MONASH University

AN INVESTIGATION OF POST-TRAUMATIC GROWTH FOLLOWNG TRAUMATIC BRAIN INJURY

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LIST OF TERMS

ABI	Acquired Brain Injury
ACT	Acceptance and Commitment Therapy
AIC	Akaike's Information Criterion
BIC	Bayesian Information Criterion
CiON	Changes in Outlook Questionnaire, Negative Subscale
CiOP	Changes in Outlook Questionnaire, Positive Subscale
CiOQ	Changes in Outlook Questionnaire
CiOQ-S	Changes in Outlook Questionnaire, Short form
DAI	Diffuse Axonal Injury
DSM	Diagnostic and Statistical Manual
GAD	Generalised Anxiety Disorder
GCS	Glasgow Coma Scale
GOS-E	Glasgow Outcome Scale - Extended
HADS	Hospital Anxiety and Depression Scale
HADS-A	Hospital Anxiety and Depression Scale, Anxiety Subscale
HADS-D	Hospital Anxiety and Depression Scale, Depression Subscale
LOC	Loss of Consciousness

PTA	Post-traumatic Amnesia
PTG	Post-traumatic Growth
PTG-BM	Behavioural Measure of Post-traumatic growth
PTGI	Post-traumatic Growth Inventory
PTGI-SF	Post-traumatic Growth Inventory, Short form
PTSD	Post-traumatic Stress Disorder
SCID	Structured Clinical Interview for DSM Disorders
TBI	Traumatic Brain Injury
VL	Valued Living
VLQ	Valued Living Questionnaire

ABSTRACT

Post-traumatic growth (PTG) is the experience of positive psychological change which emerges through a struggle with highly challenging life events. There is increasing support for the notion that PTG may occur following traumatic brain injury (TBI). PTG is associated with vitality, life satisfaction, optimism, increased levels of activity and improved general health. Given these potential benefits, clinicians have begun to focus their rehabilitative efforts on encouraging growth following TBI. As the process of PTG involves a reorganisation of life's priorities and a renewed sense of personal meaning, it is likely that valued living or living in accordance with one's values and PTG are related constructs. Valued living (VL) has been an important goal in rehabilitation; however, its role in functional and psychological adjustment following TBI has not been established. The relationship between VL and PTG also remains to be investigated. An accurate account of factors associated with PTG and its development over time is lacking given the small number of studies in the field and issues relating to measurement and conceptualisation of PTG.

Accordingly, the overall aim of the research presented in this thesis was to further our understanding of PTG following TBI. This broad aim was explored by addressing a number of specific research questions seeking to: (a) examine the role of valued living (VL) following TBI, especially its association with psychological and functional outcomes; (b) evaluate the comparative predictive validity of two measures of PTG to determine their relative suitability for use with a TBI population; and lastly (c) to examine the time-course and predictors of PTG following TBI.

The sample included participants with moderate to severe TBI who were recruited from consecutive TBI admissions to an inpatient rehabilitation hospital. Three cohorts were recruited: the first group ('Early') was recruited soon after emergence from PTA, within 3-6 months' post-injury (n = 28); a second cohort was recruited 12-24 months' post-TBI ('Mid,' n = 9) and a third cohort was recruited 36-60 months' post TBI ('Late,' n = 36). All participants were assessed at time of recruitment and 12 months later regarding current functioning. Questionnaires administered at both assessments for all three groups were: Changes in Outlook Questionnaire-Short form (CiOQ-S) and Post-traumatic Growth Inventory-Short form (PTGI-SF) as measures of PTG; Valued Living

Questionnaire (VLQ) as a measure of VL; Hospital Anxiety and Depression Scale; Structured Clinical Interview for DSM Disorders for diagnosis of psychiatric disorders and Glasgow Outcome Scale–Extended (GOS-E). The initial assessment for the Early cohort also examined pre-injury personality. Demographic and injury details were collected.

Results revealed that overall levels of PTG reported by the current sample were comparable to results of previous studies among TBI and other trauma populations. Reports of positive outlook outnumbered reports of negative outlook, and self-generated examples of behavioural change consistent with PTG were provided by approximately 45% of participants. Results revealed that compared to pre-injury estimates, VL was significantly reduced at 12 months' post-injury. Levels of VL remained reduced between 2-3 years and increased between 3-6 years post-injury. VL was strongly associated with improved functional and psychosocial outcomes. Changes in VL occurred over at least 3-5 years post-injury, with 12 months post-TBI a suitable time for intervention given VL remains low over the next 24 to 36 months' post injury. Based on these results, it was surmised that targeted intervention to facilitate re-evaluation of one's values and/or valued activities to be consistent with post-injury capacity could improve rates of return to pre-injury levels of VL.

In regards to the second aim, of the two measures of PTG (the PTGI-SF and CIOQ-S), the positive and negative subscales of CiOQ-S were more closely associated with post-injury outcomes. In particular, PTG as measured by positive subscale of the CiOQ-S was associated with return to work/study, improved levels of VL and increased behavioural reports of positive growth. These results suggested that CIOQ-S has better predictive validity than PTGI-SF and may be a more suitable measure of PTG following TBI. Extending these findings, the time-course and predictors of PTG were explored using the CiOQ-SF data to address the third aim. Results revealed that overall participants reported more positive than negative outlook. Time post-injury did not share a direct linear relationship with trajectory of PTG in the first 6 years following TBI. More years of education, being in a relationship and remaining in employment/study were associated with greater PTG.

In combination, the results of this study suggest that VL and PTG are related constructs that continually evolve over an extended period of at least 1 to 6 years. Although levels of PTG do not

appear to stabilise by 6 years post-injury, it is encouraging to note that PTG is associated with return to work/study and higher levels of value consistent living. Reports of PTG also appear to be associated with specific change in behaviours, especially those seeking to improve their level of social engagement with others. These behaviours alongside value consistent living could be fostered in rehabilitation to promote the development of PTG. It is suggested that future research continue to examine measurement related issues, specifically to generate a set of norms for the conceptualisation of and measurement of PTG over time. Qualitative studies could be designed to examine broader contributing factors to positive growth that may have been previously overlooked. Large scale longitudinal studies examining the temporal course of PTG over an extended one- to ten-year period would also be recommended, especially given the wide degree of individual variability demonstrated by this current research.

GENERAL DECLARATION

In accordance with Monash University Doctorate Regulation 17 the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes three manuscripts that have been submitted for publication. The core theme of the thesis is post-traumatic growth following traumatic brain injury. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working within the Department of Psychology under the supervision of Professor Jennie Ponsford, Dr Dana Wong and Dr Kate Gould.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of three chapters, my contribution to the work involved the following:

Thesis Chapter	Publication Title	Publication Status	Nature and extent of candidate's contribution
Two	Role of Valued Living and Associations with Functional Outcome following Traumatic Brain Injury	In Press	70% contribution by candidate. This included formulation of experimental design, data collection, data analysis and writing manuscript.
Three	Measurement of Post-traumatic Growth following Traumatic Brain Injury: Comparing the Predictive Validity of Two Measures	Submitted	70% contribution by candidate. This included formulation of experimental design, data collection, data analysis and writing manuscript
Four	Time-course and Predictors of Post-traumatic Growth following Traumatic Brain Injury	Submitted	70% contribution by candidate. This included formulation of experimental design, data collection, data analysis and writing manuscript

I have renumbered sections of submitted papers in order to generate a consistent presentation within the thesis.

Signed: _____

Date: 20/02/17

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CHAPTER ONE

INTRODUCTION

1.1 TRAUMATIC BRAIN INJURY

Traumatic Brain Injury (TBI) is commonly defined as an insult to the brain, caused by an external physical force, resulting in an alteration of brain function (Menon, Schwab, Wright, & Maas, 2010). TBI can result in range of impairments of cognitive abilities or physical functioning, as well as disturbances of behavioural or emotional functioning (Khan, Baguley, & Cameron, 2003). Following the initial physical recovery, these pervasive cognitive, behavioural and emotional changes may continue to adversely affect the individual's quality of life for decades after the injury. These difficulties can interfere with everyday functioning and impair the individual's ability to return to work, resume important life roles, re-engage in leisure activities and reintegrate into their community (Langlois, Rutland-Brown, & Wald, 2006; Ponsford & Hsieh, 2012). In many ways, the individual's capacity to lead an independent life may be compromised and subsequent difficulties with psychological adjustment are associated with an increased incidence of psychiatric disorders, particularly depression and anxiety disorders (Gould, Ponsford, Johnston, & Schönberger, 2011b).

A major part of adjustment following TBI, involves re-evaluation of one's self-concept (Moldover, Goldberg, & Prout, 2004). Individuals who are able to reflect on their values to shape a new set of achievable goals post-injury may build a sense of purpose and meaning for the future (Gracey, Evans, & Malley, 2009; Gracey et al., 2008). This new-found sense of meaning has been linked to reports of post-traumatic growth (PTG) (Powell, Gilson, & Collin, 2012; Tedeschi & Calhoun, 2004). Given the recency of research interests in PTG, little is known about its nature and course within the TBI population. It is unclear exactly when PTG emerges post TBI and how it evolves over time, particularly over longer periods of 4 to 10 years post-injury. It is also uncertain whether any demographic, injury, personality or value related factors can be predictive of PTG following TBI. Furthermore, no study has yet investigated links between psychiatric disorders following TBI and the likelihood for PTG.

This chapter will review literature with a focus on PTG following TBI. After an overview of the epidemiology and pathophysiology of TBI, the cognitive, behavioural, emotional sequelae of TBI, and their impact on functional outcomes across a range of domains will be outlined. This will

be followed by a brief review of the literature concerning the most common psychiatric disorders following TBI and role of self-concept, values and valued living (VL) in rehabilitation post-injury. Next, the concept of PTG will be introduced, measurement and conceptualisation of PTG will be considered, and factors that have been found to be associated with PTG in other trauma populations will be explored. This will provide a context for the limited research findings regarding PTG within the TBI population.

1.1.1 Epidemiology of TBI

TBI is the leading cause of injury related hospitalisation, disability and death worldwide (Harvey & Close, 2012; Helps, Henley, & Harrison, 2008). A minimum of 10 million cases of TBI serious enough to result in hospitalisation or death occur annually (Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye, 2007). A large epidemiological study of TBI in the Australian population reported that there were 22,710 hospitalisations involving TBI between the years 2004 and 2005 (Helps et al., 2008). These resulted in over 26,000 episodes of inpatient care with costs totalling $184 million. Beyond the costs of direct primary care, TBI causes ongoing disability, causing a major financial burden for the affected individual and society at large. The percentage of injury-related productivity loss attributed to TBI (15.7%) is 14 times that associated with spinal cord injury (Finkelstein, Corso, & Miller, 2006). In addition to disability, TBI can lead to increased risk for other health conditions. People with TBI are more likely to report binge drinking, more likely to develop epilepsy and also more likely to die (Langlois, Rutland-Brown, & Wald, 2006).

Common causes of TBI include motor vehicle accidents, falls, violent assaults as well as recreation, workplace and sporting accidents (Corrigan, Selassie, & Orman, 2010; Von Holst, 2009). Risk factors associated with TBI include age, gender, socioeconomic status and drugs. The first peak incidence of TBI occurs in 18-25 years age group (Baguley, Cooper, & Felmingham, 2006; Corrigan et al., 2010) and a second peak incidence occurs in adults aged of 75 years and older (Langlois, Rutland-Brown, & Thomas, 2004). The most common causes of TBI in young adults are assaults

and motor vehicle accidents, whereas TBI in older adults is usually a result of accidental falls (Corrigan et al., 2010). Irrespective of age, males have a higher risk (2-3:1) of sustaining a TBI compared to their female counterparts (Corrigan et al., 2010; Helps et al., 2008; Von Holst, 2009). It has also been found that persons under the influence of drugs and/or alcohol are at heightened risk of TBI (Bell & Elizabeth Sandel, 1998; Von Holst, 2009), most likely as a consequence of being in a motor vehicle accident. Additionally, TBI is more commonly reported in individuals with poorer educational background (Von Holst, 2009), those from a lower socioeconomic status (Heffernan et al., 2011) and minority groups (Bruns Jr & Hauser, 2003). These three factors are often present concurrently and their combined effect may confer a higher risk of TBI.

Severity of TBI may be graded into mild, moderate or severe using a number of classification systems, the most common of which are summarised in Table 1.1 (Faul & Coronado, 2015). The Glasgow Coma Scale (GCS) is used to rate level of consciousness according to eye movements and motor and verbal responsiveness (Jennett & Teasdale, 1977). Loss of consciousness (LOC) refers to the duration of coma; whilst post-traumatic amnesia (PTA) denotes a period of generalised confusion, marked by an inability to consolidate new memories (Ponsford, Sloan, & Snow, 2012). The duration of PTA can be used to gauge injury severity and has been shown to be one of the strongest predictors of TBI outcome (Iaccarino, Bhatnagar, & Zafonte, 2015).

Table 1.1. Common Classifications of TBI Severity

Injury Index	Mild	Moderate	Severe
GCS	13-15	9-12	3-8
LOC	<30 minutes	30-60 minutes	>60 minutes
PTA	< 24 hours	1-7 days	>7 days

Note. GCS = Glasgow Coma Scale; LOC = loss of consciousness; PTA = post traumatic amnesia.

1.1.2 Pathophysiology of TBI

TBI is a combined result of biomechanical, biochemical and pathological processes that are set in motion by the initial trauma to the head. Closed head injuries occur when rapid acceleration, deceleration or rotational forces are imparted to the intracranial contents without penetrating the skull (McKee & Daneshvar, 2015). These forces can be concurrent with or independent of direct blunt force trauma (Santiago, Oh, Dash, Holcomb, & Wade, 2012). Injuries typically produce diffuse brain swelling, contusions, haematomas, diffuse axonal injuries and depressed skull fractures (Santiago et al., 2012). Civilian cases of TBI are most commonly a result of closed trauma (88-95%) rather than penetrating trauma (5-12%) (Demetriades et al., 2004; Gennarelli, Champion, Copes, & Sacco, 1994; Peek-Asa, McArthur, Hovda, & Kraus, 2001). Since closed head injury cases are more commonly seen in clinical settings, this type of injury will form the focus of the rest of this review. Pathophysiological outcomes following closed TBI have been divided into primary injury and secondary injury components.

1.1.2.1 Primary Mechanisms of TBI

Primary brain injury occurs as a direct result of physical trauma to the brain (Mustafa & Al-Shboul, 2013; Werner & Engelhard, 2007). Injury can include lacerations to brain tissue, shearing of white matter tracts and cranial nerves, blood-brain barrier disruption, haematomas and contusions (Maas, Stocchetti, & Bullock, 2008). Primary brain injury occurs in the minutes to hours following the physical trauma (Werner & Engelhard, 2007). Blood-brain barrier disruption has been shown to occur as early as three minutes following brain injury (Fukuda, Tanno, Okimura, Nakamura, & Yamaura, 1995). Transection of neuronal axons and widespread lesions to white matter tracts termed ‘diffuse axonal injury’ (DAI) represents one of the most important mechanisms of primary brain damage (Mendelow & Teasdale, 1983). DAI is a major cause of LOC and prolonged coma following TBI (Maas et al., 2008). DAI evolves over time (Maas et al., 2008). The process usually begins at the site of a damaged axon which forms retraction balls thought to represent extruded axoplasm

(McGinn & Povlishock, 2015). In the following few days an inflammatory cellular reaction develops around the torn axonal fibres producing a microglial scar. Subsequently, the distal aspect of the axon begins to degenerate.

Unlike DAI which tends to affect the deeper subcortical regions of the brain, cerebral contusions and haematomas produce localised focal lesions on the grey matter closest to surface of the brain (Zink, Szmydynger-Chodobska, & Chodobski, 2010). These types of injuries most commonly result from linear acceleration forces (Zink et al., 2010). Cerebral contusions are bruises to the brain with vascular injury resulting in microhaemorrhages of small blood vessels supplying the underlying brain tissue (Blumbergs, 1997). Coup injuries usually occur at the crests of gryri from contact related impact when the brain is pushed abrasively against the skull (Blumbergs, 1997; Mendelow & Teasdale, 1983). Further contracoup contusions can occur as the brain rebounds from the original site of impact (Blumbergs, 1997; Mendelow & Teasdale, 1983). Cerebral contusions are most common on the bony undersurfaces of the frontal lobes and around the poles of the temporal lobes (Mendelow & Teasdale, 1983). Vascular damage leading to haematomas is more extensive than in cerebral contusions. Haematomas are caused by deformation of larger blood vessels leading to their rupture at the time of impact (Blumbergs, 1997). This leads to an extravasation of blood between the skull and brain (subdural) or within the brain (intracranial) depending on the location of the ruptured blood vessel. Smaller haemorrhages may coalesce to form larger hematomas (Blumbergs, 1997). Large haematomas pose a serious threat to the integrity of the brain as they occupy the already limited space and compress the brain within the cranial vault leading to complications via secondary brain injury mechanisms.

1.1.2.2 Secondary Mechanisms of TBI

Secondary brain injury occurs in the hours to weeks following the initial injury and represents the complications which arise as consequence of primary brain injury (Mustafa & Al-Shboul, 2013; Werner & Engelhard, 2007). Outcomes of secondary brain injury include oedema formation, increased intracranial pressure, ischaemia, brain shift, oxidative damage and

neuroinflammation (Mendelow & Teasdale, 1983). Complications associated with secondary brain injury predominantly involve disruptions to the auto regulation of cerebral blood flow (Zink et al., 2010). This is often as a result of haematomas which increase intracranial pressure and compress the underlying brain tissue, further restricting blood flow. The decoupling of the cerebral blood flow to match the metabolic requirements of the brain leads to ischemia-like patterns within neurons which can subsequently lead to the accumulation of fluid within cells referred to as cytotoxic oedema (Werner & Engelhard, 2007). Both the oedema and haematoma can continue to raise the intracranial pressure. If not immediately managed, increase in intracranial pressure can cause the brain to herniate through cavities in the skull or shift within the cranial vault (Mendelow & Teasdale, 1983). Displacement of brain matter into the tentorial hiatus (transtentorial herniation) or through the foramen magnum (tentorial herniation) can be fatal as it is associated with compression of brainstem structures important for maintaining respiration rate and consciousness (Mendelow & Teasdale, 1983).

As the pathological cascade continues, a series of biochemical reactions occur within neurons. Terminal membranes of neurons depolarise, releasing excessive amounts of excitatory neurotransmitters, such as glutamate and aspartate (Greve & Zink, 2009). These in turn cause an intracellular influx of calcium which activates peroxidases, proteases and phospholipases (Greve & Zink, 2009; Werner & Engelhard, 2007). These enzymes begin to digest the intracellular components, producing harmful free radicals in the process of oxidation (Werner & Engelhard, 2007). Free radicals damage the nucleosomal DNA, ultimately triggering cell death via apoptosis (Greve & Zink, 2009). Proinflammatory cytokines and immune cells are recruited to clean up debris but their continuing presence leads to a chronic state of neuro-inflammation (Zink et al., 2010).

1.1.3 Sequelae of TBI

Trauma to the brain can result in a set of enduring and persistent disturbances in neurological, cognitive, emotional and behavioural functioning. Despite variations in pathophysiology of TBI, a

common set of post-injury sequelae are reported, with the extent of difficulties dependent on severity of injury and premorbid characteristics (Riggio, 2011).

1.1.3.1 Neurological Sequelae

The most commonly reported neurological symptoms following TBI include: headaches, nausea or dizziness, fatigue, sleep disturbances and seizures (Blyth & Bazarian, 2010; Riggio, 2011). Symptoms of headaches, nausea and dizziness typically subside within 3 months post-injury (Couch & Bearss, 2001; Masson et al., 1996). Comparatively, fatigue and sleep disturbances are more debilitating and persistent outcomes for many individuals follow head injury. Fatigue and sleep disturbances are reported by approximately 73% of patients post-injury (Bushnik, Englander, & Wright, 2008; Cantor et al., 2008; Rao & Rollings, 2002). It is suggested that they are likely to be associated with poorer social integration, reduced levels of activity, poorer quality of life and slower rehabilitative recovery (Riggio, 2011). When present together, it is very likely that sleep disturbances contribute to the maintenance of chronic fatigue. Post-traumatic seizures can also develop following TBI (Annegers, Hauser, Coan, & Rocca, 1998; Chadwick, 2000; Riggio, 2011). Seizures commonly originate in either the frontal or temporal lobe regions (Riggio, 2011) and are most common in severe head injury cases involving an intracranial haemorrhage (Annegers et al., 1998; Chadwick, 2000).

1.1.3.2 Cognitive Sequelae

Cognitive sequelae following TBI include impairments in attention, memory, executive function, language and aspects of self-awareness (Dikmen et al., 2009; McCullagh & Feinstein, 2011). In uncomplicated cases of mild TBI, cognitive deficits have been shown to resolve within a period of 1-3 months (Frencham, Fox, & Maybery, 2005). In cases of moderate to severe injuries cognitive deficits tend to be more persistent (Dikmen et al., 2009). Impaired attentional processes are present at all levels of injury severity (Ponsford, 2008; Stierwalt & Murray, 2002) and because attention is essential for all other aspects of cognition, even a mild impairment can restrict new learning in rehabilitation and other contexts. Commonly reported symptoms relating to attentional

difficulties include: mental slowing, trouble following a conversation, losing the train of thought and difficulty paying attention to more than one thing at a time (McCullagh & Feinstein, 2011).

Following TBI, abnormalities in selective and sustained attention have been reported in patients with moderate to severe head injury (Mathias & Wheaton, 2007; Ponsford, 2008). Comparatively, abnormalities in divided attention have been demonstrated in patients with all levels of injury severity (Paré, Rabin, Fogel, & Pépin, 2009). In addition, there appears to be reduced information processing speed in most individuals following TBI. Compared to controls, people with TBI demonstrate slowing of reaction time that is proportional to task complexity (McCullagh & Feinstein, 2011).

Various aspects of memory are also impacted following TBI including episodic, working and prospective memory. Difficulties with episodic memory or memory of one's own life experiences is one of the most commonly reported cognitive complaints following TBI and can include reductions in immediate and delayed recall (verbal and visual), naming, verbal fluency and information processing speed (Dikmen et al., 2009). TBI also commonly disrupts working memory, or the ability to hold and manipulate information held in short-term stores of the mind. Neuropsychological (Vallat-Azouvi, Weber, Legrand, & Azouvi, 2007) and neuroimaging (Turner & Levine, 2008) studies have shown that TBI affects the manipulation aspects working memory rather than passive storage or rehearsal aspects. TBI has also been demonstrated to impact prospective memory processes. As prospective memory is necessary to enact future-based intentions, impairment in this memory system leads to problems such as forgetting to take medication, attend appointments or pay bills on time (McCullagh & Feinstein, 2011). As a result, the capacity for independent living may be compromised. However, not all memory processes are equally affected. Implicit procedural memory skills may remain intact following TBI (McCullagh & Feinstein, 2011).

The extent and type of deficits in executive functioning may contribute significantly to functional outcome following TBI (Crepeau & Scherzer, 1993). Executive functions refer to higher order cognitive abilities which engage and direct other mental activities such as attention, memory and motor behaviour (McCullagh & Feinstein, 2011). Studies involving participants with moderate

to severe TBI have revealed deficits in application of strategic memory (Vakil, 2005), planning ability (Cazalis et al., 2006), self-awareness and self-regulation (Levine, Dawson, Boutet, Schwartz, & Stuss, 2000), executive attentional functions (Zoccolotti et al., 2000), concept formation and mental flexibility (Benge, Caroselli, & Temple, 2007). On many occasions, especially following mild TBI, deficits in executive functions may only become apparent in conditions of increased demand and task complexity (McCullagh & Feinstein, 2011). In such circumstances the individual is forced to sacrifice speed and overcome accumulating mental fatigue to perform the required tasks (McCullagh & Feinstein, 2011).

In addition to impairments in executive functioning, aspects of language and communication can also be compromised. Studies have shown declines in phonemic and semantic fluency following moderate to severe TBI (Henry & Crawford, 2004). In some instances, aphasias can also result following TBI with anomia and Wernicke's type receptive aphasias being the most common (Richardson, 2000). More commonly one sees word-finding difficulties, or problems with verbosity, turn-taking and self-monitoring of verbal output and/or poor comprehension of abstract language or humour, due to executive dysfunction (Ponsford et al., 2012). Following the resolution of language deficits, dysarthria may persist (Richardson, 2000), making verbal communication a perpetually difficult task.

1.1.3.3 Emotional and Behavioural Sequelae

Following TBI individuals may experience difficulties with emotion perception (Bornhofen & McDonald, 2008). Emotion perception describes the ability to accurately perceive and appreciate affective information from facial expressions, emotional prosody, body posture, and contextual parameters (Bornhofen & McDonald, 2008). Some individuals with TBI have been shown to demonstrate an inability to recognize affective information from the face, voice and bodily movement (Allerdings & Alfano, 2006; Croker & McDonald, 2005; McDonald & Saunders, 2005; Milders, Fuchs, & Crawford, 2003; Spell & Frank, 2000). There are also some results emerging which suggest that individuals following TBI may struggle to make accurate mental state inferences,

to judge sincerity, lies or sarcasm (Bibby & McDonald, 2005; McDonald & Flanagan, 2004; Muller et al., 2010). Poor emotional perception in social interactions may result in the inability to appropriately interact with others leading to subsequent social isolation.

Emotional and behavioural sequalae are closely related following TBI. Difficulties with behavioural control of emotional states following TBI gives rise to impulsivity, irritability, aggression, reduced frustration tolerance, apathy, socially inappropriate behaviours and affective instability such as mood swings (Ponsford & Hsieh, 2012). Emotions experienced post-injury can be more intense and frequently changing, with sudden occurrence of transient emotional states (McAllister, 2008; Prigatano, 1992). Behaviourally, these may appear as exaggerated displays of extreme emotions such as weeping or angry outbursts (McAllister, 2008). There is often remorse for these behaviours (McAllister, 2008) suggesting that emotional volatility is related to lack of control and impulsivity. Impulsivity often results when individuals become stimulus bound –responding to the most salient cue in the environment without consideration of its consequences or regard to previously determined priorities (McAllister, 2008; Rochat et al., 2010). As a result of impulsivity, the individual often makes snap decisions with poor judgement (Rochat et al., 2010). Emotional volatility, combined with impulsivity, disinhibition and poor self-awareness can result in socially inappropriate responses such as swearing, sexually explicit comments and unwanted sexual advances (Lippert-Grüner, Kuchta, Hellmich, & Klug, 2006).

Increased irritability, emotional instability and impulsivity are likely to give rise to aggression. Aggression manifests most commonly verbally but also physically (Baguley et al., 2006). It is frequently reported with moderate or severe head injury cases, with risk factors including higher premorbid aggression, frontal lobe injury, premorbid personality or affective disorder and alcohol and substances use (Alderman, 2003; Baguley et al., 2006; Riggio, 2011). Another behavioural outcome of TBI is apathy. Apathy describes a lack of initiative or motivational drive to engage in behaviour (Marin, 1991). It is often mistaken for depression or laziness and may impede rehabilitative efforts (McAllister, 2008).

1.1.4 Functional and Psychosocial Impact of TBI

As a result of ongoing cognitive, emotional and behavioural difficulties following TBI, the lives of those injured can become vastly disrupted. A review of community rehabilitation outcomes reported that many individuals do not return to valued life roles or reach previous levels of integration within their community following injury (Sloan, Winkler, & Callaway, 2004). Specifically, it was highlighted that many individuals with TBI report significant changes in their living arrangements, leisure pursuits, social engagements and in their ability to return to work or study. Due to the persisting nature of these cognitive, neurological and behavioural sequalae, the impact of these difficulties can continue for decades after the injury.

Dikmen and colleagues (2003) reported that while there were significant gains in independent self-care over a span of three to five years following moderate to severe TBI, 30% of individuals were still unable to work or study and 20% were continuing to experience difficulties performing in their previous work roles. In relation to social outcomes, they reported that 45% of individuals with TBI acknowledged some change in their ability to engage in social activities as a result of the injury, with further 25% noting a reduction in their number friends, an inability to make new friends, or less contact with family and friends. Similarly, Tate and colleagues (2005) reported that while 81% of a group of severely injured individuals with TBI were able to independently self-care at 6 years post-injury, employability remained low at 45.5%. Comparable rates of employment are reported at 10-12 years post-injury (Ponsford, Draper, & Schönberger, 2008).

Furthermore, a recent review of longitudinal outcomes with three consecutive follow-ups (two, five and ten years) over a span of a decade (Ponsford et al., 2014) reported that despite a high level of independence in certain life areas (i.e. 70% return to driving), only half the sample returned to previous leisure activities and fewer than half were employed at each assessment time post-injury. Additionally, 20-30% of individuals with TBI continued to require assistance with heavy domestic activities, shopping and managing finances ten years after injury.

Ongoing impairments in functional and psychosocial adjustment not only impact the individual and caregivers but also the wider society due to significant economic costs and the

enduring nature of associated burden of disease. In the state of Victoria alone, the lifetime cost associated with moderate and severe TBI has been estimated to be $2.6 million and $5.0 million, respectively (Access Australia, 2009). Outcome studies investigating predictors of employment post injury have demonstrated that pre-injury employment, functional status at discharge, emotional wellbeing, engagement with vocational rehabilitation services and cognitive functioning are consistently associated with employment outcomes post injury (Ownsworth & McKenna, 2004; Ponsford et al., 2008). Collectively these studies suggest that although gradual gains in functional outcomes occur with increasing time post-injury, overall participation in daily activities continues to be at a lower level than pre-injury functioning for decades after the injury. The provision of appropriate rehabilitation services particularly those targeting return to employment and/or study as well as social aspects of re-integration into the community may have the potential to improve the quality of life for individuals with TBI, their caregivers and the wider society.

1.2 PSYCHOLOGICAL ADJUSTMENT POST-INJURY

1.2.1 Mood and Anxiety Disorders Post-Injury

The prevalence of anxiety and mood disorders is significantly increased following TBI. Amongst the mood disorders, major depression is most common with a wide-ranging estimated prevalence of 18.5 – 77% (Alway, Gould, Johnston, McKenzie, & Ponsford, 2016; Gould et al., 2011b; Whelan-Goodinson, Ponsford, Johnston, & Grant, 2009). Commonly reported symptoms of depression following TBI include low mood, distorted self-representation, lack of motivation and anhedonia, subjective cognitive complaints, and hyperactive and disinhibited behaviours (Jorge et al., 2004; Jorge & Starkstein, 2005).The strongest risk factor for depression after TBI is a premorbid history of depression or other mental health problem such as substance use disorder, although depression may occur in a significant proportion of individuals for the first time after injury (Alway, Gould, et al., 2016; Gould et al., 2011b). Depression is also associated with poorer functional outcome including lower likelihood of employment (Alway, Gould, et al., 2016). A history of stress, adversity and limited social support networks are also risk factors for the manifestation of psychiatric illness post trauma (Heim, Newport, Bonsall, Miller, & Nemeroff, 2001; Jorge et al., 2004).

Anxiety disorders are frequently co-morbid with depression following TBI (Alway, Gould, et al., 2016; Gould et al., 2011b). Following TBI, anxiety may manifest as generalised symptoms of worry, apprehension and fear about the future (Soo & Tate, 2007). Alternatively symptoms may cluster together into diagnosable anxiety disorders (Soo & Tate, 2007). Post injury anxiety disorders have been shown to occur in up to 44% of cases and can include generalised anxiety disorder, post-traumatic stress disorder and social or specific phobias (Gould, Ponsford, Johnston, & Schönberger, 2011a). A recent study by Alway and colleagues (2016) showed that diagnosis of anxiety disorders peaked at 12 months' post-injury and then subsequently declined to a greater extent than depression. The most common forms of anxiety disorder following TBI include Anxiety Disorder not otherwise specified, generalized anxiety disorder (GAD) and post-traumatic stress disorder (PTSD) (Alway, Gould, et al., 2016; Gould et al., 2011b). The frequency of PTSD following TBI is reported to range between 0.5 and 9.4% during the first five years post-injury, increasing throughout the first 12 months

and declining thereafter (Alway, McKay, Gould, Johnston, & Ponsford, 2016). Those diagnosed with PTSD following TBI were also more likely to experience other psychiatric comorbidity as well as poorer functional and quality of life outcomes after TBI. More generally, post-injury psychiatric disorders have also been shown to be associated with concurrent unemployment, pain and poorer quality of life (Gould et al., 2011b).

Several theories have been put forward to explain the occurrence of anxiety and mood disorders post-TBI. There is some evidence that depression and anxiety may occur as a result of damage to frontal lobe regions (Grafman, Schwab, & Warden, 1996; Jorge et al., 2004; Schönberger et al., 2011). As there is prefrontal regulation of limbic structures via the fronto-striatal-thalamo-cortical circuits, it is not surprising that abnormal prefrontal modulation of limbic regions has been found to be associated with depression (Dougherty et al., 2004). Although many studies have endeavoured to identify specific regions within the frontal lobes in relation to development of depression post-TBI, these findings have been quite inconsistent (Schwarzbold et al., 2008). In light of this, other authors cite potential causes as more diffuse neuronal damage and cell loss occurring in the weeks to months following injury within vulnerable cortical regions such as the hippocampus, striatum, amygdala, thalamus and forebrain nuclei (Bigler, Andersob, & Blatter, 2002; Jorge, Acion, Starkstein, & Magnotta, 2007; Shiozaki et al., 2001; Yount et al., 2002). Changes to catecholamine neurotransmitter systems (Jenkins, Mehta, & Sharp, 2016), white-matter microstructure (Spitz, Alway, Gould, & Ponsford, 2017) and frontal and parietal brain volumes (Schönberger et al., 2011) post-injury have been shown to related to the onset of mood disorders following TBI.

A salient factor shown to associated with depression, anxiety and poorer functional outcome 12 months' post TBI is the experience of pain (Gould et al., 2011b). Pain was shown to restrict the individual's ability to return to work and participation in leisure activities. Disruption of activities that that were associated with purpose, meaning and happiness pre-injury could potentially lead to anxiety and depression post TBI. Problems with psychological adjustment have also been suggested as explanations for the occurrence of anxiety and mood disorders post-injury. For instance, it has been shown that higher pre-injury use of non-productive coping style predicted high use of non-productive coping, more anxiety, and lower psychosocial functioning at one year postinjury

(Gregorio, Gould, Spitz, van Heugten, & Ponsford, 2014). Additionally, increased use of non-productive coping and decreased use of productive coping predicted poorer psychosocial outcome at one year post-TBI.

As there is a steady increase in onset of these psychological disorders up until two to three years post-injury (Hoofien, Gilboa, Vakil, & Donovick, 2001; Whelan-Goodinson et al., 2009) it is likely that psychological adjustment to disability also contribute to the evolution of psychiatric disorders, in addition to pathophysiological changes. As TBI frequently occurs in young adults (Corrigan et al., 2010; Khan et al., 2003), it can disrupt the attainment of important life goals in the domains of education, vocational training, career establishment, social networking and intimate relationships (Ponsford & Hsieh, 2012). This in turn can promote negative changes in self-concept and self-esteem, which may be associated with the development of depression and anxiety disorders (Hoofien et al., 2001; Whelan-Goodinson et al., 2009).

1.2.2 Self-concept Post Injury

Self-concept represents an individual's internalized perceptions regarding him or herself and his or her personal attributes (Cantor et al., 2005). It is suggested that TBI has a profound impact an individual's self-concept. A recent meta-analysis (Beadle, Ownsworth, Fleming, & Shum, 2016) reported that people with TBI experienced largely negative changes to self-concept, with one longitudinal study indicating persisting negative changes to self-concept lasting up to 2.5 years post-injury. It is believed that experience of major life event such as a TBI may sever the continuity between who the person believes he or she was before and is after the injury (Moldover et al., 2004). This creates a state of discrepancy between the past, present and future anticipated self-views. When maladaptive coping strategies are used to reduce this conflict in the short term, conflicting beliefs about the 'self' continue.

Self-discrepancy theory focuses on the goodness of fit between different aspects of self-concept (Higgins, 1987; Higgins, Bond, Klein, & Strauman, 1986; Higgins, Klein, & Strauman,

1985). The model examines three domains of self: the 'actual self', which relates to the attributes actually possessed; the 'ideal self', which involves attributes the individual would like to possess'; and the 'ought self', which encompasses attributes the individual feels he/she should possess. The ideal domain differs from the ought domain in that the former involves attributes toward which the person aspires, while the latter domain involves attributes that the person feels is his or her obligation to possess. The concept of the 'ought self' is likely to be influenced by interpersonal and social contexts such as expectations of family, friends and society. The model proposes that the discrepancy between the 'actual' and 'ideal self' leads to depression, whilst a discrepancy between the 'actual' and 'ought self' leads to development of anxiety disorders. Several studies have validated this model and reported associations between self -discrepancy and symptoms of anxiety and depression (Cantor et al., 2005; Higgins, 1987; Higgins et al., 1986; Higgins et al., 1985; Strauman, Vookles, Berenstein, Chaiken, & Higgins, 1991).

One of the first studies to characterise changes in the self-concept after brain injury (Tyerman & Humphrey, 1984) reported that whilst the personal view of pre- and post-injury 'self' differed greatly; many individuals' view of their pre-injury self closely mirrored the anticipated view of their future self. This suggests that many individuals' post-injury are seeking to return to their pre-injury self. Given the neurological, cognitive, emotional and behavioural changes following TBI, this may not be always possible. Self-regulation theory suggests that failure to make progress towards the goals set in order to return to the 'pre-injury' self, can give rise to feelings of low self-esteem and may interfere with post-injury rehabilitation and adjustment (Gracey et al., 2009; Tyerman & Humphrey, 1984).

In addition, it has been shown that some individuals adopt maladaptive coping strategies such as avoidance, worry, self-blame, wishful thinking and drug and alcohol use to reduce conflict in the 'post-injury' self (Anson & Ponsford, 2006a; Curran, Ponsford, & Crowe, 2000; Gould, Ponsford, Johnston, & Schönberger, 2011; Wolters, Stapert, Brands, & Van Heugten, 2011). These coping styles do not facilitate the acceptance of the current situation or the learning of necessary adaptation skills (Gracey et al., 2009). These types of non-productive coping styles have been shown

to relate to negative psychosocial outcomes, including anxiety and depression (Anson & Ponsford, 2006a, 2006b; Curran et al., 2000; Gould et al., 2011).

Aside from the personal view of self, self-concept has also been shown to be determined in the social context. It is suggested that social contexts help to develop, rehearse and consolidate our personal and social identities (Haslam et al., 2008). Consistent with this view, a qualitative study by Nochi (1998) examined the individual's self-concept following head injury and identified two major themes. One theme related to view of 'self in comparison to pre-injury' as discussed previously; but a second theme related to 'loss of self in the view of others.' Similarly, a study by Gracey and colleagues (2008) on personal constructs of individuals following acquired brain injury (ABI) highlighted how strongly people with ABI rely on social and activity contexts in order to derive a sense of meaning of themselves, for example whether or not they are "feeling part of things." However, as both these studies were qualitatively based, using thematic analysis, replication has not been possible and generalizability of findings is limited.

The results of such studies are, however, consistent with the proposition that discrepancies in the 'self' can have interpersonal and social domains (Gracey et al., 2009). Social discrepancy domains of self-concept relate to the experience of stigma and loss of relationships following injury (Gracey et al., 2009). By contrast, interpersonal discrepancy of self-concept relates to differences in opinion of the client and significant others regarding the nature of the client's symptoms and needs (Gracey et al., 2009). This can create a state of conflict and confusion regarding the 'self' for the client. For instance, Yeates, Henwood, Gracey, and Evans (2007) reported that although many individuals post-TBI showed the capacity to self-reflect on their identity, many of their significant others reported that they lacked self-awareness. This study supports the presence of interpersonal discrepancies in self-concept post TBI. Support for the social context of self-concept suggests that clinicians need to continue to work in collaboration with family and care givers in setting appropriate rehabilitation goals that reflect important values of the individual with consideration of their current ability to achieve these goals.

It has been suggested that rehabilitative efforts need to attempt to resolve these discrepancies. The 'Y-shaped model' of biopsychosocial rehabilitation following acquired brain injury has been proposed as a guide for clinicians working in the area of TBI rehabilitation. This model by Gracey and colleagues (2009) proposes that the process of re-integration into society following brain injury involves two stages. The first stage involves awareness and acceptance of the new circumstance post-injury, and the second stage encompasses adaptive resolution of social and psychological discrepancies. The resolution of discrepancies in the second stage denotes the joining of two previously disparate self-concepts into one, as symbolised by the character 'Y.' This model was designed to guide clinicians to help their client reduce threat reactions and support their clients' development of post-injury self through a process of positive psychological growth (Gracey et al., 2009).

In facilitating psychological growth in the second stage, clinicians are encouraged to work collaboratively with their clients to identify new adaptive and personally salient meanings arising as a result of injury and development of activities to consolidate these meanings in a purposeful manner. It is suggested that the second stage is introduced gradually, after the client has begun the process of adaptation, lest the confrontation of finding new meanings might further propagate the threat response and hinder further rehabilitative efforts (Gracey et al., 2009). This model of building awareness and acceptance of change and working towards establishing a renewed sense of self-concept through valued action is in many ways akin to the process of VL explored next in this chapter.

1.2.3 The Role of Values Post-Injury

Personal meaning is defined as an individually constructed cognitive system that is grounded in subjective values (Wong, 1989). Human values have been defined as "desirable, trans-situational goals, varying in importance, that serve as guiding principles in people's lives" (Schwartz et al., 2001). Such a definition suggests that values are ubiquitous and play a vital part in deriving and assigning priorities to goals which provide life with a sense of meaning. Previous discussion

regarding self-concept has highlighted the importance of consolidation of personal meaning by consistent activity (Gracey et al., 2009). Similarly, it has been proposed that VL, or living in accordance with one's values, is an appropriate therapeutic goal in rehabilitation following trauma such as TBI.

Values are operationalized as verbally constructed reinforcers of human behaviour (Hayes, Strosahl, & Wilson, 1999). Values are distinguished from goals in that values are freely chosen and refer to ongoing patterns of activity that are actively constructed, dynamic, and evolving (Wilson & Dufrene, 2009). Values act as guiding principles that are not time-dependent or outcome focused. VL has been propositioned as a primary core process of acceptance and commitment therapy (ACT) (Hayes et al., 1999; Wilson & Murrell, 2004). Theoretically VL has been associated with other core processes and outcomes, such as mindful acceptance, decreased psychological distress, increased psychological adjustment, and improved quality of life (Wilson & Murrell, 2004).

VL has been found to be efficacious in improving quality of life in individuals seeking therapeutic assistance for the management of pain (Branstetter-Rost, Cushing, & Douleh, 2009; McCracken & Yang, 2006), GAD (Hayes, Orsillo, & Roemer, 2010; Michelson, Lee, Orsillo, & Roemer, 2011) and depression (Arch & Craske, 2008), treatment resistant panic disorder (Wersebe et al., 2016) and withdrawal symptoms during substance detoxification (Stotts, Masuda, & Wilson, 2009). One hypothesis has been that increases in value-driven behaviour may heighten perceived control and thereby reduce distress (Arch & Craske, 2008). Another hypothesis is that when values serve as guides for actions, patients experience better levels of daily activity and better emotional functioning (McCracken & Yang, 2006). It has been reported that by identifying ways in which the individuals can continue to live in accordance with their values, they are able to relinquish their desire to control other distressing symptoms such as pain (McCracken, Carson, Eccleston, & Keefe, 2004). Furthermore, it has been reported that despite no change in the experience of these negative symptoms, by working towards valued living, their engagement and enjoyment of activities of daily living has greatly increased (McCracken, Carson, et al., 2004; McCracken, Vowles, & Eccleston, 2004; McCracken & Yang, 2006).

Valued based intervention has been shown to demonstrate maintenance of therapeutic gains beyond symptom reduction (Hayes et al., 2010). VL has been shown to have physiological effects on the body, above and beyond psychological changes in perception. Affirmation of values during times of acute stress has been found to reduce the level of cortisol release, thereby reducing the physiological stress response (Creswell et al., 2005). Another study examining the impact of VL on outcomes for individuals experiencing chronic pain reported that higher success in VL correlated with less physical and psychological disability and less depression, depression-related life interference and pain related anxiety (McCracken & Yang, 2006).

Following a traumatic experience, the individual's concept of self and reality has been shown to change (Calhoun & Tedeschi, 1998; Collins, Taylor, & Skokan, 1990; Frazier, Conlon, & Glaser, 2001; McMillen, Smith, & Fisher, 1997). With changes to self-concept, the individual's beliefs and life priorities may be altered (Calhoun & Tedeschi, 1998; Collins et al., 1990). The individual's ability to set appropriate and achievable goals consistent with their values may also need further support (Wilson, Sandoz, Kitchens, & Roberts, 2010).

The Valued Living Questionnaire (VLQ) was developed by Wilson and colleagues (2010) as a two-part clinical tool to support assessment of valued living. The VLQ is two-part instrument designed to assess VL. The first part or subscale assesses the importance prescribed to 10 domains of living (values) which include: family, intimate relationships, parenting, friendship, work, education, recreation, spirituality, community life and physical well-being. The second part or subscale establishes the consistency with which actions relating to each domain of living were enacted in the past week. Responses to both parts of the questionnaire are made via a 10-point Likert scale and a composite of two subscales 'importance' and 'consistency' produces a score for VL. The score for the VL composite (VLC) quantifies the extent to which one is living out particular values in everyday life. A validation study in a sample of 338 undergraduates reported good inter-item consistency (.77) and adequate test-retest reliability (.75) for composite measure of valued living (Wilson et al., 2010). Significant negative correlations have also been reported between VL and depression, anxiety, somatization, hostile attitude, negative psychosocial environment, relationship difficulties, general pathology and treatment difficulty (Wilson et al., 2010).

The VLQ can be administered on multiple occasions. At the beginning of therapy, it can be used to identify salient personal value domains which may be unknown to the client. It can also assess how successful the client has been with VL as a baseline before commencing therapy. The clinician and therapist can then work collaboratively towards further increasing VL by setting more achievable goals that are consistent with the priority assigned to each domain of living. The questionnaire can be then administered progressively to monitor clients' progress in therapy. Thus far, the VLQ has been used to track progress in psychotherapy in non-TBI populations and the reported efficacy of values based intervention in these populations supports the facilitation of VL to promote positive psychological growth and reduce the likelihood of negative psychosocial outcomes. However, this measure has yet to be utilised to examine psychological adaption and change following TBI.

1.3 POST-TRAUMATIC GROWTH

Post-traumatic growth (PTG) is the experience of positive psychological change. It emerges as a result of a struggle with highly challenging life events (Calhoun & Tedeschi, 1991). PTG represents the achievement of a higher level of psychological functioning from a previous 'baseline' (Hayes, Laurenceau, Feldman, Strauss, & Cardaciotto, 2007) such as improved adaptive resources, deepened self-awareness and heightened resilience to subsequent experiences of stress or trauma (Zoellner & Maercker, 2006). It manifests in a number of ways: new-found appreciation of life, more meaningful interpersonal relationships, fortified conviction in one's personal strength, changed priorities and a richer existential or spiritual life are commonly reported (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006). PTG describes an ongoing process, rather than a static outcome of trauma (Calhoun & Tedeschi, 2006; Zoellner & Maercker, 2006). Different studies have described periods of time ranging from a few months (Frazier et al., 2001) to a few years (Affleck, Tennen, Croog, & Levine, 1987; McMillen et al., 1997) as necessary for the emergence of PTG. The type of trauma experienced may contribute to variability in these reports.

In order for PTG to develop, the experience of trauma is essential. The American Psychiatric Association (1994) defines a traumatic experience as one which involves death or threatened death and/or serious injury. Strong emotions of fear, helplessness and horror are associated with such trauma. Traumatic events overpower the individuals' adaptive resources and shatter their schema established view of personal reality, sometimes referred to as the 'assumptive world' (Calhoun & Tedeschi, 1998, 2006; Tedeschi & Calhoun, 2004). PTG has been reported in individuals following death of a loved one (Davis, Nolen-Hoeksema, & Larson, 1998; Polatinsky & Esprey, 2000), violent assault (Grubaugh & Resick, 2007; Snape, 1997), rape or sexual assault (Frazier et al., 2001; Thompson, 2000), war (Elder Jr & Clipp, 1989; Powell, Rosner, Butollo, Tedeschi, & Calhoun, 2003), serious medical complications (Armeli, Gunthert, & Cohen, 2001; Koenig, Pargament, & Nielsen, 1998), breast cancer (Cordova, Cunningham, Carlson, & Andrykowski, 2001; Sears, Stanton, & Danoff-Burg, 2003; Weiss, 2002) and transportation accidents (Harms, 2004; Zoellner, Rabe, Karl, & Maercker, 2008).

Some authors suggest that PTG is a type of coping strategy implemented to deal to psychological distress resulting from a traumatic event (Davis et al., 1998; Janoff-Bulman & Frantz, 1997; Park & Folkman, 1997). It is suggested that benefit-finding following trauma could help individuals cope by giving them a sense of meaning and a feeling that something has been achieved as a consequence of trauma. Others believe that PTG represents an outcome of successful adaptation or coping through which one's belief systems are fundamentally altered (Schaefer & Moos, 1998; Tedeschi & Calhoun, 2004). Tedeschi and Calhoun (2004) posit a curvilinear relationship between level of coping and the extent of PTG. It is suggested that individuals with very poor coping strategies experience purely negative responses to trauma. On the other hand, those with very effective coping skills are resilient to trauma and therefore do not begin the process towards PTG. Ideally, a moderate degree of initial success with coping is believed to be necessary for further PTG development.

A multitude of cognitive processes and a strong affective component distinguish PTG from outcomes of developmental growth or maturity (Tedeschi & Calhoun, 2004). According to Tedeschi and Calhoun's functional descriptive model of PTG, the shattering of the 'assumptive world' by the traumatic event leads to a disruption of higher order goals and beliefs. Such an event exceeds the emotional resources available to the person, leading to psychological distress. As an initial attempt to survive this distress, the individual engages in automatic ruminations and behaviours to alleviate distress. After some initial success with coping, the individual returns to more deliberate ruminations of the traumatic event. Rumination now forms an essential cognitive process by which the individual attempts to find meaning in reappraising the situation. The individual begins to accept his/her current situation and disengage from unattainable goals or the worldview which cannot accommodate their current incapacities. Subsequently, the individual begins to rebuild the 'new self' by formulating a novel set of goals. The world-view which results from this process allows for the perception that one is moving forward towards achievement of meaningful goals, despite any shortcomings as a consequence of the traumatic event.

Initial reviews of literature suggest that in the majority of cases reports of growth outnumber the reports of psychiatric disorders following a traumatic experience (Quarantelli, 1985; Tedeschi, 1999). It has been estimated that 30% to 90% of people who experience trauma report positive gains

(Linley & Joseph, 2004; McMillen, 2004). Yet research into positive psychological outcomes following trauma has received little attention until quite recently. The field of psychology traditionally viewed stress and trauma through a negative lens, with particular emphasis on PTSD and the negative health implications associated with stressors (Haidt, 2006). Consistent with this ideology, past literature has focused on understanding the links between trauma and psychological disorders, overcoming the experience of trauma and building resilience. It was not until the 1980's and 1990's that systematic academic interest specifically directed attention towards the possibility of growth from trauma (Tedeschi & Calhoun, 2004).

1.3.1 Measures of PTG

Qualitative and quantitative techniques have been utilised in research studies investigating PTG. Qualitative techniques have been used to study PTG in female survivors of domestic abuse (Poorman, 2002), women with HIV/AIDS (Updegraff, Taylor, Kemeny, & Wyatt, 2002) and female survivors of rape (Thompson, 2000). Qualitative techniques have been largely interview based, asking participants to identify ways in which their lives have changed (Schwartzberg, 1993) or to list perceived benefits as a result of trauma (Affleck et al., 1987; Sears et al., 2003). It has been found that the precise wording of questions, whether or not positive changes were specifically queried, significantly alters the variety of responses generated (Lehman, Wortman, & Williams, 1987; Sears et al., 2003). If the question simply asked participants to describe changes, they tended to linger on the enduring negative changes as a result of trauma. Alternatively, if positive changes were specifically queried, at least one or more positive outcomes would be described.

Techniques such as a written essay task, life-story approach and focus groups have also been utilised to gather qualitative information relating to PTG (Calhoun & Tedeschi, 2006). Once the qualitative data has been gathered, participants' responses would be grouped by common themes to identify domains of PTG on a post-hoc basis (Zoellner & Maercker, 2006). Although results of qualitative studies are difficult to replicate, they do serve a unique purpose. Qualitative techniques are advantageous because participants provide information without being prompted by specific items

(Calhoun & Tedeschi, 2006). Thus, a variety of responses are generated, with each response known to be meaningful to at least one participant. The richness of qualitative data generated has commonly formed the foundation of subsequently developed quantitative scales. A number of different scales have been developed to quantitatively assess PTG, including the Stress-Related Growth Scale, Perceived Benefits Scale, Post-traumatic Growth Inventory, Revised Stress-Related Growth Scale, Thriving Scale, Illness Cognition Questionnaire and the Changes in Outlook Questionnaire. However, only a few of these scales have been validated. One of the most commonly used scales is the Post-traumatic Growth Inventory (PTGI).

The PTGI was developed by Tedeschi & Calhoun in 1996. This 21-item self-report inventory measures an individual's perception of positive changes along six dimensions of growth: new possibilities, relating to others, personal strength, appreciation of life and spiritual change. Responses to items are summed to produce a total score. The PTGI was initially validated on a sample of college students. The original validation study reports the internal consistency for the total scale as strong (α = .90), and the test re-test reliability is within acceptable limits (r =.71). The factor structure confirmed a six-factor solution and PTGI has been shown to be uncorrelated with socially desirable responding. An abbreviated version of this scale (PTGI-short form or PTGI-SF) was developed in 2010 for use in instances where time is limited. The PTGI-SF comprises 10 items and has been validated in clinical samples including bereaved parents, victims of violent abuse and patients with acute leukaemia (Cann et al., 2010). The reliability and validity of the short-form was found to be comparable to that of the full inventory (Cann et al., 2010).

A major criticism of the PTGI is its use unipolar response scales with only positively worded items (Calhoun & Tedeschi, 2006). As a result, these measures do not allow a participant to report a negative change. In order to overcome the positive response bias and reflect a broader picture of growth, scales which measure both positive and negative changes in outlook should be used. One such scale is the Changes in Outlook Questionnaire (CiOQ). CiOQ was developed by Joseph and colleagues (1993) and consists of two distinct subscales. The first subscale known as Changes in Outlook Positive (CiOP) is an 11-item subscale assessing positive changes. The second subscale referred to as Changes in Outlook Negative (CioN) is a 15-item scale assessing negative changes. It

contains items such as ‘‘I don’t look forward to the future anymore.’’ The participants are required to endorse a response on a scale ranging from 1 (strongly disagree) to 6 (strongly agree) and scores are added to give a separate sum for the CiOP and CiON subscales. Both the CiOP and CiON scales were found to possess good internal consistency: ranging from α = .80 to .87 for the CiOP and α = .86 to .88 for the CiON across four samples (Joseph et al., 2005). This measure has been used in studies following a strong experience of trauma and adversity. For instance, it has been used to measure growth in individuals exposed to the September 11 terrorist attacks (Butler et al., 2005; Linley, Joseph, Cooper, Harris, & Meyer, 2003).

Like the PTGI, The CiOQ was identified to be relatively lengthy for both practitioners and others in need of a rapid assessment tool. As a result, an abbreviated version CiOQ (CiOQ short form or CiOQ-S) was developed in 2006. Five of the highest loading items from the each subscale, CiOP and CiON were chosen for the CiOQ-SF. High internal consistency for both subscales on the shortened version was demonstrated in both adult (CiOP-S α = .78 and CiON-S α = .83) and clinical samples (CiOP-S α = .76 and CiON-S α = .82) (Joseph, Linley, Shevlin, Goodfellow, & Butler, 2006). Despite these scales having addressed concerns regarding time constraints and biased responding, an important shortcoming in test development has not been addressed. That is, there are currently no norms or cut-off scores to establish ‘growth’ or different ‘levels of growth’ for any of the quantitative measures of PTG. Minimum scores to operationalize ‘growth’ have been based in comparison with average scores reported in other studies. (Collicutt McGrath & Linley, 2006; Gangstad, Norman, & Barton, 2009; Powell, Ekin-Wood, & Collin, 2007; Silva, Ownsworth, Shields, & Fleming, 2011). Such a technique to operationalize ‘growth’ is highly questionable because it is circular in reasoning. However, no better alternative has been devised to date.

Whether PTG is restricted to changes in outlook, or whether this change in thinking always translates into observable behaviours, is an area of much contention. Some authors believe that in so far as PTG is operationalized as a change in thinking patterns and life outlook, self-report questionnaires such as the PTGI should adequately measure growth (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004). Other authors have however suggested the use of behavioural measures

of growth to supplement the self-reported measures in thought patterns (Deci & Ryan, 2000; Hobfoll et al., 2007; McMillen, 2004).

Only one published behavioural checklist of PTG is known to the authors. This checklist was developed by Shakespeare-Finch and Barrington (2012). The checklist was validated in mixed trauma sample which included survivors of motor vehicle accidents and life threatening illness, as well as individuals going through a process of bereavement. It includes five opened ended questions designed as a platform for participants to provide examples of positive behavioural change along the five dimensions of growth identified by Calhoun and Tedeschi. An example of a behavioural item from this measure: "I now show my family and/or friends how much I careforthem."

Some of the orginal questions may need to be modified or rephrased to be more suitable to a TBI population. For example the item "I have taken up more challenging mental and physical activities" cited from the original measure was rephrased to " I have taken up new interests and activities," to reflect that fact that mundane mental and physical activities may become inherently more challenging following head injury and that this would not necessarly reflect positive behavioural change. No published research as yet used used or validated this behavioural measure of growth in the TBI population.

1.3.2 Factors associated with PTG

1.3.2.1 Demographic factors

In the wider literature, there is mixed evidence for the association of demographic factors such as age, gender, socioeconomic status and education with PTG. Some studies suggest that females (Park, Cohen, & Murch, 1996; Tedeschi & Calhoun, 1996; Vishnevsky, Cann, Calhoun, Tedeschi, & Demakis, 2010; Weiss, 2002), young adults (Barakat, Alderfer, & Kazak, 2006; Helgeson, Reynolds, & Tomich, 2006; Manne et al., 2004; Wolchik, Coxe, Tein, Sandler, & Ayers, 2008) and those with higher education and socioeconomic status (Fontana & Rosenheck, 1998; Updegraff et al., 2002) are more likely to achieve PTG. It has been suggested that women are more

likely to reflect on their thoughts and emotions following trauma, and that this form of rumination may prompt the development of PTG (Vishnevsky et al., 2010). It has also been suggested that emotion-focused coping style, more commonly utilized by women, is most consistent with the idea of confronting, struggling with and later accepting the trauma, stages vital to the development of PTG (Vishnevsky et al., 2010). However, a possibility remains that PTG is simply under-reported in males who could be more reluctant or less able to verbally disclose changes in their thoughts and emotions.

Similarly, it has been suggested that younger adults can more easily adapt to changes in perspective following a traumatic experience (Barakat et al., 2006; Helgeson et al., 2006; Manne et al., 2004). It is hypothesised that younger adults may experience more distress following traumatic event and that this increased initial distress may drive PTG (Manne et al., 2004). However, depending on the age of the individual and his/her pursuits in life, the time available for cognitive deliberation is a key factor to consider. An older adult who is retired from the workforce may have more time available to reflect on the trauma and its significance compared to a younger adult who may be urgently required to return to previously held life roles. Lastly, it is imperative to recognise that the relationship of PTG with education and socio-economic status is confounded by a number of other factors. Primarily, these include resources available during recovery such as: time off work for rehabilitation, access and affordability of psychological and rehabilitative services and new opportunities for employment (Fontana & Rosenheck, 1998; Updegraff et al., 2002). Thus, when demographic variables such as level of education and socioeconomic status are uncontrolled, it is difficult to determine whether other factors, such as the level of cognitive reserve, are influencing the likelihood for PTG.

1.3.2.2 Personality factors

An individual's personality characteristics is believed to shape his/her response to traumatic events (Morris, Shakespeare-Finch, Rieck, & Newbery, 2005; Tedeschi & Calhoun, 1996). Research studies and reviews of literature have reported significant correlations between measures of positive

psychological growth following trauma and personality variables such as openness to experience (Linley & Joseph, 2004; Tedeschi & Calhoun, 1996), agreeableness and conscientiousness (Garnefski, Kraaij, Schroevers, & Somsen, 2008; Linley & Joseph, 2004), extraversion (Garnefski et al., 2008; Tedeschi & Calhoun, 1996; Val & Linley, 2006) and neuroticism (Evers et al., 2001; Garnefski et al., 2008). However, not all of these personality traits are consistently related to PTG. Bostock and colleagues (2009) failed to find a relationship between optimism and PTG in a sample of individuals with health-related complications. Likewise, Helgeson et al. (2006), in their meta-analysis on benefit finding, failed to find a relationship between neuroticism and PTG. Lastly, Tedeschi and Calhoun (1996) in their large validation study (n = 600) of the PTGI, reported significant correlations of PTG scores with only two of the Big Five personality dimensions. They concluded that only extraversion and openness to experience could affect the likelihood that people would make positive use of traumatic experiences. As only personality traits of openness to experience and extraversion appear to be consistently related to PTG, only these traits will be further examined in this review.

Tedeschi and Calhoun (1996) reported that the personality traits of extraversion (r = .29) and openness (r = .21) to experience were modestly related to total PTGI scores. Extraversion and openness were shown to be positively related to the PTGI dimensions of new possibilities and personal strength. Related to the new possibilities domain of PTGI, is the idea of novelty seeking (Seidmahmoodi, Rahimi, & Mohamadi, 2011). Novelty seeking refers to the ability to show interest in and concern about a wide variety of events (Park & Cohen, 1993). Thus aptitude for novelty seeking may be required for consideration of a wider range of alternatives (Nakaya, Oshio, & Kaneko, 2006). In the PTG context such cognitive flexibility may be necessary for modifying one's view of 'self' post-trauma and essential for consideration of more practically achievable goals during rehabilitation. Such links, although indirect, suggest ways in which personality traits such as openness and extraversion could increase the likelihood of PTG following TBI.

It has been suggested that individuals who are extraverted may be more likely to use functional coping strategies that involve support seeking, problem-solving and cognitive restructuring (Connor-Smith & Flachsbart, 2007). These techniques are likely to lead to initial coping

success, more effective affect regulation and facilitation of cognitive processes necessary for the emergence of PTG. Consistent with the idea of effective coping in the face of psychological distress, Karanci et al. (2012) reported that on all domains of the PTGI, participants with higher levels of extraversion experienced more growth whilst simultaneously reporting higher levels of post-traumatic stress. Separate studies including samples of college students (Wilson & Boden, 2008), witnesses and survivors of a bombing incident (Val & Linley, 2006), cardiovascular patients (Garnefski et al., 2008) and ambulance personnel (Shakespeare-Finch, Kathryn, & Smith, 2005) have also reported that extraversion was positively associated with perceptions of positive growth following trauma. The study by Wilson and Boden (2008) concluded that extraversion was a significant predictor of PTG score.

Like, extraversion, the personality trait of openness to experience, has also been found to be positively related to PTG (Karanci et al., 2012; Shakespeare-Finch et al., 2005; Tedeschi & Calhoun, 1996; Wilson & Boden, 2008). Openness to new experiences has been described as the ability to acknowledge the constant nature of change, to effectively manage uncertainty and to develop with change (Zoellner et al., 2008). Thus, individuals high in openness are able to better deal with traumatic events because they tend to ‘’draw strength from adversity’’ (Tedeschi & Calhoun, 1996). The study by Karanci et al. (2012) reported that much like extraversion, openness to experience was positively correlated with PTG, even in the presence of post-traumatic stress. The authors suggested that this was because individuals high on openness were more willing to cognitively process the traumatic event and its meaning, rather than avoid or deny it in an attempt to reduce psychological distress. Wilson and Boden (2008) also reported a positive but indirect relationship between openness and PTG. The relationship between openness and PTG in their study was found to be mediated by religiosity. In this case, only individuals high on both openness and religiousness were likely to report PTG.

Whist studies have undoubtedly reported significant relationships between personality variables and PTG, the causal nature of these relationships cannot be established. This is because a majority of studies have used cross-sectional designs whereby data on personality and PTG were collected simultaneously, often many years post-injury. If personality is assessed at the same time as

PTG, then personality cannot be identified as a pre-trauma variable, although it is often characterised as such (Karanci et al., 2012). For example, as a consequence of a person developing PTG, he/she may begin to appreciate new possibilities if life. Over time this growing appreciation of new possibilities may lead to openness to new experiences, which may not have been part of their personality previously. In this instance, PTG has led to increase in openness to experience, rather than vice-versa. Only a prospective longitudinal study can ascertain whether pre-trauma personality traits such as openness to experience and extraversion are true predictors of PTG development.

1.3.2.3 Adjustment related factors

The relationship between PTG and psychological adjustment is unequivocal. Whilst some studies have reported a strong negative association between PTG and level of distress (Davis et al., 1998), other studies have failed to find any such relationship (Cordova et al., 2001). These inconsistencies are apparent even within the same population, i.e. cancer survivors. For example, studies by Bower and colleagues (2005), Taylor and colleagues (1984) and Tomich and Helgeson (2002) reported that PTG was positively associated with well-being. However, Cordova et al. (2001) did not find any association between PTG and emotional distress or well-being. Differences in findings may reflect the impact of other variables such as complications of cancer and side-effects of treatment. For example, Bower and colleagues recruited participants who were not receiving any treatment other than tamoxifin, a hormone based drug therapy. Thus, in their sample individuals were either at an early stage of cancer or at least assessed when there were no side-effects of more aggressive treatments such as chemotherapy. In contrast, Cordova and colleagues recruited participants two months after they commenced chemotherapy, radiotherapy or surgery. Given the negative physical symptoms and psychological distress associated with late stage cancer, including recent side-effects of treatment, it is not surprising that in this sample of cancer patients, wellbeing was not found to be associated with PTG. The results of this study highlight, that lack of distress and negative symptoms are not mutually exclusive with PTG.

A number of studies have reported notable associations between PTG and positive psychological adjustment. In a prospective study by Davis et al. (1998), individuals grieving the loss of a family member were assessed at four time points over a period of 20 months. It was reported that finding benefits from this experience predicted lower levels of a composite distress measure incorporating depression, anxiety, and PTSD symptoms several months later. Interestingly, this association grew stronger over time. It appeared that initial benefit finding became more effective in reducing distress as the time since loss increased. A significant interaction revealed that those who had gained benefits reported a decrease in distress over time. In contrast, those who had lost benefits or did not benefit reported an increase in level of distress over time. Similarly, in a study of PTG following rheumatoid arthritis (Tennen, Affleck, Urrows, Higgins, & Mendola, 1992) a significant interaction revealed a buffering effect of benefit- finding in the face of severe distress. Among those with little pain, the benefit appraisal was unrelated to the number of activity limitation days. However, among those with relatively severe pain, benefit-finding predicted fewer activity limiting days.

PTG has also been shown to relate to positive outcomes such as health and vitality. A study by Affleck and colleagues (1987) reported that cardiac patients who perceived benefits were less likely to have suffered a subsequent heart attack and were more likely to have better general health. Likewise a study of women with breast cancer 5-15 years after diagnosis reported that PTG was associated with significantly increased reports of happiness (r = .26) and vitality (r = .19) (Lelorain, Bonnaud-Antignac, & Florin, 2010). Among the various dimension of PTG, happiness was most strongly associated with relating to others (r = .28) and vitality was most associated with personal strength (r = .23). Similarly, a recent study examining PTG in survivors of natural disaster reported significant association between PTG and domains such as meaning in life, vitality and social support (Dursun, Steger, Bentele, & Schulenberg, 2016). This may suggest that positive and supportive interpersonal interactions could be important for happiness. Similarly, conviction of one's own personal strength as a result of facing trauma may be important for vitality.

These mixed findings highlight that PTG and psychological distress are not opposing poles on a continuum but rather distinct constructs (Linley & Joseph, 2004) that may be influenced by a number of other variables including: time since trauma, degree of change, number of other enduring complications and success in re-engagement with life following trauma. Clinically, the results suggest that whilst resolution of distress does not lead to PTG, the experience of distress may foster post-event readjustment (Davis et al., 1998; Frazier et al., 2001). If this re-adjustment occurs in conjunction with relatively few complications, increased well-being may be reported (Bower et al., 2005). It has been suggested that rehabilitation to reduce psychological distress and facilitate adaptation to post-event changes could be addressed through efforts to promote PTG in survivors of traumatic experiences (Linley & Joseph, 2004).

1.3.2.4 Social Support

According to Tedeschi and Calhoun's (2004) model of PTG, social context plays a very important role in the development of PTG. Supportive others provide opportunities for self-disclosure, stimulate cognitive processing, and offer new perspectives (Schmidt, Blank, Bellizzi, & Park, 2012; Schroevers, Helgeson, Sanderman, & Ranchor, 2010). Thus, supportive others can assist people to find positive meaning and to perceive posttraumatic growth (Schroevers et al., 2010). Consistent with this perspective, perceived social support, when provided by a close other, has been shown to moderate the relationship between dispositional optimism and PTG (Bozo, Gündoğdu, & Büyükaşik-Çolak, 2009). In other studies, social support has been shown to consistently and positively relate to reported levels of PTG (Cordova et al., 2001; Luszczynska, Mohamed, & Schwarzer, 2005; Schmidt et al., 2012; Schulz & Mohamed, 2004; Swickert & Hittner, 2009). A meta-analytic review of 46 studies with a sample of 5876 people reported a significant effect (r = .26) of social support on levels of perceived post-traumatic growth (Prati & Pietrantoni, 2009).

Social support in the form of reassurance, advice and encouragement in the early period (i.e. three months) following trauma has predicted greater experience of positive consequences in the long term (Linley & Joseph, 2004; Schroevers et al., 2010). Many other studies have also reported that

good social support is predictive of self-perceived reports of PTG (Bellizzi & Blank, 2006; Sears et al., 2003; Swickert & Hittner, 2009; Thornton & Perez, 2006). Most interestingly, one study has provided neurobiological evidence to support the notion that social support modulates a pathological response to stress in the hypothalamic-pituitary-adrenocortical (HPA) pathway in the brain (Ozbay, Fitterling, Charney, & Southwick, 2008).

1.4 POST TRAUMATIC GROWTH AND TRAUMATIC BRAIN INJURY

There is substantial literature on the negative impact of TBI on cognition, psychological health and interpersonal relationships (Alway, Gould, et al., 2016; Gould et al., 2011b; Ponsford et al., 2014; Ponsford et al., 2008). In the past few years recent studies have emerged which suggest that positive psychological outcomes can also be achieved following TBI (Hawley & Joseph, 2008; Powell et al., 2007; Powell et al., 2012). This section of the review of the literature will attempt to draw out common findings, capture a summary of PTG development following TBI and also to identify gaps which will need to be further addressed in future research.

A number of studies have reported that PTG following TBI is associated with psychological adjustment. Unfortunately, whilst some studies have reported a positive association, others have reported a negative association. Collicutt McGrath and Linley (2006) reported a significant positive association between anxiety and PTG (ρ = .53), such that higher levels of positive growth were reported by individuals also experiencing higher level of anxiety. Similarly, Silva and colleagues (2011) reported a significant positive association (r = .34) between symptoms of depression and PTG six months following head injury. However, both studies utilised mixed samples with cases involving various forms of acquired brain injury. McGrath and Linley's sample was very small (n = 22) and included mostly stroke survivors. In comparison, Silva et al. (2011) recruited a larger sample (n = 60), with half the cases (53%) classified as TBI. Whilst both studies suggest that PTG may be positively associated with psychological distress at some stage, given that these samples were mixed, direct generalisations to a TBI population are limited.

In the discussion of their results, Silva and colleagues proposed that higher levels of distress may promote re-evaluation of one's priorities and values post-trauma. Such a suggestion may be valid, given that Tedeschi and Calhoun's (2004) model of PTG also suggests that psychological distress maybe an initial driving force for cognitive processes such as rumination, which eventually lead to PTG. It also is plausible that reports of psychological distress or a negative change in outlook may be under reported in current literature. Many studies (Gangstad et al., 2009; Powell et al., 2007; Powell et al., 2012; Silva et al., 2011) have examined positive growth by using measures such as the

PTGI which do not allow for reports of negative change. Collicutt McGrath and Linley (2006) reported that whilst completing the PTGI some individuals spontaneously remarked that they had experienced negative changes such as being 'less self-reliant.' This highlights the need for assessment of growth to encompass both positive and negative domains. This will ensure that a broad and unbiased assessment of PTG is reported in literature.

In contrast with the results of the aforementioned studies, PTG has also been associated with positive psychological adjustment following TBI. A recent study by Powell et al. (2012) reported that PTG was positively correlated with life satisfaction (r = .65) and optimism (r = .47) thirteen years following TBI. Whilst the direction of the relationship cannot be established, this suggests that PTG may be associated in the long term with a positive outlook following TBI. Similarly, a large scale longitudinal study (Hawley & Joseph, 2008) reported that positive changes in outlook were negatively associated with both anxiety and depression 10 years following TBI. This finding may suggest that individuals continuing to report PTG at ten years following TBI may be less likely to present with anxiety or depression. However, in this study the frequency of anxiety and depression was established based solely on the participant's response regarding how often he/she experienced feelings of anxiety and depression in the past four weeks. The participant's responses to this item was shown to correlate with HADS data obtained 10 years previously, but neither reliability nor validity of this author generated measure was examined. Thus, a similar result would need to be replicated using a psychometrically valid measure of anxiety and depression, before the findings of this study can be accepted

Whilst TBI and stroke represent distinct clinical populations, with key differences in their demographics and physical and cognitive consequences, given the limited number of studies investigating PTG following brain injury, it is important to consider all broadly relevant research findings. A negative association between depression and PTG has also been reported in a study investigating the outcomes of stroke. Gangstad et al. (2009) have reported that PTG was negatively correlated with depression (r = -.53) thirty-two months following stroke. The authors of this study proposed that the direction of the relationship between psychological adjustment and PTG may change over time. In the early stages post-injury, benefit finding aspects of PTG may be used as a

coping strategy to deal with psychological distress of trauma. Thus, it is reasoned that there might be a significant positive association between psychological distress and PTG. Over time, however, reports of PTG may reflect significant life changes and or reprioritization of life values. As a result, negative association may develop between reports psychological distress and PTG. Such an explanation is consistent with the finding of a positive association between PTG and depression at 6 months' post-injury (Silva et al., 2011), but a negative association between PTG and depression reported at 32 months (Gangstad et al., 2009) and 10 years (Hawley & Joseph, 2008) post-injury. However, conclusive support for this theory could only be gathered using a long-term longitudinal study encompassing multiple time-points of reassessment following TBI.

It remains unclear whether the severity of head injury or any other demographic variables are related to the development of PTG. With increasing injury severity, capacity for cognitive processing is more likely to be affected. Cognitive processing of trauma following brain injury has been reported to be positively correlated with PTG (Gangstad et al., 2009). Thus, it has been postulated that individuals with greater cognitive impairment make take longer or potentially have less capacity for developing PTG (Silva et al., 2011). However, studies involving severely brain injured individuals have also reported PTG (Collicutt McGrath & Linley, 2006; Hawley & Joseph, 2008; Powell et al., 2012). Furthermore, the only large scale longitudinal study on TBI reported that PTG was unrelated to any pre- injury demographic and injury related factors such as severity of TBI (Hawley & Joseph, 2008). Thus, further investigations examining whether injury severity and demographic characteristics are related to the development of PTG are necessary. It may be likely that a moderator variable such as capacity for self-reflection may be involved in any such relationships.

Research studies which have examined PTG shortly after head injury have found that PTG is reported as early as 6 to 7 months' post-injury (Collicutt McGrath & Linley, 2006; Silva et al., 2011). Levels of PTG have been found to be consistently lower at these earlier time points (PTGI total score range of 34 – 37) compared to later time-points (PTGI total score range of 60 – 80), such as 10-13 years following TBI. These lower PTGI scores have been interpreted as representing a small to moderate degree of growth, rather than no growth at all (Collicutt McGrath & Linley, 2006; Silva

et al., 2011). Unfortunately, no norms exist for any measures of PTG. Thus, it is difficult to objectively or systematically establish levels of growth. Many investigators have simply compared the average total PTGI score in their sample with similar scores reported in previous studies (Collicutt McGrath & Linley, 2006; Gangstad et al., 2009; Powell et al., 2007; Powell et al., 2012; Silva et al., 2011).

In the early stages following head injury, lower than average PTG scores are believed to represent the individual's efforts in commencing the process towards further PTG development. At this stage, individuals are likely to be struggling to adjust to the enduring changes caused by their head injury (Powell et al., 2007; Silva et al., 2011). Individuals who begin to acknowledge their impairment at this stage could be more likely to undergo psychological changes that challenge their pre-conceived notions of reality and self-identity (Silva et al., 2011). The process of search for meaning may be instigated by such challenges (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004). At 1-3 years post-injury cognitive appraisals necessary for further development of PTG, such as restructuring of self-identity and personal goals may be underway (Powell et al., 2007). No research has yet examined PTG during the period of 4 to 10 years following TBI. It appears that PTG stabilises over a period of 11 to 13 years post TBI (Powell et al., 2012). During this time, PTG has been shown to significantly correlate with personal meaning, sense of purpose and higher levels of engagement in life (Powell et al., 2012). It appears that at this stage, changes in priorities and values which were established at earlier stages are enacted as purposeful behaviours. As high activity levels and life events were positively associated with PTG, Powell et al. (2012) have proposed that change in life routines is a 'pre-requisite' for growth.

1.5 SUMMARY AND RATIONALE FOR THESIS

This review has covered aspects of the neurological, cognitive, behavioural and psychosocial outcomes of TBI, especially in relation to adjustment related changes in self-concept and the potential role of VL in rehabilitation based intervention. Although there has been a rapid growth of research in this area in recent times, there remain a number of significant gaps in the current understanding of positive psychological outcomes following TBI which need to be addressed.

There is mounting support for the notion that PTG may occur following TBI. PTG has been found to be associated with vitality (Lelorain et al., 2010), life satisfaction, optimism, increased levels of activity (Powell et al., 2012) and improved general health (Affleck et al., 1987). It has also been postulated that PTG may act as a buffer for the management of pain and distress (Tennen et al., 1992). Given the multitude of potential benefits which may be associated with PTG, clinicians have begun to focus their rehabilitative efforts on encouraging growth following TBI (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004). Clinicians have been called upon to be "expert companions" on the journey of growth (Calhoun & Tedeschi, 2006), however a number of key conceptual and empirical questions remain unanswered.

1.5.1 Role of Values and VL following TBI

Many studies have alluded to the idea that re-organisation of life's priorities and values is an important aspect of PTG development (Collicutt McGrath & Linley, 2006; Powell et al., 2007; Silva et al., 2011). Furthermore, having a sense of purpose has been identified as a significant predictor of PTG (Powell et al., 2012). Although values have been known to shape behaviour by giving it a sense of direction and purpose (Wilson & Murrell, 2004; Wong, 1989), no study has yet examined the role of values and VL following TBI or the role of VL in facilitating the process of PTG. It is unknown whether values truly change as a result of trauma, or whether only goals are reshaped according to new cognitive and physical limitations so that they are more attainable by the individual.

1.5.2 Measurement of PTG following TBI

Although a number of validated quantitative measures now exist to assist with measurement of PTG following TBI, methodological issues in relation to the scale remain a major limitation. For instance, as PTG is conceptualised to emerge along more than one domain, it is unclear whether domain specific or total scores should be used in assessment of PTG. This has led to inconsistent practices, including use of individual item scores to establish PTG and total minimum scores to operationalize 'growth' based on comparison with 'average scores' reported in other studies (Gangstad et al., 2009; Powell et al., 2007; Silva et al., 2011). Furthermore, one of the most widely used measure of PTG, the PTGI, has been further criticised for its use of a unipolar scale which does not allow report of negative change, thereby increasing the likelihood for a positive response bias. Measures of PTG are yet to be compared in relation to their efficacy to predict functional or psychological outcomes and align with behaviours believed to relate to PTG. The need for congruent behaviours to be associated with reports of PTG following TBI is particularly relevant given that insight is compromised and a disconnection between thoughts and actions is often observed (Ponsford et al., 2012).

1.5.3 Time-course of PTG following TBI

Available literature suggests time-post injury is significantly associated with PTG, with increased levels of PTG at later time-points of more than 10 years compared with early time-points such as 6 months or 1-3 years post injury (Powell et al., 2007; Powell et al., 2012; Silva et al., 2011). However, given the variation in sample characteristics and cross-sectional design of most studies, this trajectory of PTG between one and ten years post injury requires further substantiation. It is also unknown whether levels of PTG continue to steadily increase over the period of 4 – 10 years and whether stability is achieved at some point before 10 years post-injury. Longitudinal studies are required to examine a broader range of time-points to better understand the process of PTG development in the TBI population.

1.5.4 Predictors of PTG following TBI

It is uncertain whether pre-injury personality characteristics or demographic variables can influence the likelihood for PTG following TBI. Studies examining the predictors of PTG following TBI have largely reported mixed findings, with a recent meta-analysis (Grace, Kinsella, Muldoon, & Fortune, 2015) suggesting some support for the roles of employment, education and increasing time post-injury in promoting PTG. Additionally, the role of personality factors in the development of PTG following TBI has yet to be examined. Similarly, it remains unclear whether the severity of head injury and the presence of psychiatric disorders following TBI can influence the development of PTG.

Furthermore, the relationship between VL and PTG remains to be investigated. Based on theoretical underpinnings, VL and PTG appear to be related constructs. The field of positive psychology promotes intervention designed to increase well-being, rather than focus on ongoing distress. As values based rehabilitation intervention promotes meaningful participation in valued activities while managing the effects of ongoing disability, the ethos of this rehabilitation practice is congruent with positive psychological emphasis on "building what's strong" rather than focusing on "what's wrong" (Evans, 2011). If VL is predictive of growth, promoting VL in rehabilitative therapy may guide many patients along the route towards positive psychological growth.

1.5.5 Limitations of Previous Research

Existing studies of positive growth within the TBI population are still in their infancy and have been limited by the depth and scope of variables which have been shown to relate to PTG. While PTG has been known to be associated with health and vitality, only a handful of studies have examined the association between PTG and psychological and functional outcomes. These studies have often reported that PTG has no association with degree of functional adjustment (Hawley & Joseph, 2008; Powell et al., 2007) and there are conflicting reports in relation to its association with anxiety and depression following TBI (Powell et al., 2007; Powell et al., 2012). Furthermore,

recruitment of mixed ABI samples has limited generalisation specific to TBI. Measurement and conceptualisation of PTG has greatly differed across various studies leading to difficulties in our understanding of predictors of PTG following TBI. Furthermore, these studies have been limited by small sample size, cross-sectional design and range of post-injury time-points examined, as well as measures used to assess growth following trauma. The limited pool of existing studies differs in terms of sample characteristics, with PTG measured at different time-points post-injury. This has led to some inconsistencies in reported findings.

1.6 AIMS AND HYPOTHESES

The overarching aim of the research presented in the thesis was to further our understanding of the nature and course of PTG following moderate to severe TBI, with specific consideration of the role of VL in improving post-injury adjustment and contributing to this growth process. A series of three studies were conducted, each examining data collected from a cohort of individuals with moderate to severe TBI recruited over several years post-injury. The first study examines the role of VL in post-injury adjustment following TBI; the second study critically evaluates two commonly used measures of PTG to determine whether one of these measures may be better suited to individuals with TBI; lastly the third study examines the time course and predictors of post-traumatic growth.

1.6.1 Study One: Role of VL and Associations with Functional Outcome following TBI

This study aimed to examine VL in individuals with moderate to severe TBI over the course of recovery and secondly, to identify the factors associated with VL following TBI. In line with findings related to the trajectory of subjective well-being after TBI, it was hypothesized that VL would be significantly reduced immediately post-injury and would gradually increase over time. Based on results from other clinical populations, it was also hypothesized that lower levels of anxiety and depression and higher levels of functional outcome would be significantly and positively associated with VL after TBI. Based on predictors of improved subjective and functional well-being following TBI, it was further hypothesised that injury severity, level of education and age may also be associated with VL.

1.6.2 Study Two: Measurement of PTG following TBI: Comparing the Predictive Validity of Two Measures

This study aimed to compare abbreviated versions of two most commonly used measures of PTG (PTGI-SF or CiOQ-S) in relation to association between total PTG score on each scale and outcomes such as degree of functional adjustment, anxiety and depression symptomatology, current psychiatric diagnosis, degree of value consistent living and return to study and/or employment. Based on some limited previous findings, it was hypothesised that PTG total scores on both measures would share some association with anxiety and depressive symptomatology. It was also hypothesised that PTG total scores would be positively associated with degree of VL and return to employment/study post-TBI. This study also examined whether total PTG scores on these measures corresponded with behavioural change consistent with PTG. Based on theorectical indications, it was hypothesised that higher PTG scores on both measures would be associated with increased behaviours indicative of PTG. Finally, this study aimed to evaluate which of the two PTG measures is most suitable for use in TBI population. As this was the first study to compare these measures, no literature was available to support a hypothesis in relation to this aim.

1.6.3 Study Three: Time-course and Predictors of PTG following TBI

This study aimed to examine the time-course of PTG one to six years following moderate to severe TBI. A range of socio-demographic and post-injury factors were considered including age, gender, level of education, psychiatric history and treatment, employment and relationship status and injury severity as determined by duration of post-traumatic amnesia (PTA). Pre-injury personality traits of openness and extraversion were also examined. Based on previous findings, it was hypothesised that PTG would be likely associated with personality traits of openness and extraversion, as well as higher education, employment status, older age and increasing time-post injury.

CHAPTER TWO

ROLE OF VALUED LIVING AND ASSOCIATIONS WITH FUNCTIONAL OUTCOME FOLLOWING TRAUMATIC BRAIN INJURY

2.1 DECLARATION FOR THESIS CHAPTER TWO

Declaration of the Candidate: In the case of Chapter Two, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution
Formulation of experimental design, data collection, data analysis and writing manuscript.	70%

The following co-authors contributed to the work:

Name	Nature of contribution
Jennie Ponsford	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.
Dana Wong	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript
Kate Gould	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate and co-authors' contributions to this work:

Candidate's Signature: [redacted] **Date:** 20/02/17

Main Supervisor's Signature: [redacted] 20/2/17

Original Article

Role of Valued Living and Associations with Functional Outcome following Traumatic Brain Injury

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This chapter constitutes a manuscript which has been accepted for publication in Neuropsychological Rehabilitation and is formatted in accordance with requirements set by the journal, which included the use of British spelling style. References have been changed to APA citation format to be consistent with the remainder of the thesis.

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2.3 ABSTRACT

Valued living (VL) is associated with improved enjoyment and engagement with daily activities despite negative emotional state or ongoing pain. However, the role of VL in recovery following traumatic brain injury (TBI) has yet to be investigated. This study aimed to examine changes in VL over the course of recovery and variables associated with VL. Participants with moderate to severe TBI were recruited from a rehabilitation hospital in three cohorts: 'Early' (n = 25), 'Mid' (n = 9) and 'Late' (n = 36) post-TBI. All participants were assessed at time of recruitment and 12 months later. The main measure was the Valued Living Questionnaire. Compared to pre-injury estimates, VL was significantly reduced at 12 months' post-injury. Levels of VL remained reduced between 2-3 years' and increased between 3-6 years' post-injury. VL was strongly associated with improved functional and psychosocial outcomes. Changes in VL occur over at least 3-5 years' post-injury, with 12 months post-TBI a suitable time for intervention given VL remains low over the next 24 to 36 months' post injury. Targeted intervention to facilitate re-evaluation of one's values and to support VL to be consistent with post-injury capacity could improve rates of return to pre-injury levels of VL.

2.4 INTRODUCTION

Traumatic brain injury (TBI) is the leading cause of injury related disability worldwide (Harvey & Close, 2012; Helps et al., 2008), with up to 10 million cases resulting in hospitalisation or death annually (Hyder et al., 2007). The sequelae of cognitive, behavioural and emotional changes post-injury may adversely affect the individual's quality of life for decades' post-injury: affecting capacity for work, social and leisure activities, as well as mental health and quality of relationships (Gould et al., 2011; Langlois et al., 2006; Ponsford & Hsieh, 2012).

TBI may have a profound impact on an individual's self-concept by disrupting the continuity between who the person believes he or she was before, and is after the injury (Moldover et al., 2004; Ylvisaker & Feeney, 2000). Human values have been defined as "desirable, trans-situational goals, varying in importance, that serve as guiding principles in people's lives"(Schwartz et al., 2001, p. 521). Such a definition suggests that values are vital in deriving and assigning priorities to goals which provide life with a sense of meaning. Purposeful activity in pursuit of fulfilment of these goals serves to maintain one's self-concept (Gracey et al., 2009). Therefore, it has been proposed that valued living (VL), or living in accordance with one's values, may contribute to the maintenance of self-concept. Arguably, setting value-consistent goals is helpful in rehabilitation following trauma such as TBI.

VL has been found to improve quality of life in individuals seeking assistance for pain management (McCracken & Yang, 2006), anxiety and depression (Arch & Craske, 2008; Michelson et al., 2011), and withdrawal symptoms during substance detoxification (Stotts et al., 2009). It has been suggested that by identifying new ways of living in accordance with their values, individuals are able to moderate their desire to control other distressing symptoms such as pain and increase their engagement in and enjoyment of daily activities (McCracken, Carson, et al., 2004; McCracken & Yang, 2006). It has been hypothesised that increases in value-driven behaviour may heighten perceived control and thereby reduce distress (Arch & Craske, 2008).

The Valued Living Questionnaire (VLQ) was developed by Wilson and colleagues (2010) as a two-part clinical tool to support a clinician's role in identifying their client's core values and

their ability to engage in value consistent behaviour. Initial norming on a large student cohort showed significant positive correlations between VL and social functioning, vitality and action despite emotional and physical problems; as well as negative correlations between VL and depression, anxiety, somatization, hostile attitude, relationship difficulties and general pathology (Wilson et al., 2010). The VLQ has also been used to track progress in psychotherapy in clinical populations with chronic pain (Branstetter-Rost et al., 2009; McCracken & Yang, 2006), social anxiety (Dalrymple & Herbert, 2007; Ossman, Wilson, Storaasli, & McNeill, 2006) and generalised anxiety disorder (S. A. Hayes et al., 2010; Michelson et al., 2011). The results of these studies suggest that values based intervention resulted in significant therapeutic gains such as action despite pain (Branstetter-Rost et al., 2009; McCracken & Yang, 2006), improved quality of life (Michelson et al., 2011), as well as maintenance of therapeutic gains over and above symptom reduction (Hayes et al., 2010). Such results support the facilitation of VL to promote positive psychological growth and reduce the likelihood of negative psychosocial outcomes. However, this measure has not been examined in individuals with TBI.

Although little is known about the role of VL following TBI, available studies of post-injury outcome may guide further investigations on predictors of VL following TBI. TBI outcome has generally been examined from a functional perspective according to the individual's ability to participate in activities of daily living. A longitudinal study over 10 years following TBI reported that poorer functional outcome was related to longer post-traumatic amnesia (PTA), as well as lower education and higher anxiety at time of assessment (Ponsford & Hsieh, 2012), thus highlighting the long-term influence of emotional as well as demographic and injury-related factors. Concurrent reports of increased anxiety and depression symptomatology have also been associated with poorer functional outcomes in several other studies, with a steady increase in onset of these psychological disorders up until 2-3 years' post-injury (Gould et al., 2011; Whelan-Goodinson, Ponsford, Johnston, & Grant, 2009). Other investigations have also suggested that injury severity (Tate et al., 2005), and pre-injury education (Hoofien, Vakil, Gilboa, Donovick, & Barak, 2002; Wood & Rutterford, 2006) predict long-term functional outcome. Whilst age is strongly associated with outcome up to 1-2 years

post-injury, it has not been a significant predictor in longer term outcome studies and nor has gender (Hoofien et al., 2002; Tate et al., 2005; Wood & Rutterford, 2006).

Subjective well-being has also been considered as an important outcome and arguably more important to the individual than functional outcome (Blair, Wilson, Gouick, & Gentleman, 2010). Studies suggest that subjective well-being is initially reduced following TBI (Dijkers, 2004; Hawthorne, Gruen, & Kaye, 2009), with greater injury severity associated with lower subjective wellbeing (Brown & Vandergoot, 1998). However, even for individuals with severe TBI, nearly half the sample reported improved subjective well-being by 5 years post-injury (Kalpakjian, Lam, Toussaint, & Merbitz, 2004). It remains unclear what factors contribute to this improvement. Some research suggests that older age could be protective in terms of promoting long-term emotional outcome (Senathi-Raja, Ponsford, & Schönberger, 2010); however, this has not been a consistent finding (Gould & Ponsford, 2015).

Although VL has been associated with improved psychological outcomes in other clinical populations, these findings are yet to be replicated within a TBI population. Understanding the association of VL with well-being post-TBI may assist clinicians with facilitating post-injury adjustment. Socio-demographic and injury related variables previously related to post-injury outcome could also be associated with VL. The present study, which focused on individuals with moderate to severe TBI, aimed firstly to assess VL in individuals with moderate to severe TBI and determine changes in VL over time; and secondly, to identify the factors associated with VL following TBI. In line with findings related to the trajectory of subjective well-being after TBI, it was hypothesized that VL would be significantly reduced immediately post-injury and would gradually increase over time. Based on results from other clinical populations, it was also hypothesized that lower levels of anxiety and depression and higher levels of functional outcome will be significantly and positively associated with VL after TBI. Based on predictors of improved subjective and functional well-being following TBI, injury severity, level of education and age may also be associated with VL.

2.5 METHOD

2.5.1 Participants and Procedure

Hospital and university ethics approvals were obtained. Potential participants were recruited from TBI admissions (April 2010 to December 2015) to a rehabilitation hospital which treats 30-50% of all severe head injuries in the state, in the context of a no-fault accident compensation system. Inclusion criteria were: complicated mild (i.e. post-traumatic amnesia (PTA) duration < 1 day, Glasgow Coma Scale (GCS) score 13-15 and presence of intra-cranial abnormalities on neuroimaging), moderate or severe TBI; age at injury 17-80; no previous TBI or other neurological disorder; residence in Australia post-discharge; and sufficient cognitive and English ability to complete interviews according to the treating neuropsychologist. Patients with premorbid psychiatric history, learning or behavioural problems were not excluded. Written informed consent was obtained.

Three cohorts of participants were recruited to a cross-sequential design. The first group ('Early') was recruited during inpatient admission, soon after emergence from PTA, within 1-6 months' post-injury (n= 25). A second cohort was recruited 12-24 months post-TBI ('Mid', n= 9) and a third cohort was recruited 36-60 months' post TBI ('Late', n= 36). All participants were assessed at time of recruitment (T1) and 12 months later (T2). Additionally, initial assessment for the 'Early' group examined pre-injury VL. The follow-up rate was 100% for the Early, 100% for Mid, and 78% for the Late post-injury groups. Participants who were re-assessed at 12 months and did not vary on any psychological, socio-demographic or injury related factors compared to those who were unable to be followed-up (p >.05). Overall, participants across the three cohorts did not significantly vary on any pre-injury psychological or socio-demographic variables (p >.05). They were also comparable overall in terms of injury severity (p >.05). Socio-demographic and injury information for participants is presented in Table 2.1.

Table 2.1. Socio-Demographic and Injury Information for Participants

	Early (*n* = 25)			Mid (*n* = 9)			Late (*n* = 36)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Time post-injury (months)	3.43	2.15	1-6	17.33	6.32	12-24	54.33	7.30	36-60
Age at Injury (years)	43.80	18.81	17-73	42.00	13.32	24-65	40.36	17.16	20-75
Years of Education	12.54	2.78	6-18	12.22	1.98	10-16	11.89	2.56	7-18
Duration PTA (days)	23.96	23.81	0-86	31.55	28.09	3-94	22.03	24.88	0-104
GCS	10.00	4.93	3-15	7.56	2.56	4-13	8.67	4.69	3-5
Gender (% male)	84.00%			66.70%			86.10%		

Note. PTA = Posttraumatic Amnesia; GCS = Glasgow Coma Scale score

2.5.2 Measures

Participants' demographic information was obtained from semi-structured interview. Details of injury and previous health problems including psychiatric and/or substance use problems were obtained from medical files with written consent. Initial assessment for participants in the Early group were face-to face and all other assessments (including follow-up) were conducted over the telephone by clinically trained staff members.

2.5.2.1 Valued Living Questionnaire (VLQ)

The VLQ is a two-part instrument designed to assess VL (Wilson et al., 2010). In the first part, participants rate the importance of 10 domains of living on a 10-point Likert scale. These domains include: family, couples' relations, parenting, friendship, work, education, recreation, spirituality, community life, and physical well-being. In the second part participants nominate, using a 10-point Likert scale, how consistently he or she had lived in accordance with the valued behavioural pattern within each domain over the past week. For example, in relation to the value domain 'family,' participants are asked if they have "acted as the type of family member they wish to be." Some examples of value consistent behaviour for participants rating family of high

importance are provided such as 'spending time with family', 'helping out family', 'showing appreciation and affection towards family members.' Responses from both parts are used to calculate a valued living composite (VLC), which quantifies the extent to which one is living out particular values in everyday life. A validation study reported adequate inter-item consistency (α= .77) and test-retest reliability (r= .75) for the VLQ (Wilson et al., 2010). Compared to other measures of valued action, the VLQ is the most widely recognised and utilised measure of VL (Van Buskirk et al., 2012) and has been previously utilised in assessment of values intervention in clinical populations with generalised anxiety, chronic pain and depression.

2.5.2.2 Changes in Outlook Questionnaire, Short form (CiOQ-S)

The CiOQ-S is a 10 item self-report questionnaire requiring participants to rate the extent to which their views have changed as a result of trauma (Joseph et al., 2006). Two distinct subscales measure positive (CiOP-S) and negative (CiON-S) aspects of growth. For instance, the CiOP-S includes the item "I value my relationships much more now" whereas the CiON-S includes "I do not look forward to the future anymore." Items of the CiOP-S and CiON-S are presented in alternating order. Responses on a Likert scale range from 0 to 6 (0 = 'strongly disagree', 6= 'strongly agree'). Scores on each subscale item are summed to give a total subscale score. Confirmatory factory analysis supported a two-factor model, each measuring a different aspect of growth. High internal consistency was demonstrated in both adult (CiOP-S α= .78 and CiON-S α= .83) and clinical samples (CiOP-S α= .76 and CiON-S α= .82) (Joseph et al., 2006).

2.5.2.3 The Structured Clinical Interview for DSM Disorders - Research Version (SCID)

The SCID is a semi-structured clinical interview used to diagnose DSM-IV-TR Axis I psychiatric disorders (First, Spitzer, Gibbon, & Williams, 2002). The SCID was modified to allow for pre-injury and repeat assessments as described by Gould et al. (2011) At initial assessment, the

SCID was administered twice to obtain both current and pre-injury lifetime psychiatric disorders. Follow-up interviews assessed current psychiatric disorders and those occurring since the previous assessment. Presence of at least one psychiatric disorder on the SCID at each time-point was recorded.

2.5.2.4 The Hospital Anxiety and Depression Scale (HADS)

The HADS was also administered as a brief self-report measure of one-week anxiety and depression symptom severity (Snaith & Zigmond, 1994; Zigmond & Snaith, 1983)

2.5.2.5 The Glasgow Outcome Scale–Extended Version(GOS-E)

The GOS-E is an 8-point scale which describes overall functional status relative to pre-injury (Jennett, Snoek, Bond, & Brooks, 1981; Teasdale, Pettigrew, Wilson, Murray, & Jennett, 1998)

2.5.3 Data Analysis

Data were screened for outliers and missing values. Pairwise exclusion was used to deal with some minimal (<5% of cases per variable) missing data. VL scores were normally distributed and met all other assumptions of parametric tests. Reliability statistics to assess the VLQ scale were conducted. This analysis revealed good inter-item consistency at both the initial (α= .85) and follow-up (α= .88) time-points. Descriptive statistics were used to examine functional and psychological outcomes and to calculate VL for each cohort at each time-point. Participant VLQ scores were plotted over the two time-points to visually inspect changes over time. Firstly, in order to determine Change over Time (T1, T2) with VLQ scores, repeated measures t-tests were conducted using SPSS (Windows, Version 22). Secondly, in order to examine factors associated with VL and whether VL was associated with functional and psychological outcomes, a random effects regression was performed on the longitudinal data using STATA (Windows, Version 13).

2.6 RESULTS

2.6.1 Functional and Psychological Outcomes Following TBI

Based on SCID assessments at T1, 28% of participants in the Early group; 10% of participants in the Mid group and 36% of participants in the Late group received one or more psychiatric diagnosis. A representation of functional outcomes and psychological support received over the course of rehabilitation following TBI is provided in Table 2.2 below.

Table 2.2. Functional Outcomes and Psychological Support Received following TBI

		Early	Mid	Late
Employment/Study status	Returned to Work/Study	44%	67%	67%
	Unable to Work/Study	48%	33%	14%
	Retired	9%	0%	19%
GOS-E - Return to work	At previous capacity	17%	44%	61%
	Reduced	57%	34%	31%
	Unable to return	26%	22%	8%
GOS-E - Return to leisure	At previous capacity	35%	56%	56%
	Mildly reduced	26%	11%	11%
	Significantly reduced	22%	22%	22%
	Unable to engage	17%	11%	11%
Psychological Therapy	Receiving current support	67%	61%	22%
	Received support since TBI	22%	30%	64%

Note. GOS-E = Glasgow Outcome Scale- Extended. GOS-E scores based on data collected at 12-month follow-up. GOS-E = Glasgow Outcome Scale – extended.

As shown in Table 2.2, although there appeared to be a gradual improvement in level of participation in work and leisure pursuits in the years following TBI, only 61% of participants reported a return to pre-injury level of work capacity and 56% of the Late group reported a return to

pre-injury level of social engagement and leisure by 3-5 years' post-injury. A majority of participants (64%) had received some form of psychological therapy following their TBI by 3-5 years' post-injury. A majority of participants in the Late group no longer received psychological support, although they had received comparable support earlier as participants in the Early and Mid groups.

2.6.2 Distribution of VLQ Scores

In the Early cohort, the values most important to participants prior to injury (T1) in order of importance included: 'Family', 'Parenting', 'Couple Relationships', 'Work', 'Recreation' and 'Health'. In the period following injury (T2), the importance of 'Family' increased marginally but consistently and was closely followed by 'Health'. As per pre-injury, other values of importance included: Couple Relationships, Recreation and Parenting. Of particular note, the importance of work was relatively reduced across all time-points post-injury compared to pre-injury ratings. Pre-injury VL scores for the Early sample (rated by the participants soon after injury by asking them to think back to pre-injury) ranged from 28 to 95 (M= 64.23 SD= 15.99). These figures are consistent with previously published norms for VL scores in an undergraduate student sample by Wilson et al. in 2010 (Range= 29-100; M= 63.68, SD= 15.41) and also in a healthy male control sample by Michelson et al. in 2011 (M= 62.53, SD= 15.67).

2.6.3 VL across Time

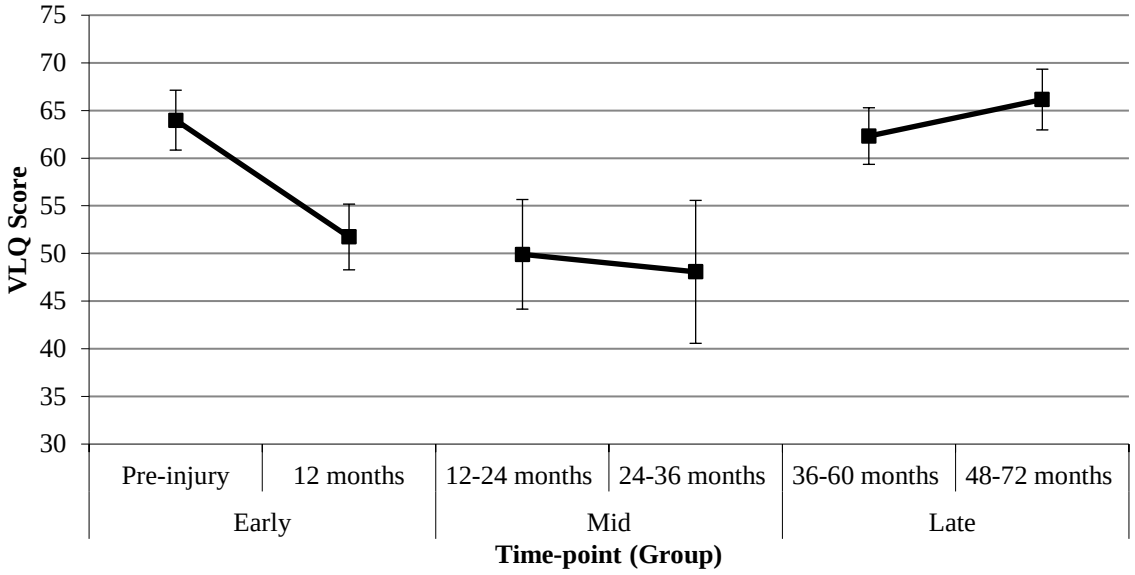

Figure 2.1. Visual representation of mean VLQ scores for participants in the Early, Mid and Late TBI groups.

Note. Continuous trend lines denote longitudinal changes in VLQ scores at 12-month follow-up. Error bars represent variation in mean scores by standard error.

Visual inspection of Figure 2.1 reveals that VLQ scores reduced post-injury compared to pre-injury estimates in the Early group. VLQ scores remained lower for individuals in the Mid group and relatively higher for individuals in the Late group. By 4-6 years post-injury, VLQ scores closely mirrored pre-injury estimates. Assessment of change over time over a 12-month period of follow-up revealed a significant decline in degree of VL as reported by participants in the Early group ($t(24)= 2.70$, $p = .01$). In comparison, there was no change in degree of VL over time for participants in Mid ($t(8)= -.20$, $p > .05$) and Late ($t(27)= -.05$, $p > .05$) cohorts.

2.6.4 Predictors of VL

Given limited sample size within each cohort, data were combined across groups. Assumptions for multivariate regression analysis were met. Demographic (age, gender, education),

injury related (PTA duration), functional adjustment and psychiatric variables (SCID diagnosis, anxiety and depression symptomatology; changes in outlook: positive and negative) at T1, were entered as potential predictors of change in VL over a 12-month period of follow-up. Predictors were entered in stages after controlling for the effect of time, with significant predictors being carried forth into successive models. Table 2.3 shows the outcome of these random effect regression models with regression co-efficient and standard error for each variable presented, followed by the model fit statistics (log likelihood, AIC, BIC; with lower values indicating better model fit). As shown in Table 2.3, Model 6 has the most parsimonious combination of multivariate predictors and reveals that age at injury, degree of functional adjustment, depressive symptomatology and changes in outlook were all associated with VL. Specifically, improved VL over time was associated with older age, improved functional adjustment, lower levels depression and negative outlook and higher levels of positive outlook following TBI.

Table 2.3. Coefficients (Co) and Standard Errors (SE) for Models of Predictors of Valued Living

VLQ	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Co	SE	Co	SE	Co	SE	Co	SE	Co	SE	Co	SE
Time	-3.62	2.10	-4.02	2.12	-4.09	2.11*	-1.69	1.82	-1.14	1.85	-1.15	1.91
Age			0.31	0.11**	0.30	0.11**	0.31	0.11**	0.29	0.10**	.28	0.09**
Gender			2.05	4.87								
Education			0.69	0.73								
PTA Duration					0.05	0.07						
GOS-E							6.55	1.22***	4.78	1.27***	4.25	1.30**
HADS-A									-0.48	.48		
HADS-D									-1.11	.49*	-.85	0.48*
SCID Dx.									.64	2.95		
CiOP-S											.52	0.24*
CiON-S											.63	0.32*
Constant	61.41	2.06	39.89	10.78	47.69	5.31	4.97	9.09	23.90	10.45	20.36	13.04
Log Likelihood	-582.73		-567.10		-566.93		-445.74		-439.36		-431.89	
AIC	1173.46		1148.2		1145.85		903.48		896.72		881.79	
BIC	1185.17		1168.54		1163.28		919.69		921.02		906.01	

Note. VLQ= Valued Living Questionnaire Score; PTA = post-traumatic amnesia; GOS-E = Glasgow Outcome Scale-Extended; HADS-A = Hospital Anxiety and Depression Scale, Anxiety subscale; HADS-D = Hospital Anxiety and Depression Scale, Depression subscale; SCID Dx. = diagnosis on Structured Clinical Interview for DSM IV Disorders; CiOP-S = Changes in Outlook Questionnaire- Short form, Positive Subscale; CiON-S = Changes in Outlook Questionnaire- Short form, Negative Subscale; *= p <.05; **= p <.01; ***= p <.001; AIC = Akaike's information criterion; BIC = Bayesian information criterion.

2.7 DISCUSSION

VL is associated with improved enjoyment and engagement with daily activities despite negative emotional state or ongoing pain. However, the role of VL in recovery following TBI has not previously been investigated. Our study aimed to establish whether the degree of VL changes over the course of recovery and determine which variables are associated with VL. This study found similar mean pre-injury VLQ scores for individuals in the Early group compared to published VLQ scores obtained for undergraduate students (Wilson et al., 2010) and a control adult sample (Michelson et al., 2011). This suggests that the data obtained in this study are representative of VL as measured by the VLQ in other exploratory and intervention studies, and that individuals with TBI show similar patterns of pre-injury values to the general population.

Examination of results suggested that levels of VL vary over the course of recovery following a moderate to severe TBI. Specifically, participants reported significantly reduced VL at

12 months following TBI compared to their pre-injury estimates. This may suggest that individuals tend to idealize their pre-injury lifestyle (Iverson, Lange, Brooks, & Rennison, 2010) and have not yet been able to adjust their level of participation to compensate for post-injury disability or impairment. Many individuals may attempt a return to their "pre-injury self," by continuing to follow the same behavioural routines which may no longer be possible. Specifically, as has been reported in past studies, issues associated with physical injuries, pain, fatigue, and cognitive difficulties may contribute to reduced participation in valued activities (Dikmen et al., 2003; Khan, Baguley, & Cameron, 2003; Langlois et al., 2006).

Mean VLQ scores for individuals in the Late (3-6 year) group closely resembled pre-injury VLQ scores obtained from the Early cohort and did not appear to decline over follow-up. This may suggest a return to pre-injury levels of VL, potentially following a period of prolonged decline reflecting the longer recovery profile of moderate to severe injury. Notwithstanding the fact that each time post-injury cohort was different, it is promising to note that similar to reports of subjective wellbeing which was noted to improve by 5 years' post-injury (Kalpakjian et al., 2004), VL was also higher in the 3-5 year cohort. Higher levels of VL could reflect increased adaptive living with ongoing impairments, some degree of recovery or a combination of both these factors. Overall it appears that changes in VL may occur over much longer periods than one year – more likely 3-5 years.

In the current study, 67% of the sample had been able to return to some form of study or work by 3 to 5 years post-injury. Based on their functional recovery at this time-point, 61% reported a return to pre-injury working capacity, with 28% noting some mild to moderate reduction. Return to pre-injury leisure and social activities was slightly poorer, with only 56% reporting similar levels of engagement compared with pre-injury estimates. While functional recovery overall may be improved by 3-5 years post-injury, especially in the area of return to work, it was evident that complete recovery was not common as per findings by Dikmen et al. (2003). Therefore, the improvements in reported VL may reflect in part an adaptation to the new level of function and related adjustment to self-concept.

Alternatively, values may have been re-shaped to accommodate changes in lifestyle. Qualitatively, there is some indication in the current results that the importance ratings of values changed post-injury. Post-injury participants reported that they valued family and health to a greater extent than other areas of life such as work. Ongoing psychological support over this time could also have contributed to this process of adaptation, with 64% of participants in the Late cohort reporting receiving some form of psychological support since the injury.

In relation to socio-demographic related predictors of VL, we found that older age was associated with improved levels of VL over time. This is broadly consistent with previous research suggesting that older adults may experience less emotional distress than younger adults (Senathi-Raja et al., 2010). It may be that older adults, due to being at a later stage in their life, have already attained the important life goals of establishing a vocation and strong personal and social relationships and are therefore not subject to the same degree of loss of identity and reduced self-worth as might a younger person. Young adults are often described as being at a crossroads of establishing their own identity, family roles and career aspirations at the time of the head injury (Olver, Ponsford, & Curran, 1996). Therefore, they may view a change in ability to participate in these valued interests as a significant reduction in VL following a TBI.

VL was also significantly associated with improved functional adjustment. However, the direction of this association is unclear, since functional capacity may in turn influence values. As noted above, two thirds of participants had been able to return to some form of work or study at 3-6 years post-injury. However, despite improvements in some areas, nearly 45% of participants reported some reduction in leisure and social engagement post-injury. VL was also a significant independent predictor of reduced anxiety symptoms after accounting for severity of injury and functional recovery. Therefore, findings of increased VL despite ongoing reductions in functional capacity, are consistent with findings in other clinical populations demonstrating that VL is associated with action despite pain and maintenance of therapeutic gains beyond a period of intervention (Branstetter-Rost et al., 2009; Hayes et al., 2010; McCracken & Yang, 2006; Michelson et al., 2011). As suggested, it is likely that when values serve as guides for actions, individuals experience improved levels of daily activity and better emotional functioning (McCracken & Yang, 2006).

Our results also revealed that improved VL is significantly associated with improved psychological outcomes. Specifically, improved VL was associated with reduced depressive symptomatology and positive outlook. Previous studies in non-TBI populations have reported that improved levels of VL are associated with reduced symptoms of depression (Arch & Craske, 2008; Wilson et al., 2010). As described in therapies such as Acceptance and Commitment Therapy (Hayes, Luoma, Bond, Masuda, & Lillis, 2006) VL requires the person to take action in the direction of their values, which is considered an important first step towards breaking the cycle of depression, an episode of which may include a lack of participation in activities of interest which subsequently maintains lowered mood. Given this two-way association, it is likely that individuals who report depressive symptoms are less able to engage with activities of interest and therefore report lower levels of VL post-injury, as has been found in this study.

To the authors' knowledge, this is the first study to examine the association between changes in outlook following TBI and VL. These preliminary current results suggest that VL is associated with a distinct change in outlook, such that individuals living in accordance with their values may report positive psychological change (post-traumatic growth) and reduced negative outlook following TBI. Alternatively, those reporting negative outlook post-TBI could be experiencing more difficulties aligning their daily life to reflect important values. This may suggest that rehabilitative intervention to improve VL following TBI may promote post-traumatic growth and would need further consideration in future research.

The results of this study may be extended by prospectively examining longitudinal changes in VL over periods of five years after injury as they relate to functional status. Whilst the current results point towards the 2-3 and 3-4 years time points as being significant periods of change in VL, given the limited sample size, predictors of VL specific to these periods could not be determined. The small sample size for the Mid cohort could also have increased potential for error and bias in overall trends observed. Future studies should aim to closely examine the role of VL in recovery following TBI between 2-3 and 3-4 years post-injury. Also, given the subjective nature of the VLQ, it is acknowledged that individuals with TBI may have been influenced by poor memory and

judgement. Future studies could seek to obtain a corroborative account from family members to address this potential limitation.

Overall, given the aforementioned benefits of VL, investigation of therapeutic approaches that focus on facilitating VL (such as Acceptance and Commitment Therapy, Hayes et al., 2006) would be useful to determine whether gains in functional and emotional adjustment are realizable. Our results indicate that 12 months post-TBI is a suitable time for intervention given levels of VL remain low over the next 24 to 36 months' post injury. We found that changes in VL occur over at least 3-5 years, with relative change in the factors influencing the degree of VL at each stage of recovery. It is promising to note that levels of VL, on average, return to pre-injury estimates by 3-5 years, despite some ongoing reductions in functional capacity at this time and acknowledging the likely impact of high levels of engagement with psychotherapeutic services. With more targeted intervention to assist individuals with TBI to re-evaluate their values and behaviour so they are consistent with post-injury capacity, it may be possible to improve the rate of return to pre-injury levels of VL.

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CHAPTER THREE

MEASUREMENT OF POST-TRAUMATIC GROWTH FOLLOWING TRAUMATIC BRAIN INJURY: COMPARING THE PREDICTIVE VALIDITY OF TWO MEASURES

3.1 DECLARATION FOR THESIS CHAPTER THREE

Declaration of the Candidate: In the case of Chapter Three, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution
Formulation of experimental design, data collection, data analysis and writing manuscript.	70%

The following co-authors contributed to the work:

Name	Nature of contribution
Jennie Ponsford	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.
Dana Wong	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.
Kate Gould	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate and co-authors' contributions to this work:

Candidate's Signature:	[redacted]	**Date:** 20/02/17
Main Supervisor's Signature:	[redacted]	20/2/17

Original Article

Measurement of Post-traumatic Growth following Traumatic Brain Injury: Comparing the Predictive Validity of Two Measures

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This chapter constitutes a manuscript submitted to Brain Injury and is formatted in accordance with requirements set by the journal, which included the use of British spelling style and a structured abstract. References have been changed to APA citation format to be consistent with the remainder of the thesis. Due to the design of sub-studies within this body of research, repetition will be apparent with regard to the methodology and limitations described in the discussion.

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3.2 ABSTRACT

Objective: Over the past decade, there has been growing awareness that positive psychological outcomes such as post-traumatic growth (PTG) can emerge following TBI. However, issues relating to measurement of PTG have received little attention. This study aimed to compare two commonly used measures of PTG: Post-traumatic Growth Inventory – Short form (PTGI-SF) and Changes in Outlook Questionnaire- Short form (CiOQ-S), on their ability to predict adjustment-related outcomes and align with behaviours associated with PTG.

Method: Participants with moderate to severe TBI were recruited from a rehabilitation hospital one to five years following TBI (n=70).

Results: A majority of participants were engaging in behaviours consistent with PTG. These behaviours clustered into specific themes and were closely associated with domains of PTG most commonly reported following TBI such an appreciation for life and improved quality of relationships with others. Among the two measures of PTG, the positive and negative subscales of CiOQ-S were more closely associated with post-injury outcomes, including return to work/study, improved valued living and increased behavioural reports of positive growth.

Conclusions: These results suggest that CIOQ-S has better predictive validity than PTGI-SF and may be a more suitable measure of PTG following TBI.

3.3 INTRODUCTION

Traumatic brain injury (TBI) is a leading cause of injury-related hospitalisation, disability and death amongst young adults. TBI can negatively impact return to work, study, leisure and social activities and relationships (Ponsford et al., 2012). Following TBI, the prevalence of depression and anxiety is significantly elevated (Gould et al., 2011); however, in recent years positive growth, also referred to as post-traumatic growth (PTG), has also been an acknowledged outcome (McGrath, 2004).

PTG represents improved psychological functioning following a 'search for meaning' triggered by a traumatic event (Hayes et al., 2007). PTG occurs in several domains, including self-perception, perspective on life and relationships with others (Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006). PTG is considered to be an ongoing process of self-discovery (Zoellner & Maercker, 2006) evolving over a period of months (Frazier et al., 2001) to years (McMillen et al., 1997). This multi-faceted and dynamic aspect of PTG complicates measurement and conceptualisation in research.

Among quantitative measures of PTG, the Post-traumatic Growth Inventory (PTGI) is most widely used. The PTGI, developed by Tedeschi and Calhoun (1996) is a 21-item self-report inventory measuring an individual's perception of positive changes along five dimensions of growth: new possibilities, relating to others, personal strength, appreciation of life and spiritual change. Item responses are summed to produce a total score but there are no established cut-offs to determine a meaningful level of growth. Furthermore, given the multi-dimensional nature of PTG, it is unclear whether a total score or individual domain scores should be used to interpret results. This has led to inconsistent practices, including use of individual item scores to establish PTG and total minimum scores to operationalize 'growth' based on comparison with 'average scores' reported in other studies (Gangstad et al., 2009; Powell et al., 2007; Silva et al., 2011).

Another criticism of the PTGI has been its use of a unipolar response scale including only positively worded items (Calhoun & Tedeschi, 2006). In failing to allow report of negative change, it captures a protracted range of responses. In order to reflect a broader picture of growth, scales

measuring both positive and negative changes in outlook were devised. One such scale is the Changes in Outlook Questionnaire (CiOQ). The CiOQ was developed by Joseph and colleagues (1993) and comprises two distinct subscales which separately assess positive and negative changes in outlook. The Changes in Outlook- Positive subscale (CiOP) consists of 11-items and has good convergent validity with the PTGI (Joseph et al., 2005). The Changes in Outlook- Negative subscale (CiON) has 15-items evaluating diminished outlook compared to pre-trauma. Both the CIOQ and PTGI have been abbreviated for use as 10 item short-forms (CiOQ-S and PTGI-SF) with consistency and reliability ratings comparable to their full forms (Cann et al., 2010; Joseph et al., 2006).

Whether PTG is restricted to changes in outlook, or whether it translates into observable behaviours, is still debated. As PTG is operationalized as a 'change in thinking patterns and life outlook,' some authors believe that self-report questionnaires should adequately measure growth (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004). However, others have suggested the use of behavioural measures of positive growth should supplement self-reported measures of thought patterns (Hobfoll et al., 2007; McMillen, 2004). This may be particularly relevant following TBI when insight is compromised and a disconnection between thoughts and actions is often observed (Ponsford et al., 2012).

The only published behavioural checklist of PTG, developed by Shakespeare-Finch and Barrington (2012) was validated in a mixed trauma sample and includes open-ended questions to elicit examples of positive behavioural change for five dimensions of growth identified by Calhoun and Tedeschi (1991). However, this measure has not been used or validated within the TBI population. This is important given that some questions are not necessarily suitable for a TBI population.

While PTG has been associated with positive psychological benefits (Lelorain et al., 2010), there is mixed evidence regarding its associaiton with functional outcome following TBI. Hawley and Joseph (2008) reported no correlation between PTG scores (measured by CiOQ) and functional outcome on the Glasgow Outcome Scale- Extended (GOS-E). However, PTG was associated with reduced anxiety and depression assessed on a single item self-rating scale, in participants ranging

from 9 to 25 years post-injury. Powell and colleagues (2007) also found no significant relationship between PTGI scores and functional disability or life-satisfaction in 'Early' (1-3 years) or 'Late' (10-12 year) post-injury groups. However, a subsequent follow-up at 13 years post injury (Powell et al., 2012) reported a positive association between PTG and life satisfaction, paid employment, activity levels and milder disability, but no relationship between PTG and anxiety or depression, although this sample was small (*n*=21). Recently, it was also found that valued living (VL) or living in accordance with one's values contributed uniquely to functional and psychological wellbeing following TBI (Pais, Ponsford, Gould, & Wong, 2017). It remains to be established whether PTG as measured by CiOQ or PTGI shares an association with VL.

Measures of PTG are yet to be evaluated in conjunction with actual behavioural change consistent with positive growth. The present study aimed to determine whether PTG scores (as measured by PTGI-SF or CiOQ-S) were related to post-injury outcomes, including functional outcome, anxiety and depression symptomatology, current psychiatric diagnosis, degree of value consistent living and return to study and/or employment. This study also examined whether these measures corresponded with behavioural change consistent with PTG. Finally, this study aimed to evaluate which of the two PTG measures is most suitable for use in TBI population.

3.4 METHOD

3.4.1 Participants and Procedure

Hospital and university ethics approvals were obtained. All participants were recruited from a rehabilitation hospital which treats 30-50% of all severe head injuries in the state, in the context of a no-fault accident compensation system. Participants who were a part of a prospective longitudinal study of psychiatric disorders following TBI (commenced in 2005) were initially approached for recruitment into the current study. Consecutive new inpatient admissions were also recruited from April 2013 until November 2015. Inclusion criteria were: complicated mild (i.e. post-traumatic amnesia (PTA) duration <1 day, Glasgow Coma Scale (GCS) score 13-15 and presence of intra-

cranial abnormalities on neuroimaging), moderate or severe TBI; age at injury 17-80; no previous TBI or other neurological disorder; residence in Australia post-discharge; and sufficient cognitive and English ability to complete interviews according to the treating neuropsychologist. Patients with premorbid psychiatric history, learning or behavioural problems were not excluded. Written informed consent was obtained. Assessments were completed in the form of years semi-structured interviews via telephone to assess mood, functional adjustment and PTG. Seventy participants were recruited into the current study. Socio-demographic and injury information for these participants is presented in Table 3.1.

Table 3.1. Socio-demographic and Injury Information (n = 70)

	Mean	SD	Range
Time post-injury (months)	34.46	21.42	12-60
Age at Injury	42.27	17.00	18-75
Years of Education	12.16	2.54	6-18
Duration PTA (days)	23.57	24.49	0-104
GCS	9.05	4.55	3-15
Gender (% male)	84.3%		

Note. PTA = Posttraumatic Amnesia; GCS = Glasgow Coma Scale score

3.4.2 Measures

Participants' demographic information was obtained from interview. Details of injury and previous health problems were obtained from medical files with written consent.

3.4.2.1 Post-traumatic Growth Inventory, Short form (PTGI-SF)

The PTGI-SF is a 10 item self-report questionnaire which measures change in five dimensions of positive growth: new possibilities, relating to others, personal strengths, appreciation

of life and spiritual change. Participants respond on a scale from 0 to 5, where "0" means 'not at all' and "5" means 'very great degree.' Scores are summed to provide an overall measure of PTG. Confirmatory factor analysis revealed that a single score, supported by five factor scores, characterized the PTGI-SF (Cann et al., 2010). The internal consistency reliability of this form within clinical samples ranged from α =.84 to .93 (Cann et al., 2010).

3.4.2.2 Changes in Outlook Questionnaire, Short form (CiOQ-S)

The CiOQ-S is a 10 item self-report questionnaire rating the extent to which respondents' views have changed as a result of trauma along positive (CiOP) and negative (CiON) domains (Joseph et al., 2006). Items on the CiOP-S state a positive aspect of growth such as "I value my relationships much more now," whereas CiON-S items state a negative aspect of growth such as: "I do not look forward to the future anymore." Responses on a Likert scale range from 0 to 6, where "0" means 'strongly disagree' and "6" means 'strongly agree.' Scores on each subscale item are summed to give a total subscale score. Confirmatory factory analysis supported a two-factor model, each measuring a different aspect of growth (Linley, Andrews & Joseph, 2007). The CiOP subscale shows convergent validity with the PTGI (r=.46) (Joseph et al., 2005). High internal consistency was demonstrated in both adult (CiOP-S α=.78 and CiON-S α=.83) and clinical samples (CiOP-S α=.76 and CiON-S α= 82) (Joseph et al., 2006).

3.4.2.3 Behavioural Measure of Post-traumatic growth (PTG-BM)

A qualitative behavioural measure of positive growth was developed for this study by adapting the open-ended questions proposed by Shakespeare-Finch and Barrington (2012). These five questions were modified to suit a TBI sample (i.e. " I now engage in more challenging physical and mental activities" was replaced with the more generally worded "I have taken up new interests/hobbies"). The final modified measure consisted of four open-ended questions (see Appendix). Participants nominated whether they demonstrated the listed behaviour (0) "less"; (1)

"same"; or (2) "more" than prior to the injury. If the participant rated a (2) on any item, they were asked to provide an example of such behaviour to ensure that positive response bias was not present. Participant responses were also qualitatively analysed for underlying themes.

3.4.2.4 Valued Living Questionnaire (VLQ)

The VLQ is a two-part instrument designed to assess VL (Wilson et al., 2010). In the first part, participants rate the importance of 10 domains of living on a 10-point Likert scale. Domains include: family, couples' relations, parenting, friendship, work, education, recreation, spirituality, community life, and physical well-being. In the second part, participants nominate, using a 10-point Likert scale, how consistently he or she had lived in accordance with the valued behavioural pattern within each domain over the past week. Responses from both parts are used to calculate a valued living composite (VLC), which quantifies the extent to which one is living out important values in everyday life. A validation study reported good inter-item consistency (α=.77) and good test-retest reliability (r=.75) for the VLC (Wilson et al., 2010).

3.4.2.5 The Structured Clinical Interview for DSM Disorders - Research Version (SCID)

The SCID is a semi-structured clinical interview used to diagnose DSM-IV-TR Axis I psychiatric disorders (First et al., 2002). The SCID was modified to allow for pre-injury and repeat assessments as described in Gould et al. (2011). At initial assessment, the SCID was administered twice to obtain both current and pre-injury lifetime psychiatric disorders. Follow-up interviews assessed current psychiatric disorders and those occurring since the previous assessment. Presence of at least one psychiatric disorder on the SCID at each time-point was recorded.

3.4.2.6 The Hospital Anxiety and Depression Scale (HADS)

The HADS was administered as a brief self-report measure of anxiety and depression symptom severity in the previous week (Snaith & Zigmond, 1994).

3.4.2.7 The Glasgow Outcome Scale–Extended (GOS-E)

The GOS-E is an eight-point scale, which describes overall functional status relative to pre-injury (Teasdale et al., 1998).

3.4.3 Data Analysis

Descriptive statistics were used to examine socio-demographic and injury related information and calculate mean total scores on PTGI-SF and CiOQ-S (CiOP and CiON subscales). Data was screened for outliers and other assumptions of parametric tests. Although small departures from normality were observed amongst some continuous variables, overall normality of distribution was assumed given a sample size of 70 (Hogg & Tannis, 2010). Multiple regressions were performed using SPSS (Windows, Version 22) to determine whether total PTG scores on PTGI-SF and CiOP-S contributed to prediction of continuous outcome variables such as scores on GOS-E, HADS and VL after controlling for time post-injury where relevant. CiON-S subscale was assessed in a similar manner to determine its association with outcome measures. Independent samples t-tests and One-way Analyses of Variance (ANOVA) were performed to determine whether PTGI-SF and CiOP-S scores differentiated between categorical variables such as return to work, current psychiatric diagnosis and the four domains of behaviour associated with positive growth. Qualitative responses elicited from each behavioural domain were further assessed for major themes.

3.5 RESULTS

3.5.1 PTG Scores following TBI

PTGI-SF total scores ranged from 2 to 46 with a mean of 19.21 (SD=11.15). PTG was most commonly endorsed on items relating to having increased 'appreciation for the value of one's life,' changed priorities about 'what is important in life,' and a knowledge that difficulties can be 'better handled' in future. The internal consistency of the PTGI-SF scale for this sample was $\alpha = .83$. CiOP-S scores ranged from 5 to 30, with a mean of 20.49 (SD=5.94). The most strongly endorsed items on the CiOP-S included "I do not take life for granted anymore," and "I value my relationships much more now." The internal consistency of the CiOP-S subscale for this sample was $\alpha = .80$.

3.5.2 Behavioural Examples of PTG following TBI

The behavioural measure of PTG was completed by 65 of the 70 participants. The most frequent behavioural changes were 'showing care towards family members and friends' (28 participants) and 'appreciating smaller things in life' (28 participants), followed by 'consideration and kindness towards others' (22 participants). Behavioural changes related to increased pursuit of 'new interests' was least likely to be endorsed (14 participants).

Table 3.2. Qualitative Sub-themes Associated with Behaviours of PTG following TBI

Theme	Subtheme	Count
Care for family and friends	Spending more time together	11
	Making them "a priority," showing interest in their welfare	11
	Appreciating help; returning the gesture; buying flowers/gifts	7
	Expressing affection: hugs, kisses, "I love you"	6
	"More tolerant"	4
Appreciation of life	Nature: "sky, ocean, garden, fresh air, sunsets"	6
	Mindfulness: being "in the moment."	6
	"Being alive: more fortunate than others"	5
	Kindness of others: "good manners," offers to help	5
	"Simple pleasures: home life, good food, good health"	4
	Family/Friends	3
	Pets, dogs	3
Kindness towards others	Engaging with others: "listening, trying to understand, connect and feel"	12
	Willingness to help strangers	6
	"Nicer person"	5
	Empathy towards people with disability	3
New Interests	Intellectual pursuits: study, career change, learning a new skill	6
	Active hobbies: playing instrument, fishing, travel	5
	Community Service	4
	Passive hobbies: relaxing, watching TV	2
	Family oriented activities	2

Note. Subthemes in quotation marks are participants own words, otherwise subthemes represent summarised information.

Qualitative responses generated by participants reporting an increase in any behavioural domain were further examined to establish major sub-themes (See Table 3.2). The most commonly reported subthemes were associated with interpersonal activities, i.e. finding new ways to 'engage with others,' 'spending more time with family/friends,' and 'making family/friend priority and showing interest in their welfare.' Although the behavioural domain of 'new interests' was infrequently endorsed, it was interesting to note that this reflected 'intellectual pursuits' such as learning a new skill rather than 'passive hobbies.'

3.5.3 Comparison of PTG Measures on Adjustment Related Outcomes

The ability of two measures of PTG to predict functional adjustment, depression and anxiety symptoms, and VL were compared using multiple regression models. As shown in Tables 3.3, 3.5 and 3.6, neither measure of PTG was significantly associated with functional adjustment or psychological distress at 1-5 years post TBI. However, CiOP-S scores were significantly associated with VL (r= .26, p< .05), suggesting a shared association between PTG and increased value consistent behaviour, which in turn has been shown to uniquely contribute towards positive psychological outcomes. PTGI-SF scores, by contrast, were not associated with VL.

Whilst there were no significant group differences on either CiOP-S (t(68)= -.13, p> .05) or PTGI-SF based on psychiatric diagnosis (t(68)= -1.32, p> .05), post-hoc analysis revealed that CiOP-S scores differentiated (F(2,67)= 8.54, p< .01) between participants who could 'return to work/ study' (M= 22.60, SD= 4.73) compared to those 'unable to return' (M= 16.60, SD= 6.19). Although participants who were able to 'return to work/ study' reported increased PTG on both measures of CiOP-S and PTGI-SF, the greater variation in scores on the PTGI-SF (return to work/study: M=20.8; SD= 11.32; unable to return: M= 17.63; SD= 10.62) resulted in no significant group differences on that measure (F(2,67)= 1.14, p>.05).

Table 3.3. Measures of PTG as Predictors of Functional Adjustment Scores Post-TBI

GOS-E	Model 1			Model 2			Model 3		
	B	SE	ß	B	SE	ß	B	SE	ß
Time post injury	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.24
PTGI-SF				0.00	0.01	0.00			
CiOP-S							0.01	0.02	0.02
Constant	5.75	0.26		5.75	0.36		5.62	0.52	
F			3.76			1.85			1.89
Adjusted R^2			0.04			0.02			0.03

Note. GOS-E= Glasgow Outcome Scale – Extended; PTGI-SF= Post-traumatic Growth Inventory Short Form; CiOP-S= Positive subscale of the Changes in Outlook Questionnaire Short-Form.

Table 3.4. Measures of PTG as Predictors of Anxiety Symptomatology Post-TBI

HADS-A	Model 1			Model 2			Model 3		
	B	SE	ß	B	SE	ß	B	(SE)	ß
Time post injury	-0.02	0.02	-0.12						
PTGI-SF				0.07	0.04	0.20			
CiOP-S							0.01	0.08	0.01
Constant	5.94	0.87		3.86	0.91		5.07	1.67	
F			1.06			2.77			0.00
Adjusted R^2			0.00			0.03			0.02

Note. HADS-A= Hospital Anxiety Depression Scale – Anxiety subscale; PTGI-SF= Post-traumatic Growth Inventory Short Form; CiOP-S= Positive subscale of the Changes in Outlook Questionnaire Short-Form.

Table 3.5. Measures of PTG as Predictors of Depression Symptomatology Post-TBI

HADS-D	Model 1			Model 2			Model 3		
	B	SE	ß	B	SE	ß	B	SE	ß
Time post injury	-0.05	0.02	-0.23	-0.05	0.03	-0.23	-0.05	0.03	-0.22
PTGI-SF				0.01	0.05	0.01			
CiOP-S							-0.07	0.09	-0.09
Constant	6.27	0.99		6.16	1.36		7.57	1.99	
F			3.68			1.82			2.11
Adjusted R^2			0.04			0.02			0.03

Note. HADS-D= Hospital Anxiety Depression Scale – Depression subscale PTGI-SF= Post-traumatic Growth Inventory Short Form; CiOP-S= Positive subscale of the Changes in Outlook Questionnaire Short-Form.

Table 3.6. Measures of PTG as Predictors of Valued Living following TBI

VLQ	Model 1			Model 2			Model 3		
	B	SE	ß	B	SE	ß	B	SE	ß
Time post injury	0.18	0.10	0.21	0.20	0.11	0.21	0.16	0.10	0.19
PTGI-SF				0.00	0.20	0.00			
CiOP-S							0.74	0.36	0.24*
Constant	51.08	4.17		51.08	5.74		36.55	8.21	
F			3.09			1.52			3.69*
Adjusted R^2			0.03			0.02			0.07

Note. *= $p < .05$; VLQ= Valued Living Questionnaire; PTGI-SF= Post-traumatic Growth Inventory Short Form; CiOP-S= Positive subscale of the Changes in Outlook Questionnaire Short-Form.

Upon closer inspection, it was noted that the overall distribution of scores for individual items and total scores on the CiOP-S and PTGI-SF varied considerably (See Figure 3.1). PTGI-SF items were often positively skewed. PTGI-SF total scores aggregated at the lowest value indicating 'no change,' with some scores indicating a 'moderate degree of positive change' following the injury. By contrast, item scores on the CiOP-S had a slightly negative skew. Most responses indicated agreement with item statements suggestive of positive change post injury, with a smaller sub-group reporting 'disagreement' or 'no change' post-injury.

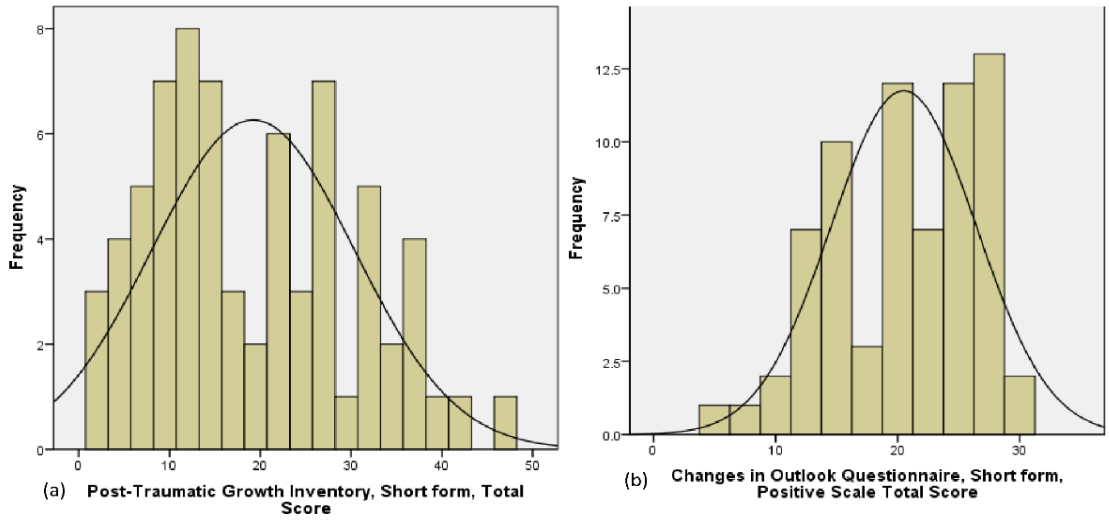

Figure 3.1. Frequency histograms illustrating distribution of total scores (n = 70).

3.5.4 Comparison of PTG Measures on Behavioural Domains of Growth

Between-group comparisons were performed using one-way ANOVAs to determine whether PTG scores on PTGI-SF and CiOP-S varied based on participants' degree of engagement in a behaviour consistent with PTG ('less' vs 'same' vs 'more' since the injury). Significant group differences were further examined with post-hoc analyses. Results of these analyses are shown in Table 3.7.

Table 3.7. Measures of PTG as a Function of Change in Behaviour Associated with PTG after TBI

	Care towards Family/Friends				New Interests			
	PTGI-SF		CiOP-S		PTGI-SF		CiOP-S	
Response	M	SD	M	SD	M	SD	M	SD
'Less'	12.75	6.34	16.00	1.63	16.84	8.75	17.79	6.30
'Same'	15.56	9.26	18.76	5.65	19.02	12.13	21.03	5.87
'More'	25.39	11.97	23.54	5.68	24.46	12.20	23.50	4.55
F	10.13	***	11.81	***	1.82		3.98	*
	Appreciation of Life				Kindness/Compassion			
	PTGI-SF		CiOP-S		PTGI-SF		CiOP-S	
Response	M	SD	M	SD	M	SD	M	SD
'Less'	9.67	3.67	14.33	4.13	11.50	5.43	14.00	3.84
'Same'	16.07	10.08	18.60	6.22	16.86	9.60	19.56	5.84
'More'	25.02	11.18	23.91	4.01	25.63	12.54	23.89	4.84
F	13.34	***	14.90	***	8.85	***	9.56	***

Note. *= $p < .05$, **= $p < .01$; ***= $p < .001$; PTGI-SF= Post-traumatic Growth Inventory Short Form; CiOP-S=Positive subscale of the Changes in Outlook Questionnaire Short-Form.

Both PTG measures differentiated between individuals reporting 'more' of a behaviour associated with PTG compared to those reporting 'less' and 'same' degree of that behaviour on 3 of the 4 behavioural domains. Additionally, only the CiOP-S scores differentiated between categories of 'more' or 'less' behaviour on the 'new interests' domain. This is significant given that this behavioural domain was least likely to be endorsed as an area of PTG and may therefore suggest that the CiOP-S is more sensitive to behavioural change compared to PTGI-SF on this domain.

3.5.5 Negative Changes in Outlook following TBI

CiON-S scores were strongly and positively associated with psychological distress as indicated by higher scores on anxiety (r= .61) and depressive (r= .66) symptomatology. Higher CiON-S scores associated with poorer outcomes on the GOS-E (r= -.45) and lower levels of value consistent living (r= -.60) on the VLQ. CiON-S scores also differentiated between individuals diagnosed with a psychiatric disorder at time of assessment, with individuals receiving a diagnosis (M=15.56, SD=5.93) more likely to report significantly higher ($t(68)$= -5.42, p< .001) levels of negative change post-injury than participants with no diagnosis (M=8.87, SD=4.23). CiON-S scores were significantly lower ($F(2,67)$= 4.04, p< .05), for retired individuals (M=8.22, SD=5.61) compared to those unable to work (M=13.95, SD=6.08). Amongst the four behavioural domains indicative of PTG, CiON-S scores consistently differentiated between individuals who reported engaging in behaviour "less" since the injury compared to those indicating the "same" or "more" of that behaviour.

3.6 DISCUSSION

It is now widely accepted that positive psychological outcomes such as PTG can emerge following TBI (McGrath, 2004). Despite this, research into the likelihood and measurement of PTG following TBI has received little attention (Grace et al., 2015). This study aimed to evaluate the relative usefulness of measures of PTG, the PTGI-SF and CiOQ-S, in predicting post-injury TBI outcomes and aligning with behaviours associated with PTG.

Items most likely to be endorsed across both measures of PTG indicated that PTG mostly reflected enhanced 'appreciation for life' and increased prioritisation of social relationships. This is consistent with previous findings 9 to 25 years following TBI (Hawley & Joseph, 2008). PTG in these domains may reflect change in outlook following a life-endangering experience (McGrath, 2004), at a time when social support is known to be associated with positive long-term outcomes (Linley & Joseph, 2004; Schroevers et al., 2010), as well as self-perceived reports of PTG (Thornton & Perez, 2006).

Whilst there is ongoing controversy regarding the need for behaviours to align with changes in thought processes emerging from PTG, this line of investigation is especially relevant following TBI, when injury-related cognitive limitations impact likelihood for value-consistent behaviour. Using a modified PTG behavioural checklist to investigate whether reports of PTG were associated with behavioural changes following TBI, qualitative analysis of themes suggested interpersonal and relationship investing behaviours were most likely to increase following TBI. The results of this study suggest that despite cognitive limitations participants reported an increase in behaviour consistent with positive changes in outlook and were able to self-generate examples to verify their account. Examining the behavioural domains closely associated with PTG may further assist clinicians to support clients with TBI in the development of positive psychological outcomes.

The results of this study are also the first, to the authors' knowledge, to report consistency between two widely used measures of PTG and behaviours associated with PTG. Results indicated that PTG total scores on CiOP-S and PTGI-SF differentiated between changes in degree of consistent behaviour in 3 of 4 behavioural domains. These domains: 'showing care towards family members

and friends', 'appreciating smaller things in life' and 'consideration and kindness towards others,' were the most frequently endorsed by participants following TBI. CiOP-S scores further differentiated between behaviour related to 'new-interests' following TBI. This suggests that the CiOP-SF overall could be a more sensitive measure of behavioural change following TBI.

The PTGI-SF (M= 19.21, SD=11.15) and CiOP-S (M= 20.49, SD= 5.94) total scores obtained were comparable to published values of PTG in TBI and other trauma populations. Abbreviated measures of PTG, both PTGI-SF and CiOQ-S have not previously been utilised in TBI research. However, the scores obtained by our TBI cohort on the abbreviated scales were approximately half of the total scores obtained in the full version of these measures (Hawley & Joseph, 2008; Powell et al., 2007), suggesting that our sample was fairly typical in terms of PTG levels. Published CiOP total scores (Hawley & Joseph, 2008) for a TBI sample based on the full form of CiOQ ranged from average of 38.46 (SD= 11.63, moderate TBI) to 47.32 (SD= 9.65, mild TBI). The average total PTGI-SF score obtained by our TBI cohort is marginally lower than scores recorded in other trauma populations including individuals involved in violent crimes (M = 27.69, SD = 13.23) and trauma workers (M=23.41, SD= 13.48) (Brooks, Lowe, Graham-Kevan, & Robinson, 2016). It is of note that across previous comparable studies (Brooks et al., 2016; Hawley & Joseph, 2008), PTG was often examined several decades following exposure to the traumatic event and therefore is not directly comparable in terms of time post-injury.

Consistent with previous findings in TBI cohort (Powell et al., 2012), there was no association between PTG and psychological distress. Similar results have been reported in other trauma populations including breast-cancer survivors (Cordova et al., 2001). The results of the current study revealed that although PTGI-SF and CiOP-S total scores were also not significantly associated with overall functional outcome 1-5 years post-injury, CiOP-S scores were associated with increased value-consistent behaviour and likelihood of returning to employment and/or study following the injury.

The results of this study are consistent with previous findings by Powell et al. (2007) who reported no association between PTGI scores and GOS-E at 1-3 years and 10 years post injury.

However, at 13-year follow-up Powell and colleagues (Powell et al., 2012) reported that paid employment and increased activity were significant predictors of PTG. As GOS-E scores represent a summary measure of functional outcome, the impact of positive changes in individual domains (work, social, leisure activities, etc.) is difficult to gauge. However, it is possible that return to work/study may, in itself have a significant association with PTG, where other aspects of disability may not.

While total scores on the CiOP-S were significantly associated with outcomes such as VL and return to employment/study, PTGI-SF scores were not associated with these outcomes. These conflicting results could be attributed to phrasing of items on each measure and the item response scales. As PTGI-SF items are positively worded and do not allow for reports of negative change, the resulting distribution of scores was positively skewed towards the lowest rating indicating 'no change.' Moreover, the separation in degree of positive change on a 5-point scale could be difficult for patients with TBI to negotiate, resulting in a smaller bimodal peak towards a 'moderate' degree of positive change.

Comparatively, the CiOP-S subscale allows participants to 'agree' or 'disagree' with statements indicating change post-injury, thereby allowing a wider range of responses. The overall distribution of total scores on the CiOP-S thus appears to be more tightly but evenly dispersed compared to the PTGI-SF total scores. The CiOP-S could therefore be a more sensitive measure for PTG following TBI. Additionally, the CiOQ-S incorporates a negative change subscale which is associated with functional and psychological outcomes following TBI. CiON-S scores distinguished between reports of decreased positive behaviour versus no change following TBI. CiON-S scores were also strongly associated with negative mental health outcomes. Administration of the CiOQ-S at commencement of rehabilitation may assist clinicians to identify individuals at risk of negative mental health outcomes. Furthermore, the scale may be used to track response to therapy which encourages PTG.

Given the subjective nature of measures of PTG, VL and PTG-related behaviour, it is acknowledged that individuals with TBI may have been influenced by poor memory and judgement.

Future studies should seek to obtain a corroborative account from family members to address this potential limitation. Corroborative accounts from family or friends who have known the individual both prior to and following the head injury might be helpful in clarifying the presence of change over-time. However, as the construct of PTG largely represents a personal change in perception, corroborative report may only be useful in identifying any behaviours reflective of PTG, if evident. Furthermore, the current study also included an uneven distribution of participants at one to five years post-injury which presents another potential limitation. As this is one of the first studies to use an abbreviated measure of PTG within a TBI cohort, the study results cannot be directly compared with previous findings. Therefore, further replication of results using both versions of the abbreviated measure in other TBI cohorts would be needed to consolidate findings.

In summary, results of this study suggest that despite cognitive limitations following TBI, participants are able to describe behaviour consistent with reports of PTG. The behaviours most likely to be associated with PTG involved building and maintaining relationships with family and friends. These behaviours could be fostered in rehabilitation to promote the development of PTG. The results of this study could be extended by examining whether similar trends are observed at later time-points post TBI (10-15 years). Among the two measures of PTG, the positive subscale of CiOQ-S was more closely associated with post-injury outcomes including return to work/study, degree of VL and consistency with behavioural reports of positive growth. These results suggest that CiOQ-S may be more suitable for use within the TBI population than the PTGI.

3.7 APPENDIX

Brief Behavioral Measure of Post Traumatic Growth

"The following questions ask about how your behaviors might have changed as a result of head injury. For each option, you can answer whether that behavior since your head injury occurs less than it used to (0), same as it used to (1) or more than it used to (2)."

If participant answers "more than I used to" for any item, please ask the participant to provide an example of this. Under each question are examples of behaviors for that category, do not list them unless participant requires clarification or does not appear to have an example for that category.

Since my head injury….	**Less than I used to (0)**	**Same as I used to (1)**	**More than I used to (2)**
1. **I show my family and friends how much I care for them** - spending more time with family and friends - saying I love you more often - greater self disclosure in relationships - increased wiliness to help family and friends	0	1	2 (Ex)
2. **I have taken up new interests and activities** - Change in study/ career path - Increase sport/exercise - Interests in arts and crafts - Involvement in community groups or charities - Travel	0	1	2 (Ex)
3. **I show appreciation for the smaller things in life** - More aware of your surroundings - Spending more time with people that matter to you - Taking the time to live in/ appreciate each moment	0	1	2 (Ex)
4. **I act with consideration and kindness for others** - More patient with other people - Willingness to help and understand others	0	1	2 (Ex)

Ex = ask the participant to provide an example for this behavior

Example for 1: _____

Example for 2: _____

Example for 3: _____

Example for 4: _____

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CHAPTER FOUR

TIME-COURSE AND PREDICTORS OF POST-TRAUMATIC GROWTH FOLLOWING TRAUMATIC BRAIN INJURY

4.1 DECLARATION FOR THESIS CHAPTER FOUR

Declaration of the Candidate: In the case of Chapter Four, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution
Formulation of experimental design, data collection, data analysis and writing manuscript	70%

The following co-authors contributed to the work:

Name	Nature of contribution
Jennie Ponsford	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.
Dana Wong	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.
Kate Gould	Consultation in formulation of experimental design, discussion of ideas expressed in manuscript and critical review of manuscript.

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate and co-authors' contributions to this work:

Student's Signature	[redacted]	**Date:** 20/02/17
Main Supervisor's Signature	[redacted]	20/02/17

Original Article

Time-course and Predictors of Post-traumatic Growth following Traumatic Brain Injury

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This chapter constitutes a manuscript submitted to *Disability and Rehabilitation* and is formatted in accordance with requirements set by the journal, which included the use of British spelling style. References have been changed to APA citation format to be consistent with the remainder of the thesis. Due to the design of sub-studies within this body of research, repetition will be apparent with regard to the methodology and limitations described in the discussion.

Pais, C., Wong, D., Gould, K. R., & Ponsford, J. L. (under review). Time-course and Predictors of Post-traumatic Growth following Traumatic Brain Injury. *Disability and Rehabilitation*.

4.2 ABSTRACT

Post-traumatic growth (PTG) refers to a higher level of psychological functioning which develops following trauma. PTG has been observed following traumatic brain injury (TBI), however the time-course and predictors of PTG remain relatively uncertain within this clinical population. This study aimed to examine the post-injury time-course of PTG at 1 to 6 years and to establish injury predictors and correlates of PTG following moderate to severe TBI. Participants were recruited from a rehabilitation hospital in three cohorts: 1 to 6 months' post-injury, 'Early' (*n*= 28); 12 to 24 months' post-injury, 'Mid' (*n*= 9) and 36 to 60 months' post-injury, 'Late' (*n*= 36). All participants were assessed at time of recruitment and 12 months later. The main measure of PTG was the Changes in Outlook Questionnaire, Short-form. Overall participants reported more positive than negative outlook. Time post-injury did not share a direct linear relationship with trajectory of PTG in the first 6 years following TBI. Higher levels of education, being in a relationship and remaining in employment/study were associated with PTG. These results suggest that rehabilitation goals designed to improve relationship skills and to assist with return to work/study may help promote positive psychological outcomes.

4.3 INTRODUCTION

Traumatic brain injury (TBI) can have life-long ramifications, resulting in physical, cognitive and behavioural changes that are associated with increased reliance on others, relationship challenges, diminished ability to return to work or study and psychiatric morbidity (Langlois et al., 2006). However, in recent times, there has been an increasing awareness of positive psychological outcomes (including post-traumatic growth) following trauma, including brain injury (Collicutt McGrath & Linley, 2006).

Post-traumatic growth (PTG) refers to a higher level of psychological functioning emerging from a search for personal meaning when facing an event that challenges one's previously held beliefs (Tedeschi, 1999; Tedeschi & Calhoun, 2004). Successful psychological adaptation results in personal growth beyond a previous 'baseline,' typified by qualities such as improved adaptive resources, deepened self-awareness and heightened resilience to subsequent experiences of stress or trauma (Zoellner & Maercker, 2006). PTG likely exists on a continuum and constitutes positive changes in various dimensions including quality of relationships, self-views and perspective on life (Tedeschi & Calhoun, 2004; Zoellner & Maercker, 2006).

PTG has been well-documented following a range of life challenges, including bereavement (Polatinsky & Esprey, 2000), cancer (Cormio, Romito, Giotta, & Mattioli, 2015), war (Elder Jr & Clipp, 1989), violent assault (Grubaugh & Resick, 2007), rape (Thompson, 2000) and illness and surgery (Armeli et al., 2001). PTG has been associated with vitality (Lelorain et al., 2010), life satisfaction, optimism, increased levels of activity (Powell et al., 2012) and improved general health (Affleck et al., 1987). It has also been suggested that PTG may act as a buffer for the management of pain and distress (Tennen et al., 1992). However, PTG has been relatively less explored following TBI. A recent meta-analysis of empirical research examining predictors of PTG following acquired brain injury (ABI) identified only eight relevant studies between 1998 and 2013 (Grace et al., 2015). Based on these studies, there is now 'general support' for the notion that people with ABI can experience positive growth, with some authors reporting PTG in up to 50% of their sample (Hawley & Joseph, 2008).

Available literature suggests time-post injury is significantly associated with PTG, with increased levels of PTG at later time-points of more than 10 years compared with early time-points such as 6 months or 1-3 years post injury (Powell et al., 2007; Powell et al., 2012; Silva et al., 2011). However, given the variation in sample characteristics and cross-sectional design of most studies, this trajectory of PTG between one and ten years post injury requires further substantiation. It also remains unclear whether factors, including severity of head injury, socio-demographic or personality variables are related to the development of PTG. The ability to engage in cognitive processing of 'trauma' through active rumination, deliberation of consequences and positive reappraisal of the situation, has been shown to positively correlate with PTG (Helgeson et al., 2006; Linley & Joseph, 2004) . Thus it has been postulated that individuals with greater cognitive impairment may take longer or potentially have less capacity for developing PTG (Silva et al., 2011). However, studies involving individuals with severe TBI have also reported PTG (Collicutt McGrath & Linley, 2006; Hawley & Joseph, 2008; Powell et al., 2012).

Grace et al.'s (2015) meta-analysis on correlates of PTG following ABI reported that PTG was significantly associated with being employed, more educated, and at longer time post-injury (moderate effect sizes). Relatively weaker associations were reported between PTG and being in a relationship, being older and having a greater injury severity (Grace et al., 2015). Many of the studies included within this meta-analysis utilised mixed ABI samples (Collicutt McGrath & Linley, 2006; Rogan, Fortune, & Prentice, 2013; Silva et al., 2011) and therefore these results cannot be directly generalised to specific subgroups such as TBI. The only large-scale longitudinal study on TBI reported that PTG was unrelated to any pre-injury demographic and injury related factors (Hawley & Joseph, 2008).

Additionally, the role of personality factors in the development of PTG following TBI has yet to be examined. Studies in other trauma populations suggest an association between PTG and personality traits such as extraversion and openness (Karanci et al., 2012; Wilson & Boden, 2008). It has been suggested that PTG can cause changes in 'personality schemas' (Joseph & Linley, 2008) and therefore may have a transformative impact on personality (Jayawickreme & Blackie, 2014). Recent studies demonstrate that personality may be malleable across the lifespan (Blackie, Roepke,

Forgeard, Jayawickreme, & Fleeson, 2014; Edmonds, Jackson, Fayard, & Roberts, 2008), therefore there is some support for the notion that personality may change in wake of trauma. However, whether pre-injury personality contributes to the development of PTG remains unclear. Typically, studies have examined personality following trauma alongside the assessment of PTG (Karanci et al., 2012; Shakespeare-Finch et al., 2005) and therefore the role of personality prior to the trauma experience has been difficult to ascertain.

PTG is most commonly assessed using quantitative measures such as the Post-traumatic Growth Inventory (PTGI). However, recent findings by the current authors (Pais, Wong, Gould, & Ponsford, under review) indicated that the Changes in Outlook Questionnaire (CiOQ) was a more suitable measure of PTG following TBI. The CiOQ enables a broader assessment personal growth as it acknowledges that change can be both positive and negative (Joseph, 2009). It has been suggested that negative outlook, to some extent could form an integral part of PTG process, which involves facing profound challenges to basic assumptions about self, others and the world (Janoff-Bulman & Frantz, 1997). Positive changes in outlook, which develop as a process of PTG, are therefore viewed to work in tandem with the experience of distress to help the person gain 'meaning' from a traumatic event (Zang, Hunt, Cox, & Joseph, 2012). Based on these suggestions, in conjunction with findings that CiON-S scores were associated with changes in behaviours related to PTG and significant functional and psychological adjustment outcomes following TBI (Pais et al., under review), assessment of negative change likely represents an important aspect for the assessment of PTG and adjustment outcomes following TBI.

Overall, available literature on the association between socio-demographic and injury related correlates of PTG following TBI has shown inconsistent findings. A stronger evidence base of the trajectory and likely factors underpinning PTG could assist clinicians to understand and promote positive psychological outcomes as part of the rehabilitation process. This study aimed to examine the time-course of PTG one to six years following moderate to severe TBI. A range of socio-demographic and post-injury factors were considered including age, gender, level of education, psychiatric history and treatment, employment and relationship status and injury severity as determined by duration of post-traumatic amnesia (PTA). Pre-injury personality traits of openness

and extraversion were also examined. Based on previous findings, it was hypothesised that PTG would be likely associated with personality traits of openness and extraversion, as well as higher education, employment status, older age and increasing time-post injury.

4.4 METHOD

4.4.1 Participants and Procedure

Hospital and university ethics approvals were obtained. Participants who were a part of a prospective longitudinal study of psychiatric disorders following TBI (commenced in 2005) were initially approached for recruitment into the current study. Consecutive new inpatient admissions were also recruited from April 2013 until November 2015. Inclusion criteria were: complicated mild (i.e. post-traumatic amnesia (PTA) duration < 1 day, Glasgow Coma Scale (GCS) score 13-15 and presence of intra-cranial abnormalities on neuroimaging), moderate or severe TBI; age at injury 17-80; no previous TBI or other neurological disorder; residence in Australia post-discharge; and sufficient cognitive and English ability to complete interviews according to the treating neuropsychologist. Patients with premorbid psychiatric history, learning or behavioural problems were not excluded. Written informed consent was obtained.

Three cohorts of participants were recruited to a cross-sequential design. The first group ('Early') was recruited during inpatient admission, soon after emergence from PTA, within 1-6 months' post-injury (n= 28). A second cohort was recruited 12-24 months post-TBI ('Mid', n= 9) and a third cohort recruited 36-60 months' post TBI ('Late', n= 36). New inpatient admissions recruited from April 2013 were part of the 'Early' cohort who were assessed approximately within the first 3 months following their head injuries. As a result, the measures of PTG were not initially administered to these cohorts as with other cohorts. Similarly, only these participants completed a personality inventory, as assessment of pre-injury personality more than 6 months following head-injury is likely to be confounded by post-injury factors including extent of recovery and mental health.

All participants were assessed at time of recruitment (T1) and 12 months later (T2). The follow-up rate was 93% for the Early, 100% for Mid, and 78% for the Late post-injury group. Participants who were re-assessed at 12 months did not vary on any psychological, socio-demographic or injury related factors, compared to those who were unable to be followed-up (p >.05). Overall, participants across the three cohorts also did not vary on any pre-injury psychological or socio-demographic variables (p >.05) or injury severity (p >.05). Socio-demographic and injury information for participants is presented in Table 4.1.

Table 4.1 Socio-demographic and Injury Information for Participants

	Early (n = 28)			Mid (n = 9)			Late (n = 36)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Time post-injury (months)	3.26	2.09	0-6	17.33	6.32	12-24	54.33	7.30	36-60
Age at Injury (years)	45.07	18.18	17-73	42.00	13.32	24-65	40.36	17.16	20-75
Years of Education	12.36	2.63	6-18	12.22	1.98	10-16	11.89	2.56	7-18
Duration PTA (days)	20.71	22.73	0-86	31.55	28.09	3-94	22.03	24.88	0-104
Mild (< 1)			14.3%			-			2.8%
Moderate (1-7)			21.4%			22.2%			36.1%
Severe (8-28)			42.9%			22.2%			36.1%
Very severe (> 28)			21.4%			55.6%			25.0%
GCS	10.54	4.71	3-15	7.56	2.56	4-13	8.67	4.69	3-5
Mild (13-15)			57.1%			11.1%			30.6%
Moderate (9-12)			3.6%			11.1%			13.9%
Severe (3-8)			32.1%			77.8%			38.9%
Gender (% male)			85.7%			66.7%			86.1%

Note. PTA = Posttraumatic Amnesia; GCS = Glasgow Coma Scale score

4.4.2 Measures

Participants' demographic information was obtained from a semi-structured interview. Details of injury and previous health problems including psychiatric history were obtained from medical files with written consent.

4.4.2.1 Changes in Outlook Questionnaire, Short form

The CiOQ-S is a 10 item self-report questionnaire rating the extent to which their respondent's views have changed as a result of trauma along positive (CiOP-S) and negative (CiON-S) domains (Joseph et al., 2006). Items on the CiOP-S state a positive aspect of growth such as "I value my relationships much more now," whereas CiON-S items state a negative aspect of growth such as: "I do not look forward to the future anymore." Responses on a Likert scale range from 0 to 6, where "0" means 'strongly disagree' and "6" means 'strongly agree.' Scores on each subscale item are summed to give a total subscale score. Confirmatory factory analysis supported a two factor model, each measuring a different aspect of growth. High internal consistency was demonstrated in both adult (CiOP-S α= .78 and CiON-S α= .83) and clinical samples (CiOP-S α= .76 and CiON-S α= .82) (Joseph et al., 2006).

4.4.2.2 NEO-Five Factor Inventory (NEO-FFI), Openness to Experience and Extraversion Subscales.

The NEO-FFI is a 60 item self-report personality inventory assessing global aspects of normal personality (Costa & McCrae, 1985). The construct of personality is assessed along five domains: 'neuroticism', 'extraversion', 'openness to experience', 'agreeableness' and 'conscientiousness.' This study assessed only two dimensions of personality: 'extraversion' and 'openness,' as only these have been consistently shown to correlate with PTG. The trait of 'extraversion' refers to quantity and intensity of energy directed outwards into the social world and is associated with warmth, gregariousness, assertiveness, activity, excitement seeking and positive

emotions. The trait of 'openness' refers to active seeking and appreciation of new experiences and is associated with interests in fantasy, ascetics and feelings as well as a willingness to consider a range of actions, ideas and values. A new list of 24 items relating to the two relevant domains was created for this purpose, retaining the order and structure of the original questionnaire. There are 12 items/statements relating to each domain. Participants are required to indicate the degree to which they agree or disagree with a particular statement, using a 5 point Likert scale ranging from 'strongly agree' to 'strongly disagree.' Items are totalled to give a score on each domain. Internal consistencies alpha coefficients reported in the manual were: r =.79 for the extraversion subscale and r =.80 for the openness subscale (Costa & McCrae, 1985). NEO-FFI 'extraversion' and 'openness' subscales were administered once post-injury to the 'Early' study (T1) sample to reflect their pre-injury personality.

4.4.2.3 The Structured Clinical Interview for DSM Disorders - Research Version (SCID).

The SCID is a semi-structured clinical interview used to diagnose DSM-IV-TR Axis I psychiatric disorders (First et al., 2002). The SCID was modified to allow for pre-injury and repeat assessments as described by Gould et al. (2011). At initial assessment, the SCID was administered twice to obtain both current and pre-injury lifetime psychiatric disorders. Follow-up interviews assessed current psychiatric disorders and those occurring since the previous assessment. Presence of at least one psychiatric disorder on the SCID at each time-point was recorded.

4.4.3 Data Analysis

All data analysis and screening was conducted using SPSS (Windows, Version 22). Descriptive statistics were used to examine socio-demographic and injury related information and to calculate CiOQ-S subscale scores (CiOP-S and CiON-S). Total CiOP-S and CiON-S scores were plotted over the time-points to visually inspect changes over time. Data was screened for potential

outliers and assumptions of parametric tests. Repeated measures t-tests were used to examine changes in CiOP-S and CiON-S scores for Mid and Late cohort over the 12-month period of follow-up. The overall effect of time was examined using a linear multiple regression with cross-sectional data. Both linear and quadratic trends were examined.

Two-tailed Pearson's correlations were subsequently conducted to examine associations between CiOP-S scores and variables such as age, education, PTA duration and personality factors. Independent samples t-tests and one-way analysis of variance was conducted to compare CiOP-S scores on categorical variables such as gender, employment and relationship status and psychiatric diagnosis and treatment. This analysis was repeated to examine similar associations for CiON-S data. The strength of associations in the current analysis were considered alongside effect size measures provided in a recent meta-analysis of predictors of PTG (Grace et al., 2015). In order to preserve power given moderate sample size, only variables with at least a small to moderate effect size (r >.20) were entered as predictors into a standard multiple regression to determine association with PTG.

4.5 RESULTS

4.5.1 CiOQ-S subscale Scores

Overall, there was higher endorsement for positive change compared with negative change. Analysis of T1 data indicated that, the mean CiOP-S score obtained for the current sample was 20.51 (SD= 5.90), with a range between 5 and 30. The mean CiON-S score was 11.20 (SD= 5.85), with a range between 5 and 30.

4.5.2 Time-course of PTG and Negative Outlook 1-6 years following TBI

As shown in Figure 4.1, there appears to be a concave quadratic trend illustrating a slight reduction in CiOP-S scores for the Mid group (between 12-36 months' post-injury), with essentially equivalent CiOP-S scores for the Early and 'Late' cohorts.

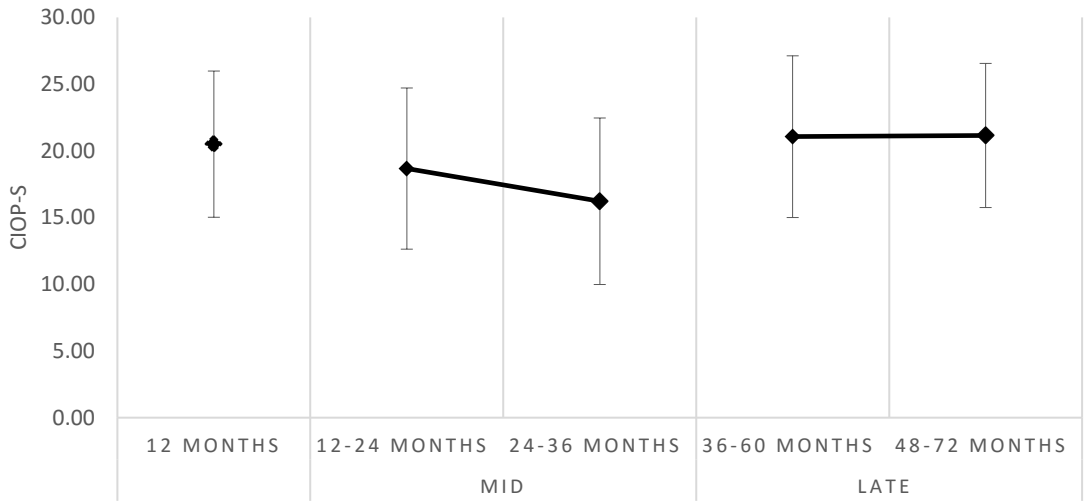

Figure 4.1. Mean of total CiOP-S scores for participants in the Early, Mid and Late TBI groups.

Note. Continuous trend lines denote longitudinal changes in scores at 12-month follow-up. Broken lines denote group differences between cohorts. Error bars represent variation in mean scores by standard deviation.

Similarly, Figure 4.2 illustrates a convex quadratic trend, with a slight increase in CiON-S scores for the Mid group, compared to the Early and Late cohorts. The significance of these trends were further examined using a multiple regression evaluating linear and quadratic effects of time post-injury.

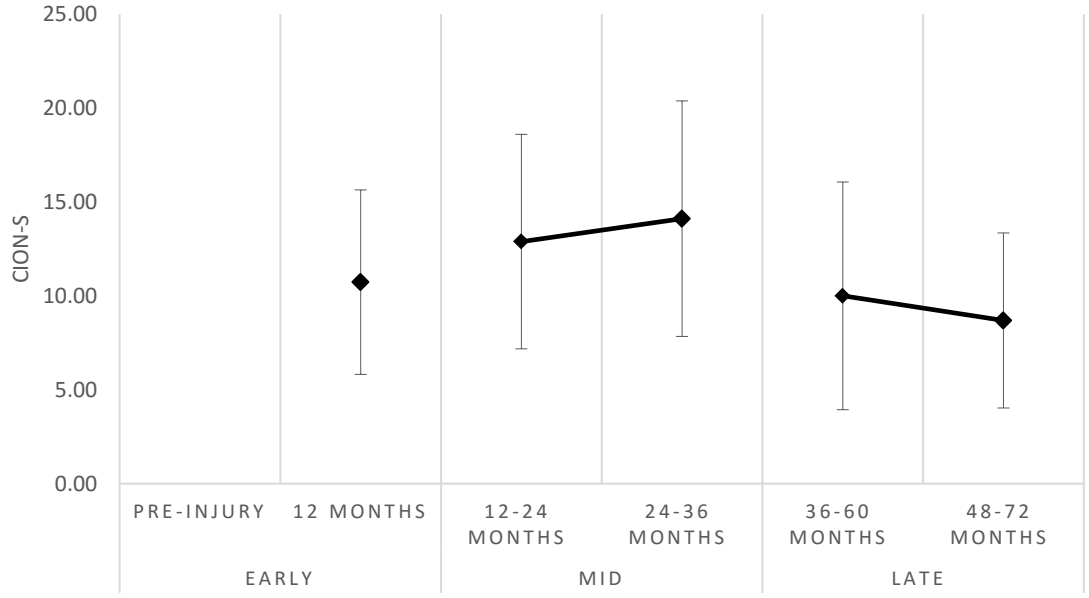

Figure 4.2. Mean of total CiON-S scores for participants in the Early, Mid and Late TBI groups.

Note. Continuous trend lines denote longitudinal changes in scores at 12-month follow-up. Broken lines denote group differences between cohorts. Error bars represent variation in mean scores by standard deviation.

Analysis of cross-sectional data using the first available CiOP-S time-point for each cohort (T2 data for Early cohort and T1 data for Mid and Late cohorts) revealed no significant effect of time ($F(2,68)= .58$, $p > .05$). Similarly, using the T2 data for participants, revealed no significant effect of time ($F(2,60)= 2.63$, $p > .05$). Similar results were obtained for the CiON-S data. Results also revealed no significant change in total CiOP-S scores between the initial (T1) and 12 month follow-up periods (T2) for participants in the Mid ($t(8)= 1.89$, $p > .05$) or Late cohorts ($t(27)= .37$, $p > .05$). Similarly, there was no significant change in total CiON-S scores from T1 to T2 for participants in the Mid ($t(8)=-.26$, $p > .05$) or Late cohorts ($t(27)= 1.46$, $p > .05$).

4.5.3 Correlates & Predictors of PTG following TBI

Available personality data for the 'Early' cohort (T1) was examined for its association with PTG at follow-up (T2) ($n= 26$). There was no association between self-reported levels of

'extraversion' (r= .09) or 'openness' (r= -.31) prior to injury and CiOP-S scores obtained at 12 months' post-injury. As there was also no overall effect of time on changes in outlook scores, available first time-point data on CiOQ-S was combined for each subscale across the three cohorts (n= 71).

As there was no effect of time on level of PTG, data across the three cohorts was combined. Initial PTG data for each cohort was used for further analysis (T2 data for Early cohort and T1 data for Mid and Late cohorts). Results revealed a significant positive correlation between years of education and CiOP-S (r= .24, p <.05). Additionally, between group comparisons revealed that participants who were employed or studying at the time of assessment reported significantly higher levels of positive outlook (M= 22.33, SD= 4.78) compared to those who were unemployed or unable to return to work or study (M= 16.73, SD= 7.05; $F(2,68)= 6.09$, $p < .01$). Participants in a relationship also appeared to endorse greater levels of positive outlook (M= 21.67, SD= 5.42) compared to those who were single (M= 18.93, SD= 6.25), $t(69)=-1.97$, $p < .05$, $d= .47$. By contrast, age (r= -.16) and injury severity (r= .06) were not associated with positive outlook and no significant differences in CiOP-S scores were observed based on gender ($t(69)=.26$, $p > .05$), current psychiatric diagnosis ($t(69)= -.17$, $p > .05$) or current psychological treatment ($t(69)= -.62$, $p > .05$).

Multiple regression analysis revealed that a multivariate model with education, employment/study and relationship status, predicted 19% of overall variance in CiOP-S scores ($F(3,67)= 5.13$, $p < .01$). Collinearity diagnostics indicated no significant multi-collinearity between these predictors. Although higher education ($F(1,69)= 4.10$, $p < .05$; *beta*= .24, $p < .05$) and being in employment/study ($F(1,69)= 12.34$, $p < .01$; *beta*= -.39 $p < .01$) were significant independent predictors in univariate models, only employment/study status (*beta*= -.33, $p < .01$) emerged as a significant predictor in the multivariate model (education *beta*=.12, $p > .05$; relationship status *beta*= .13, $p >.05$).

4.5.4 Correlates of Negative Outlook following TBI

There was no association between self-reported levels of 'extraversion' prior to injury (T1) and CiON-S scores at 12 months' post injury (T2) (r= -.21). Degree of 'openness' was however positively associated with reports of negative outlook at 12 months' post injury (r= .43, p < .05). Correlates of negative outlook at 1-5 years post injury included current psychiatric diagnosis, psychological treatment and relationship status. Participants receiving one or more diagnosis on the SCID reported significantly higher levels of negative outlook (M=15.15, SD= 6.14) compared to those without a diagnosis (M= 8.91, SD= 4.30), t(69)= -5.03, p > .001. Similarly, individuals receiving current psychological treatment reported higher levels of negative outlook (M=13.86, SD= 6.42) compared to those not receiving any psychological services (M= 9.50, SD= 4.83), t(69)= -3.24, p >.01). Participants who were single also reported higher levels of negative outlook (M=13.07, SD= 6.38) compared to those in a relationship (M=9.83, SD=5.08, t(69)= 2.38, p < .05). Age (r= -.21, p > .05), gender (t(69)= -.49, p > .05), years of education (r= -.10, p > .05) and injury severity (r= .07, p > .05) were not associated with negative outlook following TBI.

4.6 DISCUSSION

The potential for positive psychological outcomes following trauma is widely recognised; however, factors associated with PTG following TBI are yet to be clearly ascertained. This study examined the time-course of PTG 1 to 6 years following TBI. It also aimed to establish injury predictors and correlates of PTG (as measured by CiOQ-S) following moderate to severe brain injury.

Results suggested that a majority of the participants reported more positive than negative outlook following TBI on the CiOQ-S. The magnitude of total scores on the positive and negative subscales of CiOQ-S in the current study support this trend (CiOP-S: M= 20.51; SD= 5.90; CiON-S: M=11.20; SD= 5.85) and are comparable to the scores obtained on a Chinese-translated version of the CiOQ-S (Zang et al., 2012) administered to earthquake survivors in China (CiOP-S: M= 24.94; SD= 5.20; CiON-S: M=11.78; SD= 6.63). The CiOQ-S is yet to be utilised in TBI research currently

has no established norms for interpretation or comparison of subscale scores. The average CiOP-S score obtained by participants in the current study was approximately half of the score obtained on the full-form of this subscale (which has approximately double the items) in a TBI cohort, with average CIOP-S scores ranging from 38.46 to 47.32 based on increased injury severity (Hawley & Joseph, 2008). This suggests that the scores obtained by the current sample are fairly typical of scores obtained by TBI and other trauma populations.

A recent meta-analysis of previous studies in the field of ABI reported that increasing time-post injury has been associated with higher scores on measures of PTG (Grace et al., 2015). However, most studies reporting an association of time with PTG have compared very early time-points (6 months to 3 years post-injury) to much later time-points (11-13 years post injury) with the assumption that there is a linear pattern of growth in the intervening period of time following TBI (Powell et al., 2007; Powell et al., 2012; Silva et al., 2011). Our results failed to demonstrate a clear positive association between levels of PTG and time post-injury. This is consistent with previous findings by Hawley and Joseph (2008) and also Rogan et al. (2013).

It may be that the effect of time on PTG is not best represented by a linear pattern. Visual graphing of cross-sequential CiOP-SF data across 1-6 years post-injury indicated a quadratic pattern; however, given the limited sample size for the Mid cohort and degree of overall variability within each cohort, this model was not statistically significant. Future studies should aim to examine longitudinal patterns of change using a wider range of time-points centred around 1-3 years post-injury, as this period may be associated with some adjustment related difficulties (Gould & Ponsford, 2015; Pais et al.,2017).

In the domain of personality, self-reported pre-injury levels of ‘extraversion’ and ‘openness’ were not associated with PTG at 12 months’ post-injury. These results are in contrast with previous findings in other trauma populations (Karanci & Erkam, 2007; Shakespeare-Finch et al., 2005; Wilson & Boden, 2008). However, as these previous studies have assessed personality alongside PTG, often after many years following trauma, this may suggest that personality evolves over time to reflect positive outlook rather than vice-versa.

While 'openness' is typically linked with improved positive affect (Steel, Schmidt, & Shultz, 2008), the results of this study indicate that individuals reporting higher levels of 'openness' prior to injury were more likely to report negative outlook within the first 12 months' post-injury. As individuals reporting high levels of 'openness' are known to seek out new experiences, their ability to engage in this behaviour may be compromised 12 months following TBI. Previous findings have suggested a reduction in value consistent behaviour at 12 months' post-injury compared to pre-injury estimates (Pais et al., 2017). The relationship between pre-injury levels of 'openness' and a negative outlook at 12 months' post-injury is therefore likely mediated by factors which influence the level of adjustment following TBI. It may be worthwhile for future studies to examine the mediating influence of factors such as coping style and degree of value consistent behaviour on the relationship between pre-injury personality factors and changes in outlook following TBI. Longitudinally examining changes in personality post-injury may also be beneficial in further understanding the complex relationship between of personality and PTG.

As hypothesised, higher levels of education and employment were positively associated with PTG. This is consistent with previous findings by Gangstad et al. (2009) who also demonstrated that education predicted PTG in persons with ABI. The results are also consistent with Powell et al. (2012) who reported that employment and improved levels of activity were positively associated with PTG at 11-13 years following TBI. It may be likely that employment status and level of education are both indicative of a person's overall level of 'cognitive reserve' which has commonly been associated with improved outcomes (Satz, 1993; Stern, 2003). This common underlying factor may explain why only employment was a significant predictor in a combined multivariate model. However, it has also been postulated that return to employment or study in particular could be linked with deriving a sense of 'personal meaning' (Grace et al., 2015) which has been demonstrated to be an independent and significant predictor of PTG following head-injury (Powell et al., 2012). The relationship between PTG and these socio-demographic factors could also be bidirectional, in that people who are able to identify positive personal benefit from their trauma are more motivated to return to employment. Future studies could examine the motivation associated with return to work following TBI, particularly amongst individuals who report PTG following TBI.

Although relationship status has been reported to have to 'small' effect on PTG (Grace et al., 2015), the results of this study suggested that it might not only be relevant to PTG, but also to development of negative outlook following TBI. As relationship difficulties are quite commonly reported following TBI (Kersel, Marsh, Havill, & Sleigh, 2001; Wood & Rutterford, 2006; Wood & Yurdakul, 1997), they have a significant potential to impact psychological and functional outcomes. The current results suggest that individuals who were in a relationship were more likely to report PTG and less likely to report negative outlook following TBI. Some authors have suggested that relationship status contributes to overall level of social support and is thereby positively associated with PTG (Updegraff & Taylor, 2000). Although less acknowledged, it is equally likely that individuals reporting PTG tend to focus their efforts on improving social relationships and are therefore more likely to report being a relationship. There is some support for reports of PTG being associated with behaviour related to improving social engagement and quality of relationships (Pais et al., under review). The direction of this relationship should not be assumed and may need to be further explored by future research.

As expected, negative outlook was more likely to be reported by individuals with a current psychiatric diagnosis and those currently receiving psychological support. However, it is of benefit to note that psychiatric diagnosis did not preclude the development of PTG. As has been previously suggested, psychological distress may act as a catalyst for development of PTG and in some cases may also be outcome of the reflective process of self-evaluation following trauma (Silva et al., 2011; Tedeschi & Calhoun, 2004). The current results also revealed that psychological treatment was not directly associated with PTG. This may suggest that the ability to adopt a positive outlook following TBI can develop inherently through the process of PTG without direct psychological intervention to promote this change. Studies in the field of TBI are yet to directly investigate impact of psychological diagnosis and treatment on the development of PTG and this should remain an avenue for future investigations.

The findings that age, gender and injury severity were not associated with PTG is consistent with past research by Hawley and Joseph (2008) and Rogan et al. (2013). Of particular interest, it is promising to note that severity of injury did not appear to compromise the likelihood for PTG. As

suggested by previous authors, PTG may be equally likely following a more severe head injury as a high level of ongoing distress and trauma associated with injury are needed to ignite a search for meaning associated with process of PTG (Powell et al., 2007). However, given this study examined PTG in a sample of individuals with predominantly moderate to severe TBI, the comparative results of PTG for individuals with mild TBI cannot be established. Furthermore, the level of individual support received through family and rehabilitation services by participants in the current study is unknown. Therefore, it may be that those with more severe injuries required substantial support to overcome the cognitive deficits particularly relating to memory and insight which could impact on their ability to engage in self-reflective process required for the development of PTG.

The limitations of the current study include its lower sample size of participants in the Mid cohort, with the results for this group therefore less reliable and generalizable to a wider TBI population. As CiOQ-S is a subjective self-report measure of PTG, reporting of outlook may be impacted by insight and memory impairments following TBI. Future studies could aim to gather some corroborative history from close others to overcome this short-coming. As participants in this study were recruited from a hospital during the process of in-patient rehabilitation, a majority of the participants likely received some rehabilitation support services following TBI. Therefore, the results of the current study maybe less generalizable to individuals with TBI who have not received such support.

Despite these limitations, this study is one of the first to examine the continuity of PTG over an extended 6-year period following TBI. The results of the current study suggest that PTG may remain fairly stable across 1-6 years post injury. Consistent with previous findings, the current results suggest that higher levels of education and a return to employment or study are important factors which contribute to the development of PTG following TBI. Furthermore, relationship status could have reciprocal associations with development of positive and negative outlook. These results suggest that rehabilitation goals designed to promote relationships and to assist with returning to work or study could be a means to promote positive psychological outcomes.

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CHAPTER FIVE

GENERAL DISCUSSION

While there is now substantial evidence of the negative impact of TBI on cognition, psychological health and interpersonal relationships, our understanding of positive psychological outcomes following head injury is yet to be established. Initial reports suggest that up to 50 percent of individuals with moderate to severe TBI report some aspect of PTG (Hawley & Joseph, 2008). Also, while it has been suggested that the process of PTG involves a reorganisation of life's priorities, the role of value consistent living following TBI, especially in association with PTG, remains to be investigated. A review of literature revealed that an accurate account of factors associated with PTG following TBI and its development over time is lacking. This is mainly due to the small number of studies in the field and issues relating to measurement and conceptualisation of PTG. Against this background, the overall aim of the research presented in this thesis was to further our understanding of PTG following TBI.

In order to this broader aim and the limitations of previous research, three studies were conducted, drawing on data from a cohort of participants with moderate to severe TBI recruited in a cross-sequential design. The first study, explored in Chapter 2, examined the role of VL following TBI, in particular its association with psychological and functional outcomes. The second study in Chapter 3, evaluated the comparative predictive validity of two measures of PTG (CiOQ-S and PTGI-SF) within a TBI population. Furthermore, this study assessed the association of total scores on each of the two measures with behaviours related to PTG, using a modified qualitative measure developed for this purpose. The third study in Chapter 4, examined the time-course and predictors of PTG using the CiOQ-S as this measure was established to be more suitable for use following TBI. This final chapter presents an integrated interpretation of the findings. The limitations, strengths, unique contributions and implications of this research will be discussed, and directions for future research will be outlined.

5.1 ROLE OF VL FOLLOWING TBI

VL has long been utilised as a core component of Acceptance and Commitment Therapy (Hayes et al., 1999; Wilson & Murrell, 2004). It is introduced as a process to identify and reconnect

with personal values which provide life with a sense of purpose and direction (Hayes et al., 2010; Hayes et al., 2006). However, the role of VL specifically following TBI has not been examined. Literature has suggested that changes in life priorities, re-alignment of beliefs and sense of purpose and meaning are important for the development of PTG (McGrath, 2004; Powell et al., 2012; Wilson & Murrell, 2004). These factors likely reflect different aspects of VL and therefore it was important to firstly understand the trajectory of VL and the association of VL in shaping functional and psychological outcomes following TBI. In order to address these aims, in Study One participants with moderate to severe TBI were recruited from a rehabilitation hospital in three cohorts: 'Early' (*n*= 25), 'Mid' (*n*= 9) and 'Late' (*n*= 36) post-TBI. All participants were assessed at time of recruitment and 12 months later. The main measure used was the VLQ (Wilson et al., 2010).

One of the main study findings was that compared to pre-injury estimates, VL was significantly reduced at 12 months' post-injury. This provided some indication of change in an individual's ability to lead a value consistent life immediately post-injury. In the early period, individuals with moderate to severe TBI are often confronted with significant physical and cognitive limitations (Dikmen et al., 2009; Dikmen et al., 2003) which may compromise their ability to return to their pre-injury life-style. Given this change in functional ability, individuals may idealise their life prior to injury and attempt to return to a 'pre-injury self' rather than acknowledge a need for a change in behaviour to compensate for post-injury disability or impairment (Gracey et al., 2009; Gracey et al., 2008). There is substantial literature on changes to self-concept to indicate a distorted view of 'self' in the past, present and future in the first year following head-injury (Carroll & Coetzer, 2011; Ponsford, Kelly, & Couchman, 2014; Tyerman & Humphrey, 1984). It has been suggested that these "unrealistic expectations" may initially serve to psychologically protect the individual and even motivate him/her towards recovery (Tyerman & Humphrey, 1984). However, it has also been cautioned that persisting idealisation of the 'pre-injury self' may interfere with post-injury rehabilitation and adjustment (Gracey et al., 2009; Tyerman & Humphrey, 1984). Therefore, examining the continued trajectory of VL following the first 12 months provides some insight into the processes and degree of adjustment with increasing time post-injury.

Continued exploration of changes in trajectory of VL post TBI in the present study suggested that levels of VL remained reduced between 2-3 years and subsequently increased between 3-5 years post-injury. This finding was of particular interest as it indicated that levels of VL seemed to improve over the course of recovery. However, the extent to which this process may be naturally occurring or influenced by contextual factors such as access to ongoing rehabilitation services and degree of social support provided in familial and other contexts was not examined. Furthermore, given the limited sample size at 2-3 years post-injury, correlates and predictors of reduced VL at this time were not explored. This represents a significant limitation in interpretation of findings. While it has been acknowledged that adjustment at this time is likely impacted by factors such as psychological illness, growing self-awareness and lack of expected recovery, among other stressors (Gould & Ponsford, 2015), the impact of these factors could not be directly examined.

Given the limited sample size within each cohort, the data across participants was combined in order to examine association between VL and socio-demographic, injury related, functional and psychosocial outcomes. It was found that older age was associated with improved levels of VL at follow-up. This was partially consistent with previous findings indicating that older age may be associated with better emotional adjustment (Senathi-Raja et al., 2010). This may suggest that older individuals view initial changes to their level of participation to be less threatening due to having already well-established vocational experiences and social and personal relationships. By contrast, younger individuals may be in the process of studying or establishing a vocation, a social network and romantic relationships at the time of injury, processes that assume great importance for them, and therefore the failure to achieve these things has a greater negative impact.

Lower levels of depressive symptoms were associated with higher levels of VL. The relationship between depressive symptomatology and VL is likely bidirectional. As VL promotes action consistent with values, it is an important first step in breaking the cycle of low mood and limited participation that typifies depression (Veale, 2008); conversely, depressed individuals are less likely to engage in effortful and pleasurable activities consistent with their values. Alternatively, it could also be suggested that individuals who are unable to participate in valued interests (i.e. sports,

work) due to cognitive and/or physical limitations associated with their brain injury, and therefore report low VL, would be likely to experience low mood and depressive symptoms.

As expected, higher levels of VL were associated with lower levels of negative outlook and higher levels of positive outlook. It has been suggested that by living in accordance with one's values individuals may be able to reduce their 'control over distressing symptoms,' such as pain (McCracken & Yang, 2006). Given the cognitive and physical limitations commonly associated with brain injury, individuals who seek to control distressing symptoms may be more likely to focus on these symptoms and thereby report increased awareness of negative changes in life following TBI. Alternatively, individuals who are able to continue to live life in accordance with their values despite these limitations, could be more receptive to experiences of positive psychological growth. It may also be likely that individuals who are experiencing positive growth and who do not report a negative outlook post-injury are more able to live their lives in accordance to their values. The direction of this association of this relationship would need to be more carefully examined in future studies. Regular review of VL and changes in outlook throughout the course of psychotherapy and rehabilitation may assist clinicians to identity an initial direction of change. However, this is most likely a bidirectional relationship which is self-regulatory in some capacity to assist with maintenance of gains over time. As this is the first study to examine the association between VL and changes in outlook following brain injury, further replications of this study would be required.

This study highlighted that while a majority of participants (67%) were able to return to some form or work or study by 3-5 years post-injury, levels of social participation were comparatively reduced at only 56% compared to self-reported pre-injury estimates. Therefore, it was suggested that an improvement in VL at 3-5 years post-injury may reflect in part an adaptation to the new level of function and related adjustment to self-concept. However, it is important to acknowledge that there was no direct measure of self-concept or adjustment in this study and therefore it is difficult to ascertain whether changes in VL were attributable to early idealisation of 'pre-injury self' followed by later adjustment with developing insight or rather, the result of functional recovery with time influencing the ability to act in a value consistent way. A combination of both these factors seems most likely.

Alternatively, an improvement in VL by 3-5 years post-injury may indicate that values were re-shaped post-injury to accommodate changes in lifestyle. Qualitatively, there was some indication in the results of Study One that the importance ratings of values changed post-injury. After injury, participants reported that they valued family and health to a greater extent than other areas of life such as work. However, as this study did not gather pre-injury data pertaining to values for all participants (only for the Early cohort), it was difficult to clearly assess whether values had changed post-TBI or whether individuals had adapted to change in such a way that they were able to lead value consistent lives despite ongoing limitations. It is suggested that future studies collect prospective data regarding values with longitudinal follow-up over time (3-5 years) to establish whether improvements to VL are associated with a shift in values, adaptive change in behaviour or a combination of these factors.

This study was one of the first to the authors' knowledge to use the VLQ to assess changes in VL over several time-points (longitudinal and cross-sectional) following TBI. The results suggested that changes in VL occur over at least 3-5 years post-injury. An important clinical implication of this finding is that 12 months post-TBI may be a suitable time for intervention, given that VL remains low over the next 24 to 36 months' post injury. Most importantly, the results of this study suggested that VL was uniquely associated with functional and psychological outcomes following TBI. Notwithstanding the likelihood that this relationship is bidirectional, VL could be specifically targeted as a means of improving these outcomes. For instance, psychological and behavioural therapy in the first year following head-injury could aim to identify important personal values and to shape participation to be as consistent with these values as possible despite changes in cognitive and physical abilities. The VLQ could be used to inform such intervention and could also be re-administered to track progress in VL over time. Given significant limitations in degree of insight and self-awareness in the early period post-injury, individuals with TBI could benefit from additional support to identify personal values and to modify behaviours to re-align with their values. Psycho-education to highlight the potential for positive outcomes through VL early post-injury could also be used to flag the availability of support services which may be useful or needed after the initial period of acute inpatient rehabilitation.

5.2 MEASUREMENT OF POST-TRAUMATIC GROWTH FOLLOWING TBI

In order to more broadly assess the relationship between VL and PTG, as well as to examine its time-course and factors associated with PTG, it was important to address issues relating to measurement and conceptualisation of PTG following TBI. The PTGI, one of the most commonly used measures of PTG, has been previously criticised for its design because it increases the likelihood for a positive response bias (Calhoun & Tedeschi, 2006). A scale assessing both positive and negative outlook (CiOQ) was therefore designed to overcome this limitation (Joseph et al., 1993). However, the suitability of each measure as a tool for assessment of PTG in persons with TBI was yet to be evaluated. Prior to Study Two, there was no previous research comparing these two measures of PTG on outcomes important for recovery following TBI. Similarly, the association between behaviours consistent with PTG and total scores on these two measures of PTG was yet to be determined. To address these aims, 70 participants with moderate to severe TBI were recruited from a rehabilitation hospital one to five years following TBI. Main study measures included the validated short-forms of the PTGI (PTGI-SF) and CiOQ (CiOQ-S).

Results revealed that most participants (45%) were engaging in behaviours consistent with PTG. These behaviours clustered into specific themes and were closely associated with domains of PTG commonly reported following TBI, such as 'appreciation for life' and 'improved social relationships' (Hawley & Joseph, 2008). This suggests that participant responses are unlikely to be shaped by a positive response bias and more likely to reflect genuine changes in outlook and behaviour associated with PTG. However, while examining the consistency between behaviours and outlook could be a useful means of reducing the likelihood of positive response bias; it remains difficult to objectively assess and quantify these behaviours. For instance, without direct observation of behaviour change, self-reported examples of behaviour could be influenced by other factors such as level of self-awareness, insight and memory which are known to be compromised following TBI (Ponsford et al., 2012). Seeking corroborative report from a close other who has known the individual both prior to and following TBI may help to address this limitation.

Qualitative examination of sub-themes generated through elicitation of behavioural examples of PTG in Study Two represents a unique contribution to the study of PTG following TBI. The results specifically suggest that PTG is associated with behaviours seeking to show a greater appreciation of life (i.e. kindness to others and "being present in the moment") and to improve the level of social engagement with others (i.e. "listening", making an effort to "understand/connect/ feel"), including but not limited to family and friends. This is consistent with endorsement of items on measures of PTG as demonstrated in previous research following TBI (Hawley & Joseph, 2008; Powell et al., 2007; Silva et al., 2011). The results of the present study represent a significant development on these previous findings by demonstrating that corroborative behavioural change is associated with change in outlook in this area of life. In combination, these results may suggest that specific domains of PTG such as a 'change in relating to others' 'appreciation of life' could be especially relevant to rehabilitation following TBI. For instance, it may suggest a particular role for mindfulness based therapies, training in social communication skills, and psychological support to improve understanding of the importance of relationships after TBI.

The behavioural sub-themes generated by qualitative analysis of participants' responses also have important clinical implications. For instance, while the concept of PTG may be abstract and therefore at times difficult to assess, participants with TBI may be encouraged to build on specific behaviours (i.e. showing gestures of gratitude, making time for family activities, practicing mindfulness/ awareness of self in the moment) associated with PTG. Through engagement in these behaviours, positive changes in outlook and self-concept may be further consolidated. Furthermore, the experience of positive outlook generated through engagement in these behaviours could encourage the development of PTG as opposed to negative mental health outcomes.

The results of this study also revealed that among the two measures of PTG, the positive and negative subscales of CiOQ-S were more closely associated with post-injury outcomes, including return to work/study, improved VL and increased behavioural reports of positive growth. This could suggest that the CiOQ-S is a more sensitive measure of PTG following TBI. However, while the CiOQ may be advantageous in this regard, it does not yet have an established set of norms or a means of comparing its positive and negative subscales. Literature suggests that positive and negative

outlook are not mutually exclusive (Joseph et al., 2005; Joseph et al., 1993) and may in fact occur in tandem during the early phase of PTG development (Zang et al., 2012). Therefore, it would be useful to determine what degree of negative outlook is naturally associated with the process of PTG, as opposed to being potentially detrimental to its development. It may be that a U-shaped curve for negative outlook exists for optimal PTG. For instance, some moderate level of negative outlook could be naturally associated with process of PTG. However, very low levels of negative outlook may suggest an insufficient degree of change in outlook/behaviour and very high levels of negative outlook could interfere with process of benefit finding through trauma. Certainly, a similar hypothesis has been suggested for the relationship between levels of psychological distress and PTG (Calhoun & Tedeschi, 2006). A major limitation in the assessment of PTG remains the lack of established norms for the interpretation of scores on any established measure of PTG. While scores on various studies appear to cluster around similar figures, the significance of variation in scores over time would need to be established to increase the utility of these measures when tracking progress and development of PTG in therapy.

The results of this study suggest that PTG may be associated with positive outcomes following TBI, such as a likelihood of return to work and VL with PTG. Whilst the direction of this relationship is difficult to determine and is likely bidirectional, this finding suggests that continued research into positive psychological outcomes following TBI is required. Similar to past studies, in the current research, it was found that PTG had no significant association with level of distress (Cordova et al., 2001; Powell et al., 2012) or functional adjustment following TBI (Powell et al., 2007; Rogan et al., 2013). This substantiates the account that process of PTG may not be directly associated with reduced distress (Cordova et al., 2001) but rather an experience of positive outlook despite some ongoing distress and functional limitations. It could be argued that the process of PTG empowers individuals to overcome significant impediments such that they can improve their levels of activity and engagement and continue to lead value consistent lives. This is consistent with previous findings suggesting that PTG may act as a buffer and thereby assist in the management of pain and distress (Tennen et al., 1992). However, as the assessment of PTG has been limited to the first six years following TBI in previous studies, the relationship between PTG and psychological

and functional outcomes at later time-points has not been established. It maybe that PTG is yet to stabilise by 6 years post-injury and therefore further examination of the time-course and correlates of PTG is required over longer periods. This line of investigation formed the focus of Study Three.

5.3 TRAJECTORY OF PTG FOLLOWING TBI

Due to the limited number of studies examining positive outcomes following brain injury, the nature and time-course of PTG specifically following TBI is yet to be established. Previous studies have generally found that the levels of PTG appear to increase with time post-injury. However, these studies have generally compared time-points many years apart (Collicutt McGrath & Linley, 2006; Powell et al., 2007), assuming a linear trajectory in levels of growth over time. Only one longitudinal study (Powell et al., 2012) has examined PTG over multiple time-points (11 years to 13 years post-TBI) and this study was limited by a small sample size (n= 20) and reported no change over the two-year period of follow-up.

Potentially, PTG development may have stabilised by this time. While some cross-sectional studies have failed to report an effect of time post-injury on levels of PTG (Rogan et al., 2013), other studies suggest a moderate effect of time post-injury, with participants at later time-points reporting higher levels of PTG (Collicutt McGrath & Linley, 2006; Powell et al., 2007). In light of these mixed findings, Study Three aimed to examine the post-injury time-course of PTG at one to six years following moderate to severe TBI. Participants were recruited from a rehabilitation hospital in three cohorts: 'Early' (n= 28), 'Mid' (n= 9) and 'Late' (n= 36) post-TBI. Participants were assessed at time of recruitment and 12 months later. The main measure of PTG (based on findings from Study Two) was the CiOQ-S.

The results revealed that time post-injury did not share a direct linear relationship with trajectory of PTG in the first 6 years following TBI. The trends in PTG scores across cohorts seemed to indicate a curvilinear pattern, such that there appeared to be a decline in positive growth around 1-3 years, very similar to pattern of change observed in VL following TBI. As suggested in Study

One, this time-period could reflect early adjustment difficulties in self-concept and functional ability characteristically experienced following TBI as compared to other trauma populations. However, further analysis of data indicated that these trends were not significant, likely due to the small sample size for the 'Mid' cohort and level of individual variability in scores over time.

The compilation of total PTG scores across many individuals could have masked some patterns of change in PTG over time since there was likely to have been considerable variability in injury and disability levels, pre-morbid personality factors as well as family and relationship situations. Furthermore, the trajectory of growth for each individual may be influenced by factors such as the degree to which life has changed post-injury, amount of time engaged in self-reflection and nature of opportunities available to explore alternative work/study options. These factors are difficult to assess quantitatively and may introduce variability in the amount of personal growth experienced by each individual as well as the stability and ongoing development of PTG over time.

As a result of the significant cognitive and functional limitations faced by many individuals with TBI, it may take longer, indeed longer than six years for levels of PTG to be established and to stabilise as compared to other trauma populations. Ongoing access to rehabilitation and other support services as well as degree of social support may further impact opportunities to develop PTG. Additionally, this research did not examine the relationship between type and amount of rehabilitation received and PTG which may be of interest for future studies. Long-term follow-up studies are needed to elucidate clear prospective trends as cross-sectional and short-term follow up studies may provide incomplete information. As this study provided some indication of continual changes in PTG over a 6-year period, the results of this study fill an important gap in literature that can be further extended by future studies.

5.4 FACTORS ASSOCIATED WITH PTG FOLLOWING TBI

In view of literature indicating conflicting views regarding the relationship between various personality, demographic and injury related factors and PTG following TBI, Study Three also aimed

to establish predictive and associative factors related with PTG following moderate to severe TBI. Results suggested that higher levels of education, being in a relationship and remaining in employment/study were associated with PTG. These findings are consistent with previous findings (Gangstad et al., 2009; Grace et al., 2015; Powell et al., 2012).

Various hypotheses have been put forth regarding the role of cognitive reserve (Stern, 2003), social support (Updegraff et al., 2002) and personal meaning (Powell et al., 2012) in facilitating the development of PTG. Specifically, it has been suggested that education may represent an aspect of cognitive reserve which serves to maintain greater levels of cognitive functioning despite objective injury severity (Grace et al., 2015). Similarly, employment status could indicate a level of cognitive reserve, such that individuals with greater cognitive reserve would be more persistent or resourceful in their attempts to return to work or study following TBI, perhaps because they find work more intrinsically rewarding. Indeed, there is evidence that individuals in professional occupations are more likely to return to work earlier and have greater stability of employment after TBI than those who are machinery workers (Ponsford & Spitz, 2014). It has also been postulated that an individual's ability to return to employment or study is important for his/her broader sense of self-identity and well-being (Ownsworth & McKenna, 2004). Being employed has also been associated with other functional outcomes such as improved social integration into the community, greater health status, more frequent pursuit of leisure activities and a greater sense of autonomy (Steadman-Pare, Colantonio, Ratcliff, Chase, & Vernich, 2001; Wehman, Targett, West, & Kregel, 2005). Therefore, taking a proactive approach to getting individuals with TBI back to work or study should be a high priority in rehabilitation. Being in employment or study and the associated wider access to social support networks and a renewed sense of self-identity could contribute to reports of positive outlook or PTG.

With regards to the association between relationship status and PTG, it has been suggested by some that the presence of a close relationship may provide an important source of social support which acts as a buffer through periods of intense distress, thereby increasing the likelihood for positive outcomes following the initial period of emotional/psychological turmoil (Updegraff & Taylor, 2000). However, it has also been found that while involvement in a new relationship

following TBI is associated with higher levels of PTG, being in the same relationship is not associated with greater PTG (Powell et al., 2012). It was suggested that involvement in a new relationship may facilitate the development of new post-injury identity (Powell et al., 2012), thereby facilitating the process of PTG. However, it may also be that individuals who are not in a relationship overall experience greater social difficulties post-injury and this contributes to lower levels of positive outlook. Alternatively, it has also been acknowledged that individuals reporting PTG could be more open to forming new social bonds and interpersonal relationships (Grace et al., 2015). There is some support for this notion given the results of Study Two, in relation to behaviours most likely to be associated with PTG. These included examples suggesting a desire to make family/friends "a priority" post-injury and to better "understand/connect" with others.

These results provide some support for rehabilitative practices targeting return to study and/ or employment and facilitation of social relationships as being relevant to promoting positive psychological outcomes. However, the relationship between these factors is most likely bidirectional; therefore, by signposting positive outlook as a possibility following TBI and directly facilitating this positive change in outlook, we may also improve the individual's motivation to return to work/study and to engage in meaningful personal relationships. Future studies may need to examine the role of PTG in shaping motivation to engage in meaningful personal activities following TBI.

The results of this study also highlight that our ability to predict positive outlook remains vastly inferior to our ability to predict negative outlook. Most studies with sufficient sample size and appropriate selection of predictors have not been able to account for more than 20-40% of variation in PTG scores following TBI (Grace et al., 2015). Combining the most likely predictors of PTG in this study only accounted for 18% of variability overall. It may be that the factors contributing to negative outlook (such as injury severity, functional disability, education, psychological disorders) differ from the factors which promote positive outlook. It seems likely that we have not yet identified and considered all relevant factors associated with development of PTG. For instance, based on research in other trauma populations there may be role for personality factors (Karanci & Erkam, 2007; Wilson & Boden, 2008), coping styles (Prati & Pietrantoni, 2009), spirituality (Cadell, Regehr,

& Hemsworth, 2003) and flexible social support systems (Teixeira & Pereira, 2013) encouraging self-reflection and change.

This study examined the role in PTG of some specific pre-injury personality factors ('openness' and 'extraversion') commonly known to be associated with PTG in other trauma populations (Karanci & Erkam, 2007; Wilson & Boden, 2008). The results of Study Three indicated that while pre-injury levels of 'openness' was shown to be associated with negative outlook, there was no significant relationship between pre-injury personality factors of 'extraversion' and 'openness' with development of PTG at 12 months' post-injury. While this finding is contrary to the study hypothesis, methodological differences in assessment of personality and PTG may have contributed to discrepant findings. For instance, most studies have examined personality many years after the trauma, alongside assessment of PTG (Karanci et al., 2012; Shakespeare-Finch, 2005; Wilson & Boden, 2008). Therefore, it is plausible that personality has evolved over time to reflect a positive change in outlook (Jayawickreme & Blackie, 2014) such that individuals who were previously 'introverted' are more likely to be interested in seeking out social interactions with others. Future studies of PTG following TBI would need to examine personality prospectively (soon after injury) with continued follow-up to determine whether personality changes over time.

The experience of trauma sustained through a TBI is fairly unique in that the initial experience is often forgotten as a result of significant disruptions to neural networks at the time of injury (Ponsford et al., 2012). The resultant life-changing ramifications are only realised many months or years after TBI, depending on the extent of ongoing physical, cognitive, neurological and behavioural consequences. Therefore, the onset and development of PTG could be very different following TBI than other forms of trauma. Qualitative studies are yet to examine themes relevant to development of positive outlook specifically following TBI. As mentioned previously the extent to which individuals have been able to self-reflect on the experience of trauma associated with TBI may be a significant contributor to the development of PTG. During the process of interviews with participants, it was clear that some individuals had not previously considered changes in outlook or the possibility of positive growth following their accident. By contrast, other participants described qualities associated with PTG during assessment prior to administration of relevant PTG

questionnaires. It would therefore be of interest to determine whether the extent of self-reflection and opportunities afforded to discuss these changes with others affects the process of growth. This may be especially important following TBI where capacity for self-reflection and insight could be impacted by the injury.

5.5 LIMITATIONS

The findings of this research need to be considered in light of certain limitations. Given that the majority of limitations pertaining to each of the individual studies have been outlined in detail previously, the following section will focus on the more global limitations of the research.

As PTG is operationalised as a personal change in outlook, it is a largely subjective construct, which therefore relies solely on self-report measures. This might influence the reliability of reporting especially for individuals with TBI who experience cognitive difficulties in areas of memory and self-awareness. There is also a lack of norms for the interpretation of scores relating to various measures of PTG. While some studies have utilised total item scores, many others have focused on individual items. Studies generally compare overall levels of growth obtained by their sample to some 'average' value obtained in other comparable studies. While this suggests some consistency in range of scores obtained, it does not elucidate the clinical significance of these scores. The current study is also affected by similar limitations given the lack of current normative data on measurement of PTG. This would be especially important to assess the outcomes of translational studies seeking to develop PTG through targeted psychological or behavioural therapy.

This research had a cross-sequential design to enable exploration of trends in VL and PTG following TBI across various time-periods post-injury, within the time-frame of this doctoral research project. In order to enable assessment of change over time, in Studies One and Three, longitudinal assessment of change over time was considered alongside time by group comparisons. It is acknowledged that comparisons across cohorts are not equivalent to comparisons over follow-ups due to variability in control of confounding factors such as individual demographic and injury-

related variables. Furthermore, given the current research focus on the role of pre-injury personality in shaping the PTG, personality variables were only examined for the Early cohort at the time of initial assessment. This limited the interpretation of findings as it could not be determined whether personality evolves over time to reflect changes in outlook such that traits of 'openness' and 'extraversion' could eventually be positively associated with PTG. Similarly, given the initial assessment for the Early cohort largely focused on pre-injury assessment, levels of PTG within 1-6 months following TBI were not assessed. This may have provided some additional insight into early development of PTG.

Although this study included a modest sample, recruitment of some cohorts (Mid: 1-3 years) was especially limited. Given this restricted sample size, many forms of data analysis could not be conducted and the reliability and generalisability of data at this time-point is less than ideal. The results also suggest a great deal of individual variability in levels of PTG which likely reflected variability in factors such as levels of disability, social and living arrangements and opportunities to return to work and/or study. As participant data were combined at various time-points, this may have masked underlying patterns, with some participants showing no change, whilst others may demonstrate incremental changes in positive growth over time. It may be possible that with a larger dataset the effect of these individual differences is superseded by more significant overall trends.

A final limitation relates to the generalisability of current findings more broadly to individuals with TBI living in the community. The current research included a sample of individuals with moderate to severe TBI, the majority of whom received comprehensive inpatient and community based rehabilitation through a no-fault accident compensation system. Therefore, the results may not generalise to those with mild injuries, different systems of post-acute rehabilitation or those with no access to rehabilitation. Furthermore, participants in the current research were predominately middle-aged Australian males who were injured in a motor vehicle accident Therefore, the findings may not generalise to females, individuals from other countries, or those with other mechanisms of injury. Lastly, due to anticipated difficulties in providing informed consent and/or accurate responses, participants with very severe cognitive limitations were excluded. These results may therefore not generalise to those with very severe cognitive impairments, who arguably

may have great difficulty engaging in the self-reflective process of PTG. Similarly, individuals who did not have a good command of English had to be excluded, and therefore results may not reflect the response of individuals from different cultures.

5.6 FUTURE DIRECTIONS

In light of the findings and limitations of the current research as well as the outstanding gaps in the broader literature to date, there are a number of areas worth considering in future studies. Continued prospective longitudinal follow-up of positive outcomes following TBI would be recommended. Specifically, it would be important to study the temporal course of PTG over an extended one- to ten-year period to further examine the development of PTG following TBI, especially given the wide degree of individual variability demonstrated by this current research. Longitudinal investigation remains the gold standard for assessment of trends over time and research on PTG following TBI is especially lacking in this regard. Multi-level modelling or cluster analysis to examine different types of trajectories of PTG in a longitudinal study with a large sample would be ideal. It may also be of benefit for future research to take a broader perspective on PTG, given current limitations in our ability to explain individual variability in PTG following TBI. Future studies may need to utilise qualitative methodology to explore the factors that have inspired people with a brain injury to adopt positive outlooks. This may involve a dialogue which encourages self-reflection in a socially supportive environment such as group workshop. Future studies are also needed to generate norms for interpretation of CiOQ-S and PTGI-SF scores. Ideally, these would be specific to various trauma populations given the aetiology of trauma likely affects development of PTG. Lastly, based on the results of this explorative study, translational studies could seek to target improvements in VL at 12 months' post-injury as well as to foster behaviours related to PTG following TBI. Evaluation of changes in outlook following such intervention could help to further consolidate the link between VL and PTG, as well as the importance of consistent behaviours to reflect PTG following TBI.

5.7 CONCLUDING REMARKS

Even after a significant brain injury, individuals can engage in a re-evaluation of their lives, and through this find benefits and personal growth through their experience of trauma. VL and PTG are likely to be related constructs that continually evolve over a period of at least 1 to 6 years following TBI. With some targeted intervention (12 months' post injury) to assist individuals with TBI to re-evaluate their values and adjust their behaviours to be consistent with post-injury capacity, it may be possible to reduce the time taken (3-5 years) to return to pre-injury levels of VL, and hopefully to encourage further growth. Although levels of PTG do not appear to stabilise by 6 years post-injury, it is encouraging to find that PTG is associated with return to work/study and higher levels of value consistent living. Reports of PTG also appear to be associated with specific change in behaviours, especially those seeking to improve the level of social engagement with others. These behaviours could be fostered in rehabilitation to promote the development of PTG.

This research was the first to examine the role of VL following TBI, specifically in terms of its association with functional and psychological outcomes, including the development of PTG. This research was also the first to compare two of the most widely used measures of PTG to determine association with consistent PTG behaviour and suitability for research following TBI. We further examined the time-course and predictors of PTG over several years following moderate to severe TBI. The results of this research add to the growing evidence regarding the potential for individuals to experience positive psychological outcomes following TBI. While the results of this study have addressed some of limitations raised by previous research and contributed to our understanding of PTG following TBI, it is evident that our understanding of positive outcomes remains inferior to our knowledge of negative outcomes following TBI. Further research will be required to addresses the current methodological limitations in relation to measurement of PTG following TBI and to further consolidate current findings. Qualitative research to more broadly examine the motivating factors encouraging a shift in outlook specifically following TBI could also be valuable to our building our understanding of PTG after TBI.

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