilient class (48.00%), a delayed class (22.16%), a chronic class (7.48%), a recovering class (12.54%), and a chronic-worsening class (9.81%; see Figure 2). Four classes mirror the groups described by Bonanno et al. (2011). The data also produced a class not described by Bonanno et al. (2011), a chronic-worsening class.

The resilient class began with moderate levels of depression and showed steadily declining depression over time. Initially, the delayed class reported moderate levels of depression, but showed increasing levels of depression from hospitalization to 12 months post-discharge, with a sharp increase from six months to 12 months post-discharge. By 12 months post-discharge, levels of depression in the delayed class exceeded the cutoff score (i.e., 10) for a probable diagnosis of major depression.

The chronic class began with clinically significant levels of depression and remained elevated from hospitalization to 12 months post-discharge. Between the initial assessment (i.e., while hospitalized) and the second assessment (i.e., three months post-discharge) levels of depression increased, but from three months to 12 months post-discharge levels of depression declined. The recovering class began with clinically significant levels of depression, but showed steadily declining depression over time and by 12 months post-discharge levels of depression were in the subclinical range. The

Table 5

Latent Growth Mixture Model Parameter Estimates of the Unconditional and Conditional Five-Class Depression (PHQ-8) Models

		Intercept		Linear Slope		Intercept ON PWB (T1)		Slope ON PWB (T1)		Intercept ON PI (T1)		Slope ON PI (T1)	
Latent Classes	*n*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*
Unconditional model													
Delayed	89	5.98***	0.79	0.35***	0.08								
Recovering	48	13.74***	1.54	-0.37***	0.11								
Chronic	30	17.11***	1.39	-0.05	0.11								
Chronic-worsening	41	11.85***	1.34	0.73***	0.10								
Resilient	199	4.32***	0.60	0.00	-								
Conditional model													
Delayed	44	17.19***	1.20	.39***	0.11	-0.10***	0.01	0.01***	0.001	-0.02*	0.01	0.002	0.001
Recovering	116	14.302***	1.27	-0.19	0.11	-0.10***	0.01	0.01***	0.001	-0.02*	0.01	0,002	0.001
Chronic	24	23.60***	2.34	-1.01***	0.19	-0.10***	0.01	0.01***	0.001	-0.02*	0.01	0.002	0.001
Chronic-worsening	24	24.38***	1.87	-0.48**	0.17	-0.10***	0.01	0.01***	0.001	-0.02*	0.01	0,002	0.001
Resilient	199	13.82***	1.20	-0.78***	0.11	-0.10***	0.01	0.01***	0.001	-0.02*	0.01	0,002	0.001

Note. $n = 406$. PHQ-8 = Patient Health Questionnaire-8. *Est.* = parameter estimate; *SE* = standard error of the estimate. PWB = psychological well-being; PI = pain interference. T1 = while hospitalized.

*$p < .05$, ***$p < .001$.

Table 6

Fit Indices for the Unconditional and Conditional Five-class Depression (PHQ-8) Latent Growth Mixture Models

	Latent Growth Mixture Models	
Fit Indices	5-Class Unconditional Model	5-Class Conditional Model (pain interference (T1), psychological well-being (T1))
AIC	9735.04	7306.189
BIC	9811.21	7444.082
SSBIC	9750.92	7326.734
Entropy	0.810	0.896
LRT *p* value	0.0070	0.0322
BPLRT *p* value	< 0.001	< 0.001

Note. n = 406. PHQ-8 = Patient Health Questionnaire-8. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSBIC = Sample Size Adjusted Bayesian Information Criterion; LRT = Lo-Mendell-Rubin Test; BLRT = Bootstrapped Parametric Likelihood Ratio Test. T1 = while hospitalized.

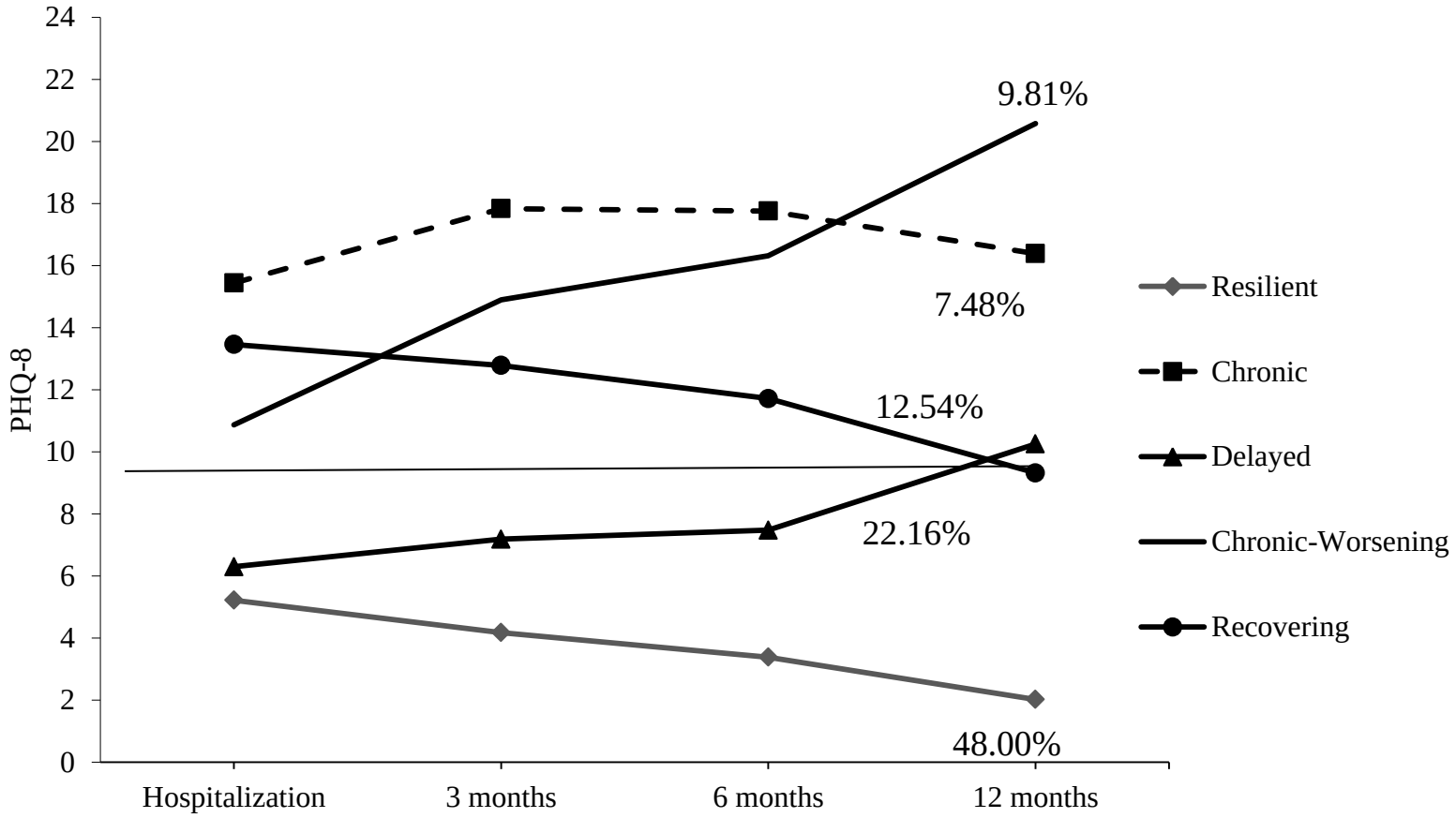

Figure 2. Five-class Conditional Model of Depression (*n* = 406; includes covariates).

chronic-worsening class began with clinically significant levels of depression and showed a trend of increasing depression from hospitalization to 12 months post-discharge.

Multinomial logistic regressions were used to better understand which covariates predicted class membership. For the covariates included in the conditional model (i.e., pain interference, psychological well-being while hospitalized), the resilient class was set as the reference class (see Table 7). Higher pain interference scores (indicative of less pain interference) while hospitalized were significantly associated with decreased odds of membership in the chronic-worsening (OR = .97, $p < .001$) and delayed (OR = .98, $p < .01$) classes compared to the resilient class. Greater psychological well-being while hospitalized was significantly associated with decreased odds of membership in the chronic-worsening (OR = .94, $p < .001$), delayed (OR = .96, $p < .001$), recovering (OR = .96, $p < .05$), and chronic (OR = .96, $p < .05$) classes compared to the resilient class.

The pseudo-class method in Mplus was utilized to obtain the multinomial logistic regressions results for the covariates not included in the conditional model (e.g., gender, TBI status, injury severity; see Table 8), with the resilient class was set as the reference class. Greater psychological well-being at six months post-discharge was significantly associated with decreased odds of being in the delayed (OR = .91, $p < .001$), chronic-worsening (OR = .95, $p < .01$), and chronic (OR = .92, $p < .05$) classes compared to the resilient class. Higher pain interference scores (indicative of less pain interference) at 12 months post-discharge were significantly associated with decreased odds of being in the delayed class (OR = .97, $p < .05$) compared to the resilient class. Greater psychological

Table 7
Covariate Prediction of Class Membership: Depression (PHQ-8)

	Delayed		Recovering		Chronic		Chronic-worsening	
Covariates	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR
Pain interference (T1)	-0.02***	0.97	-0.01**	0.98	0.01	1.01	-0.005	0.99
Psychological well-being (T1)	-0.06***	0.94	-0.04***	0.96	-0.04*	0.96	-0.04*	0.96

Note. n = 406. Resilient class set as the referent.PHQ-8 = Patient Health Questionnaire-8. OR = odds ratio. Pain interference = Veterans Rand Health Survey item 5; Psychological well-being = Veterans Rand Health Survey items 6a and 6c. T1 = while hospitalized.
*p < .05, **p < .01, ***p < .001.

Table 8

Auxiliary Variable Prediction of Latent Class Membership: Depression (PHQ-8)

	Delayed		Recovering		Chronic		Chronic-worsening	
Auxiliary Variables	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR
Age at injury	-0.01	0.99	-0.05	0.95	-0.02	0.98	-0.01	0.99
Injury severity	0.06	1.06	-0.01	0.99	0.06	1.06	0.01	1.01
Gender$_a$	0.11	1.12	-0.16	0.85	0.74	2.10	-0.14	0.87
Ethnicity/race$_b$	-1.26	0.28	-0.13	0.88	-1.36	0.26	-0.28	0.76
Education level$_c$	-0.17	0.84	-0.22	0.80	0.11	1.12	0.04	1.04
Income$_d$	-0.57	0.57	0.17	1.19	-1.03	0.36	-0.77†	0.46
Cause$_e$	-0.14	0.87	-1.01	0.36	-1.46	0.23	-1.04	0.35
Mild TBI$_f$	-0.20	0.82	-0.29	0.75	-0.15	0.86	-0.30	0.74
Pain interference (T2)	-0.003	1.00	0	1.00	-0.01	0.99	0.003	1.00
Pain interference (T3)	0.01	1.01	-0.02	0.98	-0.001	1.00	-0.01	0.99
Pain interference (T4)	-0.03	0.97	-0.01	0.99	-0.03	0.97	-0.01	0.99
Psychological well-being (T2)	-0.02*	0.98	-0.06	0.94	-0.06†	0.94	0.004**	1.00
Psychological well-being (T3)	-0.09***	0.91	-0.03	0.97	-0.08*	0.92	-0.045	0.96

Note. n = 406. Resilient class set as the referent. PHQ-8 = Patient Health Questionnaire-8. Auxiliary variables = covariates not included in the conditional model. OR = odds ratio. $_a$0 = women; 1 = men. $_b$0 = European-American; 1 = ethnic minorities. $_c$0 = high school or less; 1 = at least some college. $_d$0 = less than or equal to 49,000; 1 = greater than or equal to 50,000. $_e$0 = intentional; 1 = accidental. $_f$0 = negative for mild traumatic brain injury; 1 = positive for mild traumatic brain injury. Pain interference = Veterans Rand Health Survey item 5; psychological well-being = Veterans Rand Health Survey items 6a and 6c. T1= while hospitalized; T2 = 3 months post-discharge; T3 = 6 months post-discharge; T4 = 12 months post-discharge. *p < .05, **p < .01, ***p < .001. † p < .10.

well-being scores at three months post-discharge were marginally associated with decreased odds of being in the chronic class (OR = .94, p = .07) compared to the resilient class. Higher income was also marginally associated with decreased odds of being the chronic class (OR = .46, p = .07) compared to the resilient class. No other relationships were significant.

PTSD. After comparing the five latent class models, a two-class, a three-class and a four-class model appeared to be the best unconditional models. Although the two-class model had lower BIC and SSBIC values and significant LRT and BPLRT p values, the addition of covariates (i.e., pain interference, psychological well-being while hospitalized) produced two classes with the same trajectories. The three-class model had a higher entropy value and significant LRT and BPLRT p values compared to the four-class model. The four-class model had lower AIC, BIC, and SSBIC values and significant LRT and BPLRT p values compared to the three-class model (see Table 9). However, the differences between the three and four-class models were minor. In addition, both the three and four-class models had one class with zero participants. After the addition of covariates (i.e., pain interference, psychological well-being while hospitalized) to the three and four-class models, the four-class model continued to have one class with zero participants and the three-class model had participants in each class. The three-class model was selected as the best unconditional model. Table 10 contains the parameter estimates for unconditional and conditional three-class model. Table 11 lists the fit indices for the unconditional model and the conditional three-class model with bodily pain and psychological well-being scores from the first assessment.

Table 9
Fit Indices for the Unconditional PTSD (PC-PTSD) Latent Growth Mixture Models Testing One to Five-Classes

Latent Growth Mixture Models					
Fit Indices	1 Class	2 Classes	3 Classes	4 Classes	5 Classes
AIC	5047.94	4991.25	4997.25	4980.760	-
BIC	5063.97	5019.31	5037.34	5032.875	-
SSBIC	5051.28	4997.10	5005.61	4991.624	-
Entropy	-	0.733	0.83	0.791	-
LRT *p* value	-	< .001	< .001	< .001	-
BPLRT *p* value	-	< .001	< .001	< .001	-

Note. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSBIC = Sample Size Adjusted Bayesian Information Criterion; LRT = Lo-Mendell-Rubin Test; BLRT = Bootstrapped Parametric Likelihood Ratio Test.

(i.e., while hospitalized) added as covariates. The conditional model had lower AIC, BIC, SSBIC values, higher entropy, and significant LRT and BPLRT *p* values compared to the unconditional model.

The conditional three-class PTSD data produced a model containing a resilient class (43.97%), a chronic class (22.08%), and a stable, moderately distressed class (30.94%; see Figure 3). Two out of the four classes were consistent with those described by Bonanno et al. (2011). The data also produced a class that evidenced moderately high, but stable levels of PTSD symptoms. From hospitalization to 12 months post-discharge, the resilient class reported stable, low levels of PTSD symptoms, with a slight decrease between six and 12 months post-discharge. The initial levels of

Table 10

Latent Growth Mixture Model Parameter Estimates for the Unconditional and conditional Three-class PTSD (PC-PTSD) Model

		Intercept		Slope		Intercept ON PWB (T1)		Slope ON PWB (T1)		Intercept ON PI (T1)		Slope ON PI (T1)	
Latent classes	*n*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*
Unconditional model													
Stable, Moderately Distressed	0												
Chronic	181	2.71***	0.09	-0.02*	0.01								
Resilient	225	0.80***	0.07	-0.002	0.01								
Conditional model													
Stable, Moderately Distressed	125	2.47***	0.22	-0.01	0.02	-0.005	0.004	< .001	< .001	-0.003	0.002	< .001	< .001
Chronic	110	3.42***	0.18	0.04*	0.02	-0.005	0.004	< .001	< .001	-0.003	0.002	< .001	< .001
Resilient	171	1.25***	0.25	-0.04	0.02	-0.005	0.004	< .001	< .001	-0.003	0.002	< .001	< .001

Note. n = 406. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. *Est.* = parameter estimate; *SE* = standard error of the estimate. PWB = psychological well-being; PI = pain interference. T1 = while hospitalized.

*p < .05, **p < .01, ***p < .001.

Table 11

Fit Indices for the Unconditional and Conditional Three-class PTSD (PC-PTSD) Models

Latent Growth Mixture Models		
Fit indices	3-Class Unconditional Model	3-Class Conditional Model (bodily pain (T1), psychological well-being (T1))
AIC	4997.25	4802.913
BIC	5037.34	4887.098
SSBIC	5005.61	4820.462
Entropy	0.83	0.84
LRT *p* value	< .001	0.005
BPLRT *p* value	< .001	<. 0.001

Note. *n* = 406. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSBIC = Sample Size Adjusted Bayesian Information Criterion; LRT = Lo-Mendell-Rubin Test; BLRT = Bootstrapped Parametric Likelihood Ratio Test. Pain interference = Veterans Rand Health Survey item 5; psychological well-being = Veterans Rand Health Survey items 6a and 6c. T1 = While hospitalized.

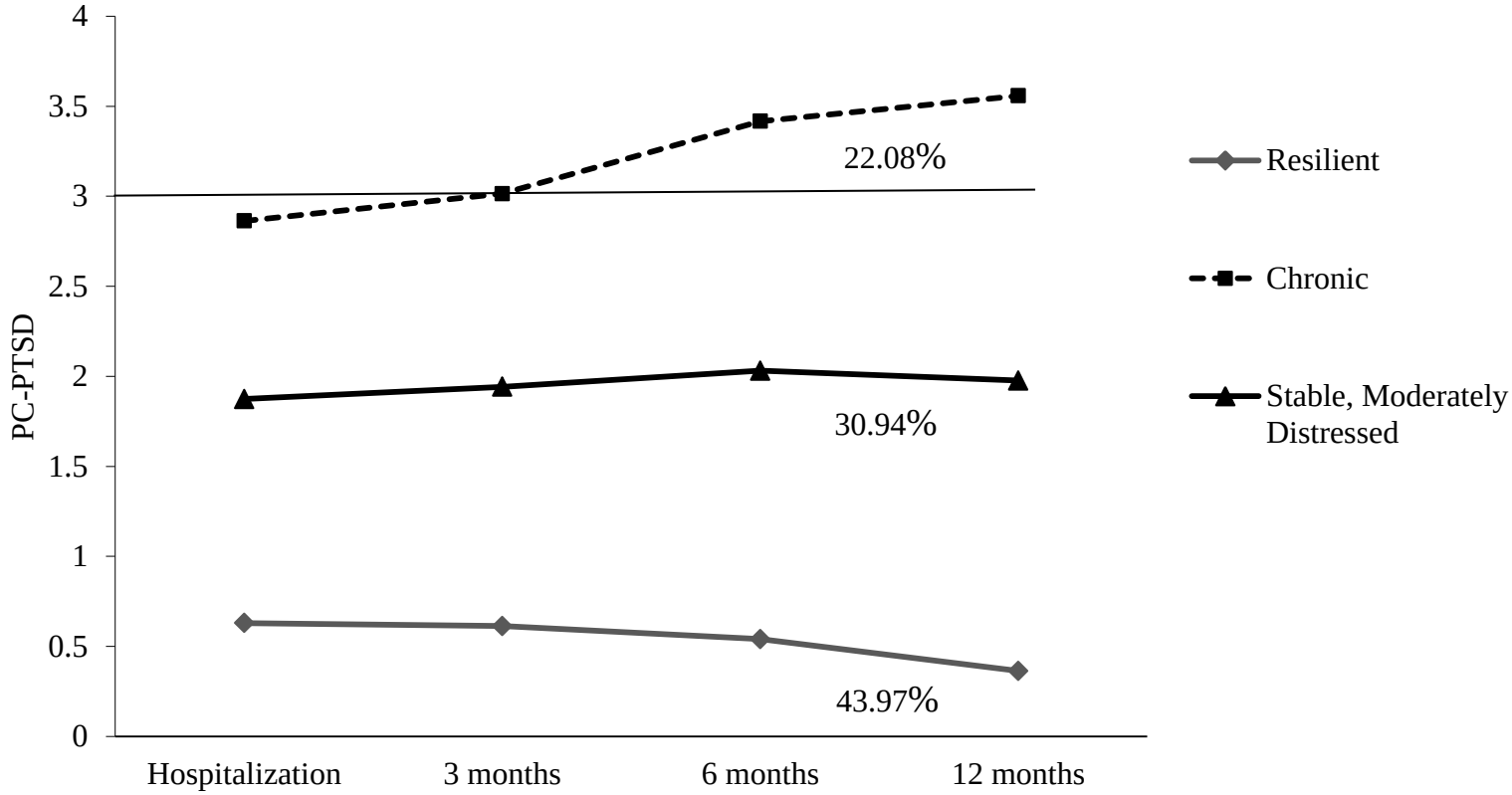

Figure 3. Three-class Conditional Model of PTSD (*n* = 406; includes covariates).

PTSD symptoms for the chronic class nearly met the cutoff for a probable diagnosis of PTSD (i.e., 3) and showed steadily increasing levels of PTSD symptoms from hospitalization to 12 months post-discharge. The stable, moderately distressed class reported moderately high levels of PTSD symptoms that remained stable over time.

Multinomial logistic regressions were conducted to understand which covariates predicted class membership. For the covariates included in the conditional PTSD model, the chronic class was set as the reference class (see Table 12). While hospitalized, greater psychological well-being was associated with increased odds of being in the resilient (OR = 1.05, $p < .001$) and stable, moderately distressed (OR = 1.02, $p < .05$) classes compared to the chronic class.

For the covariates not included in the model, the resilient class was set as the reference class (see Table 13). Older age was associated with decreased odds of being in the stable, moderately distressed (OR = .96, $p < .05$) and the chronic (OR = .93, $p < .01$) classes compared to the resilient class. Greater psychological well-being was associated with decreased odds of being in the chronic class at three (OR = .95, $p < .05$) and six (OR = .92, $p < .001$) months post-discharge compared to the resilient class. Greater psychological well-being at three months post-discharge was marginally associated with decreased odds of membership in the stable, moderately distressed class (OR = .96, $p < .10$) compared to the resilient class. Greater injury severity was also marginally associated with increased odds of being in the chronic class (OR = 1.06, $p < .10$) compared to the resilient class. No other relationships were statistically significant.

Table 12
Covariate Prediction of Class Membership: PTSD (PC-PTSD)

	Stable, Moderately Distressed		Resilient	
Covariates	Estimate	OR	Estimate	OR
Pain interference (T1)	-0.002	1.00	-0.004	1.00
Psychological well-being (T1)	0.021*	1.02	0.05***	1.05

Note. Chronic class set as the referent. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. OR = odds ratio. Pain interference = Veterans Rand Health Survey item 5; psychological well-being = Veterans Rand Health Survey items 6a and 6c.T1 = while hospitalized.
*$p < .05$, ***$p < .01$.

Table 13
Auxiliary prediction of Class Membership: PTSD (PC-PTSD)

	Stable, Moderately Distressed		Chronic	
Auxiliary Variables	Estimate	OR	Estimate	OR
Age at injury	-0.04*	0.96	-0.07**	0.93
Injury severity	0.03	1.03	0.06†	1.06
Gender$_a$	-0.60	0.55	0.38	1.46
Ethnicity/race$_b$	0.13	1.14	1.04	2.83
Education level$_c$	0.04	1.05	-0.09	0.91
Income$_d$	-0.15	0.86	-0.26	0.77
Cause$_e$	-0.03	0.97	-0.93	0.39
Mild TBI$_f$	0.12	1.13	0.67	1.95
Pain interference (T2)	-0.005	0.99	-0.02	0.98
Pain interference (T3)	-0.001	1.00	0.01	1.01
Pain interference (T4)	.001	1.00	-0.01	0.99
Psychological well-being (T2)	-0.04†	0.96	-0.05*	0.95
Psychological well-being (T3)	-0.03	0.97	-0.08***	0.92

Note. n = 406. Resilient class set as the referent. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. Auxiliary variables = covariates not included in the conditional model. OR = odds ratio. $_a$0 = women; 1 = men. $_b$0 = European-American; 1 = ethnic minorities. $_c$0 = high school or less; 1 = at least some college. $_d$0 = less than or equal to 49,000; 1 = greater than or equal to 50,000. $_e$0 = intentional; 1 = accidental. $_f$0 = negative for mild traumatic brain injury; 1 = positive for mild traumatic brain injury. Pain interference = Veterans Rand Health Survey item 5; psychological well-being = Veterans Rand Health Survey items 6a and 6c.T1= while hospitalized; T2 = 3 months post-discharge; T3 = 6 months post-discharge; T4 = 12 months post-discharge.
*p < .05; **p < .01; ***p < .001; †p < .10.

Comparison of the five-class depression and three-class PTSD models on demographics variables

Comparison of demographic variables were conducted to investigate potential differences between the five classes of the depression (e.g., resilient, delayed, chronic, chronic-worsening, recovering) and the three classes of the PTSD models (e.g., resilient, chronic, stable, moderately distressed). Continuous variables were assessed using one-way ANOVAs and categorical variables (e.g., gender, TBI status) were assessed using Pearson's chi-square (see Tables 14, 15).

Depression. There were multiple significant differences between the five latent depression classes and the demographic variables including injury severity and income (see Table 14). Post hoc analysis using the Scheffe correction at $p \leq .01$ showed that the chronic-worsening class was significantly more injured than the resilient class (*MD* = 4.71) while hospitalized. There were significant relationships between the five latent depression classes and income. The significance can be attributed to the overrepresentation of participants in the resilient class who reported making more than $50,000.00 (standardized residuals = 2.45) and their underrepresentation among participants who reported making less than 50,000.00 (standardized residuals = -2.25).

PTSD. There were multiple significant differences between the three PC-PTSD latent classes and the demographic variables including age at injury, injury severity, mild TBI status, education level, and income (see Table 15). Post hoc analysis using the Scheffe correction at $p \leq .01$ showed that the resilient class was significantly older than the chronic (*MD* = 11.01) and stable, moderately distressed (*MD* = 7.85) classes. The

resilient class was also less severely injured than the chronic (*MD* = -2.56) and stable, moderately distressed (*MD* = -1.15) classes. There were significant relationships between the three latent PTSD classes and income. The significance can be attributed to the overrepresentation of participants in the resilient class who reported making more than $50,000.00 (standardized residuals = 2.08) and their underrepresentation among participants who reported making less than 50,000.00 (standardized residuals = -1.91). There were significant relationships between the three latent PTSD classes and education level and mild TBI status. Participants with at least some college experience were underrepresented among participants in the chronic class (standardized residuals = -1.26) and overrepresented among participants in the resilient class (standardized residuals =1.36). Participants in the chronic class had more cases positive for mild TBI (standardized residuals = 1.75) and fewer cases negative for mild TBI (standardized residuals = -1.34) than expected.

Comparison of within and between class differences

Mixed design and repeated measures ANOVAs were conducted to identify whether depression and PTSD levels differed significantly within and between the latent classes in the first year following a PTE. Because the test of sphericity was violated, the Greenhouse-Geisser correction was used to determine if the overall main effects were significant. Within-group simple effects were tested by conducting repeated measures and one-way ANOVAs on each class using the Scheffe correction at $p \leq .01$ to adjust for multiple comparisons.

Table 14

Comparison of the Five-class Depression (PHQ-8) Model on Demographic Characteristics

	Delayed			Recovering			Chronic			Chronic-worsening			Resilient			
Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*p* value
Age at injury	116	42.17	16.00	24	36.92	11.74	24	40.83	15.19	44	42.98	13.48	199	45.13	18.37	.14[a]
Injury Severity	116	12.69_c	8.42	24	10.58	7.42	24	13.58	8.56	44	15.75	10.49	199	11.04_c	7.73	.01[a]
	n	%		*n*	%		*n*	%		*n*	%		*n*	%		
TBI status																
Negative for TBI	54	62.07		11	64.71		10	50.00		19	57.58		100	66.23		.63[b]
Positive for TBI	33	37.93		6	35.29		10	50.00		14	42.42		51	33.77		
Gender																
Female	41	35.65		9	37.50		7	29.17		15	34.09		68	34.17		.98[b]
Male	74	64.35		15	62.50		17	70.83		29	65.91		131	65.83		
Education level																
High school or less	75	64.66		14	58.33		14	58.33		27	61.36		104	52.53		.32[b]
Some college or more	41	35.34		10	41.67		10	41.67		17	38.64		94	47.47		
Income																
≤ 49,000.00	51	67.11		7	50.00		12	80.00		26	74.29		60	40.54		< .001[b]
≥ 50,000.00	25	32.89		7	50.00		3	20.00		9	25.71		88	59.46		
Cause of injury																
Accident	67	77.91		14	82.35		15	75.00		22	66.67		129	85.43		.13[b]
Intentional	19	22.09		3	17.65		5	25.00		11	33.33		22	14.57		

Table 14 Continued

	Delayed		Recovering		Chronic		Chronic worsening		Resilient		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Ethnicity											
Caucasian/White	75	72.12	14	66.67	16	76.19	27	67.50	124	69.66	.93 [b]
Ethnic Minorities	29	27.88	7	33.33	5	23.81	13	32.50	54	30.34	

Note. PHQ-8 = Patient Health Questionnaire-8. [a] = One-way ANOVA; [b] = Pearson Chi-square. TBI = traumatic brain injury. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

Table 15
Comparison of the Three-class PTSD (PC-PTSD) Model on Demographic Characteristics

	Stable, Moderately Distressed			Chronic			Resilient			
Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*p value*
Age at injury	126	40.90_{c}	16.69	110	37.65_{d}	12.26	171	48.75_{cd}	17.82	< .001[a]
Injury Severity	126	12.25_{c}	8.24	110	13.65_{d}	9.13	171	11.09_{cd}	7.91	.04[a]
	n	%		*n*	%		*n*	%		
Mild TBI status										
Negative for mild TBI	64	66.67		42	51.22		88	67.69		.04[b]
Positive for mild TBI	32	33.33		40	48.78		42	36.84		
Gender										
Female	49	35.00		32	22.86		59	42.14		.27[b]
Male	76	28.57		78	29.32		112	42.11		
Education level										
High school or less	75	32.05		72	30.77		87	37.18		.04[b]
Some college or more	50	29.07		38	22.09		84	48.84		
Income										
≤ 49,000.00	49	31.41		56	35.90		51	32.69		.001[b]
≥ 50,000.00	33	25.00		27	20.45		72	54.55		
Cause of injury										
Accident	77	31.17		60	24.29		110	44.53		.10[b]
Intentional	19	31.67		22	36.67		19	31.67		
Ethnicity										

Table 15 Continued

	Stable, Moderately Distressed		Chronic		Resilient		
	n	%	*n*	%	*n*	%	
Caucasian/White	85	33.20	65	25.39	106	41.41	.91 [b]
Ethnic minorities	36	28.57	36	28.57	54	42.86	

Note. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. [a] = One-way ANOVA; [b] = Pearson Chi-square. TBI = traumatic brain injury. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

Depression. The five by four mixed-design ANOVA for the depression data yielded significant effects of time, $F(2.5, 1015) = 7.09$, $p < .001$, and class membership, $F(1, 4) = 286.09$, $p < .001$**.** Post hoc analyses using repeated measures ANOVAs revealed several significant within-group differences using the Scheffe correction at $p \leq .01$ (see Table 16). The resilient class reported significantly higher levels of depression while hospitalized than at three (*MD* = 1.05), six (*MD* = 1.83), and 12 (*MD* = 3.17) months post-discharge. The resilient class reported significantly higher levels of depression than at three (*MD* = 2.12) and six months (*MD* = 1.34) post-discharge than at 12 months post-discharge. The chronic class also reported significantly higher levels of depression while hospitalized than at three months post-discharge (*MD* = 5.38) and reported significantly higher levels of depression at three months post-discharge than at 12 months post-discharge (*MD* = 3.71).

The recovering class reported significantly lower levels of depression at 12 months post-discharge than at hospitalization (*MD* = -6.16) and at three (*MD* = -6.25) and six months (*MD* = -3.58) post-discharge. The delayed class reported significantly higher levels of depression at 12 months post-discharge than at hospitalization (*MD* = 2.36) and at three (*MD* = 2.33) and six months (*MD* = 1.70) post-discharge. The chronic-worsening class reported significantly lower levels of depression while hospitalized than at three (*MD* = -3.43), six (*MD* = -4.77), and 12 months (*MD* = -9.14) post-discharge. At three (*MD* = -5.70) and six months (*MD* = -4.36) post-discharge, the chronic-worsening class reported significantly lower levels of depression than at 12 months post-discharge.

Table 16

Summary of Repeated Measures ANOVA for the Depression (PHQ-8)

		PHQ-8 (T1)		PHQ-8 (T2)		PHQ-8 (T3)		PHQ-8 (T4)		
Latent Classes	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*Partial Eta*^{2}
Delayed	116	7.99_{a}	5.26	8.02_{b}	4.25	8.65_{c}	5.40	10.35_{abc}	2.35	.08
Recovering	24	15.37_{a}	4.27	15.46_{b}	3.65	12.79_{c}	4.56	9.21_{abc}	2.23	.43
Chronic	24	14.79_{a}	6.75	20.17_{ab}	3.24	18.37	4.76	16.46_{b}	2.47	.24
Chronic-worsening	44	11.27_{abc}	6.58	14.70_{c}	5.42	16.04_{b}	4.91	20.41_{cb}	2.64	.46
Resilient	199	5.19_{ab}	4.46	4.14_{a}	3.96	3.36_{bc}	3.65	2.02_{ac}	2.16	.16

Note. PHQ-8 = Patient Health Questionnaire-8. T1 = while hospitalized; T2 = three months post-discharge; T3 = six months post-discharge; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

Post hoc analyses using one-way ANOVAs revealed several significant between-group differences using the Scheffe correction at $p \leq .01$. The post hoc analyses were restricted to the first and last assessment (i.e., while hospitalized, 12 month post-discharge) as these assessments were the only between-group analyses of interest (see Table 17). While hospitalized, participants in the resilient class reported significantly higher levels of depression than participants in the chronic-worsening (*MD* = -6.08), chronic (*MD* = -9.60), delayed (*MD* = -2.80), and recovering (*MD* = -10.18) classes. While hospitalized, the delayed class reported significantly lower levels of depression than the chronic (*MD* = -6.80) and recovering (*MD* = -7.38) classes. While hospitalized, the recovering class reported significantly higher levels of depression than the chronic-worsening (*MD* = 4.10) and delayed (*MD* = 7.38) classes.

At 12 months post-discharge, the resilient class reported significantly lower levels of depression than the chronic-worsening (*MD* = -18.39), chronic (*MD* = -14.438), delayed (*MD* = -8.33), and recovering (*MD* = -7.19) classes. The chronic-worsening class reported significantly higher levels of depression at 12 months post-discharge than the delayed (*MD* = 10.05), recovering (*MD* = 11.20), and chronic (*MD* = 3.95) classes. The recovering class reported significantly lower levels of depression at 12 months post-discharge than the chronic class (*MD* = -7.25). At 12 months post-discharge, the chronic class reported significantly higher levels of depression than the delayed class (*MD* = 6.10).

PTSD. The three by four mixed-design ANOVA for the PC-PTSD data yielded significant effects for time, $F(2.5, 1018.08) = 4.83$, $p < .01$, and class membership, $F(1,$

Table 17
Summary of One-way ANOVAs for the Depression (PHQ-8)

	Chronic-worsening			Delayed			Recovering			Chronic			Resilient	
Indicator Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PHQ-8 (T1)	44	11.27_{a}	6.58	116	7.99_{bc}	5.26	24	15.38_{b}	4.27	24	14.79_{dc}	6.75	199	6.75_{abd}	5.19
PHQ-8 (T4)	44	20.41_{aefg}	2.64	116	10.35_{be}	2.35	24	9.21_{cf}	2.23	24	16.46_{cbf}	2.47	199	2.02_{abc}	2.16

Note. PHQ-8 = Patient Health Questionnaire. T1 = while hospitalized; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

404) = 896.18, $p < .001$**.** Post hoc analyses using repeated measures ANOVAs revealed several significant within-group differences using the Scheffe correction at $p \leq .01$ (see Table 18). The average PC-PTSD score for the resilient class at 12 months post-discharge was significantly lower than at hospitalization (*MD* = -.29), and at three (*MD* = -.24), and six months (*MD* = -.17) post-discharge. The average PC-PTSD score for the chronic class was significantly lower while hospitalized than at six (*MD* = -.58) and 12 months (*MD* = -.70) post-discharge. The average PC-PTSD score for the chronic class at three months post-discharge was significantly lower than at six (*MD* = -.44) and 12 months (*MD* = -.56) post-discharge. There were no significant differences on the PC-PTSD for the stable, moderately distressed class.

Post hoc analyses using one-way ANOVAs revealed several significant between-group differences using the Scheffe correction at $p \leq .01$. The post hoc analyses were again restricted to the first and last assessment (i.e., while hospitalized, 12 month post-discharge) as these assessments were the only between-group analyses of interest (see Table 19). The average PC-PTSD score for the resilient class while hospitalized was significantly lower compared to the chronic (*MD* = -2.23), and stable, moderately distressed (*MD* = -1.21) classes. The average PC-PTSD score for the stable, moderately distressed class while hospitalized was significantly lower compared to the chronic class (*MD* = -1.02). The average PC-PTSD score for the resilient class at 12 months post-discharge was significantly lower compared to the chronic (*MD* = -3.22), and stable, moderately distressed (*MD* = -1.61) classes. The average PC-PTSD score for the stable,

Table 18
Summary of Repeated Measures ANOVA for the PTSD (PC-PTSD)

		PC-PTSD (T1)		PC-PTSD (T2)		PC-PTSD (T3)		PC-PTSD (T4)		
Latent Classes	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*Partial Eta*^{2}
Stable, Moderately Distressed	126	1.84	1.36	1.96	1.96	2.01	.95	1.95	.58	.005
Chronic	110	2.86_{ac}	1.27	$3.00d_{e}$	1.03	3.44_{ad}	.70	3.56_{ce}	.50	.14
Resilient	171	$.63_{a}$	1.01	$.58_{b}$	.85	.51c	.70	$.35_{abc}$	.48	.30

Note. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. T1 = while hospitalized; T2 = three months post-discharge; T3 = six months post-discharge; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

moderately distressed class at 12 months post-discharge was significantly lower compared to the chronic class (*MD* = -1.61).

Comparison of between class differences on health related quality of life variables

One-way ANOVAs were conducted to test whether the latent classes for the depression and PTSD data differed in levels of psychological well-being and pain interference. To account for the multiple comparisons, post hoc analyses used the Scheffe correction at $p \leq .01$. Analysis of differences in psychological well-being used data from three and six months post-discharge. Analysis of differences in pain interference used data from three, six, and 12 months post-discharge. The psychological well-being and pain interference data while hospitalized were not included because they were used as covariates in the generation of the latent classes. See Tables 20 and 21 for all significance levels and mean differences.

Depression. Post hoc analyses using the psychological well-being data revealed significant difference across the latent classes at three and six months post-discharge (see Table 20). The resilient class reported significantly greater levels of psychological well-being at three months post-discharge than the chronic-worsening (*MD* = 27.67), delayed (*MD* = 10.64), recovering (*MD* = 33.45), and chronic (*MD* = 44.03) classes. The delayed class reported significantly greater levels of psychological well-being at three months post-discharge than the chronic-worsening (*MD* = 17.03), recovering (*MD* = 22.80), and chronic (*MD* = 33.38) classes. At three months post-discharge, the chronic-worsening class reported significantly greater levels of psychological well-being than the chronic class (*MD* = 16.36). The resilient class reported significantly greater levels of

Table 19
Summary of One-way ANOVAs for the PTSD (PC-PTSD)

	Stable, Moderately Distressed			Chronic			Resilient		
Indicator Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PC-PTSD (T1)	126	1.84_a	1.36	110	2.86_a	1.27	171	$.63_a$	1.01
PC-PTSD (T4)	126	1.95_a	.58	110	3.56_a	.50	171	$.35_a$	.48

Note. PC-PTSD = Primary Care PTSD. T1 = while hospitalized; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

psychological well-being at six months post-discharge than the chronic-worsening (*MD* = 37.23), delayed (*MD* = 16.60), recovering (*MD* = 27.53), and chronic (*MD* = 42.45) classes. The delayed class reported significantly greater levels of psychological well-being at six months post-discharge compared to the chronic-worsening (*MD* = 20.63) and chronic (*MD* = 25.85) classes.

Post hoc analyses using the pain interference data revealed significant differences across the classes at three, six, and 12 months post-discharge (see Table 20). The resilient class reported significantly greater pain interference scores (indicating less pain interference) at three months post-discharge than the chronic-worsening (*MD* = 33.18), delayed (*MD* = 17.52), recovering (*MD* = 27.94), and chronic (*MD* = 40.36) classes. At six months post-discharge, the resilient class continued to report significantly greater pain interference scores (indicating less pain interference) than the chronic-worsening (*MD* = 36.00), delayed (*MD* = 19.88), recovering (*MD* = 38.05), and chronic (*MD* = 47.09) classes. The delayed class reported significantly greater pain interference scores (indicating less pain interference) at six months post-discharge than the chronic class (*MD* = 27.21). At 12 months post-discharge, the resilient class still reported significantly greater pain interference scores (indicating less pain interference) than the chronic-worsening (*MD* = 39.10), delayed (*MD* = 17.66), recovering (*MD* = 34.81), and chronic (*MD* = 46.14) classes. The delayed class reported significantly greater pain interference scores (indicating less pain interference) at 12 months post-discharge than the chronic-worsening (*MD* = 21.44) and chronic (*MD* = 28.48) classes.

Table 20

Summary of One-way ANOVAs for Health Related Quality of Life Variables for the Five-class Depression (PHQ-8) Model

	Chronic-worsening			Delayed			Recovering			Chronic			Resilient		
Variables	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PI(T2)	44	26.93_{a}	23.21	116	42.59_{b}	29.26	24	32.17_{c}	27.77	24	19.75_{d}	29.41	199	60.11_{abcd}	28.31
PI (T3)	44	31.84_{a}	25.20	116	47.96_{be}	32.26	24	29.79_{c}	28.00	24	20.75_{de}	21.03	199	67.84_{abcd}	28.96
PI (T4)	44	31.80_{ae}	24.46	116	53.23_{bef}	28.44	24	36.08_{c}	27.84	24	24.75_{df}	23.41	199	70.89_{abcd}	27.42
PWB (T2)	44	33.77_{ae}	17.84	116	50.80_{befg}	17.32	24	28.00_{cf}	17.84	24	17.42_{dge}	14.32	199	61.45_{abcd}	16.08
PWB(T3)	44	26.64_{ae}	17.55	116	47.27_{bef}	19.44	24	36.33_{c}	15.85	24	21.42_{df}	16.36	199	63.86_{abcd}	15.76

Note. PHQ-8 = Patient Health Questionnaire-8. PI = pain interference. PWB = psychological well-being. T2 = three months post-discharge; T3 = six months post-discharge; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

PTSD. Post hoc analyses using the psychological well-being data revealed significant difference across the latent classes at three and six months post-discharge using the Scheffe correction at $p \leq .01$ (see Table 21). The resilient class reported significantly greater levels of psychological well-being at three months post-discharge than the chronic (*MD* = 26.98) and stable, moderately distressed (*MD* = 11.51) classes. The stable, moderately distressed class reported significantly greater levels of psychological well-being at three months post-discharge than the chronic class (*MD* = 15.47). At six months post-discharge, the resilient class continued to report significantly greater levels of psychological well-being than the chronic (*MD* = 33.17) and stable, moderately distressed (*MD* = 12.29) classes. The stable, moderately distress class reported significantly greater levels of psychological well-being than the chronic class (*MD* = 20.88).

Post hoc analyses using the pain interference data revealed significant differences across the classes at three, six, and 12 months post-discharge (see Table 21). The resilient class reported significantly greater pain interference scores (indicating less pain interference) at three months post-discharge than the chronic (*MD* = 30.39) and stable, moderately distressed (*MD* = 14.32) classes. The stable, moderately distressed class at three months post-discharge reported significantly greater pain interference scores

(indicating less pain interference) than the chronic class (*MD* = 16.07). At six months post-discharge, the resilient class continued to report significantly greater pain interference scores (indicating less pain interference) than the chronic (*MD* = 31.11) and stable, moderately distressed (*MD* = 15.02) classes. The stable, moderately distressed class reported significantly greater pain interference scores (indicating less pain interference) at six months post-discharge than the chronic class (*MD* = 16.09). At 12 months post-discharge, the resilient class reported significantly greater pain interference scores (indicating less pain interference) than the chronic (*MD* = 30.25) and stable, moderately distressed (*MD* = 11.48) classes and the stable, moderately distressed class reported significantly greater pain interference scores (indicating less pain interference) at 12 months post-discharge than the chronic class (*MD* = 18.77).

Table 21

Summary of One-way ANOVAs for Health Related Quality of Life Variables for the Three-class PTSD (PC-PTSD) Model

Variables	Resilient			Stable, Moderately Distressed			Chronic		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
PI (T2)	171	60.15_a	29.88	126	45.83_a	27.33	110	29.76_a	28.36
PI (T3)	171	66.32_a	30.31	126	51.30_a	32.25	110	35.21_a	29.36
PI (T4)	171	68.59_a	28.94	126	57.11_a	29.98	110	38.34_a	28.00
PWB (T2)	171	61.71_a	18.08	126	50.20_a	17.25	110	34.73_a	20.18
PWB (T3)	171	63.75_a	16.93	126	51.46_a	17.84	110	30.58_a	19.73

Note. PC-PTSD = Primary Care Posttraumatic Stress Disorder Screen. PI = pain interference. PWB = psychological well-being. T2 = three months post-discharge; T3 = six months post-discharge; T4 = 12 months post-discharge. *M* = mean; *SD* = standard deviation. Means sharing the same subscript represent significant differences at $p < .01$ using the Scheffe correction.

CHAPTER V

CONCLUSIONS

The number of studies investigating individual trajectories of adjustment following a PTE is limited. Similarly, longitudinal studies of individuals discharged from a Level 1 trauma center are also lacking. The present study may be the first to examine Bonanno's process model of adjustment among individuals over the course of a year following discharge from a Level 1 trauma center, accounting for the possible influences of mild TBI, demographic, physical health, and health related quality of life variables on class membership. This may also be the first study to test for within and between-class differences in these classes.

The study had three primary aims. One aim was to reproduce the four-class model of adjustment described by Bonanno et al. (2011). The goal was to identify and categorize the process of adjustment. It was hypothesized that a four-class model (i.e., resilient, chronic, delayed recovering) would best represent the data obtained from a measure of depression and a PTSD screener. The expected class sizes were 35 to 65% for the resilient class, five to 30% for the chronic class, zero to 15% for the delayed class, and 15 to 20% for the recovering class. The second aim was to determine if physical health, demographic, and health related quality of life variables (psychological well-being, pain interference) predicted class membership. It was hypothesized that lower injury severity, male gender, higher education, higher psychological well-being, and less pain interference would predict membership in the resilience class over time. In

addition, mild TBI and intentional injuries were expected to predict chronic distress over time. The study also explored whether age and ethnicity predicted class membership.

A third goal was to explore between-class and within-class differences on the indicator variables (i.e., PHQ-8, PC-PTSD). While hospitalized, the resilient class was hypothesized to report significantly fewer symptoms of depression and PTSD compared to the delayed, recovering, and chronic classes. At 12 months post-discharge, the resilient class was expected to report significantly fewer symptoms of depression and PTSD compared to the chronic and delayed classes. The levels of depression and PTSD for the resilient and chronic classes were hypothesized to be stable overtime. The levels of depression and PTSD for the delayed classes were hypothesized to increase significantly and the levels of depression and PTSD for recovering class were hypothesized to decrease significantly over the first year of recovery. The hypotheses were only partially supported.

The LGMM results revealed distinct patterns of adjustment following a PTE. Bonanno's prototypical classes of adjustment were replicated in this sample, but a four-class model as described by Bonanno et al. (2011) was not apparent. The data also produced trajectories of adjustment not accounted for by Bonanno's process model of adjustment. Results were consistent with prior research, which reported a variety of ways in which people adjusted to a PTE, with resiliency as the most common pathway (deRoon-Cassini et al., 2010; Myhren et al., 2010).

Trajectories of depression and PTSD

Depression. The best fitting model for depression (as measured by the PHQ-8) resembled Bonanno's et al. (2011) process model. However, instead of four classes, a five-class model was observed in this sample. In addition to the resilient, delayed, recovering, and chronic classes, a chronic-worsening class emerged. Variations in Bonanno's process model were also found among SCI survivors (van Leeuwen et al., 2012), in a mixed sample with SCIs and multiple physical traumas (Quale & Schanke, 2010), and among breast cancer survivors (Helgeson et al., 2004) and sexual assault victims (Steenkamp et al., 2012).

Consistent with expectations, the largest group of participants exhibited resiliency. Five out every 10 participants reported low levels of depression. Individuals in the resilient class experienced some symptoms of depression at hospitalization, but these symptoms were transient and never exceeded a moderate level. Individuals in the resilient class remained psychologically flexible in response to a potentially life altering event that required admission to the trauma unit (Bonanno et al., 2012). Other studies also document resiliency in a high percentage of individuals in the months and years following a PTE as reflected by low scores on measures of PTSD, depression, and anxiety and higher scores on general mental health (Bonanno et al., 2012; Lam et al. 2009; Myhren et al., 2010; van Leeuwen et al., 2012). The current study adds to literature showing resiliency as the primary pathway of recovery following a PTE.

The size and shape of the class exhibiting high distress in the present study corresponds with the size predicted by Bonanno et al., (2011). In the present study, only

eight percent of the sample reported high levels of depression throughout the year. The individuals in the chronic class could represent those with premorbid depression who continued to be depressed after a PTE. Although speculative, before the PTE individuals with chronic distress might have had higher levels of negative emotions and the combination of the two resulted in increased levels of depression. This idea was supported by previous research where higher levels of negative emotions before a PTE decreased general mental health (Bonanno et al., 2012; Galatzer-Levy et al., 2013).

The delayed class made up 22% of the sample, which was larger than the expected range of zero to 15% (Bonanno et al., 2011). The individuals in the delayed class initially reported sub-threshold levels of depression, which steadily increased throughout the duration of the study. While hospitalized, individuals in the delayed class nearly met the cutoff of 10 and by 12 months post-discharge exceeded the cutoff for a probable diagnosis depression. Consistent with previous findings, the individuals in the delayed class displayed an increase in psychological distress over time (Bonanno et al., 2005; Pietrzak et al., 2013). This class could represent individuals who initially underestimated the extent to which their injuries would affect their lives, but over time, they realized the negative effects of the PTE (deRoon-Cassini et al., 2010).

The 12% of the sample that comprised the recovering class was outside the expected range (15 - 20%). Consistent with prior research, the individuals in the recovering class, while hospitalized, exhibited clinically significant levels of depression, which decreased to subclinical levels by 12 months post-discharge (deRoon-Cassini et al., 2010). However, at the end of the study the average level of depression for the

recovering was one point below the cutoff score of 10 and a probable diagnosis of depression. If followed for another year, it is possible the individuals in the recovering class would report fewer symptoms of depression (Bonanno, Brewin, Kaniasty, & La Greca, 2010). The recovering class was considered the primary pathway of adjustment to a PTE, but the extent literature has failed to support this hypothesis (Wortman & Boerner, 2011). Only a minority of PTE survivors experience high levels of distress immediately following a PTE and improve slowly over time (Bonanno et al., 2012; Quale & Schanke, 2010).

The recovering class reported the second highest levels of depression while hospitalized, which indicated how psychologically impactful the PTE was for this class. However, the improvements seen over the first 12 months since being injured showed positive adaptations to an-out-of-the-ordinary experience and could be a result of flexibly expressing and suppressing positive and negative emotions (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004). Bonnano et al. (2004) showed that greater control over the expression and suppression of emotions predicted better adjustment to a PTE over time.

The chronic-worsening class comprised about 10% of the sample. This class was not identified in Bonanno et al.'s (2011) conceptualization, but it has appeared in subsequent studies of soldiers (Bonanno et al., 2012) and breast cancer survivors (Helgeson et al., 2004). In the present study, the chronic-worsening class had clinically significant levels of depression at hospitalization and throughout the first year post-discharge with no signs of abating.

The chronic-worsening class could represent participants who, prior to the PTE, were depressed, reacted negatively to a previous PTE, or were coping with other stressors and the stress of the PTE overwhelmed their ability to cope. It is likely they did not have the resources to adequately handle the additional stress imposed by the PTE. In previous research, a group with progressively worsening mental health lacked self-esteem, internal locus of control, and social support (Helgeson et al., 2004). The chronic-worsening class in this study may have had a negative self-view, felt they had little ability to affect change in their life, and were deficient in level of social support and therefore became increasingly depressed.

There was partial confirmation of the hypothesized direction of change for the classes described by Bonanno et al. (2011). The resilient and chronic classes were expected to have stable levels of depression over time. However, the resilient class reported significant decreases and the chronic class reported significant increases in depression over time. In addition, the delayed class reported significant increases in depression from hospitalization to 12 months post-discharge and the recovering class reported significant decreases.

Consistent with expectations, the resilient class at hospitalization reported significantly fewer depressive symptoms than the delayed, recovering, chronic, and chronic-worsening classes. However, the results did not support the hypothesis that the resilient and recovering class would not be significantly different at 12 months post-discharge. The resilient class at 12 months post-discharge continued to report

significantly fewer depressive symptoms than the delayed, recovering, chronic, and chronic-worsening classes.

Overall, the resilient class had the fewest symptoms of depression and was the largest class. The results also showed the individuals in the resilient class were not immune to effects of the PTE. The resilient class initially reported mild levels of depression, but the resilient individuals were able to persevere in the face of adversity. The percentage of resilient individuals in the present study is consistent with prior research (deRoon-Cassini et al., 2010; Myhren et al., 2010).

PTSD. The best fitting model for PTSD contained three classes. These classes included a low distress group (resiliency), a high distress group (chronic class) and a stable, moderately distressed group. Only two of the four described by Bonanno et al. (2011) were found in the current data. A three-class model was found among individuals admitted to an intensive care unit (Toien et al., 2010) and among individuals with multiple severe traumas (Quale & Schanke, 2010). In these two studies, the three classes represented low and high distress classes and a recovering class. The only other study to identify a stable, moderately high group examined sexual assault victims (Steenkamp et al., 2012). The model for PTSD found in the present study has not occurred in any other study to date.

The present study is also the first to use the PC-PTSD in an attempt to replicate Bonanno et al.'s (2011) four-class model. Consequently, it is possible that the four-item screener might not produce enough variability to capture the four classes described by Bonanno et al. (2011). In contrast, previous studies with a four-class model used longer

measures like Impact Event Scale (Toien et al., 2010), the PTSD Checklist (Pietrzak et al., 2013), or the Post Traumatic Stress Diagnostic Scale (deRoon-Cassini et al., 2010).

The resilient class comprised about 44% of the sample. In the previous studies that produced a three-class model, the resilient class comprised 49% (Toien et al., 2010) and 43% (Quale & Schanke, 2010) of the sample. The size of the resilient class was also within the range (35% - 65%) described by Bonanno et al. (2011) and consistent with other studies of resiliency (deRoon-Cassini et al. 2010).

Consistent with expectations, the largest group of participants exhibited low levels of PTSD: Four out every 10 participants reported low levels of PTSD. The resilient class endorsed less than one symptom of PTSD throughout the duration of the study. Recent research indicates that although individuals in the resilient class may report some difficulties with intrusive thoughts, avoidant behaviors, or hyperarousal (Toien et al., 2010), the resilient individuals in the current study essentially denied experiencing any symptoms related to PTSD. This, too, could be an artifact of the brief measure used to assess PTSD in the present study.

The chronic class comprised 22% of sample, which was within the range described by Bonanno et al. (2011) and similar to previous findings (Bonanno et al., 2005; deRoon-Cassini et al., 2010; Myhren et al., 2010). Twenty-two percent of the participants in the present study met criteria for a probable diagnosis of PTSD during the first year following a PTE. Initially, the chronic class did not meet criteria for a probable diagnosis of PTSD, but by three months post-discharge, their scores exceeded the cutoff score of three and met the criteria for a probable diagnosis of PTSD. The same pattern of

increasing levels of PTSD was previously reported in trauma survivors (deRoon-Cassini et al., 2010).

The chronic class included individuals who endorsed avoidant behaviors, intrusions, hyperarousal or distressing dreams throughout the duration of the study. Early symptoms of PTSD were a risk factor for the later development of PTSD (Shalev et al., 1998). Moreover, the stress of the PTE likely exceeded their ability to cope effectively (Agaibi & Wilson, 2005). Instead of emotionally processing the trauma and increasing distress tolerance, this class avoided reminders of the trauma and experienced the thoughts and dreams about the PTE as distressing, and became watchful for cues of danger (Brewin et al., 1996). It is also possible that individuals in the chronic class had an excessive focus on the consequences of the trauma, which could have interrupted processing of the PTE (Brewin et al., 1996). Avoidance is one of the primary symptoms of PTSD and leads to isolation, reduced social support, increased feelings of sadness and anger, as well as stronger physiological and emotional responses to reminders of the PTE. If individuals in the chronic class viewed the PTE as being too stressful for them to process and they avoided emotionally processing the PTE than it is likely their PTSD symptoms will increase over time (Ehlers, Mayou, & Bryant, 1998).

The stable, moderately distressed class, which was not identified as one of Bonanno et al.'s (2011) prototypical classes of adjustment, comprised about 31% of the sample in the present study. The PC-PTSD scores were moderately high and stable over time, but the average scores were below the cutoff indicative of a probable diagnosis of PTSD throughout the year. The stability and level of distress of this group was similar to

the pattern observed for the resilient class. Both classes reported fairly stable, subclinical levels of PTSD. However, the average level of distress for the stable, moderately distressed class was significantly higher than the resilient class. This class represented individuals who endorsed experiencing some avoidant behaviors, intrusive thoughts or hypervigilance.

The hypothesized direction of change for the classes described by Bonanno et al. (2011) was not supported. The resilient and chronic classes were expected to have stable levels of PTSD over time, but the resilient class reported significant decreases and the chronic class reported significant increases in PTSD over time. The PTSD scores for the stable, moderately distressed class did not change significantly over time.

Consistent with expectations, the resilient class at hospitalization and 12 months post-discharge reported significantly lower PC-PTSD scores than the chronic class and the stable, moderately distressed class. However, a recovering class was not found in this study; therefore, the hypothesis that the resilient and recovering classes would not be significantly different at 12 months post-discharge was not supported.

The resilient class was the largest class and it had the lowest PC-PTSD scores. The resilient class endorsed less than one out four symptoms clusters on average. The stable, moderately distressed class endorsed two out of the four symptom clusters on average, and the chronic class endorsed three out of the four symptoms cluster on average. One year after surviving a PTE, two out 10 participants meet criteria for a probable diagnosis for PTSD and 4 out of ten reported low levels of PTSD symptoms. These results are consistent with previous research on PTEs (see Bonanno et al., 2011).

Despite an injury severe enough requiring hospitalization most participants exhibited few symptoms of depression and PTSD during the first year of recovery. Most exhibited a stable psychological profile immediately following admission that generally improved over time. The resilient participants remained hardy in the face of adversity (Bonanno & Mancini, 2010). These results bolster the argument that resiliency is not a superhuman trait, but an inherent ability most people have (Bonanno, 2004).

Prediction of class membership

After the unconditional models were selected, psychological well-being and pain interference from the first assessment were added as covariates to improve model fit. Multinomial logistic regression analyses were employed to understand if the covariates included in the model (psychological well-being and pain interference while hospitalized) and the covariates not included in the model (gender, income, race/ethnicity, injury severity, education, pain interference scored at three, six and 12 months post-discharged, and psychological well-being scores at three and six months post-discharge) predicted class membership.

Depression. For the depression data, having pain that did not interfere with daily function in the four-weeks preceding the PTE predicted class membership and improved the odds of being in the resilient class compared to the delayed and recovering classes. Other studies of severely injured trauma survivors have found higher levels of physical functioning (Baranyi et al., 2007) and less pain (Toien et al., 2010) are associated with less psychological distress. However, decreased pain interference only increased the

odds of being in the resilient class by three percent. Moreover, the pain interference variable did not predict class membership beyond the first assessment.

Higher psychological well-being while hospitalized predicted class membership and increased the odds of being in the resilient class compared to all the other classes. Reporting more days of feeling calm and at peace and fewer days of feeling down and blue in the four-weeks preceding the PTE increased the odds of being in the resilient class between four and six percent.

Unlike the pain interference variable, higher psychological well-being at three and six months post-discharge was associated with increased odds of being in the resilient class compared to the delayed and recovering classes. For example, at three months post-discharge, the odds of being in the resilient class increased by eight percent for participants with higher psychological well-being compared to the delayed class. Positive emotions and feeling peaceful increased the odds of reporting low levels of depression (Galatzer-Levy et al. 2013). In addition, prior research has shown that perceived stress is associated with increased depressive symptoms (Catalano, Chan, Wilson, Chiu, Muller, 2011). It is possible that the resilient class experienced less stress preceding the PTE and therefore had more cognitive resources available to buffer the individuals against the stress associated with the PTE compared to the other classes.

At three months post-discharge, the chronic-worsening class had a positive beta weight for the psychological well-being variable, indicating that higher psychological well-being increased the odds of being the chronic-worsening class. However, the odds

ratio was one. In this case, higher psychological well-being scores did not increase or decrease the odds of being in the chronic-worsening class compared to the resilient class.

PTSD. Greater psychological well-being during hospitalization predicted class membership for the PTSD variable and increased the odds of being in the resilient class between two and five percent. Like the depression data, experiencing greater peace and calmness in the four-weeks preceding the PTE increased the odds of reporting low levels of PTSD symptoms. This trend continued at three and six months post-discharge in which greater psychological well-being increased the odds of reporting low levels of PTSD symptoms between three and eight percent.

For the PTSD data, age significantly predicted class membership. Older age was associated with increased odds of being in the resilient class between four and seven percent compared to the other classes. In the Brewin et al. (2000) meta-analysis, older age was identified as a protective factor against the negative effects of a PTE.

The results of the present study indicate greater psychological well-being over the first six months post-discharge, lower levels of pain interference during hospitalization and older age at the time of the injury were protective factors against a non-resilient outcome. These results were in the predicted direction. Experiencing less pain interference (Karoly & Ruehlman, 2006; Zatzick, et al., 2007) and having more positive emotions (Bonanno et al., 2012a; Kilic et al., 2012; McCauley et al., 2012) appear to protect against psychological distress.

Importantly, this may be the first study to investigate whether the presence or absence of mild TBI increased or decreased the probability of reporting low levels of

distress following a PTE. Despite previous research indicating that TBI is a risk factor for distress (Katz & Alexander, 1994; Zatzick et al., 2010), mild TBI did not predict membership in any of the classes at any time post-discharge. Additional research is warranted to better understand the intersection between mild TBI, PTSD and depression following a PTE (Vasterline, Bryant, Keane, 2012).

Gender, education, cause of injury, and ethnicity did not predict class membership at any measurement occasion. Prior research shows that female gender (Bonanno et al., 2011; Bonanno et al., 2006), lower education (Bonanno & Mancini, 2008; Bonanno et al., 2010) and intentional injuries (deRoon-Cassini et al., 2010; Johansen et al., 2007) are associated with increased distress or a non-resilient outcome following a PTE. However, in the current study these variables did not predict class membership.

However, the results from the multinomial logistic regressions should be interpreted with some caution. The odds ratio associated with the covariates in these analyses were around 1.00. The largest odds ratio only increased the probability of being in the resilient class by eight percent. This means the likelihood of the covariates affecting the reference class (i.e., resilient) or the response class (i.e., delayed, chronic, recovering, chronic-worsening, stable, moderately distress) was small.

Characteristics of latent classes

Participants in the resilient class incurred considerable injuries, but on average, their injuries were less severe than the ones experienced by the non-resilient classes. In addition, the resilient class was mostly male, European-American, and older. Compared

to the other classes, individuals in the resilient class were also almost as likely to be college educated as high school or less educated, to have earned more than $50,000.00 a year as, have higher psychological well-being and less pain interference, and a smaller percentage of resilient individuals had intentional injuries or a mild TBI.

Participants in the stable, moderately distress class were more likely to be European-American, male, high school or less educated, to have earned less than $50,000.00 a year, and report moderate levels of psychological well-being and pain interference scores. However, a higher percentage of participants who earned more than $50,000.00 a year were female and college educated were in this group. In addition, a smaller percentage of individuals in this group had a mild TBI or was from an ethnic minority group compared to the other classes.

Participants in the delayed class were more likely to have earned less than $50,000.00 a year, to be male, European-American, high school or less educated, and have moderate levels of psychological well-being and pain interference scores. This group also had a higher percentage of women and participation with intentional injuries, and a smaller percentage of ethnic minorities compared to other classes.

Participants in the recovering class were younger, almost as likely to be college educated as high school or less educated, and as likely to have earned more or less than $50,000.00 a year. In addition, this group had moderate levels of psychological well-being and pain interference scores, and had a smaller percentage of participants with intentional injuries, a mild TBI, and a greater percentage of ethnic minorities compared to the other classes.

Participants in the chronic and chronic-worsening classes were more likely to be younger, male, high school or less educated, and to have earned less than $50,000.00 a year. This group had a lower percentage of women and had a greater percentage of participants with intentional injuries and a mild TBI compared to the other classes. Additionally, this class had the lowest psychological well-being and the greatest pain interference.

Overall, the results showed those with a more chronic outcome were more like to be high school or less educated, to have earned less than $50,000.00 a year, had more pain that interfered with daily life and lower levels of psychological well-being. In addition, they had a greater percentage of participants with intentional injuries and a mild TBI. In contrast, the resilient class had more education, earned more money, had less pain interference, and higher psychological well-being. This group also had fewer participants with intentional injuries or a mild TBI. Although income, mild TBI, education, and cause of injury did not predict class membership, these variables help to differentiate those who were more likely to show a resilient versus a non-resilient outcome. These results on the characteristics of the classes coincide with previous research in which individuals in the resilient class had more economic resources, education, and fewer intentional injuries (Bonanno et al., 2007; Brewin et al., 2000; van Leeuwen et al., 2012).

Conclusions

As much of the previous research suggests, most individuals report low levels of distress following a PTE. The ability to persevere in the face of adversity is

characteristic of most survivors of a PTE. Individuals with low levels of distress find a number of different ways to cope. Bonanno (2004) argues there is no one road to resiliency. Adjustment following a PTE is idiosyncratic process and the variables influencing the process include self-enhancement, positive emotions, social support (Bonanno et al., 2011), self-image (Lam et al., 2012), self-efficacy and less anger (deRoon-Cassini et al., 2010). The process to outside observers may be perceived as "coping ugly," (Bonanno & Mancini, 2008, p. 372), but it is a process that allows a large portion of individuals to maintain their current level of functioning despite experiencing a significant out-of-the-ordinary event (Brewin et al., 2000).

The current results support previous studies investigating adjustment to a PTE using Bonanno et al.' (2011) process model. Adjustment following a PTE is not a "one size fits all" process. The four classes identified by Bonanno et al., (2011) were replicated with the depression data, albeit with the addition of a chronic-worsening class. The PTSD data produced a novel three-class solution containing a resilient, a chronic and a stable, moderately distressed class. These results confirm that recovery from a PTE is a heterogeneous process that can be influenced by demographic, psychological, and physical health variables. In the current study, greater health-related quality of life scores (i.e., psychological well-being, pain interference) and age predicted membership in the resilient class. In addition, only one group had stable levels of psychological distress. Each class reported significantly different scores across the yearlong study except the stable, moderately distressed class.

Clinical implications

Resiliency is the most common pathway of adjustment following a PTE. Individuals who show minimal symptoms of PTSD or depression or low psychopathology in general may not require an extensive menu of psychological services. The research to date suggests resilient individuals will find their own ways to cope, adjust, and evidence low levels of psychological distress. Perhaps it is more clinically important to identify those who will experience low to moderate levels of psychological distress. There are a host of different variables that can be used to help discern who will be and who will not be resilient (Bonanno et al., 2011). In the current study, psychological well-being, low pain interference and age were identified as protective factors. In turn, low psychological well-being and greater pain interference during hospitalization may serve as risk factors that merit clinical attention post-discharge. Although intentional injuries, mild TBI, income, and education did not predict class membership, they distinguished the non-resilient classes from the resilient class. These, too, may be important clinical indicators of future problems.

There is growing research showing that most people will not require the assistance of a mental health professional to recover from a PTE (Bonanno, 2004). Forcing resilient individuals to undergo psychological debriefing or any single session psychological intervention may cause distress (Mayou, Ehlers, & Hobbs, 2000). There is data to suggest that only a small percentage of people will benefit from psychological debriefing (Litz et al., 2002). Psychological debriefing should be used judiciously,

perhaps for individuals who appear to have characteristics indicative of a chronic distress pathway.

Any psychological intervention given to survivors of a PTE should be targeted like the brief intervention created by Bryant, Harvey, Dang, Sackville, and Batsen (1998) in which survivors have five weekly sessions and complete extensive homework focusing on cognitive restructuring. Psychological interventions immediately following a PTE should be limited to assessing whether survivors may need sustained psychological treatment, providing information on reactions to traumas, and treating emergent concerns (Litz et al., 2002).

Limitations and future direction

This study was not free from limitations. First, this study attempted to follow individuals treated by and discharged from an urban hospital, but during the yearlong study, a sizeable percentage of participants were lost to follow-up. Of the 479 individuals that consented to participate, 406 actually participated and only 127 had complete data. In addition, several variables were associated with missing data including age at injury, gender, education, income, mild TBI, cause of injury and levels of depression, PTSD, pain interference, and psychological well-being. The participants with complete data were different from participants with incomplete data. These differences could have affected the size and shape of the latent classes. It may also have influenced the variables that predicted class membership. In addition, the measures used in the current study were not normally distributed. Because of the missing data and the lack of normality, the results should be interpreted with some caution. However, the

research assistant for the project attempted to contact participants 12 times during each assessment window. Great efforts were taken to reduce and prevent attrition. To assuage the impact of missing data, multiple imputations were used on all continuous variables.

Another limitation is that the participants were a convenience sample. Only individuals sent to this specific hospital during the enrollment period could have participated in the current study. The hospital is in a large urban city and it serves a wide variety of patients. However, the pool of potential participants is limited to one hospital with its particular catchment area. In the future, longitudinal studies of adjustment to a PTE could benefit from a multisite investigation to reduce potential selection bias.

A third limitation is the length of the study. Following participants for a year is longer than many studies investigating adjustment to a PTE, but there are examples of studies following participants up to 10 years post-discharge. Moreover, Bonanno (2004) suggests that recovering from a PTE can take many years. In the current sample, the depression data showed a recovering class, but the decline in depression symptoms did not match the proposed pathway described by Bonanno et al. (2011). We do not know if participants in the recovering class would continue to experience fewer symptoms past the final measurement occasion and eventually report levels of depression comparable to the resilient class. Future research should examine data collected over several years.

There were no pre-injury data for participants. Thus, we do not know if participants in the chronic or chronic-worsening class were experiencing clinical levels of depression or PTSD before the PTE, or if the co-occurrence of a psychiatric condition and a PTE produced a high distress outcome following a PTE. The PHQ-8 requires participants to

think about how they were functioning in the two weeks before the PTE, but the extreme nature of the PTE may have influenced their judgments, which would also affect their judgment about pre-injury functioning.

It would be difficult to collect pre-injury data without having a substantially larger pool of participants because the researchers would have to wait until a certain amount of the pool experienced a PTE. In the future, researchers could involve friends and family member of participants who survived a PTE in order to gain a better understanding of the participants functioning before the PTE. This method was used by Bonanno et al. (2005) when investigating resiliency following the 9/11 terrorist attacks.

The study is also limited by the reliance on self-report questionnaire data. Self-reported data can be biased by social desirability, misunderstanding of questions, and fatigue. Perhaps future studies could include physiological data (e.g., levels of the stress hormone, cortisol, blood pressure) and behavioral observations from alternate sources like friends and family members. Moreover, the measure use to assess PTSD symptoms, the PC-PTSD may have been insufficient to adequately capture the four class identified by Bonanno given its limited range of response options and questions. The measure of psychological well-being did not fully capture positive affect or emotions and is not the best measure of positive emotions.

This study attempted to explore the intersection between PTSD, depression, and mild TBI, but mild TBI did not predict class membership. The inability of mild TBI to predict class membership given the overlap in causes, symptoms, and comorbidity highlights a possible limitation in the way cases of mild TBI were measured and conceptualized. For

example, measuring mild TBI based on ICD-9 codes may not provide the sensitivity required to capture the individual variation in mild TBI or identify individuals with persistent symptoms. Instead of relying solely on ICD-9 codes, future studies can look to incorporate a measure post-concussive symptoms throughout the study period because those who are likely to exhibit persistent symptoms related to a mild TBI do so in the weeks and months following the PTE. In the same way that Bonanno's model provides a fine tuned method for understanding recovery from a PTE, measurement of mild TBI in the future should be more specific than relying on the information provided by the ICD-9 codes. Finally, like most studies of adjustment to a PTE the current study used measures of psychopathology to chart the trajectories of adjustment. Future research could use positively-valenced variables on which the resilient class would theoretically score higher than other classes, such as measure of quality of life, social support, or psychological well-being. This would provide further support for Bonanno's process model among persons admitted to a Level 1 trauma center and demonstrate that resiliency is not merely the absence of psychopathology, but the presence of positive adjustment.

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