Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making.

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Abstract

Traumatic brain injury (TBI) leads to cognitive, behaviour, and social functioning difficulties. It has also been associated with offending behaviour. The common area of damage is to the fronto-temporal brain regions (Salmond et al, 2006). These are considered important for moral reasoning. Moral reasoning is believed to be important for upholding social function and preventing delinquent behaviour (Gibbs, 2010). It is suggested that TBI may disrupt moral reasoning and contribute to social and behaviour deficits (Anderson & Catroppa, 2006). Studies to date have indicated that there are greater difficulties in moral reasoning following a childhood TBI than adulthood TBI. Studies have been small and have not examined the impact of childhood TBI in early adulthood. Fewer studies have explored the neurocognitive processes underpinning moral reasoning.

This study compared moral reasoning, measured by the Sociomoral Reflection Measure - Short Form (SRM-SF, Gibbs, Basinger & Fuller, 1992) in a group of 20 survivors of TBI aged between 17 and 25 years and a group of 34 healthy individuals. It also explored the relationships between moral reasoning and executive functions, cognitive flexibility, inhibition; empathy and emotion-based decision making.

The healthy comparison group demonstrated significantly higher moral reasoning. This was maintained when the groups were matched on age, sex, socioeconomic status and when intellectual functioning was controlled. The study revealed significant relationships between moral reasoning and cognitive flexibility, inhibition, executive function difficulties and empathy in the healthy comparison group. Only one significant correlation was revealed in the TBI group; between cognitive flexibility and moral reasoning. This was attributed to insufficient power to detect other significant findings.

The study concluded that TBI sustained during childhood does disrupt moral development. It also indicated that executive function processes and empathy may be involved

in moral reasoning. These findings were considered in relation to theories of moral reasoning, brain development and methodological rigour. Further research is suggested.

Table of Contents

List of Appendices

List of Tables

Table of Figures

Chapter One

Introduction

1.1 Overview

"Moral reasoning promotes and enhances socially appropriate behaviours whilst regulating and inhibiting inappropriate or negative behaviours"

(Dooley, Beauchamp & Anderson, 2010, pp. 152)

Moral reasoning is believed to develop through cognitive, emotional and social maturation. The frontal region of the brain is considered important for these cognitive and emotional processes and is activated during moral reasoning tasks (Raine & Young, 2006). It is widely recognised that the frontal lobe is one of the brain regions commonly affected in a traumatic brain injury (Bigler, 2007). Traumatic brain injury (TBI) causes deficits in several areas of functioning and has a great impact on individuals, families and wider society. These difficulties may in part be explained by moral reasoning deficits. The study aims to explore the impact of TBI on moral reasoning.

Research to date has reported difficulties in moral reasoning after a brain injury in childhood. Most studies have, however, been small and the larger studies have tended to focus on examining the impact on moral reasoning in childhood. To date, no studies have examined the impact of child brain injury on moral reasoning in late adolescence-early adulthood. This period of development is important for several reasons. It is the period during which the frontal areas of the brain complete their maturation and, therefore, the cognitive and emotional processes believed integral to moral reasoning are completing development. In addition, it is considered to be at this time that individuals are reaching the stage of mature moral reasoning (Gibbs, Basinger & Fuller, 1992). Moreover, it captures a period when individuals are gaining their independence – starting careers, forming relationships and living independently (Morton &

Wehman, 1995; Turkstra, Williams, Tonks & Burgess, 2008) and, therefore, are more responsible for making important decisions. There is a consensus in the literature that the true impact of a brain injury is only known when the individual approaches these crucial stages (Chapman & McKinnon, 2000; Eslinger, Grattan, Damasio & Damasio, 1992; McKinlay, Grace, Horwood, Fergusson & MacFarlane, 2009).

This requires closer examination as deficits in moral reasoning may contribute to social and behavioural problems commonly reported following a TBI. Furthermore, moral reasoning is considered to prevent delinquent behaviour as it involves an appreciation of wider society and others in decision making (Gibbs, 2010; Dooley et al., 2010). So if there are deficits in moral reasoning after childhood TBI, this may in part, explain the emerging research suggestive of an increased vulnerability to offending behaviour following a TBI. A greater understanding will facilitate the development of effective interventions for neuro-rehabilitation programmes.

This study plans to examine moral reasoning in individuals who have survived a TBI and are currently aged between 17 and 25 years of age. In addition, this study intends to address another important area. Research studies have provided mixed evidence to support the notion that moral reasoning is associated with cognition (executive functioning), empathy, and emotion based decision making or intuition. This requires closer examination as a better understanding of the processes that underpin moral reasoning would inform targets for interventions. This study, therefore, plans to explore the relationship between moral reasoning and these processes.

This chapter will introduce the background to the study. It will begin with a brief overview of TBI inclusive of definition, causes, and epidemiology. It will next discuss the impact of TBI with a particular focus on injury sustained during childhood. It will briefly describe the cognitive, emotional, and behavioural deficits associated with TBI. Following this the relationship between moral reasoning and offending will be considered. It will then summarise theories about moral reasoning and highlight the processes which are considered important; including executive function, empathy and emotion-based decision making/ intuition,

before highlighting their neural correlates which are vulnerable to damage in a TBI. Following this the literature which has explored the impact of childhood and adulthood brain injury on moral reasoning will be reviewed. Finally, the rationale and aims for this current study will be presented: to focus on the impact of brain injury on moral reasoning in early adulthood; and to explore the processes that underpin moral reasoning.

1.2 Traumatic brain injury

TBI refers to damage to the brain from an external force (Donders, 2006). The most common causes of TBI are road traffic accidents, assaults, and falls. They are also sustained during sports and recreational activities (Langlois, Rutland-Brown, & Thomas, 2004). It has been reported that there are 10 million incidents a year worldwide which result in death or hospitalisation (Langlois, Rutland-Brown, & Wald, 2006). This is, however, an underestimate because the majority are mild TBIs so many people do not seek help and in the military, help is provided but not recorded (Langlois et al., 2006). Additionally, TBI can often become a hidden disability due to an absence of any obvious physical problems, despite many cognitive difficulties (Khan, Baguley, & Cameron, 2003; Langlois et al., 2006).

The highest prevalence of TBI is reported in children and adolescents aged between 0-4 and 15-19 years of age (Langlois et al., 2004; Yates, Williams, Harris, Round & Jenkins, 2006). TBI is believed to be the leading cause of disability or death for children, adolescents and young adults across the world (World Health Organisation, 2009). It often leads to impairments in cognitive, behavioural, physical and psychosocial domains and has a large impact on the individual and wider society. However, the impact of a TBI is mediated by a number of factors including the extent and location of the injury, rehabilitation, family support and possibly genetic factors and pre-injury function e.g. cognitive reserve (Turner-Stokes, Nair, Sedki, Disler, & Wade, 2005). It is also associated with the development of other co-morbid conditions (e.g.

mood disorders and Alzheimer's disease; Langlois et al., 2006) and epilepsy in younger children (Yeates, 2010).

1.2.1 Neuropathology of TBI

TBI results in damage to the brain by primary and secondary injuries (Noppins & Brambrink, 2004; Yeates, 2010). Primary injuries result from the direct trauma to the brain and through the acceleration-deceleration force of the incident (Donders, 2006; Yeates, 2010). This can cause contusions and lesions to focal points as well as deformation of the skull. In addition, rotational trauma can occur when the skull stops on impact but the brain moves due to angular acceleration. This action can result in tearing of blood vessels leading to focal lesions or haemorrhage and shearing which give rise to diffuse axonal injury (Donders, 2006; Yeates, 2010). Studies using advanced structural magnetic resonance and diffusion tensor imaging have consistently demonstrated damage to bilateral frontal and temporal lobes after TBI (Salmond et al., 2006; Wallesch, Curio, Galazky, Jost, & Synowitz, 2001). Bigler (2007) suggested that this may be due to their proximity to the bony aspects of the skull. It may also be because it is the common impact point in an assault and road traffic accidents. In addition, the acceleration-deceleration force of a TBI can cause diffuse axonal injury (Donders, 2006; Yeates, 2006). This is because the human brain is unable to withstand the impact of the rapid rotational mechanisms (Smith, Meaney & Skull, 2003). The stretching results in damage to the axonal cytoskeleton resulting in disconnected axons (Smith et al., 2003). This disconnection disrupts the communications between the cells and is believed to correlate with functional recovery and clinical outcomes. The most common area for disconnection is in the frontal lobe (Lillie, Urban, Lynch, Whitlow & Stitzel, 2013). The frontal lobe is believed responsible for control, organisation and monitoring of the information from the other parts of the brain (Stuss & Alexander, 2007; Stuss & Knight, 2002). Disruptions to connections between the frontal lobe and other areas of the brain will disrupt this function (Smith et al., 2003). For example the

limbic system is responsible for emotions and these are managed and controlled by the frontal lobe. Disruptions in the frontolimbic pathway, therefore, may lead to agitation and behavioural difficulties (Smith et al., 2003).

TBI gives rise to secondary injuries through consequential complications of brain swelling e.g. haemorrhage, and increased cerebral blood volume resulting in increased intracranial pressure and hypoxic injury (Bruce, 1995; Rao & Lyketsos, 2000; Werner & Engelhard, 2007).

1.2.2 Measurement of Severity

There are three main methods for measuring severity. One method is using the Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974). A score is derived through assessment of eye opening, motor and verbal function to various stimuli. The scores correspond to severity: 13-15 (mild); 9-12 (moderate); and less than 9 (severe). The alternative is the duration of Post-traumatic Amnesia (PTA), the period of time post-injury that the brain is unable to hold continuous memories (Russell & Smith, 1961). In addition, the loss of consciousness for more than 30 minutes is considered indicative of a moderate-severe brain injury (The Mayo classification system; Malec et al., 2007).

1.2.3. Outcomes of TBI

Survival rates from TBI have improved as a result of advances in neurosurgery and intensive care (Khan et al., 2003). Nevertheless, damage to frontal-temporal limbic structures (Bigler, 2007) often leads to emotional, cognitive, and behavioural difficulties.

Traditionally it was believed that a brain injury during childhood resulted in less residual difficulties. The Kennard Principle (Finger & Wolfe, 1988) suggested damage was overcome by the plasticity of the young brain, the structural and functional adaptations made to counteract the lesions (Buchwald, 1990). This theory was supported by findings from earlier studies of

recovery in young chimpanzees (Kennard, 1938) and younger children with focal lesions (Aram & Enkleman, 1986).

In contrast to this view, Catroppa, Anderson, Morse, Haritou and Rosenfield (2008) highlighted the vulnerability of the developing brain. They suggest childhood TBI may cause more diffuse damage due to the smaller size of neck to head ratio, more flexible cranial bones, and thinner cortex. In addition, the injury would occur at a time when there are limited cognitive reserves and, therefore, less to draw upon to aid recovery (i.e., compensatory strategies; Savage, 2009). This alternative view has been supported by advances in neuroimaging and a better understanding of brain development. Brain development occurs through myelination and pruning. Myelination adds a fatty sheath to enable neurons to transmit signals quicker and allow better communication between the brain regions (Belsky & de Haan, 2011; Paus et al., 1999). In addition, communication between neurons occurs across synapses and the synaptic density increases rapidly after birth (Lenroot & Giedd, 2006). Pruning enables a reduction in synapses thereby stabilisation of the important networks of neurons (Belsky & de Haan, 2011). These processes continue into the third decade of life (Gogtay et al., 2004; Lenroot & Giedd, 2006). They begin in the motor and sensory areas associated with most basic functions and finish in the more complex areas; the frontal areas which are responsible for executive function, and emotion processing (Belsky & de Haan, 2011; Sowell et al., 2004). The last structures to mature, in the mid twenties, are the dorso-lateral prefrontal cortex (DLPFC) and ventromedial prefrontal cortex (VMPFC), consistent with maturation of executive function skills (Gogtay et al., 2004; Sowell et al., 2004). Given the prolonged nature of this process of development, damage inflicted during this period may adversely affect brain structure, by distorting creation of new structures or pathways and limiting elaboration and usage of earlier ones (Black, Jones, Nelson, & Greenough, 1998; Cicchetti, 2002). In addition, damage may cause disruption to the processes of myelination and pruning. It is also likely to have a particular impact on later maturing structures, mainly the frontal lobe (Reinis & Goldman, 1980). Therefore, instead of preserved

function after early brain injury, it may result in "neuro-cognitive stall" which slows the rates of cognitive, social and motor development (Chapman, 2007) and limits development to the pre-injury skills (Ewing-Cobbs, Barnes, & Fletcher, 2003). The plasticity of the brain may cause further problems by recruiting other areas to perform roles and hinder development of the specified region (Klintsova & Greenough 1999). This is known as the "crowding hypothesis" (Teuber & Rudel, 1962) which has suggested the young brain compensates through maximal rewiring of available neural space. This theory suggests this may help initially but it proposes greater difficulties emerge later in the developmental trajectory as these early adaptations "crowd" out the brain, and compromise the later developmental of new skills and adaptations. Furthermore, genes and experience are also implicated in brain development. Brain structural development is considered to be reliant on the complexity of the environment and the ability to interact with this (Karmiloff-Smith, 1998; 2006; Westermann et al., 2007). An early brain injury is likely to alter life experiences, thereby presenting another cause for disruption to brain development. In keeping with this, a paper has reported increased synapse connections, cortical thickness and weight, and better cognitive function in rats reared in more stimulating environments (Sale, Berardi & Maffei, 2009). Interestingly, an enriched environment has not been shown to lead to the same improvements in cortical thickness or enhanced cognitive performance, in rats that have sustained an early TBI (Fineman, Giza, Nahed, Lee, & Hovda, 2000). This is supportive of disruption from TBI on brain development, regardless of environment.

These theories concur that whilst it may appear there is initial recovery; this is preceded by a plateau or decline in functioning relative to peers, ultimately manifesting itself in individuals not being able to reach future milestones (Savage, 2009). Further difficulties may arise in adolescence when protection from familial structure disperses, there are greater social challenges, and independent functioning is expected (Eslinger et al., 1992). Hence children may develop cognitive, behavioural and language difficulties later (McKinlay et al., 2009). In

keeping with this, Tonks, Williams, Yates, and Slater (2011) revealed a significant difference between child survivors of TBI, aged between 10 and 16 years, and their peers on cognitive assessments but did not reveal discrepancies in a group at a younger age. In light of these issues, Chapman and McKinnon (2000) warn against premature judging of recovery in children.

In summary, there appears to be much evidence to support the view that early damage to the brain results in numerous residual difficulties. Indeed Catroppa et al. (2008) have shown that very young preschool children have worse outcomes in terms of greater disability in later life. This section will now summarise these difficulties.

1.2.3.1 Cognitive impact

Cognitive difficulties often present the most troublesome outcomes from a TBI, with possible problems in areas of attention, processing speed, memory, and language (Schiff, Plum, & Rezai, 2002). These can occur alongside further difficulties in areas of executive functioning including cognitive flexibility, problem solving, impaired judgement, inhibitory control, planning, and working memory (Khan et al., 2003; Levin & Hanten, 2005; Yeates, 2010). It is considered that cognitive skills that have not been developed pre-TBI are the most affected (McKinlay, 2012). Childhood TBI of differing severity has been seen to result in issues with memory, processing speed, and attention deficits (Catroppa & Anderson, 2003; Catroppa, Anderson, Morse, Haritou & Rosenfield, 2007; Donders, 2006; Yeates et al., 2005). Anderson, Catroppa, Morse, Haritou and Rosenfield (2000; 2005) revealed difficulties in intellectual functioning in children several years post injury. Cognitive deficits are considered to be moderated by injury severity and greater damage is expected when there has been greater acceleration-deceleration action (Levine, 2012). Moderate and severe TBI have been associated with cognitive deficits, poor social outcomes, and behaviour problems (Crowe, Catroppa, Babl, & Anderson, 2012; Stambrook, Moore, Peters, Deviaene, & Hawryluk, 1990). However, mild

severity has also been associated with neuropsychological deficits (Catroppa & Anderson, 2003; Catroppa et al., 2007; Donders, 2006; Mathias, Beall & Bigler, 2004; Yeates et al., 2005).

1.2.3.2 Behavioural and Psychosocial impact

Anderson et al. (2000; 2005) suggested the residual deficits from childhood TBI impact negatively on social, emotional, and academic development, placing a considerable burden on families and the wider context (Anderson & Catroppa, 2006). Childhood TBI is believed to disrupt emotional and behavioural regulation (Yeates, 2010). A study revealed the same levels of emotional distress, measured by the strengths and difficulties questionnaire (SDQ; Goodman, 1997), in an acquired brain injury group compared to a mental health group (Tonks, Yates, William, Framptom, & Slater, 2010). More recently, a study revealed significantly more psychiatric difficulties in a brain injury group compared to an orthopaedic comparison group (Max et al., 2012). These differences were not accounted for by pre injury characteristics such as socioeconomic status, family adversity, family psychiatric history, adaptive function, or injury severity.

Furthermore, there has been an association between TBI and difficult peer relationships for children and adolescents (Bohnert, Parker, & Warschausky, 1997; Tonks et al., 2010). In young adults, Morton and Wehman (1995) reported a significant reduction in friendships, social support, and leisure activities.

1.2.3.3 TBI, conduct problems and offending behaviour

Childhood TBI has been associated with conduct problems (Anderson & Catroppa, 2006). A prospective study has reported greater instances of attention-deficit disorder and oppositional defiant disorder /conduct disorder in children who had sustained a mild TBI, which required hospitalisation, than those which did not require hospitalisation and a healthy comparison group (McKinlay et al., 2009). Schwartz et al. (2003) reported significantly higher

behavioural deficits in severe and moderate TBI groups when compared to a healthy comparison group. In keeping with these findings, a study revealed greater behavioural difficulties in a group of children who had sustained brain injuries of varying severity compared to a matched healthy comparison group (Catroppa, Godfrey, Rosenfield, Hearps & Anderson, 2012). Furthermore, Damasio (1996) reported children with frontal lesions demonstrated high levels of violence and antisocial behaviour. In addition, a study reported higher levels of self reported interpersonal violence, in individuals who sustained a head injury prior to adulthood, compared to a healthy comparison group (Stoddard & Zimmerman, 2011).

Further research has emerged suggesting a link between brain injury and criminal behaviour. Luiselli, Arons, Marchese, Potoczny-Gray, and Rossi (2000) reported that a third of children, adolescents and young adults attending a community neuro-rehabilitation centre admitted to participation in a criminal activity, and of these 75% had offended more than once. In support of this view, Timonen et al. (2002) found in a sample of male adults, TBI during childhood was associated with a four-fold risk of offending behaviour. An interesting finding by Leon-Carrion and Ramos (2003) found that history of childhood untreated head injury was able to discriminate between a group of non violent and violent offenders in a prison population. Furthermore, the prevalence of a history of TBI in selected prison samples was 86.4% in New Zealand (Barnfield & Leathem, 1998), 87% in America (Slaughter, Fann, & Ehde, 2003) and more recently 65% in Britain (Williams, Cordan, Mewse, Tonks, & Burgess, 2010). In addition from a sample of 720 youth offenders, 18.3% reported a significant head injury in earlier life (Perron & Howard, 2008).

Several psychosocial factors mediate the brain's adaptation after an injury including social support (Chapman & McKinnon, 2000). There is an argument that conduct problems may arise either due to pre-injury behavioural and family characteristics or alternatively from the burden on the family and systems around the child caused by the brain injury. Increased levels of stress, burden and mental health difficulties have been reported in families with children with

TBI (Stancin, Wade, Walz, Yeates & Taylor, 1996; Wade, Taylor, Drotar, Stancin & Yeates, 1996). A study by Rivera et al. (1994) revealed that family cohesion, social support, and parental control were associated with better adaptive behaviour and functional outcomes after TBI. The importance of the family environment for moderating outcome after TBI has been emphasised more recently by Yeates, Taylor, Walz, Stancin, and Wade (2010). Similarly, Crowe et al. (2012) revealed that intellectual, social, and behavioural function post injury was influenced by socioeconomic status, family burden, and parental mental health. In addition, Moffitt (2005) has suggested a role of genetic factors, in particular the interplay between genetic factors and environmental factors on anti-social behaviour. Some studies, however, have indicated cognitive and behavioural difficulties remained when pre-injury differences and familial factors have been accounted for (Anderson et al., 2005; McKinlay et al., 2009). Other factors may mediate these difficulties including the biological pathophysiology of the injury and the stage of development at the time of injury. Severity, size of lesion and frontal damage has been associated with greater behavioural difficulties (Chapman & McKinnon, 2000; Levin et al., 1993). In addition, it is suggested behavioural difficulties may be explained by neuropsychological difficulties in particular deficits in executive functioning, social problem solving, understanding of emotion and pragmatics, caused by damage to brain regions involved in social cognition (Yeates et al., 2004). Tonks et al. (2011) have reported greater social difficulties, measured by the SDQ, in a group of children who had sustained a TBI compared to their peers and also reported some correlations between these difficulties and measures of executive functions and processing speed.

In summary TBI causes several residual deficits which impact on the individual, their families, and society. The traditional view that TBI sustained during childhood may reduce these deficits has been contradicted by more recent findings. Instead the developing brain appears more vulnerable to greater damage and deficits resulting from a TBI. Cognitive,

emotional, behavioural, and social difficulties have been reported. There is growing research suggesting a link between childhood TBI and offending.

1.3 Moral Reasoning

1.3.1 Definition of moral reasoning

Moral is defined as "concern with principles of right and wrong behaviour" and "examining the nature of ethics and the foundations of good and bad character" (Oxford English Dictionary, 2004, pp.922). Moral reasoning is the process of considering what is right and wrong in thoughts, behaviours and actions (Moll, Zahn, Oliveira-Souza, Krueger & Grafman, 2005; Wainryb, 2004). It is considered crucial for adaptive and appropriate social function (Dooley et al., 2010) and interpersonal interactions (Moll et al., 2005).

1.3.2 Moral reasoning and offending behaviour

One of the factors underpinning offending behaviour is moral reasoning. Moral reasoning "promotes and enhances socially appropriate and positive behaviours while regulating and inhibiting inappropriate or negative behaviours" (Dooley et al., 2010, pp. 152). Mature moral reasoning involves an appreciation of wider society and is considered to prevent delinquent behaviour (Gibbs, 2010). Palmer (2003) theorised that immature moral reasoning leads to a generation of cognitive schemas used by individuals to support their illegal behaviour. Palmer (2012) reported that offending behaviour usually occurs at the less mature stages of moral reasoning. Gibbs (2010) suggested that "developmental delay in moral judgement" (pp.135) coupled with distorted cognitions and social skills were common across perpetrators of illegal behaviour. Gibbs (2010) suggested that cognitive distortions may contribute to the relationship between moral reasoning and offending behaviour and may enhance the egocentric

reasoning. These cognitive distortions may include attribution biases, minimisation, and mislabelling.

There is some inconsistency in the literature surrounding this relationship. There are some studies which have not found any difference in moral reasoning, measured by the Kohlbergian Moral Stories, between female offenders and non-offenders (Watt, Frausin, Dixon, & Samuels, 2000) or between male offenders and normative data from the general population (Griffore & Samuels, 1978). A positive correlation was reported between moral reasoning and psychopathy; however, this appeared to be mediated by intellectual functioning (O' Kane, Fawcett, & Blackburn, 1996). Despite this, performance on a moral reasoning measure has predicted behavioural disturbance (Blair, Monson, & Frederickson, 2001). In addition, a greater number of studies have demonstrated lower moral reasoning in adult offenders (Stevenson, Hall, & Innes, 2003; Thornton & Reid, 1982) and delinquent adolescents (Blasi, 1980; Campagna & Harter, 1975; Chandler & Moran, 1990; Gavaghan, Arnold, & Gibbs, 1983; Gibbs, 2003; Gregg, Gibbs, & Basinger, 1994). Palmer and Hollin (1998) revealed significantly lower reasoning in delinquents across all of the moral constructs. They also reported a gender difference, with higher reasoning in female offenders. However, Raijmakers, Engels, and Van Hoof (2005) reported a negative correlation between moral reasoning and offending behaviour in young adults, irrespective of gender. Meta-analyses have revealed lower levels of moral reasoning in delinquents which are unexplained by levels of intelligence or socioeconomic status (Nelson, Smith, & Dodd, 1990; Stams et al., 2006). In addition, lower levels of moral reasoning have been shown to correlate with reoffending (Van Vugt et al., 2011). In summary, it appears, therefore, that there is a direct correlation between moral reasoning, legal order, and society function (Beauchamp & Anderson, 2010).

Manual based treatment programmes for antisocial behaviour have targeted moral reasoning. The EQUIP programme, designed to "teach youth to think and act responsibly through a peer helping approach" (Gibbs, Potter, & Goldstein, 1995), focuses on three areas:

teaching pro-social skills; altering pro-aggressive beliefs; and moral development. A study demonstrated EQUIP's effectiveness in reduction in antisocial beliefs and aggressive in a group of 57 males juvenile offenders (Leeman, Gibbs, & Fuller, 1993). This supports the relationship between moral reasoning and antisocial behaviour. In a smaller study, Manchester, Wall, Dawson, and Jackson (2007) adapted this programme and delivered it to three TBI survivors with high levels of aggression and bullying behaviour and demonstrated some reductions in aggression and bullying. These programmes are in their infancy but suggest a focus on moral reasoning led to improvements in antisocial behaviour.

Furthermore, cognitive and emotional processes which depend on the frontal areas of the brain are believed to underpin moral reasoning and are, therefore, likely to be disrupted following a TBI. This argument lends weight to the existence of a relationship between TBI and offending behaviour. This chapter will review the literature examining the relationship between brain injury and moral reasoning, after a consideration of the theories and assessments of moral reasoning.

1.3.3 Moral reasoning theories

Theoretical accounts of moral reasoning differ in the way in which they view the underlying processes, in particular the involvement of cognition and emotion. Cognitive developmental theories have suggested moral reasoning development is dependent on cognitive development and socialisation. Piaget (1968) emphasises the importance of logical reasoning and socialisation for progression through the two stages of moral development. In the first stage, *heteronomous*, moral decisions are based on rules, obedience, and the perceived consequences of an act. In the next stage, the *autonomous* stage, reached by adolescence, decisions are made by incorporating others perspectives and agreed rules designed to promote justice and fairness. This theory was criticised as it did not explain development beyond childhood (Langdon, Clare, & Murphy, 2011).

Kohlberg (1969; 1976) expanded this interpretation to incorporate the social perspective taking theory (Selman, 1971). He argued that this was paramount to moral reasoning as it provided opportunities for conflict, resolution, and consideration of other people's views which develops mature moral reflection. Cognitive maturity supports this process (Walker & Taylor, 1991). Kohlberg (1969; 1976) proposed a three stage theory each with two levels. In the early stage, *preconventional*, moral reasoning is based on an individual's perspective and their own wishes before progressing to the next level which incorporates others' wishes in a mutual pragmatic encounter. In the next stage, *conventional stage*, the individual begins to appreciate the groups' collective view. Finally, in the *post conventional stage*, the individual makes moral decisions by merging the different values of others with the overarching rules, before developing and applying the consideration of universal ethical principles. Kohlberg and Gilligan (1971) proposed that 80% of boys meet the stage of pre-conventional moral reasoning by adolescence. This theory has, however, received criticism in that it did not appear applicable across cultures (Simpson, 1974). The higher stages were absent in some cultures and this was attributed to the focus on western philosophies (Snarey, 1985). It was also not a reliable measure across genders (Gilligan, 1982) and neglected emotions (Sullivan, 1977).

The theory was refined to overcome these criticisms by Gibbs et al. (1992; Gibbs, 2003; 2010) in the Sociomoral Stage Theory summarised in Table 1. This proposes that moral maturity develops in four stages over two levels. In the first level, *immature moral reasoning*, the individual focuses on salient features of a situation and then progresses to make decisions based on pragmatic reciprocity e.g. help someone then they will help you (stage two). With further development, they reach *mature moral reasoning*, where they consider pro social understanding of care, emotional states, and good conduct to make decisions. In the next level they consider society and incorporate social structures, conscience, and social justice. Gibbs et al. suggested the mature stage was reached by late adolescence/ early adulthood. It is argued that cognitive maturation encourages a more balanced and wider perspective in managing and

resolving the conflict that arises in social situations. It enables a process of decentration whereby the individuals can move their focus from salient features to incorporate the wider societal and cultural context (Gibbs, 2003; 2010; Gibbs et al., 1992). This theory of moral reasoning has demonstrated validity across several different cultures, age groups, and offending populations (Gibbs, Basinger, Grime, & Snarey, 2007). This is important given the argument that moral reasoning is context dependent (Krebs & Denton, 2005).

Table 1: Gibbs Sociomoral Stage Theory (Gibbs, 2003; 2010; Gibbs et al., 1992)

Level	Stage	Description
Immature	Stage 1: Unilateral and Physicalistic	Reasoning is driven by salient here and now factors. They are driven by appeals to authority and physical status. Rules are viewed in absolute terms. Justifications are based on avoidance of physical consequences.
	Stage 2: Pragmatic exchanges	Moral decisions are made in relation to interactions with others. They are concerned with pragmatic deals or exchanges, and practical benefits.
Mature	Stage 3: Mutual and pro-social	Reasoning is concerned with the interpersonal expectations of empathic role-taking, intrinsic concern, pro-social intentions, and generalised caring or valuing. Decisions incorporate intrapersonal factors.
	Stage 4: Systemic and Standard	Moral reasoning is concerned with social structure in life including; requirements, basic rights; values, responsibilities, and obligations. Individuals consider their character and conscience.

In support of this, Rest, Narvaez, Bebeau, and Thoma (1999) suggest that moral schemas exist in the long term memory store and are developed through re-occurrence of sociomoral

situations and cognitive dissonance (Festinger, 1957). The experience of situations which cannot be understood with current schemas encourages a more complex integrated way of thinking. Education, age, social stimulation (Rest, 1986) and cognitive flexibility are all vital in this process (Endicott, Bock, & Narvaez, 2003) to consider alternative solutions, tolerate ambiguity, and reach a decision.

Overall, these theories agree that moral maturation is influenced by cognitive factors and social experience. Cognitive flexibility, part of executive function, is considered particularly important alongside other executive functions such as inhibition, the utilisation of representational knowledge and the generation of different response possibilities (Eslinger, Flaherty-Craig, & Benton, 2004). In support of this, studies have reported correlations between moral reasoning and cognitive development (Lee, 1971; Tomilinson-Keasey & Keasey, 1974), inhibition, and abstract reasoning (Cottone, Drucker, & Javier, 2007). Furthermore, large samples of children from the general population have demonstrated a significant positive relationship between intelligence and moral reasoning development (Hoffman, 1977; Johnson, 1962). These developmental theories have been criticised as they have focused more on cognitive factors and less so on emotional developmental factors (Dooley et al., 2010).

Gibbs et al. (1992; Gibbs, 2003; 2010) suggest emotion processes, in particular empathy, are also important to moral reasoning, alongside cognitive factors. Hoffman (2000, 2008) also highlights the importance of empathy; as the human concern for others through vicarious reactions to others' experiences; as if you are in their shoes. He suggests moral behaviour is driven through the bonding of moral principles and empathy, where cognitive representations become charged with empathic affect (e.g., in cognitive conflict) and individuals think about the impact on others. He indicates, therefore, that empathy is the primary motivator of moral behaviour (Miller, Eisenberg, Fabes, & Shell, 1996). Whilst these theories may place differing amounts of emphasis on the role of empathy, they both consider the relevance of empathy in conjunction with cognitive factors. Theoretically, as cognitive factors are important for the

development of empathy, alongside biological readiness, cognitive factors remain important for moral reasoning. Hoffman is consistent with previous theories that cognitive decentration enables the wider appreciation of others' distress as separate to own (Hoffman, 2000; 2008). A study has revealed correlations between empathy and moral reasoning in a learning disability population (Langdon, Murphy, Clare, Stevenson, & Palmer, 2011).

An alternative perspective is the social intuitionist model of moral judgement (Haidt, 2001). This proposes moral judgements and actions are based on intuition, a sudden automatic and effortless decision, and that cognitive processes are only required to construct the post-hoc justifications. This is often referred to as the "hot" system. Intuitions are believed to emerge without language, are culturally shaped and become sharper and more accessible with experience (Haidt, 2001). Haidt (2001) proposes that moral judgement is effective even in time-limited situations when effortful, slow, cognitive processes are not possible. In support of this, according to the somatic marker hypothesis, Damasio (1994) suggests that during socio-emotional decision making, signals from the body indicative of emotional response, somatic markers, trigger rapid decisions in the absence of cost-benefit analysis. The somatic marker hypothesis also proposes that decisions can be made using "as if" representational emotional states. This emotion-based decision-making considered to depend on the insula and the VMPFC (Damasio, 1994; 1996). The Iowa Gambling Task (IGT, Bechara, Damasio, Damasio, & Anderson, 1994) is believed to be an experimental analogue of real-world emotion-based decision making. A study has revealed anticipatory skin conductance (SCRs) in risky advantageous decisions, on the IGT, in a healthy comparison group, supporting the somatic marker hypothesis (Bechara, Damasio, Tranel, & Damasio, 1997). Conversely, the study revealed absent SCRs and poor decisions on the IGT in individuals with VMPFC damage, which suggested that the VMPFC is important for emotion-based decision making (Bechara, Damasio, Tranel, & Damasio, 2005). This perspective suggests that the cognitive processes, often referred to as the "cold system", are considered to occur secondary, to block intuitive responses (Blasi,

1990) and develop alongside frontal lobe maturation. These mirror the two systems of decision making; the intuitive, automatic and rapid mode; and the controlled, deliberate and slow mode (Kahneman, 2003). An opposing view, however, may be that intuition is created as a consequence of historical effortful cognitive processes.

There appears, therefore, to be inconsistency in theories regarding the processes underpinning moral reasoning. Greene and Haidt (2002) propose both cognitive and emotional processes are important in their dual processing theory. Controlled cognitive processes are important in utilitarian decisions, in the promotion of the greater good; whereas personal decisions are driven by emotional processes.

In summary, the theories do not reach a consensus about what specific processes underpin moral judgements. Instead they propose two processes may be at work, on the one hand, controlled cognitive processes such as cognitive flexibility and inhibition, and on the other hand emotional processes such as, empathy and intuitive processes. The next section will consider the research findings from neuroimaging and studies of brain injury in relation to the theories discussed above. First of all, consideration needs to be given to the different ways of assessing moral reasoning.

1.3.4 Assessments of Moral reasoning

There are different ways of measuring moral reasoning. The main difference is between recognition and production measures. Traditionally, moral reasoning was assessed using recognition measures, where the respondent is asked to choose a justification that matches their own reasoning in relation to a moral dilemma. Examples of recognition measures are Defining Issues Test (Rest, 1975), Sociomoral Reflection Objective Measure (SROM, Gibbs et al., 1984), and Moral Theme Inventory (MTI, Narvaez, Gleason, Mitchell, & Bentley, 1999). These are compared to production measures, where the respondent has to verbalise their own reasoning in response to a moral question. It is thought that production measures provide a more valid

measurement and reduce the social desirability responding bias (Langdon, Murphy, Clare, & Palmer, 2010). Examples of production instruments are the Moral Judgement Interview / Standard Issue Moral Judgement (MJI / SIMJ, Colby & Kohlberg, 1987), the Sociomoral Reflection Measure-Short form (SRM-SF, Gibbs et al., 1992) and So Moral and So Mature (Dooley et al., 2010).

Langdon et al. (2010) demonstrated that a production measure, SRM-SF, had greater utility than a recognition measure, MTI, in a group of individuals with intellectual disabilities. It was proposed that the MTI may have been more complex and placed greater cognitive demands than the production measure, SRM-SF (Langdon et al., 2010). The SRM-SF corresponds to Gibbs et al. (1992) theory. It has 11 questions about moral values and asks respondents to describe the importance of each value and justification. These are examined to determine moral stage. It can be administered as a questionnaire or an interview. It is a favoured production measure as it is shorter and less complex than others (Langdon et al., 2010). It distinguishes between delinquent and non-delinquent children of differing ages and correlates with the MJI, indicating good validity alongside high levels of internal consistency, test-retest reliability, and cross cultural validity amongst different age groups (Gibbs et al., 1992; Gibbs et al., 2007). It has also been used to assess moral reasoning in individuals with brain injury (Couper et al., 2002).

Another measure is hypothetical scenarios (Greene, Sommerville, Nystrom, Darley & Cohen, 2001). These have been used with individuals who have survived a brain injury and include personal moral, non-personal moral and non-moral scenarios. This measure asks respondents to state what they would do in the scenario but does not ask for justification. The absence of justification may reduce the reliability of this measure, as incorporating justifications in assessment are considered to reduce the social desirability bias (Langdon et al. 2010).

More recently a measure, So-Moral and So-Mature, has been developed to be used with individuals who have survived a brain injury (Dooley et al., 2010). The task presents moral

dilemmas and individuals are asked to respond and explain their reasoning which is scored based on Kohlberg's theory. It has high internal consistency, ecological, and construct validity. This measure, however, determines moral reasoning ability according to a theory which has been criticised. In addition, it is still in its infancy and it has yet to demonstrate the level of effectiveness in measuring moral reasoning demonstrated by long established measures such as the SRM-SF.

1.3.5 Moral reasoning and neuropathology

This chapter so far has highlighted that moral reasoning is believed to involve two brain processes: intuition; and more deliberate effortful cognitive processes (Greene, Nystom, Engell, Darley & Cohen, 2004). It is widely accepted that the proposed executive function and emotional processes rely on the PFC. The DLPFC is recruited for executive functions including working memory, planning, cognitive flexibility and inhibitory control which are important when solving complex decisions (Knabb, Welsh, Ziebell, & Reimer, 2009; Rankin, 2007). The VMPFC is important for emotional responsitivity (Koenigs et al., 2007) and emotion-based decision-making (Damasio, 1994). Furthermore, the VMPFC continues to develop into early adulthood and reaches maturation after completion of DLPFC at about 25 years (Samango-Spouse, 2007). This is in keeping with the later maturation of moral reasoning (Gibbs et al., 1992) and possibly supports the view of cognitive and emotional processes in moral reasoning.

In addition, the neuroimaging findings of activation in the PFC during moral reasoning (Raine & Young, 2006), alongside posterior cingulate, and amygdala/angular gyrus support the role of these processes in moral reasoning. In support of this, further studies have highlighted the role of PFC in moral or prosocial behaviour and a study has reported correlations between PFC impairment and antisocial behaviour (Anderson, Bechara, Damasio, Tranel, & Damasio 1999). Furthermore, deception has been associated with activation in PFC and anterior cingulate (Abe et al., 2006). In addition, a correlation between PFC grey matter volume and ratings on the

psychopathology checklist has been reported (Yang et al., 2005). Paxton and Greene (2010) have reviewed neuroimaging studies which have provided support for the involvement of cognitive processes in moral reasoning. The DLPFC has been activated whilst making moral judgements (Borg, Hynes, Van Hom, Grafton, & Sinnott-Armstrong, 2006; Reniers et al., 2012), and during personal and difficult moral dilemmas (Greene et al., 2004). Additionally, there has been a correlation between activation of DLPFC and moral judgement competence (Prehn et al., 2008). Furthermore moral decisions, in particular utilitarian decisions, were seen to be slowed down when engaged in a task requiring cognitive load (Greene, Morelli, Lowenberg, Nystom, & Cohen, 2008).

In summary these neuroimaging studies have indicated that the PFC is important for moral reasoning. The activation of the PFC, known to be important for executive function and emotion processing in moral reasoning, are supportive of the involvement of executive function and emotion processes in moral reasoning. It may be that damage to different areas of the PFC impacts on moral reasoning in different ways. It has been proposed that VMPFC damage causes deficits in emotional responding, damage to the anterior cingulate causes deficits in cognitive conflict and damage to the DLPFC causes deficits in abstract reasoning, and that overall this disrupts moral reasoning (Greene et al., 2004; Koenigs et al., 2007).

The findings of increased activation of the PFC in moral reasoning may explain the association between TBI and offending behaviour. It is widely accepted that frontal temporal damage including damage to the PFC is common after TBI (Bigler, 2007) and therefore disrupts the functions of the VMPFC and DLPFC in moral reasoning. In addition, the frontal lobe is believed to be particularly vulnerable to diffuse axonal injury following a TBI. Diffuse axonal injury disrupts the connections between the frontal lobe and other areas of the brain and has negative implications as the frontal lobe is important for control and organisation of messages from other areas of the brain. Increased behavioural difficulties are expected when there is disruption between frontal and limbic regions of the brain (Lillie et al., 2013; Smith et al., 2003).

The relationships between the frontal lobe, in particular PFC, and moral reasoning may explain in part, therefore, the findings of higher prevalence of offending behaviour following TBI (Perron & Howards, 2008; Timonen et al., 2002; Williams et al., 2010).

The exploration of the impact of TBI on moral reasoning warrants further exploration, as does the possible involvement of executive function and emotion processes, as an integrated view is yet to emerge (Knabb et al., 2009). A greater understanding of the cognitive and emotional processes underpinning moral reasoning is important for economic and criminal interest (Zak, 2004) as it will influence psychological, medical and environmental interventions to promote prosocial behaviour in wider society (Moll et al., 2005) which may predict and prevent criminal behaviour (Knabb et al., 2009). This chapter will now continue by reviewing the findings from studies exploring the impact of brain injury on moral reasoning and highlight any co-morbid deficits.

1.4 Moral reasoning and acquired brain injury

1.4.1 Literature review

A literature search was performed separately on Medline and PsycInfo to identify studies which had explored moral reasoning after acquired brain injury. Initially the search was "brain in*" and "head in*" combined with "moral*" to encompass all derivatives. This was streamlined combining "moral*" with "traumatic brain injury (TBI)" or "acquired brain injury (ABI)" or "brain", "head" or "cerebral" AND "injury", "insult", "damage", "trauma" or "lesion".

The search was performed within certain parameters, the selected language was English; and only peer reviewed journals were included. No parameters were set on age or on year of publication. The search revealed 66 articles on Medline and 46 articles on Psychinfo. The titles were reviewed and selected if there was mention of acquired brain injury and social/ behaviour

function. The abstracts were read to select the articles that measured moral reasoning after brain injury. Eleven studies were identified and a search of their reference lists revealed further two articles. A summary of the studies are presented in Table 2.

Table 2 Studies measuring moral reasoning in survivors of brain injury

Author	Type	Sample size (localisation)	Group (Lesion: N)	Mean age (SD)	Age at injury (years)	Assessment	Moral reasoning outcome
Price, Daffner, Stowe, & Mesulam (1990)	Case Studies	2 (PFC)	Non 24	28	Birth 4 years	SIMJ	Impaired
Gratton & Eslinger (1992)	Case study	1 (FL)	Non	33	7	Abbreviated MJI	Impaired
Anderson, Bechara, Damasio, Tranel, & Damasio (1999)	Case studies	2 (PFC)	Non 23	20	15 months 3 months	SIMJ	Impaired

Couper et al. (2002)	Cross sectional group comparison	28	FL:16 HC:12	13.3 (2.6) 11.5 (2.7)	>3 years prior.	SRM-SF	FL group significant lower moral reasoning ($p<.001$)
Dooley et al. (2010)	Cross Sectional Group Comparison	51	TBI: 25 HC: 26	13.8 (2.1) 15.2 (2.6)	Child	So-Moral and So-Mature	TBI group scored lower, not significant. Effect size = 0.17
Beauchamp, Dooley, & Anderson (in press)	Cross sectional group comparison	91	TBI: 25 HC: 66	13.34 (1.63) 13.95 (1.27)	11-19	So-Moral and So-Mature	TBI group significantly lower moral reasoning ($p < .0001$). Effect size = 0.45.

Sayer & Damasio (1991)	Case study	1 (VMPFC)	Non	35	Adult	SIMJ	Preserved
Ciaramelli, Muccioli, Ladavas, & di Pellegrino (2007)	Cross sectional group comparison	19	VMPFC:7 HC:12	55(6.8) 57.3 (6.3)	Adult	Hypothetical scenarios (Greene et al., 2001)	VMPFC group: more violations on personal dilemmas ($p<.05$).
Anderson, Wisnowski, Barrash, Damasio, & Tranel (2009)	Case studies	7 (PFC)	Non	4-32	early childhood	Behavioural assessment	6 with severe impairment

Moretto, Ladavas, Mattioli, & de Pellegrino (2009)	Cross sectional group comparison	33	VMPFC: 8 BDC: 7 HC: 18	53.1 (10.8) 52.7 (16.6)	adult	Hypothetical scenarios	VMPFC group faster for personal moral ($p<.05$)
Koenigs et al. (2007)	Cross sectional group comparison	30	VMPFC: 6 BDC: 12 HC:12	Adult	Adult	Hypothetical scenarios	VMPFC group more violations in personal moral ($p<.05$).
Thomas, Croft & Tranel, (2011)	Cross sectional group comparison	29	VMPFC: 9 BDC: 9 HC: 11	60.2 (8.0) 60.2 (11.2) 59.8 (8.5)	Adult	Hypothetical scenarios	VMPFC group made more violations in personal moral ($p<.05$)

Martins, Faisca, Esteres, Muresun & Reis, (2012)	Cross sectional group comparison	70	TBI: 29 HC: 41	29.31 (5.89) 27.98 (5.73)	Adult	Hypothetical Scenarios	More violations in personal moral ($p<.05$) in the TBI group.

HC = healthy comparison group; BDC = brain damaged comparison group; FL = frontal lesion; VMPFC = ventromedial PFC; MJI = Moral Judgement Interview (Kohlberg, 1969); SIMJ = Standard Issue Moral Judgement (Colby & Kohlberg, 1987); SRM-SF = Sociomoral Reflection Measure Short Form, (Gibbs, Basinger & Fuller, 1992); So Moral, So Mature (Dooley et al., 2010); p = level of statistical significance

1.4.2 Child onset

1.4.2.1 Cases studies

Gratton and Eslinger (1992) described the case of DT, who had normal development but experienced an injury to her frontal lobe at 7 years of age. She was assessed at 33 years of age. She had difficulties in areas of psychosocial development, social functioning, interpersonal relationships, and conforming to rules. Her performance on the abbreviated MJI showed reasoning, at pre-conventional stage. She also had difficulties in self regulation, executive function, and empathy. In everyday life she engaged in interpersonal conflicts, demonstrated poor judgement, and failed to conform to social rules. The authors hypothesised that the deficits in developing and applying knowledge were a consequence of the self regulation and executive functioning difficulties. Given her low empathy, they did not discount the role of emotion in moral reasoning. The omission of psychometric properties of the abbreviated measure limited reliability of the study findings.

Price et al. (1990) reported cases, GK and MH who had experienced frontal lobe damage at birth and 4 years old respectively. When they were assessed at 33 years and 26 years respectively, both had histories of delinquent behaviour and poor interpersonal relationships. The assessments revealed impaired moral reasoning on the SIMJ. They had average intelligence but impairments in empathy and executive functioning particularly mental flexibility.

Similar findings were revealed by Anderson et al. (1999) in their assessments of ML and FD who had experienced PFC damage at 3 and 15 months retrospectively. They experienced difficulties including poor academic achievement and interpersonal relationships alongside disruptive, socially unacceptable, and criminal behaviour. Despite average intelligence, performance on the SIMJ revealed impaired moral reasoning when assessed in

adulthood. Neuropsychological assessment revealed deficits in rule learning and working memory. They also failed to demonstrate anticipatory skin conductance responses (SCRs) in a gambling task indicating disruption in emotion processing.

Overall, these case studies enabled in-depth exploration of social and cognitive development in relation to specific lesions (Graffton & Eslinger, 1992) and captured individual complexity and uniqueness (Barker, Pistrang & Elliot, 2002) which would have been lost in a group design (Shallice, 1979). Across the studies early frontal damage has been associated with deficits in moral reasoning in later adulthood. The deficits have occurred within a context of preserved intelligence, stable backgrounds and normal development pre-injury. Furthermore, the difficulties have emerged a few years post injury which is consistent with the current neuropsychological theories about protracted deficits. The studies have revealed additional deficits in assessments of executive function and emotion processes. These findings, therefore, support the dual processing theory. However, these studies reported individual cases and, therefore, this limited the generalisability to the wider population. In addition, measurements were at a single time-point and longitudinal studies examining changes over the development period may be more useful. Also, the selected measures may have reduced the reliability of the findings. The particular production measures selected in these studies have been criticised for their length and complex coding, and have not been standardised in a brain injury population (Dooley et al., 2010). Furthermore, adaptations to the measures compromise comparisons between the studies and further impact on the generalisability of the results to the wider population.

1.4.2.2 Group designs

Some studies have examined moral reasoning in group designs to increase generalisation. Anderson et al. (2009) assessed seven individuals who had experienced PFC

damage between prenatal and 5 years of age. They were assessed between 4 and 30 years of age and despite average intelligence, six individuals were severely impaired on social function which included ability to comply with moral standards, laws, and rules. Judgements were made by a neuropsychologist based on parental interview as well as academic, medical, and mental health history. Methodological weaknesses may have affected the reliability and generalisability of this finding as the measure was not standardised and did not focus on moral reasoning specifically. Furthermore, there may have been researcher bias as the judgements were made by a single person, aware of the purpose, in the absence of inter-rater reliability.

Other studies have replicated these findings using recognised measures and a comparison group. Couper et al. (2002) have reported significantly lower moral reasoning stage in a group of children who had experienced frontal lobe injuries compared to an aged matched healthy comparison group. Methodological aspects strengthened the generalisability of these findings, including explicit inclusion criteria and no significant differences between groups on socioeconomic status and age. The study also used the SRM-SF which is a shorter production measure than the MJI. The study did not control for injury severity and the comparison group had higher intelligence. Also, the study did not report inter-rater reliability, vital to ensure reliable scoring of the SRM-SF. These factors may, therefore, have limited the reliability of the results.

Dooley et al. (2010) suggested that the length and complexity of existing moral reasoning measures reduced the ecological validity for the TBI population. They examined moral reasoning, using their own measure, in adolescents with TBI of differing severity in comparison to a healthy aged matched group. The comparison group scored higher on the task indicating a small to medium effect size, but this was not significant. Strengths of this study were the matched comparison group, no significant differences in maternal occupation,

age, or intelligence. Nevertheless, whilst the study revealed differences between the groups, this was not reported to be significant. The authors attributed the non significant finding to the over-representation of mild TBI in the sample.

A recent study revealed significantly lower moral reasoning in adolescence with TBI, using the same measure (Beauchamp et al., in press). This study indicated that the TBI groups, mild and moderate-severe, gave fewer moral responses and demonstrated a lower level of maturity in their justifications compared to a matched healthy comparison group. The TBI groups also displayed significantly lower levels of empathy. In addition, the study revealed positive correlations between moral reasoning and intellectual functioning, and empathy. This study provides further evidence that moral reasoning is impaired after a TBI in adolescence of differing severity. It also revealed a relationship between moral reasoning and empathy. However, in both studies, they have not yet demonstrated that this measure is a reliable measure of moral reasoning, including inter-rater reliability, nor evidenced that the measure placed fewer demands on cognitive load e.g. working memory and information processing compared to other measures. This may reduce the reliability and generalisability of these findings. The studies indicated areas for further research in examining the impact of moral reasoning later in the developmental trajectory and examining the relationship between moral reasoning and cognitive factors, such as executive functioning.

Overall, most of the group and case studies concur that moral reasoning is affected following a brain injury in childhood. Some of the studies also highlight co-existing deficits on assessments of executive functioning and emotional processes. This finding may support the theories which have suggested that both executive functioning and emotion processes are involved in moral reasoning (Greene & Haidt, 2002) alongside other factors such as social experience (Kohlberg, 1976). The generalisability of these findings is limited by methodological weaknesses. Furthermore, they captured single time-points in childhood/

adolescence. Whilst a longitudinal study would be helpful to track the trajectory, in the interim, an assessment of moral reasoning later in the developmental trajectory, for example, at a time of more independence, such as in early adulthood may be useful for understanding the impact of TBI on moral reasoning.

1.4.3. Adult studies

Studies examining moral reasoning following injury in adulthood have revealed different findings. Saver and Damasio (1991) reported case EVR, who at 35 years of age experienced VMPFC damage, in the presence of an unremarkable developmental history. Assessments revealed no difficulties in moral reasoning (SIMJ) and reasonable performance on neuropsychological assessments. The generalisability of this finding to the wider population is limited as it is a single case study.

Group studies have supported these findings. Ciaramelli et al. (2007) compared seven individuals with VMPFC injury in adults to matched controls. When presented with hypothetical personal and impersonal moral dilemmas, the clinical group were significantly faster, suggesting impulsivity, and endorsed more moral violations in personal dilemmas. This impairment was attributed to a failure to predict self focused and emotional consequences of the decisions, consistent with VMPFC importance in emotion-based decision-making (Damasio, 1996). Methodological strengths included the matched control group on age, education and gender, adaptations to the method to manage fatigue, and a significant finding; these support reliability and subsequently generalisability. A weakness was that the measure was converted to Italian with no standardisation and the study focused on one lesion area.

Koenigs et al. (2007) have replicated these findings in their comparison of six individuals with VMPFC damage to 12 individuals with damage to other areas of the brain.

Using similar scenarios, the study found significantly greater inappropriate responses in personal moral dilemmas in the VMPFC group in comparison to the other groups. It was, therefore, proposed that overall moral knowledge was intact, but that the absence of emotional reaction in the VMPFC group impaired their performance on personal scenarios. Further improvements could be made by having an equal number of participants in both groups, by assessing time since injury, and by a more detailed description of the inclusion/ exclusion criteria for the clinical control groups.

These findings were further replicated by Moretto et al. (2009) in their comparison between eight individuals with VMPFC injury, seven individuals with damage to other brain areas and seven healthy controls. The study demonstrated increased anticipatory SCRs in the personal moral dilemmas in the control and "other lesion" group but, not in the VMPFC group. The authors concluded brain injury, specifically damage to the VMPFC, may disrupt moral reasoning, but only in relation to scenarios which require affective evaluation. Clear methodological strengths included the use of brain injured comparison groups, and no significant differences in age, gender, education or clinical features, which enhanced the generalisability of these findings. The study did not, however, examine the impact of damage to other areas of the frontal lobe or discuss the differences observed in age since injury and lesion volume.

Thomas et al. (2011) made adaptations to the dilemmas to create indirect personal scenarios from first and third person perspective. Samples included individuals with VMPFC damage (n=9), those with damage to other areas of the brain not considered involved in emotion processing (n=9), and 11 healthy controls. The pattern of performance was replicated in the VMPFC group, regardless of whether direct or indirect personal dilemmas, indicating that the VMPFC is vital for making high conflict personal moral decisions. Methodological strengths included equal number matched control groups (age and

education), and set inclusion criteria of months since injury. This homogeneous sample increased internal validity of the study but may however, have reduced the generalisability of the findings to the wider population.

More recently, Martins et al. (2012) hypothesised that the findings of abnormal utilitarian decisions in personal moral dilemmas following brain injury were due to impairment in emotional processing, causing moral decisions to be made via cognitive processes. They compared 29 individuals who had experienced a TBI on the hypothetical personal moral scenarios with a healthy comparison group. They reported a larger number of inappropriate, utilitarian responses in the TBI group compared to the healthy comparison group, in the personal dilemmas. There were less inappropriate responses in the TBI group with damage to the DLPFC compared to a group with damage to the other parts of the PFC. Furthermore, the comparison group appeared to take longer than the TBI group when giving a utilitarian response, which the authors suggested was due to resolution of the conflict. They also revealed a negative correlation between number of utilitarian responses and performance on a social emotion recognition task. Martins et al. (2012) attributed their findings to diminished responsitivity to emotional load accompanying the personal moral dilemmas following a TBI. The TBI group did not display any difficulties on cognitive tasks.

Overall, there was a consistent finding that brain injury in adulthood does not impair all aspects of moral reasoning (Anderson et al., 1999). However, impairments are observed following VMPFC damage in personal moral dilemmas and this was attributed to impairment in emotional functioning. The significant findings and the good methodological quality of these studies support generalisability of the findings to the wider population. Improvements are possible, however, as the studies did not report reliability or validity of the measures, for a brain injury population. The studies did not incorporate the varying lengths of time since

injury in the analysis. All studies reported matched groups, but not all incorporated measures of economic status or family background, factors known to be important in moral reasoning.

1.4.4 Summary of literature review

In summary, there was more evidence for deficits in moral reasoning after a brain injury in childhood than in adulthood. In addition, co-morbid difficulties were observed in domains of executive and emotional functioning in adults following childhood injury. These deficits may underpin moral reasoning deficits, which support the dual processing theory (Greene & Haidt, 2002). The generalisability of these findings is limited as the evidence is mainly from case studies. Furthermore, some of the group comparison studies did not find significant differences. The group studies have also focused on assessment during childhood/adolescence; they have not examined the impact on an injury later in the developmental trajectory. They also have not investigated the relationship between moral reasoning and specific executive function and emotional processes. The absence of moral reasoning deficits after injury sustained in adulthood may suggest that after years of decision making and applying social rules, with preserved cognitive and emotional development, most moral decision making is automatic and, therefore, robust following brain injury (Anderson et al., 1999). This is aside from decisions about personal moral dilemmas which appears reliant on emotional processing and the VMPFC (Anderson et al., 1999).

1.5 Summary, rationale, and aims of the current study

This chapter began by presenting the impact of TBI on brain pathology, cognitive, social, emotion, and behaviour functioning. There seems to be a consensus that a TBI during childhood has a greater impact than the original understanding. One of the main areas highlighted was the deficits in behaviour; particularly the association between TBI and

offending behaviour. This chapter highlighted the importance of moral reasoning to the criminal justice system and societal welfare. Theories of moral reasoning have suggested a dependence on cognitive and emotion processes. These processes rely on areas of the brain that are commonly damaged in a TBI and, therefore, moral reasoning may be impaired after a TBI. Such moral reasoning difficulties may explain the behavioural and social difficulties commonly reported following a TBI (Beauchamp et al., in press) including the increased risk of offending following a brain injury (Williams et al., 2010). If this is found, it may suggest a clinical need to assess moral reasoning following paediatric brain injury to guide early intervention to improve social and behavioural functioning both in community and clinical justice settings. It would also contribute to theoretical understanding of moral reasoning and the processes underpinning it. In addition, it would enhance the wider understanding of the impact of TBI on brain development and moral reasoning. There has been growing interest in this and some studies have examined the association between brain injury and moral reasoning. The literature review included in this chapter revealed that deficits may exist following a brain injury, with greater disruption following a childhood onset. However, there have been only a few group studies with small sample sizes and methodological weaknesses. Given the potential clinical and theoretical implications, the relationship between brain injury and moral reasoning needs to be explored further so that more robust conclusions can be drawn.

No group studies have examined the impact of a brain injury at a later stage in the developmental trajectory. This is important given the growing research suggesting that the true extent of a TBI is not understood until early adulthood. A particular period of interest is 17-25 years of age when moral reasoning should be entering the mature stage (Gibbs et al., 1992). This is also a stage of crucial development in terms of independence, developing meaningful relationships, and making choices about the direction of their future lives. In

addition, the literature to date has failed to reach a consensus about what particular processes are important to moral reasoning (Knabb et al., 2009). To address these gaps in the field, this study aims to explore the impact of a brain injury on moral reasoning in early adulthood. To this end, it will compare a group of individuals between 17 and 25 years who have experienced a TBI with an aged matched healthy comparison group on measures of moral reasoning. Studies have used different measures to capture moral reasoning. This study will use the SRM-SF. This measure has been chosen as it has good reliability and validity and has been used within the brain injury and learning disability populations. Furthermore, it reduces the social desirability bias as it asks for justifications, and can be administered as an interview which will be helpful in overcoming cognitive difficulties. The study will also explore the relationship between moral reasoning and empathy, emotion-based decision making, and executive function (inhibition and cognitive flexibility).

It is hoped that this study will provide a greater understanding of possible deficits after a TBI, alongside the factors underpinning moral reasoning. This will contribute to our theoretical understanding of moral reasoning, and will have clinical implications for brain injury services. In addition, a better understanding could help inform and develop targeted interventions for immature moral reasoning, for example, programmes such as EQUIP, and could contribute to enhance outcomes. There could also be financial benefits for society in the long term, if identification and improvements in moral reasoning were supported.

1.6 Research Question and Hypotheses

1.6.1 Primary

The primary question is whether individuals with TBI aged 17 to 25 years have lower moral reasoning (measured by the SRM-SF) relative to the comparison group. The literature

has indicated that TBI is commonly associated with damage to the fronto-temporal regions (Bigler, 2007, Salmond et al., 2006; Wallesch et al., 2001). Given the involvement of the PFC in moral reasoning (Raine & Young, 2006), the late maturation of these structures (Samango-Sprouse, 2007), and the findings from the literature review, the first hypothesis is that survivors of TBI (aged 17-25 years) will have lower scores on the SRM-SF (moral reasoning) than the comparison group. Moral reasoning has been shown to correlate highly with intellectual functioning (Langdon et al., 2010), and brain injury can disrupt intellectual functioning (Levin, 2012). This study predicts, however, that the difference between the groups will remain when intelligence is controlled in the analysis.

1.6.2 Secondary

Research studies have provided mixed evidence to support the notion that moral reasoning (measured by SRM-SF) is associated with executive functioning and emotion. After the consideration of the literature, this study predicts that moral reasoning will be associated with these processes. Exploratory questions will, therefore, be addressed in both groups.

The study will address whether moral reasoning is associated with executive functioning performance. A second hypothesis is made that individuals with higher moral reasoning will have less executive functioning difficulties in everyday situations (negative correlation).

Another question will assess whether moral reasoning relates to cognitive flexibility. It is hypothesised that individuals with higher moral reasoning will have higher cognitive flexibility (positive correlation).

A fourth question aims to explore whether moral reasoning relates to inhibition. A fourth hypothesis is made that individuals with higher moral reasoning will have higher inhibition (positive correlation).

A fifth question is whether moral reasoning relates to empathy. A fifth hypothesis is made that individuals with higher moral reasoning will have greater empathy (positive correlation).

A final question is whether moral reasoning relates to emotion-based decision making. This study proposes a sixth hypothesis, that individuals with higher moral reasoning will have better performance on an emotion based decision making task (positive correlation).

Chapter Two

Method

This chapter details information on the design, participants, measures, procedure, analyses plan, and ethical considerations for the study.

2.1 Design

This was a cross-sectional study with a between groups design. The independent variable was group (with two levels: brain injury vs. no brain injury), and the dependent variable was moral reasoning. It also utilised a within-subjects correlational design to conduct exploratory analyses of the relationships between moral reasoning and performance on measures of executive functioning, empathy, and emotion-based decision-making. The correlations were conducted in the TBI group and then separately in the healthy comparison group.

The study attempted to match the groups on age and sex by recruiting participants from the same age range and gender. Any differences in age, sex, IQ, socioeconomic status revealed post hoc were controlled for. Furthermore, the range in severity of injury was also included as a confounding variable where appropriate.

2.2. Participants

2.2.1 Sample size

To estimate sample size, for Hypothesis 1, a power calculation was conducted on G Power 3.1. The effect size was determined using the means (TBI M = 225.6; Healthy comparison group M = 250.14) and standard deviations (SD = 25.9; SD = 34.4) from moral reasoning scores in a clinical group of children with frontal lobe lesions and healthy controls

(Couper et al., 2002). An effect size of .81, power of .80, alpha significance level of .05 with one tailed hypothesis revealed a sample size of 20 in each group required to reach statistical significance in an independent t-test, or a total sample size of 52 for an ANCOVA with IQ as the covariate. The power calculation used large effect sizes and therefore the sample size was conservative.

For the secondary exploratory hypotheses (2-6), correlations reported between moral reasoning and cognitive functioning were r=.58 (Tomlinson-Kearsey & Kearsey, 1974) and between r=.20 and r=.53 with aspects of executive functioning (Cottone et al., 2007). Using the same parameters this indicated a sample size of between 14 and 153 participants. The generalisability of these correlations may be compromised by use of a selective religious group and there were higher correlations in other studies. In a non offender and offender population with and without intellectual disabilities correlations between SRM-SF and similarities, digit span and other WAIS subtests ranged between r=.52 and r=.86 and with empathy, r=.33 (Langdon et al., 2011). A medium to large effect size of .45 was, therefore, used and indicated a total sample size of 58 participants with 29 in each group which was rounded to 30. Given the small sample size, these correlations were preliminary and exploratory and caution was taken in interpretation.

2.2.2 Inclusion criteria

The following inclusion criteria were set to ensure internal validity of the study.

- This study was interested in examining the impact of TBI on moral reasoning ability in individuals who are aged between 17 and 25 years. This is an interesting period in development as the frontal lobes are still developing and maturing in structure and function (Samango-Sprouse, 2007) and these are believed to be important for the cognitive and emotion processes underlying moral reasoning.

- Individuals who have experienced a TBI. This was chosen as the study aimed to explore the impact of frontal lobe damage on moral reasoning and TBI is commonly associated with fronto-temporal damage (Bigler, 2007). It was not possible to recruit individuals with specific frontal damage as this information is rarely available after a brain injury. In particular, CT scan data is often available and it can detect gross lesions and swelling but it does not have sufficient spatial resolution to detect discrete grey/ white matter changes, diffuse axonal injury, frontal, or temporal damage (Salmond et al., 2006). Research with more advanced technology has suggested TBI is associated with damage to frontal and temporal areas (Salmond et al., 2006) and therefore, this study was interested in the impact of TBI on moral reasoning ability.
- Individuals with English Language as their first language. This was to ensure they were able to participate and comprehend the test instructions.
- Individuals able to understand the study information and give informed consent.
- Individuals who were at least six months post-injury and were medically stable. This was consistent with other studies in the literature, providing time for initial recovery, for example, to ensure brain swelling may be resolved (Noppens & Brambrink, 2004)

2.2.3 Exclusion Criteria

The following exclusion criteria were set to reduce confounding variables.

- A diagnosis of a developmental disorder, attentional disorder, a learning disability, mental health difficulties, drug or alcohol dependency. Individuals with these conditions had to be excluded as these factors are known to interfere with cognitive and emotional processing (Brown, Tapert, Granholm, & Delis, 2000; Rucklidge & Tannock, 2002)

- Severe aphasia which would disrupt their ability to participate or understand test instructions, which in turn may cause distress for the individuals.

These criteria were discussed with the teams and were verified by the researcher during initial meetings.

2.2.4. Recruitment

Participants for the TBI group were recruited from NHS and voluntary Brain Injury organisations in East Anglia. These included Addenbrookes Hospital, Cambridgeshire; Brain Injury Rehabilitation Trust, Ely; Colman Centre for Specialist Rehabilitation, Norwich; Community Brain Injury Team, Peterborough; Cambridge Centre for Paediatric Neuropsychological Rehabilitation, Cambridge; Evelyn Community Head Injury Service, Cambridge; and Headway, Norfolk and Waveney; and Cambridgeshire; and Oak Farm Neurological Rehabilitation Centre, The Select Care group, Norwich. Participants were also recruited via health professionals that work within the Child Brain Injury Trust.

The researcher contacted each team. They were informed about the study and offered the opportunity for their site to be a participant identification site. Once the teams had agreed and the researcher had received ethical and NHS permission, they were asked to distribute the participant information sheets to individuals who met the study criteria (Appendix C). Individuals who expressed an interest were asked to sign a consent form (Appendix D) which enabled their contact details to be shared with the researcher. The researcher also recruited other participants in the TBI group using the volunteer database at the Developmental Neuropsychology Research Group, University of East Anglia. She contacted individuals who had given their permission for their details to be held on this register and to be contacted about research studies. The researcher made contact with all eligible and willing participants,

via telephone or email, reassessed eligibility and arranged a date and time suitable for the data collection.

The researcher contacted several schools and colleges in the surrounding area about the study to recruit the healthy comparison group. The researcher received support from Springwood High School, Kings Lynn, and the University of East Anglia, Norwich (UEA). Students at these establishments were informed about the study and interested individuals were encouraged to contact the researcher. Participants were recruited from the UEA via an undergraduate psychology student database, adverts on the Medical school website, and posters. To enhance recruitment, posters about the study with further contact information were placed in public areas (Appendix E). When the researcher was contacted through either method, eligibility was reassessed and a suitable time and place to meet for the assessment session was arranged.

2.2.5 Sample Characteristics.

34 individuals were recruited to the comparison group. Participants were screened prior to the assessment session to ensure they met the eligibility criteria. 20 survivors of TBI were recruited to the TBI group. They were recruited from brain injury organisations and NHS trusts in East Anglia. Clinicians used their clinical judgement when approaching potential participants. An additional six individuals declined participation in the study. The total sample was recruited from The Brain Injury Rehabilitation Trust, Fen House, Ely, (n=1); Addenbrookes (n=1); Colman Centre for Specialist Rehabilitation, Norwich (n= 3); Evelyn Community Head Injury Service, Cambridgeshire (n= 7); Headway, Cambridgeshire (N= 1); Headway, Norfolk and Waveney (N= 5); Oak Farm Neurological Rehabilitation Centre, Select Healthcare group (n=1), and UEA volunteer panel (n=1). See Tables 3, 4 and 5 the sample characteristics of both groups.

Table 3 Sample characteristics of both groups.

Group	N	Mean age (SD)	Sex (M:F)	Socioeconomic status (n: %)				
				1	2	3	4	5
HC	34	20.76 (2.51)	14:20	12 (35.3)	6 (17.6)	4 (11.8)	7 (20.6)	5 (14.7)
TBI	20	21.75 (2.27)	10:10	6 (35.3)	3 (17.6)	3 (17.6)	2 (11.8)	3 (17.6)

Socioeconomic status categories (Office of National Statistics, 2010): 1= Managerial, administrative and professional occupations; 2= Intermediate occupations; 3= Small employers and own account workers; 4= Lower supervisory and technical occupations; 5 = Semi-routine and routine occupations. SES missing data in TBI n=2.

Table 4 Descriptive statistics for age at testing for TBI group. Data are frequency and percentage values

Age	Frequency	Percentage
17	0	0
18	1	5
19	3	15
20	4	20
21	2	10
22	2	10
23	2	10
24	4	20
25	1	5
26[1]	1	5

[1] 25 years of age when approached about the study.

Table 5 Descriptive statistics for age at testing for HC group. Data are frequency and percentage values

Age	Frequency	Percentage
17	3	8.8
18	5	14.7
19	4	11.8
20	4	11.8
21	7	20.6
22	1	2.9
23	3	8.8
24	4	11.8
25	3	8.8

2.2.5.1 Injury characteristics

Information was collected on the nature of injury (for a summary see Table 6 and 7). The majority of the participants sustained their injury between 15 and 19 years of age. This was consistent with previous research which has indicated this was one of the high risk times for sustaining a TBI (Langlois et al., 2004; Yates et al., 2006).

Table 6 and 7 Descriptive statistics for age at injury and time since injury for the TBI group. Data are frequency and percentage values. Age at injury (frequency of time since injury)

	Age (years)				
	0 – 4	5 – 9	10-14	15 – 19	20-25
Frequency (N)	2	1	0	14	3
Percentage (%)	10	5	0	70	15

N = 20

	Time since injury				
	< 1 year	1-2 years	2-5 years	5-10 years	Over10 years
Frequency	2	2	8	4	4
Percentage	10	10	40	20	20

N = 20.

There was a variation in the cause of the injury. The majority were as a result of a road traffic accident but other injuries were sustained by falls, assaults and as a result of a fairground ride. Two participants were still within the first year of recovery. It was not possible to comment on the localisation of the injury due to the absence of MRI data.

Severity was captured by the GCS. This was available for 11 participants. The majority, 10, had GCS scores consistent with a severe TBI. One participant was recorded as having a mild TBI due to the GCS. Determination of severity from GCS can be limited as there is variability in the stage it is recorded. The GCS scores were not available for the other

participants, but each participant reported loss of consciousness for over 30 minutes which satisfies the Mayo classification for a moderate to severe head injury (Malec et al., 2007).

Table 8 Descriptive statistics for severity and type of TBI. Data are frequency and percentage values.

		Frequency	Percentage (%)
Severity (GCS)	Mild	1	5
	Medium		
	Severe	10	50
	Unreported	9	45
Type	RTA-Driver	3	15
	RTA- Passenger	3	15
	RTA – Pedestrian	4	20
	RTA – Motorbike	2	10
	RTA – Cyclist	1	5
	Fall	4	20
	Assault	2	10
	Other	1	5

N = 20. GCS = Glasgow Coma Scale; Severity score: Mild (13+), Moderate (9-12) and Severe (3-8). RTA = road traffic accident

2.3 Measures

This section describes the measures which were used in this study. Measures were selected that assessed moral reasoning, cognitive flexibility and inhibition, everyday executive functioning difficulties, empathy, and emotion-based decision making. Further information was collected to capture other relevant variables. The researcher recorded demographic information and conducted an assessment of intellectual functioning.

2.3.1 Demographic Information

Participants were asked their age and sex. Additional information about the injury was requested from the individuals in the brain injury group. They were asked the date of the injury and for their permission to contact the service to obtain information about the severity of the injury. The services were contacted and asked for GCS (Teasdale & Bennett, 1974) or duration of loss of consciousness or PTA(Russell & Smith, 1961).

2.3.2 Socioeconomic status

Socioeconomic status was calculated using the National Statistics Classification System (Office of National Statistics, 2010), the National Statistics socioeconomic classification, self coded version. Participants were asked their occupation and details on the size of organisation, supervisory, and management responsibilities. Participants in the TBI group were asked their occupation at the time of the injury. If they were a student they were asked information on their parents' occupation and if they were unemployed they were asked information on their previous employment. This information was then placed onto a grid to provide the National Statistic Social Economic Classification Class code. These codes related to five classes - managerial, administrative, and professional occupations; intermediate occupations; small employers and own account workers; lower supervisory and

technical occupations; and semi-routine and routine occupations. This method has been designed to improve the previous methods of identifying classification. It aimed to produce a standardised tool to be used in government and academia with improved population coverage. The previous methods have been criticised as being outdated and lacking in conceptual rationale and clear allocation rules (Rose & Peralin, 2005). The self coded version is clear and rigorous. Although it is quicker it has an agreement level of .87 with the full interview version (Rose & Peralin, 2005).

2.3.3 General Intellectual functioning

The Wechsler Abbreviated Scale of Intelligence – Second Edition II (WASI II; Wechsler, 2011) assesses intellectual functioning. It is a revised version of the Wechsler Abbreviated Scale of Intelligence I (Wechsler, 1999). The revisions have enhanced the likeness to the Wechsler Adult Intelligence Scale- fourth edition (Wechsler, 2008), user-friendliness and psychometric properties (Wechsler, 2011). It is standardised for individuals aged between 6 and 89 years. It comprises of four subtests; vocabulary, similarities, block design and matrix reasoning which yield the full scale IQ. There is a manual that provides standardised instructions for administration and scoring of the subtests. The scores are then compared to age related norms to derive the individuals suggested level of intellectual ability. The assessment takes between 20 and 30 minutes to administer. It has good internal consistency ranging from .95 to .97, good test-retest correlation of .91, and good validity correlating with WAIS IV, .92 (Wechsler, 2011).

2.3.4 Moral reasoning

The SRM-SF is an interview based assessment of moral reasoning. It comprises of 11 questions related to moral values; Contract, Truth, Affiliation, Life, Property, Law, and Legal

Justice. Respondents are asked to rate the importance of these as very important, important, or not important e.g. “In general how important is it for someone to tell the truth?” and their justifications. There are instructions and rules in the manual. These are used to score the justifications. The scores are combined, averaged and multiplied by 100 and related to moral stage, ranging from 1 (100) to 4 (400). Stage 1 = 100-125; Transition Stage 1 (2) = 126-149; Transition Stage 2 (1) = 150-174; Stage 2 = 175-225; Transition Stage = 2 (3) 226- 249; Transition Stage 3 (2) = 250-274; Stage 3 = 275-325; Transition Stage 3 (4) = 326-349; Transition Stage 4 (3) = 350-374; Stage 4 = 375-400. The measure has demonstrated good internal consistency of .92, test-retest reliability of .88 and cross cultural validity of .69 (Gibbs et al., 1992). The researcher undertook several hours of self-training, provided in the manual, to ensure reliability. In addition, an expert rater provided inter-rater reliability. Inter-rater reliability was conducted on 19% of the data set indicated an intraclass correlation $r = .94$, $p < .001$. This exceeded the value of .80 suggested by Gibbs et al. (1992). A copy of the SRM-SF can be found in Appendix G.

2.3.5 Executive function

These are standardised assessments appropriate for this age range. Each has a manual with set instructions which ensures reliability. Each manual also has age related norms which are used to convert the raw scores into scaled scores with a mean of 10.

2.3.5.1 Cognitive Flexibility [Verbal Fluency (VF); Delis-Kaplan Executive Function System; Delis, Kaplan & Kramer, 2001 (DKEFS)]

Individuals are asked to generate as many words in a minute under three different conditions; beginning with a set letter (verbal fluency), from a set category (category fluency) and alternate between two set categories (category switching). The category switching was

used to measure cognitive flexibility. It has reasonable internal consistency, ranging from .43 to .85 (Delis et al., 2001) and validity (Swanson, 2005).

2.3.5.2 Inhibition [Color-word inference (CWI); DKEFS]

This assesses an individual's ability to inhibit an over-learned verbal response of reading a written colour word to name the colour of the ink. The time taken was calculated to compute the raw score. It has good internal consistency .75-.82 and validity (Delis et al., 2001). The scores on a separate subtest, colour reading were recorded to control for this variable.

2.3.5.3 Dys-executive questionnaire [DEX, Behavioural Assessment of the Dysexecutive Syndrome (Wilson, Alderman, Burgess, Emslie & Evans, 1996)].

The DEX assesses difficulties associated with everyday executive dysfunction and comprises 20 questions. Examples of the questions include "I act without thinking, doing the first thing that comes to mind" and "I do or say embarrassing things in the company of others". Respondents are asked to rate frequency of behaviours on a 5 point likert scale from 0 "never" to 4 "very often". The items are added to give the total score. It is considered a sensitive measure of executive functioning difficulties (Bennett, Ong, & Ponsford, 2005). It has good concurrent and ecological validity (Chamberlain, 2003). There can be problems with insight following a brain injury and as a consequence there is sometimes a distortion in an individual's awareness of difficulties (Bond, 2008). The DEX, therefore, has an additional form to be completed by an independent rater and this was sent to carers of the participants in the TBI group to complete with appropriate consent. Recent research involving Rasch analysis has suggested the DEX does not measure one dimension construct and instead captures three domains of executive function (Simblett & Bateman, 2011; Simblett et al.,

2012). The three constructs included: Executive Cognition functions, which captures the higher level processes responsible for controlling and directing automatic function through planning, monitoring and switching; Behavioural-emotional self-regulation, is believed to capture processes implicated in emotional and reward processing in the absence of cognitive resources; and Metacognition function, is responsible for integrating the other domains to shape personality and social interaction. The correlation between moral reasoning and total DEX and these domains will be explored.

2.3.6 Empathy (Empathy Quotient, Baron-Cohen & Wheelwright, 2004)

The Empathy quotient (EQ) is a self report measure comprising of 60 items, 40 which pinpoint empathy and 20 filler items (Appendix G). Responses are on a four point likert scale ranging from definitely disagree to definitely agree. The 40 items are given a score of 1 or 2 based on strength of empathic response. It has good validity correlating with other measures of empathy (Lawerence, Shaw, Baker, Baron-Cohen, & David, 2004) and is able to identify Aspergers Syndrome (Baron Cohen & Wheelwright, 2004). It has good reliability with internal consistency correlation of .85 (Muncer & Ling, 2006). It was valid for brain injury population (Adlam, Dunn, Gracey, Menon, & Adams, 2009; de Souza et al., 2010) and has good reliability. Furthermore, Adlam et al. (2009) reported no difference between the empathy scores reported by survivors of the TBI and the EQ completed about them by relatives/spouse/carers/partners. De Souza et al. (2010) reported good reliability without proxy ratings.

2.3.7 Emotion-based decision making (Intuitive Reasoning Task, Dunn et al. 2010)

The IRT has evolved from the IGT (Bechara et al., 1994). The computer screen displays four decks of cards at the top and a card in the centre of the screen. Participants have 3 seconds to pick a card from four possible decks at the top of the screen and guess whether it will be the same colour as the card in the centre. Participants receive feedback and money increases or decreases if correct or incorrect respectively. There are 100 trials and final score range from -100 to 100. The outcomes of each deck are predetermined by the computer; Deck A and B are more profitable as six out of ten responses are correct and Deck C and D are less profitable as four out of 10 responses are correct. To succeed on the task, participants have to select cards from the profitable decks and avoid the unprofitable decks. The intuitive ability is determined by their ability to learn this strategy and calculated by the total number of selections from the two profitable decks minus the total selections from unprofitable decks over the 100 trials. These can also be broken down into five blocks of 20 selections to examine the learning over the trials. The higher scores indicate better emotion-based decision making.

The reinforcement schedule is designed to be out of the participant's conscious awareness and this was confirmed by a validation study (Dunn et al., 2010). Participants were asked several questions to explore their conceptual and hunch understanding of the reinforcement schedule. This revealed minimal conscious awareness of the reinforcement schedule despite an increased tendency to select more profitable decks indicative of intuitive learning. Also, bodily responses differentiated between profitable and unprofitable decks. It revealed more anticipatory bodily responses associated with selection from profitable decks. This relationship, therefore, was consistent with the somatic marker hypothesis (Damasio, 1994) and indicative of a test of emotion-based decision making. Dunn et al. (2010) designed

this task to overcome some of the criticisms of the IGT uncovered in the review (Dunn, Dalgleish & Lawrence, 2006). These included reduced cognitive load (e.g. working memory). It has included different versions with positions and cards counterbalanced to control for biasing effects and set up to allow as many selections from each deck.

2.6 Ethical Considerations

The main areas for ethical considerations will be summarised below (Field & Hole, 2003). The research study was reviewed by the Hertfordshire NHS Ethical Committee in a proportionate review and granted favourable ethical approval (Appendix A). Permission was sought from the relevant Research and Development Departments. This was granted by Cambridge University Hospitals NHS foundation trust (Addenbrookes), the Cambridge Community Services NHS Trust (Community Brain Injury Team, Peterborough; Evelyn Community Head Injury Service, Cambridge), Cambridge and Peterborough NHS Foundation Trust (Cambridge Centre for Neuropsychological Rehabilitation Team) and Norfolk Community Health and Care NHS Trust (Colman Centre for Specialist Rehabilitation, Norwich). Copies of these approval letters can be found in the Appendix B. Further ethical approval was sought from Brain Injury Rehabilitation Trust (Appendix A). Following NHS and ethical approval, the researcher liaised with the managers of the services and from other non-NHS services to ensure they were happy for the study to run in their service.

2.6.1 Informed consent

This study took several procedural steps at recruitment and assessment stages to ensure each participant gave informed consent. The researcher asked teams to provide details about the study to individuals or alternatively asked schools to distribute information about

the study in an email to students who were able to give informed consent. Individuals who contacted the researcher after seeing the poster advertisement were sent further information on the study. Every participant was given a participant information sheet to provide more information and invite them to participate in the study. This explained that participation would be voluntary and their decision would not affect their standard of care. Interested participants could contact the researcher or alternatively they gave their consent for their clinical team to make contact. The researcher contacted them, gave them an opportunity to ask questions and ensured that they were able to give their informed consent. This was repeated at the assessment session. Participants that were able to give their informed consent were asked to sign the consent form. It was reiterated that they could withdraw at any time when their information would be destroyed.

The study sought an independent rater for the DEX questionnaire in the brain injury group. This was someone who knew the participant well. An information sheet explaining the study, what was required from them, consent form and the questionnaire were either given in the session, if the identified person was present, or sent to them with contact details for the researcher and stamped addressed envelope. They were asked to return the questionnaire and consent form to the researcher.

2.6.2 Coercion

To ensure the study was free from coercion, the participants were informed about the study by people unconnected to it. They were given a participant information sheet, time to consider the information (at least 24 hours) and contact numbers for further details. It was reinforced that their decision would not affect their standard of care.

2.6.3 Managing risk and distress

The researcher carefully considered possible areas of risk and psychological distress and implemented strategies to manage this.

Steps were taken to minimise the burden on participants. Every participant was asked to read an information sheet which explained what they would be asked to do in the study. This was to ensure all the participants were fully informed about the length, duration, and tasks involved in the study before they were asked to give their informed consent to it. They were informed at the beginning that they could withdraw from the study at any point if they changed their mind. To minimise fatigue and ensure the participants were able to perform at their best, the researcher offered regular breaks. The researcher also explained that in the event of fatigue, she could visit on another day to complete the task or alternatively the questionnaires could be completed outside the session and returned by post, in a stamped addressed envelope.

The researcher did not anticipate that the nature of the assessments was likely to cause distress for participants. However, she was aware that participants might become distressed if they perceived underperformance on neuropsychological assessments. The researcher reiterated phrases to minimise this distress including "I would not expect anyone to get everything right". "I can see you are trying really hard, well done". If the participant became distressed at any point, it was planned that the session would be terminated, data destroyed, and clinical team informed. For participants in the comparison group they would be encouraged to contact their GP. This was not necessary in any assessment session. If the participant wished to make a complaint about the conduct of the study they were given a number on the participant information sheet to do so.

To reduce the burden on participants, the researcher conducted the assessment sessions in the homes of the participants. To ensure her safety and minimise any risk, the

researcher adhered to the lone worker policy for Cambridge and Peterborough NHS Foundation Trust (CPFT, 2008).

2.6.4 Confidentiality

Several steps were taken during the course of the study to ensure confidentiality. These were fully explained to the participants on the participant information sheets. Firstly, the participant had to agree and sign a consent form to allow their details to be given to the researcher. Secondly, participants in the study were assigned a unique participant number to retain anonymity under which all data were entered on the computer database. This was stored on an NHS encrypted memory stick. Thirdly, the consent forms were stored in a locked filing cabinet separate from the assessment data which had the unique participant number to ensure data could be destroyed if consent is withdrawn. Fourthly, a locked briefcase was used to transport data during visits. Finally, data will be stored for a minimum of 5 years (Good practice guidelines of psychological research within the NHS; British Psychological Society, Cooper, Turpin, Bucks & Kent, 2005).

2.4 Procedure

Participants for the study were recruited by the methods outlined in the recruitment section. At the assessment sessions, the researcher revisited the participant information sheet with the participants, they had an opportunity to ask questions and were reminded they could take a break and/or withdraw their consent at any time. They were asked to sign a consent form, (Appendix D), after reading the participant information sheet. Participants in the TBI group were asked for their consent to inform their clinical team about their participation and share the summary of standardised measures with the clinical team. Participants in the

healthy comparison group were asked for their consent to inform their GP that they have participated in this research study. A copy of this letter can be found in Appendix F.

All participants were asked their age, sex and details about their occupation or parents occupation. Following this the assessments were administered, WASI (20 minutes), SRM-SF (20 minutes), CWI (5 minutes), VF (5 minutes) IRT (25 minutes), EQ (10 minutes) and DEX (10 minutes). The administration of these measures was counterbalanced across participants to reduce fatigue, interference, and potential practise effects which can arise when assessments are administered in the same order. The counterbalanced test order was based on a Latin square design; this can be found in Appendix H. The anticipated duration of the assessments was between 90 and 120 minutes. If it took longer or if the participant required several breaks, they were offered the opportunity to return the questionnaires by post and given a stamped addressed envelope, or alternatively the researcher visited for another session. As a consequence the questionnaires were removed from the counterbalanced test order to enable them to be completed outside the assessment session.

It was planned that if at any time the participant experienced distress, the session would be stopped, reasons for distress explored, and the participant would be encouraged to contact the clinical team or their GP, or the researcher sought permission to do this. This did not happen at any of the sessions.

Consent was sought from the TBI group to contact a family member to complete the DEX. If given, a participant information sheet (Appendix C), consent form (Appendix D) and DEX (10 minutes) was sent by post or given in the session if the selected person was present.

2.5 Plan for analysis

All the data including demographic information and scores on the assessments were entered onto a database on PASW version 18 statistics programme. The demographic information recorded was sex, age, and SES. The scores recorded into the database for each participant were the total scores for SRM-SF, DEX, and EQ. The age-adjusted scaled scores were recorded for WASI II, VF and CWI. The total selections from profitable decks minus unprofitable decks were recorded for the IRT.

2.5.1 Preliminary analyses

Preliminary analyses were conducted to check parametric assumptions of: normal distribution; homogeneity of variance; interval data; and independence. The interval data and independence of test scores were decided by the study design. Data were, therefore, examined to ensure that they were normally distributed and had equality of variance. This included checks on the SRM-SF, EQ, CWI, VF, the DEX and IRT scores for each group separately.

To check whether the data were normally distributed, the histograms for the data for each measure were inspected (Appendix J and K). The researcher also conducted an objective test, the Shapiro- Wilk test, to decide whether the sample data for each test were normally distributed. If the test was non significant ($p>.05$), the distribution was not significantly different to a normal distribution.

To check the assumption of homogeneity of variance, the variance in each group needed to be roughly equal. This was performed using the Levine's test. If the test was significant ($p<.05$) then the variances were significantly different.

The study aimed to control the confounding variables of age by recruiting individuals between 17 and 25 years in both groups and tried to ensure an equal distribution of sex. The

researcher conducted further preliminary checks to see if there were any significant differences between the groups on the other confounding variables age and IQ. The assumption of normal distribution was met for IQ but not the assumption of equal variance, therefore, an independent t-test was conducted to compare the difference between the two groups, equal variance not assumed. Parametric assumptions were not met for age, and therefore the difference between the groups was explored using a non parametric equivalent, a Mann Whitney test. In either case, a significant finding indicated there were differences between the groups on these variables.

Other potential confounding variables were sex and SES. These data sets were categorical and, therefore, were analysed using a Chi-Square test.

2.5.2 Hypothesis 1

The sample data for each group SRM-SF were normally distributed and had equal variance therefore the parametric test assumptions were fulfilled. The difference between group 1 (TBI group) and group 2 (healthy comparison group) were analysed using a between-subjects t-test. There were significant differences between the groups on the confounding variable, IQ, and IQ significantly correlated with the dependent variable in each group separately. An ANCOVA was used to eliminate the confounding variable, IQ, from the analysis. An ANCOVA was still used, despite the Levine's test indicating the assumption of homogeneity of variance had been violated. This decision was based on two reasons, an ANCOVA is considered quite robust against these violations (Field, 2009). T-tests and F tests have been shown to be robust against violations of assumptions of parametric tests. Boneau (1960) has demonstrated accurate t-test results when assumptions of homogeneity of variance and normality have been violated in several different situations. Furthermore, the difficulties of skewed data were overcome in sample sizes of 25 to 30. Boneau (1960)

concluded that t-tests and f-tests were robust providing the sample sizes and variance were roughly equal. Furthermore, an additional test of homogeneity of variance, the variance ratio (Pearson & Hartley, 1954), conducted by comparing the variance in both groups, indicated that the ratio was within the necessary limits to imply equal variance (Field, 2009).

Exploratory analyses were conducted to see if there were differences across the domains of moral reasoning, using t-tests. The normal distribution assumption was violated in the TBI group across Truth, Life, Property, Law and Legal Justice domains (SRM-SF). Despite the findings from Boneau (1960) caution was applied and the differences between the groups on these domains were explored using, non-parametric equivalent, Mann-Whitney test. In order to use an ANCOVA to explore the differences, controlling for IQ, bootstrapping was applied as it was a robust way to overcome violations to a normal sampling distribution (Efron & Tibshurani, 1993; Field, 2013). Normality in the data provides information on the shape of the sampling distribution, as this is unknown in small samples. Bootstrapping works by empirically deriving the sampling distribution from the sample, by treating the data as a population and taking several smaller samples from this, calculating the mean from each sample and the sampling distribution. From this standard error can be computed and robust calculations of the confidence interval and significance level are determined. There was a significant difference if the confidence interval does not cross zero (Field, 2013) and has a significant p value. Bootstrapping was applied to 5000 samples, using bias corrected accelerated 95% confidence intervals. Bootstrapping is not applied to the F value but to the confidence intervals and statistical values.

2.5.3 Hypothesis 2-6

Each of these hypotheses were concerned with determining whether there was a relationship between moral reasoning and executive function, cognitive flexibility, inhibition,

empathy and emotion-based decision making. For each hypothesis the data were analysed to see if there was a correlation between the scores on the SRM-SF and scores on DEX and its sub domains, VF, CWI, EQ, and IRT. These analyses were conducted separately for both groups. A Pearson's correlation was conducted to explore these correlations. A non-parametric equivalent, Spearman's Rho correlation, was used for the analyses where the variables did not meet the parametric assumptions, these included CWI in both groups; IRT in the HC group, and DEX Metacognition in the TBI group. These correlations were exploratory and preliminary given the small sample size, and required cautious interpretation.

2.5.4 Additional analyses

Further information was collected on the TBI group. This included age at injury and the severity. The researcher performed correlations between the age at injury/ time since injury and moral reasoning in the TBI group. The information on severity was considered in relation to the findings.

Chapter Three

Results

3.1 Introduction to this chapter

This chapter presents the findings of the study. It will summarise the data preparation and preliminary analyses including the parametric assumption checks and the matching of the groups. It will then present the findings for the primary research question. Following this it will present the finding for the exploratory secondary research questions before concluding with a summary of the main findings from the study.

3.2 Data preparation and preliminary analyses

The data were entered on a database on PASW statistics 18. The data were explored for missing values and assumptions of parametric data.

3.2.1 Missing data

Every participant completed the SRM-SF, VF, and CWI. One participant in the TBI group was unable to complete one of the subtests on the WASI II due to physical limitations, however could complete the other subtests and therefore was included in the study. Five participants in the TBI group did not complete the IRT, one declined participation and four asked to finish the task early. A DEX questionnaire was sent to an independent rater, i.e. a relative, carer or partner. Sixteen questionnaires (80%) were returned and the missing data were attributed a missing value and recorded as missing in the database.

3.2.2 Testing assumptions of parametric data

To use parametric analyses, the data had to be explored to ensure it satisfied the parametric assumptions of normal distribution and homogeneity of variance. The data were explored for normality by inspecting the histograms. It was further confirmed by a non significant Shapiro Wilk Test (S-W) result. Homogeneity of variance was assumed by a non significant Levine's test. The results from these analyses can be found in the Appendix I.

These preliminary analyses revealed that the SRM-SF, VF, EQ, DEX, DEX OTHER and DEX sub domains Executive cognition and Behavioural-emotional self-regulation data met the parametric assumptions. The data on WASI II Full Scale IQ (FSIQ), Verbal comprehension index (VCI) and the Metacognition sub domain of the DEX violated the assumption of equal variance.

The normal distribution assumption was violated in the healthy comparison group for age, CWI and IRT; and the Truth, Property, Law and Legal Justice domains (SRM-SF). The normal distribution assumption was violated in the TBI group for CWI; and across Truth, Life and Legal justice domains (SRM-SF). For these caution was applied and non-parametric equivalent tests were used.

3.2.3 Matching the groups

The age of the TBI group (M= 21.70; SD = 2.32) did not significantly differ to the age of the healthy comparison group (M = 20.76; SD = 2.51), $U = 269$, p = .20. The sex difference between the groups was not significant, $\chi^2 (1) = 0.40$, p = .53. In addition, there was no significant difference between groups in socioeconomic status $\chi^2 (1) = .848$, p = .93. These findings indicated the groups were matched on age, sex and SES. There are several different categories within the SES and, therefore, caution should be taken as the sample size may have not had sufficient power to detect a difference.

An independent t-test indicated that FSIQ was significantly lower in the TBI group FSIQ (M = 92.37; SE = 2.98) compared to the healthy comparison group (M = 100.59; SE = 1.59), t (28.47) = - 2.43, $p < .05$.

One participant in the TBI group was unable to complete the whole WASI II and was omitted from the above analysis. The difference between the groups on the Verbal Comprehension Index (VCI) domain was, therefore, explored. Any difference on this variable is likely to confound performance on the SRM-SF measure. The TBI group were significantly lower on the VCI, (M = 88.8; SE = 2.67) relative to the healthy comparison group (M = 99.94; SE =1.31), t (28.2) = - 3.72, $p< .01$. This difference was likely attributable to the severity of TBIs.

As expected, intellectual functioning, FSIQ and VCI, and moral reasoning (SRM-SF) significantly correlated in the TBI group $r_s = .592$, $p < .01$ (FSIQ), $r_s = .523$, $p < .01$ (VCI), and in the healthy comparison group, $r_s = .409$, $p < .01$(FSIQ), $r_s = .473$, $p < .01$ (VCI). This indicated that variance in IQ shared 35% of the variance in moral reasoning in the TBI group and 17% of the variance in the healthy comparison group. Given the relationship between intellectual functioning and SRM-SF, and the significant differences between the groups on these variables, the FSIQ, and VCI were included as covariates in the analysis for the primary research question.

3.2.4 TBI group – preliminary tests

3.2.4.1 DEX and DEX Independent rater

There was no significant difference between the DEX completed by individuals with TBI (M = 31.75; SE = 2.76) and DEX completed by an independent rater (M = 36.63; SE =

5.27), t (15) = -1.16, p = .26. The DEX completed by self was, therefore, used throughout the subsequent analysis.

3.3 Main Analysis

3.3.1 Primary research question

Literature indicates that TBI is commonly associated with damage to the fronto-temporal regions (Bigler, 2007, Salmond et al., 2006; Wallesch et al., 2001). Given the involvement of the PFC in moral reasoning (Raine & Young, 2006), the late maturation of these structures (Samango-Sprouse, 2007), and the findings from the literature review, the first hypothesis was that survivors of TBI aged 17 – 25 years will have lower scores on the SRM-SF (moral reasoning) than the healthy comparison group.

3.3.1.1 Hypothesis 1

The means and standard errors of the SRM total score and sub domains are shown in Table 9. As predicted, moral reasoning, measured by the SRM-SF total score, was higher in the healthy comparison group than the TBI group, this difference was significant t (52) = -7.17, p < .001. The groups also appeared to differ by a moral development stage, with the healthy comparison group mean falling within Stage 3, mature stage of moral reasoning, and the TBI group within the transition stage 3 (2) suggestive of lower moral reasoning. .

Table 9 Mean SRM-SF total score and sub-domain scores for each group. Data are means and standard error of the mean.

SRM-SF domains	TBI group Mean (SE)	HC group Mean (SE)
SRM-SF (total)	260.50 (7.29)	315.85 (4.11)
Contract	266.67 (9.37)	314.22 (6.26)
Truth	277.78 (7.26)	307.81 (9.55)
Affiliation	257.89 (8.34)	312.50 (6.18)
Life	261.25 (8.79)	324.26 (5.01)
Property	237.50 (15.34)	287.50 (6.74)
Law	255.26 (17.48)	328.13 (9.77)
Legal Justice	262.50 (18.45)	331.82 (9.93)

TBI = Survivors of TBI group, HC = Healthy comparison group, SE = Standard error of the mean, SRM-SF = Sociomoral Reflection Measure- Short Form.

3.3.1.1.1 Intellectual functioning and Moral reasoning

An ANCOVA was conducted to explore the difference in moral reasoning between the TBI and healthy comparison groups whilst controlling for FSIQ and VCI. The means and standard errors for the SRM-SF total scores, adjusted after controlling for FSIQ and VCI, are displayed in Table 10. An ANCOVA revealed that the main effect of brain injury on moral

reasoning remained after controlling for FSIQ, F (1, 50) = 35.54, p < .001 and VCI, F (1, 51) = 26.08 p < .001.

3.3.1.2 Differences across moral reasoning domains

Further exploratory analyses were conducted on the differences between the groups on the domains of moral reasoning. Means and standard errors are displayed in Table 9. Independent t-tests revealed significant differences between the TBI group and healthy comparison group across the domains, on Contract, t (52) = -4.62, p < .001 and Affiliation, t (51) = -5.27, p < .001. Mann Whitney tests revealed significant differences on domains of Truth, *U* = 390.50, p < .05; Life, *U* = 613. 50, p < .001; Property, *U* = 470, p < .01; Law, *U* = 470.00, p < .01 and Legal Justice, *U* = 490.50, p < .05. These analyses revealed that the healthy comparison group had higher moral reasoning, as measured by the SRM-SF, than the TBI group across the seven moral reasoning domains of Contract, Truth, Affiliation, Life, Property, Law and Legal Justice.

3.3.1.2.1 Intellectual functioning and domains of moral reasoning

An ANCOVA was conducted to the difference in the moral reasoning domains between the TBI group and comparison group whilst controlling for IQ. As the mean values on the sub-domains had violated the assumption of normality, bootstrapping was applied across all domains, using 5000 samples and bias corrected accelerated confidence intervals at 95%. The adjusted means and standard error are displayed in Table 10. The adjusted means remained in the same developmental stage. There was a significant effect of brain injury after controlling for FSIQ, on domains of Contract, F (1, 50) = 11.29, p < .01, BCa 95% CI [13.29, 66.54]; Affiliation, F (1, 49) = 20.33, p < .01, BCa 95% CI [24.13, 73.41]; Life, F (1, 50) = 32.02, p < .001, BCa 95% CI [34.24, 76.85]; Law, F (1, 47) = 9.50, p < .001 BCa 95%

CI [19.53, 97.22] and Legal Justice, F (1, 49) = 4.48, p < .05, BCa 95% CI [1.14, 71.07]. The main effect of brain injury was not retained after controlling for FSIQ on the domains of Truth, F (1, 46) = 2.62, p = .07, BCa 95% CI [-1.26 to 51.84] and Property, F (1, 48) = 4.15, p = .06, BCa 95% CI [2.67, 55.73).

There was a significant main effect of brain injury after controlling for VCI, on domains of Contract, F (1, 51) = 10.34, p < .01, (BCa 95% CI = 12.14 to 69.61); Affiliation, F (1, 50) = 15.28, p < .01, (BCa 95% CI = 17.12 to 71. 32); Life, F (1, 51) = 23.71, p < .001, (BCa 95% CI = 27.10 to 74.90) and Law, F (1, 48) = 5.76, p < .05 (BCa 95% CI = 6.41 to 88.24). The main effect of brain injury was not maintained after controlling for VCI on Truth, F (1, 47) = 2.30, p = .05, (BCa 95% CI = 1.90 to 47.82); Property, F (1, 49) = 3.05, p = .08, (BCa 95% CI = -2.68 to 60.31) and Legal Justice, F (1, 50) = 1.68, p = .20, (BCa 95% CI = -13.10 to 63.08) domains.

Table 10 Adjusted means and standard error of means for SRM-SF in both groups (controlling for FSIQ and VCI).

	FSIQ		VCI	
SRM-SF	TBI	HC	TBI	HC
	Mean (SE)		Mean (SE)	
Total Score	267.67 (5.84)	312.15 (4.29)	269.06 (6.18)	310.82 (4.57)
Contract	272.49 (10.98)	311.45 (6.59)	271.28 (11.44)	311.50 (6.67)
Truth	281.37 (8.05)	305.79 (9.18)	281.85 (7.60)	306.52 (10.01)
Affiliation	260.62 (10.87)	310.56 (6.34)	263.58 (11.56)	309.32 (6.55)
Life	265.91 (9.47)	321.26 (5.14)	269.26 (9.43)	319.55 (5.50)
Property	251.26 (13.52)	280.50 (7.57)	250.65 (13.44)	279.28 (8.15)
Law	263.58 (17.36)	322.05 (10.53)	270.30 (17.05)	319.20 (10.46)
Legal Justice	285.51 (14.10)	321.98 (11.24)	290.53 (15.25)	314.83 (11.86)

FSIQ = Full Scale IQ, WASI II; VCI = Verbal Comprehension Index, WASI II; TBI = Traumatic brain injury group; HC = Healthy comparison group; SRM-SF = Sociomoral Reflection Measure- Short Form; SE = standard error of the mean

3.3.1.3 Further analyses in the TBI group

Given the variability of a TBI group, the relationships between age at injury and time since injury and moral reasoning, as measured by the total SRM-SF, were also explored.

Injury severity was not explored due to missing data and lack of variability in the data (see Methods Section, most patients had severe TBI). Preliminary analyses revealed that the data on age at injury and time since injury were not normally distributed (see Appendix I) so non parametric, two-tailed correlations were used to explore these relationships. There was a significant positive correlation between moral reasoning and age at injury, $r_s = .75$, $p < .001$. This suggested that moral reasoning was higher in individuals with a later age at injury. Consistent with this finding, an additional analysis revealed a significant negative correlation between moral reasoning and time since injury, $r_s = -.50$, $p < .05$ which suggested that moral reasoning increased as time since injury decreased.

3.3.2 Secondary research questions

Research studies have provided mixed evidence to support the notion that moral reasoning (measured by SRM-SF) is associated with executive functioning and emotion. This study aimed to explore these relationships further. After consideration of the literature, this study predicted that moral reasoning would be associated with these processes. It made directional hypothesis, as detailed below, and explored the correlations using one-tailed tests of significance. Pearson's correlation or Spearman's Rho correlation tests were selected based on earlier preliminary tests of parametric assumptions.

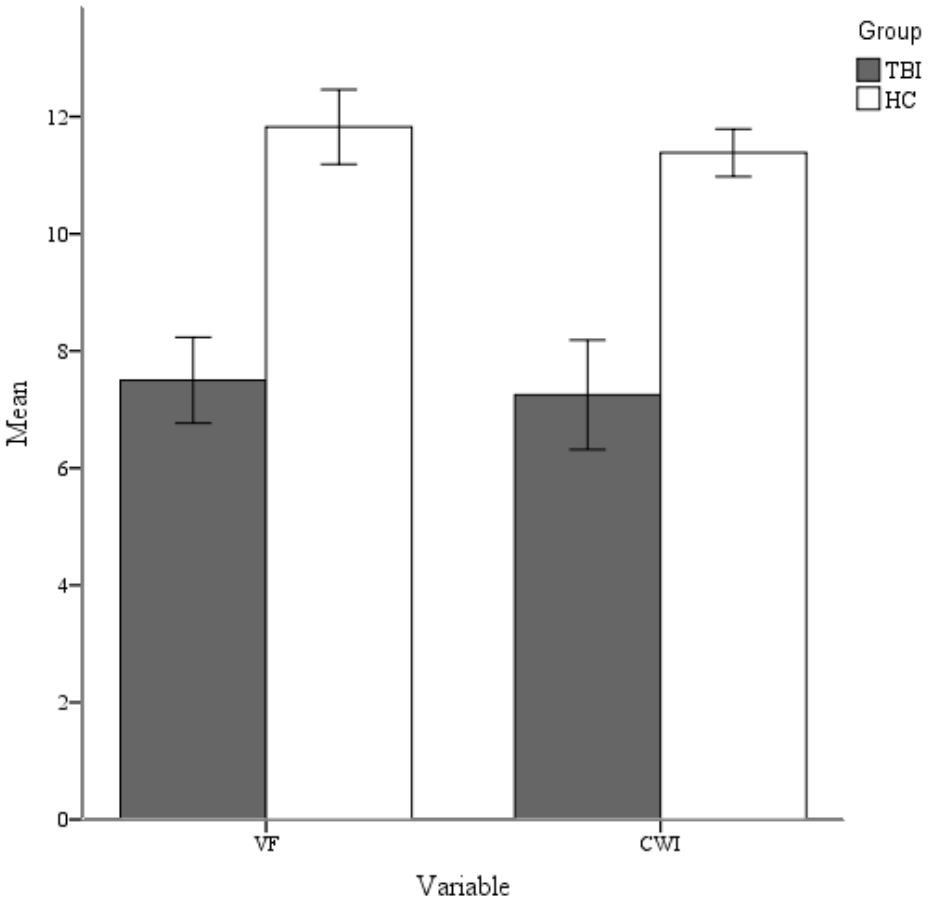
3.3.2.1 Preliminary analyses

Prior to conducting the correlations, the data were compared to explore differences on each variable between the groups. Significant differences confirmed that the correlations were to be performed separately in the groups.

3.3.2.1.1 Cognitive Flexibility and Inhibition across both groups

There were significant differences between the groups on domains of inhibition (CWI) and cognitive flexibility (VF). The means and standard errors are displayed in Figure 1. The healthy comparison group performed significantly better on the CWI than the TBI group , $U = 547$, $p < .001$. This was significant when the effects of colour word reading were controlled for $F(1,51) = 5.54$, $p < .05$. This finding was repeated in VF, the healthy comparison group mean was significantly higher than the TBI group , $t(52) - 4.3$, $p < .005$. This suggested that the healthy comparison group had significantly higher levels of inhibition and cognitive flexibilty than the TBI group.

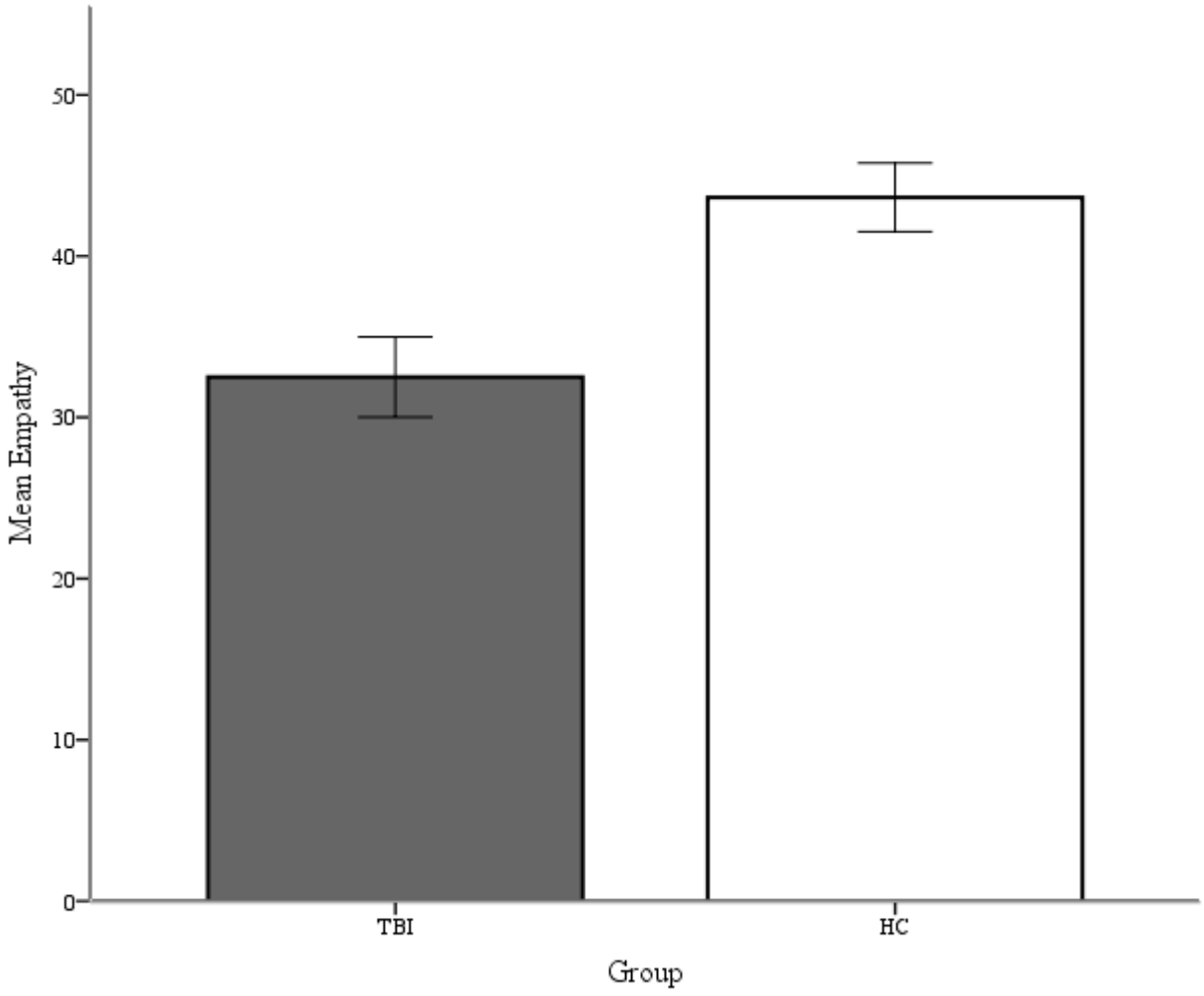
Figure 1 Performance on Color Word Inference (CWI) and Verbal Fluency (VF) for each group. Data are means and standard error of mean.



3.3.2.1.2 Empathy across the groups

Empathy was measured by the empathy quotient (EQ). The means and standard error scores are displayed in Figure 2. The healthy comparison group had significantly higher levels of empathy than the TBI group, $t(52) = -3.30$, $p < .01$.

Figure 2 Mean and standard error scores on the empathy quotient (EQ) for each group

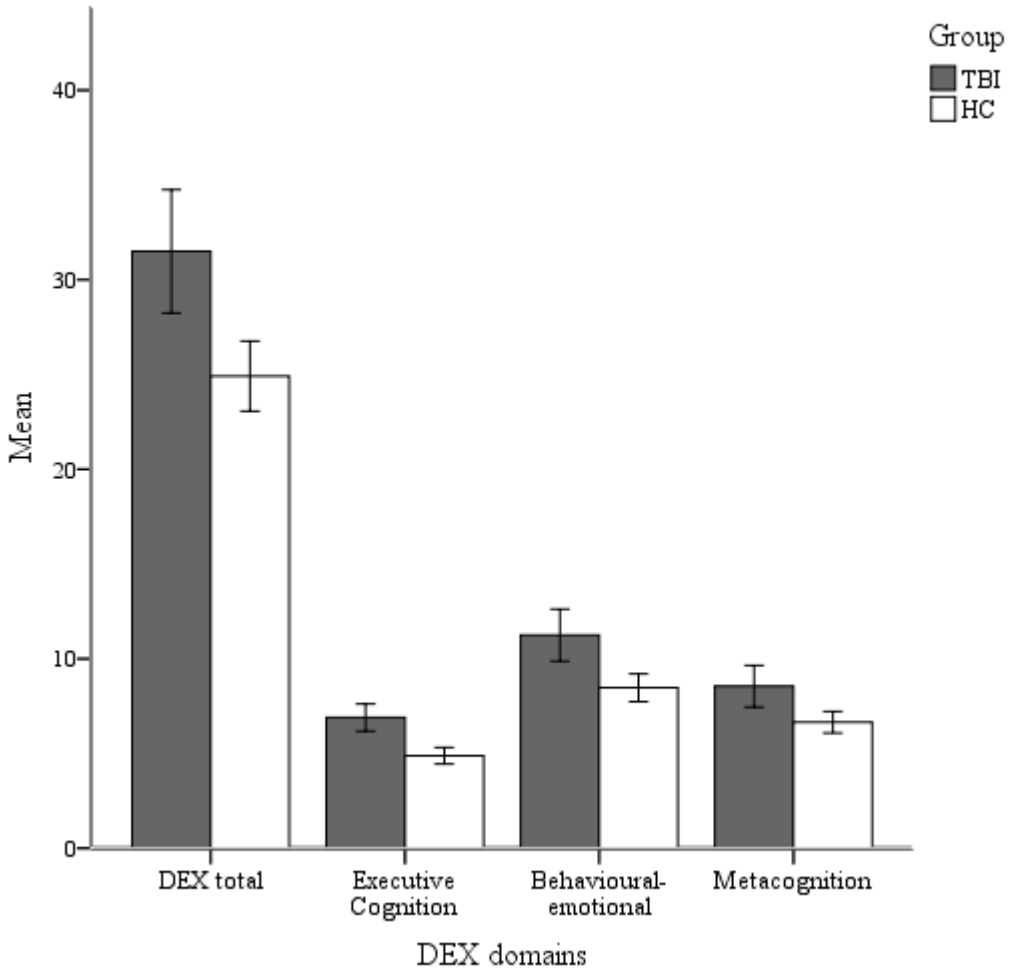


3.3.2.1.3 Executive function difficulties across the groups

Executive function difficulties were captured by the DEX. Recent research has suggested that this measures three constructs, Executive cognition, Behavioural-emotional self-regulation, and Metacognition (Simblett & Bateman, 2011). The means and standard errors for both groups on the total DEX and sub domains were calculated and are displayed in

Figure 3. The TBI had higher scores on the total DEX questionnaire than the healthy comparison group, t (52) = 1.90, p = .06, suggestive of greater number of everyday executive function difficulties, this was near significance. The TBI group had significantly higher scores than the healthy comparison group on Executive Cognition sub domain, t (52) = 2.55, p < .05. The TBI group did not have significantly higher difficulties on the Behavioural-emotional self-regulation , t (52) = 1.96, p =.06 or on the Metacognition, t (29.16) = 1.70, p =.14 sub domains.

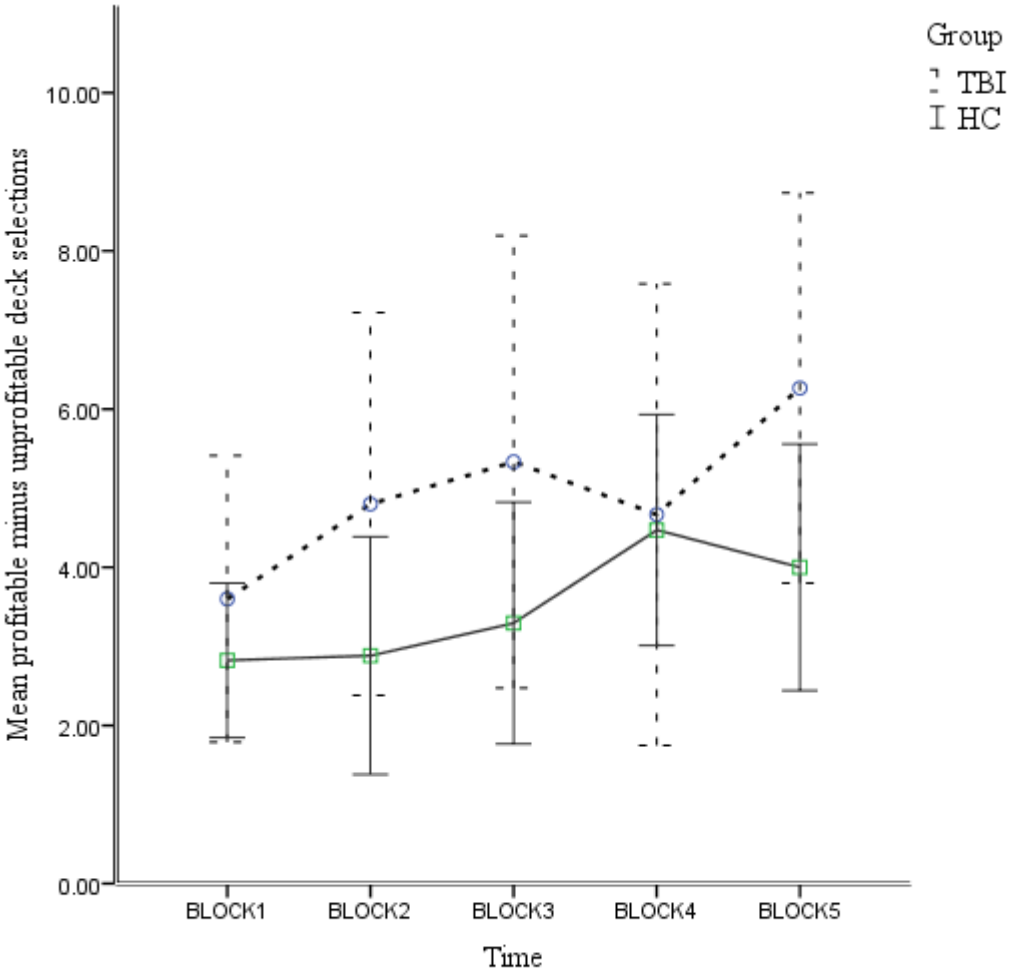
Figure 3 Mean total score on the DEX and sub-domains for both groups. Data are means and standard error of the mean.



3.3.2.1.4 Emotion based decision making across the groups

This was captured by the Intuitive Reasoning Task. There were no significant differences between the TBI group (M = 23.67; SE = 10.18) and the healthy comparison group (M = 16.91, SD = 5.80), across the 100 trials, U = 214, p = .37. The deck selections were also examined over five blocks, each consisting of 20 trials, to examine intuitive learning ability. The means and standard error of profitable minus unprofitable deck selections are displayed in Figure 4. The mauchly's test indicated assumptions of sphericity had been violated, χ^2 (9) = 34.02, p < .05, therefore degrees of freedom were corrected using the Huynh feldt estimate of sphericity (Ɛ = .87). The results show no main effect of block (time) on performance F (3.48; 163.28) = .67, p = .59. There was also no main effect of group on performance F (1, 47) = .43, p = .52 and no interaction of block (time) and group F (3.47; 163.27) = .28, p = .88.

Figure 4 Profitable minus unprofitable deck selections across the blocks for each group. Data are mean and standard error bars. and standard error bars.



3.3.2.2 Correlations between moral reasoning and variables

Table 11 Correlations between mean SRM-SF and the mean CWI, DEX, DEX other, EQ, IRT and VF for each group separately. Data are Pearson's correlation (r) values unless otherwise specified

	SRM-SF	
Variable	TBI	HC
CWI	.18[a]	.47[a]**
DEX	-.26	-.28*
DEX EC	-.21	-.36*
DEX BE	-.30	-.19
DEX MC	-.16[a]	-.25[a]
DEX OTHER	.15	-
EQ	.11	.34*
IRT	.38[a]	.23
VF	.43*	.30*

Note. [a]Spearman's Rho (r_s) * p < .05; ** p < .01

HC = Healthy Comparison Group. TBI = Survivors of traumatic brain injury. CWI = Color word inference, (DKEFS, Delis et al., 2001); VF = Verbal Fluency, (DKEFS); DEX = Dys-executive questionnaire, (BADS, Wilson et al., 1996); DEX EC = DEX Executive Cognition; DEX BE = DEX Behavioural-emotional self-regulation; DEX MC = DEX Metacognition; EQ = Empathy Quotient, (Baron-Cohen & Wheelwright, 2004) HC *N* = 34, TBI *N* = 20. DEX OTHER = DEX proxy rater (TBI *N* = 15); IRT = Intuitive Reasoning Task (Dunn et al., 2010; HC *N* = 34; TBI *N* = 15).

3.3.2.2.1 Hypothesis 2 – Moral reasoning and executive function difficulties

The study predicted that moral reasoning would be related to executive function difficulties and hypothesised a negative correlation between the SRM-SF and DEX, a measure of executive function difficulties in everyday life. The correlations and level of significance are displayed in Table 11. There was a significant negative correlation between DEX and the SRM-SF in the healthy comparison group. This suggested that 8% of the variance in moral reasoning was explained by the variance in the DEX, difficulties in executive functioning. It suggested that fewer executive function difficulties were associated with higher moral reasoning. There was no significant correlation in the TBI group ($p = .14$).

3.3.2.2.1.1 Further analysis of the DEX.

The relationships between the constructs of the DEX and moral reasoning were also explored in both groups. The correlations and level of significance are displayed in Table 11.

3.3.2.2.1.2 Executive Cognition Domain

A significant negative correlation was found between moral reasoning and the Executive Cognition domain in the healthy comparison group. This suggested that in the healthy comparison group, fewer Executive Cognition difficulties were associated with higher moral reasoning

3.3.2.2.1.3 Behavioural-emotional self-regulation Domain

There were no significant correlations between moral reasoning and Behavioural-emotional self-regulation scores in either group.

3.3.2.2.1.4. Metacognition domain

No significant correlations were revealed between moral reasoning and scores on the Metacognition domain for either group.

3.3.2.2.2 Hypothesis 3 – Moral Reasoning and Cognitive flexibility

It was predicted that individuals with higher cognitive flexibility would have higher moral reasoning (positive correlation, VF). A significant positive correlation was found in the TBI group and the healthy comparison group supportive of the hypothesis. The values are displayed in Table 11. It suggested that 18% of the variance in moral reasoning was accounted for by variance in cognitive flexibility in the TBI group. 9% of the variance in moral reasoning was accounted for by variance in cognitive flexibility in the healthy comparison group. This supported the hypothesis that individuals with higher cognitive flexibility had higher moral reasoning.

3.3.2.2.3 Hypothesis 4 – Moral reasoning and Inhibition

The study predicted that individuals with higher inhibition would have higher moral reasoning (positive correlation, CWI). The correlations are displayed in Table 11. A significant positive correlation was found in the healthy comparison group. This suggested that 22% of the variance in the ranks of moral reasoning was shared by the variance in inhibition and supported the hypothesis that individuals with higher levels of inhibitory control would have higher moral reasoning. No significant correlation was found in the TBI group.

Performance on the CWI is believed to be confounded by colour naming speed (Delis et al., 2001). The CWI incorporates a test for colour word reading speed (colour naming). The TBI group (M = 6.75; SE = 0.85) performed significantly slower on this colour word

naming than the HC group (M = 9.85, SD = 0.38), t (26.68) = -3.34, p < .05. This was held constant in a partial correlation. There were still significant positive correlations between CWI and moral reasoning in the healthy comparison group r = .33, p < .05 but not in the TBI group r = .03, p = .49. The degree of variance the CWI had on moral reasoning appeared to reduce in both groups, however, it still suggested that individuals with higher levels of inhibition had higher moral reasoning.

3.3.2.2.4 Hypothesis 5 – Moral reasoning and empathy

The study aimed to explore the relationship between moral reasoning and empathy, measured by the Empathy Quotient. It made a further hypothesis that individuals with higher empathy would have higher moral reasoning (positive correlation). The correlation values can be found in Table 11. A significant positive correlation was reported between SRM-SF and EQ in the healthy comparison group, supportive of the hypothesis. This indicated that 12% of the variance in moral reasoning was accounted for by empathy and suggested that individuals with higher levels of empathy had higher moral reasoning. A significant correlation was not revealed in the TBI group probably due to insufficient power.

3.3.2.2.5 Hypothesis 6 – Moral reasoning and emotion based decision making

The IRT was used to capture emotion-based decision making. The study predicted a positive correlation between the IRT and SRM-SF (moral reasoning). The analyses revealed near to significant positive correlations for both groups, (p = .09), as displayed in Table 11. This was probably due to insufficient power.

3.4 Summary of findings

The findings were supportive of the primary hypothesis. As predicted, the study revealed that the age- , sex-, and SES-matched-healthy comparison group performed significantly better on the assessment of moral reasoning than the TBI group, and across all the domains of moral reasoning. This finding was maintained in the total moral reasoning measure when variance in IQ, which was shown to correlate with moral reasoning, was accounted for by the analysis. As predicted, this suggested that the difference between the groups on moral reasoning could not be explained by differences in intellectual functioning, age, sex or socioeconomic status. Additional exploratory analyses of the sub domains of moral reasoning revealed there were differences across all the sub domains of moral reasoning. These differences were maintained when IQ was controlled in analyses in the Contract, Affiliation, Life and Law domains. Interestingly, these differences were not maintained across the Truth, Property and Legal Justice domains, once IQ was removed from the analysis. This exploratory finding implied that the difference between the groups in the Truth, Property and Legal Justice domains were accounted for by differences in variance between groups in intelligence.

In addition, the findings, in part, supported the secondary research questions. These were, however, preliminary given the small sample sizes and therefore caution should be applied when interpreting these findings. It was predicted that moral reasoning would relate to cognitive and emotion processes, including executive functioning, inhibition and cognitive flexibility, empathy and emotion based decision making. As predicted, all correlations were in line with the directional hypothesis. The hypotheses were not fully supported, however, as there were not significant correlations in both groups. The findings in the healthy comparison group provided support for these hypotheses. Consistent with the hypotheses, significant positive correlations were found between moral reasoning and assessments of

inhibition, cognitive flexibility and empathy. Furthermore a significant negative correlation was revealed between moral reasoning and everyday executive functioning difficulties. Individuals with higher levels of inhibition, cognitive flexibility and empathy had higher levels of moral reasoning. In addition, individuals with better executive functioning had better moral reasoning. The study also explored the sub-domains of executive function difficulties. The analyses revealed significant negative correlation between moral reasoning and the Executive Cognition domain but no significant relationships with the other domains. Unexpectedly, there was not a significant correlation between moral reasoning and emotion based decision making. The significant findings of correlations between moral reasoning and executive function, but not between moral reasoning and emotion-based decision-making could suggest that the relationship may be stronger between moral reasoning and executive cognitive skills. There were positive correlations, however, between emotion-based decision making and moral reasoning, and therefore the failure to reach significance may be a consequence of insufficient power rather than an absence of relationship between these variables. Therefore a conclusion cannot be made given the small sample size.

Similarly, the TBI group had a smaller sample size and therefore the results would have been compromised by insufficient power. The findings from the TBI group revealed a significant positive correlation between moral reasoning and cognitive flexibility, suggesting individuals with higher levels of cognitive flexibility had higher moral reasoning. However no other significant correlations were revealed in the TBI group.

Overall, these findings suggest that some of the variance in moral reasoning may be accounted for, in part, by difficulties in executive functions, such as cognitive flexibility and inhibition, and also empathy. The co-existing finding of differences between the groups on these variables may indicate that the differences between the groups on moral reasoning may be explained, in part, by these variables. The lack of significant correlations in the TBI

group, prevent these from being explored by further analyses such as an ANCOVA. The interpretations, therefore, are limited by non-significant findings in the TBI group which may be explained by the insufficient power to detect significant relationships due to the relatively small sample size.

Chapter Four

Discussion

4.1 Overview

Moral reasoning is considered vital for social function (Gibbs, 2010). It is dependent on cognitive, emotion and social experience. These processes are believed to be dependent on the frontal brain region, in particular the PFC, and a moral reasoning task has been shown to activate the frontal lobe in a neuroimaging study (Raine & Young, 2006). This area of the brain is vulnerable to damage from a TBI (Bigler, 2007; Salmond et al., 2006). TBI causes damage to brain structures and deficits in areas of cognitive, behavioural, emotional and social functioning. More recently, it has been associated with offending behaviour. Consequentially, it may be that moral reasoning is disrupted by a TBI and this contributes to some of the behavioural and social difficulties commonly reported. A consideration of the literature outlined in the introduction concluded that the impact of a TBI on moral reasoning warranted closer examination. In addition, it highlighted the necessity to explore the processes which underpin moral reasoning to provide greater clarity of this area to inform interventions.

This study sought to explore these research gaps with its main aim being to consider the impact of TBI on moral reasoning. A specific age group, 17 to 25 years, was selected to capture a time when moral reasoning is suspected to reach maturity (Gibbs et al., 1992). In addition, it captures a period of later development than previous studies, when individuals are gaining their independence, separating from the family network, a time of increasing responsibility (Morton & Wehman, 1995; Turkstra et al., 2008). This is a time when true deficits from TBI are often recognised (Eslinger et al., 1992). The study made a hypothesis that moral reasoning would be lower in the TBI group than the healthy comparison group. It

also had secondary aims to explore the relationships between moral reasoning and aspects of executive function, empathy and emotion-based decision making in both groups. The study made several hypotheses that better performance on these areas would correlate with higher moral reasoning.

This chapter will first consider the findings from this study in relation to each hypothesis and previous research. It will then consider the theoretical and clinical implications. It will proceed with a consideration of the strengths and limitations of the study before highlighting areas for future research. The chapter will conclude with a summary of the main findings of this study, strengths and limitations and main areas for future research.

4.2 Summary of the findings

The study compared 34 individuals in the healthy comparison group with 20 individuals in the survivors of TBI group on a measure of moral reasoning; SRM-SF (Gibbs et al., 1992). In addition, it explored the relationship between moral reasoning, as measured by the SRM-SF, and cognitive and emotion processes, based on theories of moral development. These included inhibition, measured by the CWI, cognitive flexibility, measured by the VF, and executive function difficulties, measured by the DEX. It also included empathy, measured by the EQ, and finally emotion based decision making, measured by the IRT. This chapter will now present the findings from these analyses and consider each one in relation to previous research.

4.2.1 Hypothesis 1

The primary aim and hypothesis was to explore whether survivors of TBI aged between 17 and 25 years demonstrated lower moral reasoning relative to the comparison group.

This hypothesis was supported by the findings. The healthy comparison group performed significantly better than the TBI group on the SRM-SF total score suggesting higher moral reasoning. In fact, the healthy comparison group were functioning at a higher moral developmental stage than the TBI group and demonstrated mature moral reasoning, at stage 3. This is consistent with the proposal that mature moral reasoning is reached by late adolescence/ early adulthood (Gibbs et al., 1992). The TBI group did not demonstrate reasoning at this stage, and therefore, is suggestive of a moral developmental delay, consistent with previous research. Several case studies have demonstrated moral reasoning difficulties in adults who have experienced a brain injury during childhood (Anderson et al., 1999; Gratton & Eslinger, 1992; Price et al., 1990). Additionally, the findings from this present study support evidence from group studies. For example, Anderson et al. (2009) showed difficulties with complying with moral standards, laws and rules following a brain injury. Similarly, moral reasoning difficulties were shown in children with frontal lobe injuries (Couper et al., 2002) and adolescents with TBI (Beauchamp et al., in press). In summary, therefore, the findings from this study, alongside those from previous research using different individuals and different measures of moral reasoning, demonstrate a consistent finding, of moral reasoning difficulties following a TBI in childhood to young adulthood.

The study used an age, sex, and SES matched comparison group. These variables had not been controlled for in all the previous studies (Couper et al. 2002). As expected, there was a correlation between moral reasoning and intellectual functioning (Hoffman, 1977; Johnson, 1962). The study found a significant difference in intellectual functioning between the groups, however, the difference in moral reasoning between the groups was retained when intellectual functioning was accounted for by the analyses. This suggested that the difference between the groups on moral reasoning could not be explained by the variance in

IQ, and is consistent with case studies showing moral reasoning deficits in the context of average intelligence (Anderson et al., 1999; Anderson et al., 2009; Price et al., 1990). The current study findings implied that difficulties in moral reasoning could not be explained by sex, age, SES or intellectual functioning which is consistent with Beauchamp et al. (in press). This implication highlighted the need to identify other factors that may underpin difficulties in the area of moral reasoning.

This study also explored the sub-domains of moral reasoning, captured by the SRM-SF, which has not been previously researched in a TBI group (Couper et al., 2002). The study revealed that the healthy comparison group performed significantly better than the TBI group, across all the domains of Contract, Truth, Affiliation, Life, Property, Law and Legal Justice. Both groups displayed a relative lower moral reasoning stage in the Property domain compared to performance in the other domains. Furthermore, these exploratory analyses revealed that the differences remained between the groups on the Contract, Affiliation, Life and Law domains, once IQ had been removed from the analysis. The differences did not, however, remain in the Truth, Property and Legal Justice and, therefore, suggested that these could be accounted for by the variance in IQ between the groups. These findings may imply that the TBI group may have greater difficulties in some areas of moral reasoning. It may also suggest that different aspects of moral reasoning may depend on different functions.

This study has also provided evidence of moral reasoning difficulties at a later stage in the developmental trajectory - young adulthood. Studies exploring the impact of TBI during adulthood have reported that moral reasoning is intact, aside from the proposed relationship between VMPFC damage and disruption to personal moral dilemmas. These studies, however, have focused on injuries sustained during mid-adulthood. In this current study, the TBI group included individuals who had sustained injuries in early adulthood and, therefore, may suggest that young adults who had sustained a TBI were still vulnerable to

moral reasoning difficulties. A few of the participants, however, had sustained their injuries earlier in life. The negative correlation between age at onset and moral reasoning is suggestive of greater disruption to moral development for individuals with an earlier injury and this may account for the absence of moral reasoning difficulties from adulthood injury research studies (Ciaramelli et al., 2007; Koenigs et al., 2007; Martins et al., 2012; Moretto et al., 2009; Saver & Damasio, 1991; Thomas et al., 2011). It may also support the research suggestive of greater residual deficits after a childhood TBI (Catroppa et al., 2008).

The age group captured in this study had not been examined before. Previous studies have queried whether the difficulties in moral reasoning were reflective of a delay or arrested development (Anderson et al., 1999; Couper et al. 2002; Grattan & Eslinger, 1991). Couper et al. (2002) showed children with frontal lobe injuries had moral justifications within the stage 2/ stage 2 (3) levels. In this study, using the same measure, the young adults demonstrated a higher stage of moral development, Stage 2 (3) stage, than the younger participants in the Couper et al. (2002) study. Whilst this was a separate group of individuals, it may suggest that moral development following brain injury may be delayed in comparison with their peers but perhaps not arrested.

The study did not obtain sufficient information about the damage for further analyses on the impact of severity and localisation on moral reasoning deficits. A previous study attributed the absence of significant moral reasoning difficulties to the mild severity of the TBIs in the sample (Dooley et al., 2010). More recently, Beauchamp et al. (in press) has demonstrated greater moral reasoning deficits in adolescents with mild and moderate/severe TBI when compared to a healthy comparison group. This current study was unable to explore this further, as the majority of the sample had sustained a severe TBI. Nevertheless, it did reveal moral reasoning difficulties following a severe TBI which was consistent with previous research (Beauchamp et al., in press).

It was not possible to explore the impact of specific localisation on moral reasoning as the scan data were only available for eight individuals. Nevertheless frontal lobe damage was reported in six scans consistent with previous studies suggesting frontal/temporal lobe damage was common after a TBI (Bigler, 2007; Salmond et al., 2006). Given the moral reasoning deficits in this group of survivors of TBI and previous groups (Beauchamp et al., in press), it may support the suggestion that moral reasoning is dependent on processes conducted by the frontal lobe. This is consistent with the study by Raine and Young (2006) which revealed neuro-imaging findings of activation in the prefrontal cortex during moral reasoning.

In summary, the study revealed that the young adult TBI group had significantly lower levels of moral reasoning than the healthy comparison group. The study indicated that age, sex, SES and IQ could not account for these differences in overall moral reasoning. This finding supported the hypothesis and is consistent with previous research. Further exploratory analyses revealed differences between the groups in the sub-domains of moral reasoning, Contract, Truth, Affiliation, Life, Property, Law and Legal Justice. Interestingly, some of these differences, however, could be accounted for by variance between the groups in IQ, i.e. sub domains of Property, Truth and Legal Justice. The performance on the domains after a TBI has not been previously explored.

4.2.2 Research question 2

The study aimed to explore what factors relate to moral reasoning in both groups separately. The power equation suggested a sample size of thirty individuals in each group to explore these relationships. Data were available for thirty-four participants in the healthy comparison group and twenty participants in the TBI group. The proposed sample size was therefore not reached in the TBI group. Given the exploratory nature of these research

questions and the power issues, these findings should be interpreted with caution and treated as preliminary.

4.2.2.1 Hypothesis 2, 3 and 4 - Moral reasoning and Executive Functions

Based on previous studies and taking into account theory, it was hypothesised that moral reasoning would be related to executive function difficulties and that greater executive function difficulties and lower inhibition and cognitive flexibility would be associated with lower moral reasoning scores.

A significant negative correlation was revealed between executive function difficulties and moral reasoning in the healthy comparison group and this was a medium effect size. This suggested executive function difficulties explained some of the variance in moral reasoning and that fewer difficulties in executive function were associated with higher moral reasoning which supported the hypothesis.

It has been suggested that the DEX questionnaire, is better understood by three individual constructs; Executive cognition, Behavioural-emotional self-regulation and Metacognition (Simblett & Bateman, 2011). The study revealed a significant negative correlation in the healthy comparison group between moral reasoning and the Executive cognition domain. This finding may indicate, therefore, that the Executive cognition domain may be the particular aspect of executive functioning important to moral reasoning. The Executive cognition domain captures controlled processes such as planning, monitoring, switching and directing automatic function.

This was consistent with findings from the comparisons between moral reasoning and other measures of executive function. Cognitive flexibility and Inhibitory control are processes within the Executive cognition domain. Significant positive correlations were revealed between moral reasoning and cognitive flexibility in both groups with medium and

medium to large effect sizes reported in the healthy comparison and TBI group respectively. This suggested that cognitive flexibility accounted for some of the variance in moral reasoning and indicated individuals with higher cognitive flexibility had higher moral reasoning. A significant positive correlation of medium effect size was also revealed between moral reasoning and inhibition in the healthy comparison group. This indicated that some of the variance in moral reasoning was shared by inhibition. In addition, it supported the hypothesis that individuals with higher levels of inhibitory control would have higher moral reasoning. Significant correlations were not reported in the TBI group, between inhibition and moral reasoning, and this may be because many participants underperformed on this subtest and there was a lack of variability in the dataset.

The findings from the healthy comparison group supported the hypotheses and were supportive of studies which have shown correlations between moral reasoning and cognition (Cottone et al., 2007; Lee, 1971; Tomilinson-Kearsey & Kearsey, 1974) and specific correlations between moral reasoning and inhibition (Cottone et al., 2007). It was also consistent with the case studies which have demonstrated executive function deficits alongside moral reasoning deficits (Gratton & Eslinger, 1992; Price et al., 1990) and in contrast, no deficits in either domain following adult brain injury (Saver & Damasio, 1991). Furthermore, it was in line with others studies that have shown co-existing cognitive flexibility deficits and moral reasoning deficits in brain injury samples (Price et al., 1990; Anderson et al., 1999). The current study reported larger correlations between these domains and moral reasoning in the healthy comparison group than previous studies but could not account for all of the variance in moral reasoning.

Significant correlations between executive functioning domains and moral reasoning were not reported in the TBI group, apart from cognitive flexibility. It is likely that given the small sample, the study did not have enough power to detect significant relationships. The

study did reveal coexisting differences, however, between the groups on moral reasoning and cognitive flexibility, inhibition and executive-cognitive domain. The healthy comparison group performed significantly better on all of these domains. This may infer that the aspects of executive function captured by this study may contribute to moral reasoning, thereby supporting the link between moral and cognitive development (see theoretical implications section), and encourage future research.

4.2.2.2 Hypothesis 5 - Moral reasoning and Empathy

The study also aimed to explore the relationship between moral reasoning and empathy, as measured by the EQ, and predicted a positive correlation between empathy and moral reasoning.

The hypothesis was supported in the healthy comparison group, where a significant positive correlation of a medium effect size was revealed between empathy and moral reasoning. This suggested that empathy may explain some of the variance in moral reasoning. There was no significant correlation between these variables in the TBI group.

The finding in the healthy comparison group was consistent with previous research. This was in line with the finding of co-existing moral reasoning and empathy deficits in brain injury studies (Graffton & Eslinger, 1992; Price et al., 1990). It was also consistent with a similar finding in individuals with intellectual disabilities (Langdon et al., 2011). The non significant correlation in the TBI group may be explained by the smaller sample size. This study did reveal significantly higher levels of moral reasoning and empathy in the healthy comparison group compared to the TBI group and this may suggest they are related. Indeed a larger study has revealed a significant positive correlation between empathy and moral reasoning in a TBI population (Beauchamp et al., in press).

4.2.2.3 Hypothesis 6 – Moral reasoning and Emotion-based decision making

Based on theoretical background suggestive of the role of intuition and emotion-based decision making in moral reasoning (Damasio, 1994; Haidt, 2001), a final hypothesis was made that there would be a positive correlation between moral reasoning and emotion-based decision making. These did not quite meet significance. In addition, there was not a significant difference between the groups in their performance on this task across the 100 deck selections or across the five blocks. Furthermore, there was no learning curve over the five blocks for either group.

In addition no significant difference was reported between participants on the Behavioural-emotional self-regulation sub domain of the DEX which may tap into a similar function. This is not consistent with previous research that has indicated individuals who have sustained a brain injury have difficulties with emotional processing. Anderson et al. (1999) demonstrated that individuals with a brain injury did not demonstrate anticipatory skin conductance responses (SCRs) in a similar gambling task and inferred this represented difficulties in emotion based decision making. Furthermore, Adlam, Turnbull, Yeates and Gracey (submitted; personal communication) found that adults with TBI showed poorer performance on an emotion-based decision-making task (the Bangor Gambling Task; BGT, Bowman & Turnbull, 2004), as reflected by a delay in learning to select the profitable stimuli.

4.3 Theoretical implications

The findings from this study have a number of theoretical implications. The implications for moral reasoning and brain development theories will be reviewed in turn.

This study has contributed to the understanding of the impact of brain injury on moral reasoning. The significant finding of delayed moral development in the TBI group,

combined with the correlations with cognitive components of executive function, provides support for the cognitive developmental theories of moral development. These theories suggest that moral reasoning is a construct which develops in stages, alongside brain development (Gibbs et al., 1992; 2010; Kohlberg, 1969, 1976; Piaget, 1968). Mature moral reasoning requires an individual to move their focus from salient features to incorporate the wider societal and cultural context (Gibbs et al., 1992). The differences between immature and mature moral reasoning were demonstrated between the groups. The TBI group would often consider the personal consequences of the act or pragmatic reciprocity and some were beginning to consider the emotional states of others to make their decisions. The healthy comparison group made more justifications incorporating the pro social understanding of care, emotional states and wider society, demonstrating more mature moral reasoning. This study has, therefore, supported the suggestion that moral development is a staged process which may be delayed by disruptions to brain development. Furthermore, it indicated that disruption leads to global delay across all the constructs of moral reasoning. The finding of stage 3 (and not stage 4) reasoning in the healthy comparison group supports the suggestion that moral reasoning continues to develop into early adulthood (Gibbs et al., 1992). This is contradictory to the earlier suggestion that development is complete by adolescence (Piaget, 1968; Kohlberg & Gilligan, 1971). Moreover, this may support the importance of brain development for moral development as the brain continues to develop up until the third decade (Gogtay et al., 2004; Lenroot & Giedd, 2006).

The study may also have implications for the understanding of the processes that underpin moral reasoning. Traditional cognitive developmental theories suggest the importance of cognitive maturation and social experience to moral development (Kohlberg, 1969, 1976; Piaget, 1968). These factors are considered to enable opportunities for conflict and resolution in interactions with others (Selman, 1971) and require cognitive maturity to

support this process (Walker & Taylor, 1991). Cognitive processes enable options to be considered, allow inhibition of inappropriate responses (Eslinger et al., 2004; Gibbs et al., 1992; 2010; Kohlberg, 1969, 1976; Piaget, 1968) and encourage an awareness of wider societal issues alongside empathy (Gibbs et al., 1992; Hoffman, 2000; 2008). Contrary to this view is the social intuitionist model of moral judgement (Haidt, 2001), which suggests moral judgements and actions are based on intuition; a sudden automatic and effortless decision. Similarly, the somatic marker hypothesis (Damasio, 1994) suggests signals from the body indicative of emotional response, somatic markers, trigger rapid decisions in the absence of cost-benefit analysis. A further suggestion is the dual-process theory, which implies cognitive and emotion processes are important for moral reasoning (Greene & Haidt, 2002). The findings in the healthy comparison group appeared to support the role for cognitive processes. Some of the variance in moral reasoning was accounted for by intellectual function, inhibition, cognitive flexibility, and empathy. In addition, there was a significant correlation between cognitive flexibility and moral reasoning in the TBI group. Furthermore, the healthy comparison group demonstrated higher levels than the TBI group in areas of inhibition, empathy and fewer executive function difficulties, alongside higher levels of moral reasoning. These findings appeared to support Gibbs et al. (1992; 2010) and Greene and Haidt (2002) theories which suggest moral development is dependent on cognitive and emotional constructs. The non significant correlations in the TBI group may be reflective of the smaller sample size and lack of variability in the data set.

Exploratory analyses revealed group differences across all the domains of moral reasoning, with the healthy comparison group consistently demonstrating higher levels of moral reasoning than the TBI group. Interestingly, there were differences in performance across the individual constructs of moral reasoning. The healthy comparison group reached stage 3, mature stage of moral reasoning, across all the domains, apart from the Property

domain. This finding is consistent with Gibbs et al. (1992) proposal that moral reasoning develops until early adulthood. Similarly, the TBI group demonstrated a lower moral reasoning stage in this domain compared to other domains. Furthermore, variance in intelligence between the groups appeared to impact on the domains differently. Variance in IQ, accounted for the differences between the groups, across the domains of Truth, Property and Legal Justice but not in the other domains. This is the first study to examine these domains in a TBI population and no prior hypotheses were made about the individual domains. These findings suggest that the differences between the groups varied across the domains. It may also suggest that the different aspects of moral reasoning should be explored separately, as they may develop differently and may be dependent on different processes. Future research is suggested. Nevertheless, it is consistent that intellectual functioning is a construct underpinning moral reasoning, supportive of the cognitive development theories (Gibbs et al., 1992; 2010; Kohlberg, 1969, 1976; Piaget, 1968).

Unexpectedly, the study did not reveal significant differences between the groups on the IRT or on the behavioural-emotional self-regulation construct on the DEX. Furthermore, there were no significant correlations between these measures and moral reasoning in either group. This study did not, therefore, support the role of intuition and automatic decision making in moral reasoning (Damasio, 1994; Haidt, 2001). This may indicate that the findings provide more support for the cognitive developmental theories, (Piaget, 1968; Kohlberg 1969, 1976; Gibbs et al., 1992; 2010) implying that moral reasoning has a greater dependence on cognitive processes than intuition or emotion based decision making. This finding was unexpected and is not consistent with previous research and may be explained by the small sample size or the selection of the measure (see Strengths and Weaknesses section below). Therefore, the role of these processes in moral reasoning cannot be ruled out.

Another perspective may be that there were no significant differences in emotion-based decision-making because the study captured moral reasoning during development. It might be that whilst moral reasoning is still developing, it is more effortful and dependent on cognitive processes. In contrast, by adulthood, it may be less effortful, more automatic and have greater dependence on emotion based decision making. In adulthood, moral reasoning may be more dependent on the signals from the body, somatic markers, indicative of emotional response, which trigger rapid decisions in absence of cost benefit analysis (e.g. Somatic marker hypothesis; Damasio, 1994). These two different processes mirrors the distinction between Type I and 2 systems in decision-making (e.g. Kahneman, 2003). This may explain the divide in studies examining moral reasoning following childhood/ young adolescence and adulthood TBI. Studies have consistently shown moral reasoning deficits following childhood/ adolescence injuries (Anderson et al., 1999; 2009; Beauchamp et al., in press; Couper et al., 2002; Dooley et al., 2010; Graffton & Eslinger, 1992; Price et al., 1990). Conversely research to date has not shown moral reasoning deficits following adulthood injury (Ciaramelli et al., 2007; Koenigs et al., 2007; Martins et al., 2012; Moretto et al., 2009; Saver & Damasio, 1991; Thomas et al., 2011). Instead adult studies have presented specific moral reasoning deficits in relation to personal moral dilemmas when there has been damage to the ventro-medial PFC, an area hypothesised to be vital for emotion processes. This requires further examination. This current study captured individuals at a single time point and moral reasoning would have to be measured at various points through the development trajectory, in the same individuals, to ascertain how this relates to cognitive and emotion functioning.

Whilst this study has indicated that some of the variance in moral reasoning was accounted for by executive functioning and empathy, these factors did not account for all the variance. There are, therefore, other factors which impact on moral reasoning that this study

did not capture. This may be other unmeasured executive functions or emotion-based decision making. Another possible factor may be social experience as Kohlberg (1969, 1976) suggested that social opportunities for conflict and resolution were important to moral reasoning. This is believed to be dependent on cognitive maturity to support this process (Walker & Taylor, 1991), but also having these social experiences would be necessary. It may be that disruption in quality and quantity of social experiences following a brain injury may impact on moral reasoning development. This disruption may be caused by pre-morbid factors, the result of the adjustment to the brain injury, the level of support available and familial factors. Studies have revealed increased family burden and stress; increased levels of parental psychological difficulties; and problematic peer relationships following TBI in childhood (Stancin et al., 2010; Tonks et al., 2010; Wade et al., 1996). In keeping with this, family factors have been shown to mediate outcome from TBI (Crowe et al., 2012; Rivera et al., 1994; Yeates et al., 2010).

The finding of lower moral reasoning in young adults following a TBI may have implications for the understanding of brain development. Although specific localisation information was not obtained for every participant in the TBI, the majority of the available information revealed frontal lobe damage. This supported the widely accepted understanding that TBI causes damage to the frontal lobe, in particular the PFC (Bigler, 2007; Salmond et al., 2006; Wallesch et al., 2001) due to the close proximity of this area to the bony aspects of the skull (Bigler, 2007) and the acceleration-deceleration force of the incident (Donders, 2006; Yeates, 2010). Consequentially, the finding of this study revealed moral reasoning deficits following this damage and, therefore, may support the role of the PFC in moral reasoning.

Furthermore, the study revealed moral reasoning deficits in young adults who had sustained a TBI. Most of the TBIs had been sustained in late adolescence/ early adulthood.

This was consistent with previous research which has revealed moral reasoning deficits following brain injury during childhood and adolescence. The study also revealed moral reasoning difficulties after injury in early adulthood and it is the first study to have examined this part of the developmental trajectory. This is consistent with the understanding that structural brain development completes in the frontal lobes in the early twenties for females and mid twenties for males (Belsky & de Haan, 2011; Sowell et al., 2004). This is the area considered important for moral reasoning as it is responsible for executive function and emotion processing (Gogtay et al., 2004). The findings from this study support, therefore, the theory that injury to the brain during development causes deficits. The study did find a correlation between age at injury and moral reasoning deficits which suggested that earlier damage was associated with greater deficits in moral reasoning. There were only two participants, however, who had sustained their injury in early childhood and therefore conclusions about this are tentative. Nevertheless, it may contradict the traditional theories, namely the Kennard Principle (Finger & Wolfe, 1988; Kennard, 1936) which has suggested that the young brain is resilient to damage due to plasticity and adapts to counteract the lesions (Buchwald, 1990). The findings were also in line with more recent theories suggesting the developing brain is more vulnerable to damage due to the neck to head ratio; thinner cortex (Catroppa et al., 2008), limited cognitive reserves to aid recovery (Savage, 2009); and disruption to the prolonged development of the brain (Gogtay et al., 2004; Lenroot & Giedd, 2006). Likewise it was consistent with the crowding hypothesis that suggests that early damage disrupts the brain structural development by distorting the creation of new structures and limiting the elaboration and usage of earlier ones (Black et al., 1998; Cicchetti, 2002; Greenough & Klintsova, 1999). Furthermore, some argue brain development is moulded by experience and genes and therefore, it could be suggested that a TBI disrupts these experiences, thereby altering the development (Karmiloff-Smith, 1998, 2006;

Westermann et al., 2007). Further research is required to examine moral reasoning in a greater number of participants at various ages on the developmental trajectory to make more robust conclusions.

Although the study indicated that an early injury was associated with greater moral reasoning deficits, it was unable to explore the impact of an injury at different stages in this trajectory on moral reasoning. Nevertheless, the TBI group in the current study demonstrated a higher level of moral reasoning ability than the group in the Couper et al. (2002) study. In fact, using the same measure, the individuals in the current study were at a later stage in the developmental trajectory; young adulthood, than the individuals in the Couper et al. (2002) study. Together, these studies may support the theory that early injury leads to greater difficulties or the "neuro-cognitive stall" hypothesis that injury slows the rates of cognitive, social and motor development (Chapman, 2007) but may not limit development to pre-injury skills (Ewing-Cobbs et al., 2003). These conclusions are tentative as they captured different individuals. A future study assessing moral reasoning at different stages of the developmental trajectory in the same individuals would provide more robust conclusions as to whether the difficulties were a consequence of a delay or plateau.

This study also has implications on the understanding of brain-behaviour links. The PFC is considered responsible for executive functions and emotional responsivity (Knabb et al., 2009). This may be supported by the findings that the healthy comparison group performed better than the TBI group on assessments of executive function and empathy.

Overall, to summarise the theoretical implications, the study does support the suggestion that moral development is dependent on frontal system functioning. In keeping with this, disruption to brain development, through TBI, appeared to delay moral development. It suggests that cognitive processes, in particular executive functions and empathy, may be important for this. The impact of emotion-based decision making and

intuition needs to be revisited as this study did not provide support for this which may be explained by limitations in the methodology. Furthermore, the variables captured by this study did not account for all of the variance in moral reasoning, which suggests there may be other processes that explain this difference between the groups.

4.4 Clinical Implications

This chapter will now consider the clinical implications for understanding the impact of brain injury, and for the wider legal justice system. The findings from this study, alongside previous research, have indicated that brain injury during childhood/ adolescence and early adulthood may cause moral reasoning deficits. This has important clinical implications, as links between moral reasoning and offending behaviour and social difficulties have been consistently reported in offending populations (Nelson et al., 1990; Palmer & Hollins, 1998; Stams et al., 2006; Van Vugt et al., 2011) and a direct correlation between moral reasoning, legal order and society function has been suggested (Beauchamp & Anderson, 2010). Moral reasoning deficits may therefore underpin the widely reported behavioural and social functioning difficulties following a TBI. Several studies have consistently demonstrated that a TBI can have negative impact on social functioning (Anderson et al., 2000; 2005), behavioural regulation (Yeates, 2010); emotional wellbeing (Tonks et al., 2010) and peer relationships (Bohnert et al., 1997). Young adult survivors of TBI have been shown to have a significant reduction in friendships (Morton & Wehman, 1995). TBI has also been associated with conduct problems (Anderson & Catroppa, 2006), higher levels of violence and antisocial behaviour (Damasio, 1996; Stoddard & Zimmerman, 2011) and greater behavioural difficulties (Catroppa et al., 2012). In addition, there is growing research which has suggested TBI is related to an increased risk of offending behaviour (Leon-Carrion & Ramos, 2003; Luiselli et al., 2000; Timonen et al., 2002) and a

high prevalence of TBI history reported in prison samples (Barnfield & Leathe, 1998; Perron & Howard, 2008; Slaughter et al., 2010; Williams et al., 2010).

Given the fact there appears to be deficits in moral reasoning following TBI and the possibility that these may contribute to these difficulties in social function, behavioural function, and even offending behaviour, it is important to consider how these relate to clinical implications. The literature understanding difficulties to moral reasoning is still developing and therefore it is not suggested that everyone following TBI will have deficits. However, brain injury services should be aware of these potential difficulties in moral reasoning, so they can assess them on an individual basis and provide appropriate support. The study findings have suggested TBI in earlier life may lead to more difficulties in moral reasoning which would suggest that a particular focus on monitoring and assessing individuals with a brain injury sustained during childhood could be useful. The study also supports the inclusion of regular assessments at different points throughout the developmental trajectory in order to recognise areas of difficulties and intervene. It may also indicate a need for extra caution and support during the period from adolescence to later adulthood when there is greater independence as the protection from familial structure disperses alongside greater social challenges (Eslinger et al., 1992). In addition, it may suggest a requirement for interventions to target possible deficits. It may be possible to use adaptations of the EQUIP programme (Gibbs et al., 1995). Furthermore, the study has suggested these difficulties may be due to a developmental delay, and therefore, interventions may support further development. It may be that greater recognition of these difficulties and targeted interventions may enable better social functioning and even reduce the risk of criminal behaviour in survivors of TBI

The study aimed to examine specific factors that may impact on the relationship between moral reasoning and TBI. This is important for economic and criminal interest (Zak,

2004) as knowledge of these factors can inform psychological, medical and environmental interventions to promote pro-social behaviour in wider society (Moll et al., 2005). This was the first study to examine the relationships between moral reasoning and cognitive and emotional factors in a TBI group design. Unfortunately, it did not reveal significant findings in the TBI group and this has limited the generalisability to this population. However, it did reveal, with the data available, that TBI resulted in damage to the frontal lobe and moral reasoning deficits, suggesting these are important factors impacting on the relationship between moral reasoning and TBI. Furthermore, processes commonly associated with the frontal lobe, executive function, inhibition and cognitive flexibility; did explain some of the variance in moral reasoning, in the healthy comparison group. This may have implications for the general population and legal justice system. Programmes designed to target anti-social behaviour and increase pro-social behaviour in offending populations, for example the EQUIP (Gibbs et al., 1995) may benefit from focusing on improving these functions. It may be that these programmes could be adapted to improve moral reasoning difficulties in the brain injury population. However, it is important to consider that this study did not identify all of the factors underpinning moral reasoning and therefore, future research is required to explore this further to inform adaptations of these intervention programmes.

The findings from the study may have other implications for the wider legal justice system. It demonstrated that overall moral reasoning within the healthy comparison group was within stage 3 - a mature stage of moral reasoning (Gibbs et al., 1992). The study examined individuals in late adolescence and early adulthood and supported a previous suggestion that moral reasoning does not reach maturity until this age (Gibbs et al., 1992). Given the link between moral reasoning and offending behaviour and the late onset of the moral reasoning, this area warrants further examination as at the moment in this country, individuals can be tried for a criminal offence at the age of ten.

4.5 Strengths and Weaknesses of the study

The findings of this study need to be interpreted in relation to an evaluation of the methodology. Methodological strengths and weaknesses of the design, participants, measures, procedure and data analysis will be considered in turn.

4.5.1 Design

There were a number of strengths in the study design. The between group design enabled the study to explore the difference in moral reasoning between the age, sex, and SES-matched healthy comparison group and TBI group. The design also enabled this difference to be explored whilst controlling for intellectual functioning across the groups. There were, however, some limitations to this finding, the study captured individuals at a single time point and, therefore, cannot make conclusions about the impact on later moral development. In addition, the between group design and small sample size did not enable within group analyses about severity, localisation and age at injury in the TBI group. This information would have enabled more specific conclusions to be drawn about the impact of type and age of TBI on moral reasoning.

The correlational design enabled the study to draw conclusions about the relationships between moral reasoning and other variables. Significant findings in the healthy comparison group could be considered in relation to theory and previous research. Due to the nature of the correlational design, however, there are limitations on the interpretations that can be made. The study could conclude that the variables accounted for some of variance in moral reasoning but were unable to conclude which accounted for more or make any causal links as it does not mean that these variables definitely caused this variation.

4.5.2 Participants

The strict eligibility criteria and the exclusion of mental health diagnoses and developmental disorders helped reduce the confounding variables in this study. In addition, the tight age range for recruitment reduced further variability. A further strength of the study was the heterogeneity of the comparison group. The sample was recruited from several places and the study collected information on age, sex and occupation. This enabled the study to demonstrate the groups were matched in age, sex and SES. The measures thus taken will have reduced confounding variables and enhanced the internal validity of the findings.

Furthermore, the study managed to recruit a sufficient number of participants in the TBI group to enable enough power to detect a difference in moral reasoning between the groups. They were recruited from various NHS and brain injury organisations in East Anglia to increase variability in the sample and maximise recruitment. In addition, the study examined moral reasoning in survivors of brain injury in early adulthood, aged between 17 and 25 years of age. This was a particular time point of interest which had been missed in previous studies. A focus on a particular age range may have reduced some variability within the groups.

The study also focused specifically on individuals who had sustained a TBI. There are difficulties pinpointing the exact localisation of the damage as CT scans are the most readily available method and they often do not have sufficient spatial resolution to detect frontal or temporal damage (Salmond et al., 2006). Nevertheless, research with more advanced technology has suggested TBI is associated with damage to these areas (Bigler, 1997). The focus on a TBI group was a strength as it may have increased the likelihood of examining damage in the frontal regions than would have been achieved in a wider acquired brain injury group. This was supported by the study, as when scan data was available; it mostly reported damage to the frontal regions.

There were, however, some factors within the study that may have limited the conclusions and generalisability of these findings. Whilst there were no significant differences found between the groups on age, sex or SES, there may have been some subtle differences. The healthy comparison group had a greater number of females, were slightly older and consisted of more professionals. These factors may have contributed to the higher level of moral reasoning. They may have been further in their moral development. It may have been helpful to have collected more information on the participants in order to understand about other potential differences between the groups which may have accounted for some of the other variance in moral reasoning. Areas for future focus should be familial factors and information on social and academic functioning for both groups.

It may have been useful to have collected further information in the TBI group to increase the understanding of the impact of TBI on moral reasoning. Specifically, this may have included information on support received, the impact and adjustment to the brain injury by the individual and family. It also would have been helpful to obtain further details on the localisation and severity of the brain injury.

There are some factors which may have limited the conclusions and generalisability of these findings to the wider population. The focus on a specific age range, one geographical area and individuals in receipt of service, for recruitment may have limited the generalisability to the wider population. In addition, a key limitation was the small sample size in the TBI group. Many participants underperformed on the measures and this reduced the variability in the data set. This may be due to the study capturing a group with severe TBIs with two participants within the first year of recovery this may have reduced the power to detect significant correlations between moral reasoning and the other variables in the TBI group. Furthermore, a larger sample size would have enabled more conclusions to have been made about the impact of TBI at different points along the developmental trajectory.

A final consideration about the participants in both groups is the fact they were able to consider whether they participated in this study for obvious ethical reasons. The fact every participant made this decision to participate and give up their time; potentially shows prosocial behaviour and empathy; and may suggest the study recruited individuals with higher moral reasoning for their population.

4.5.3 Measures

A strength of this study was the fact the measures were selected based on greater reliability and validity where possible. A further strength was the use of varied methods of assessment. This may have made the session more interesting and may have contributed to the paucity of missing data, thus increasing the reliability and validity of the findings.

There were some limitations in the measures. Some were timed tasks and the TBI group may have been compromised by fatigue, attention, language and slow processing difficulties rather than difficulties in the assessed domain. It was not possible to assess for all these confounding factors as it would have increased the burden for participants.

There were some further limitations in relation to specific measures. The study used a validated and reliable measure of intellectual functioning. It was, however, an abbreviated measure, WASI II, and this may have less validity than the full assessment of intellectual functioning such as the WAIS IV. Nevertheless this measure was chosen to reduce the time demand and it has been shown to demonstrate high levels of reliability with the WAIS IV. In addition, there may be some limitations in relation to the assessment of cognitive flexibility. The verbal fluency task, in particular category switching, has received criticism due to its level of internal consistency for this age group (Strauss, Sherman, & Spreen, 2006). This may have limited the reliability of the findings. This measure was selected because it was a verbal measure of cognitive flexibility (Delis et al., 2002), and short in duration, reducing the

burden on participants. An alternative measure of cognitive flexibility, for example the DKEFS Trails making task, has also received the same criticism about its reliability (Strauss et al., 2006). Executive function measures are still developing and current measures are criticised for their impurity as they often tap into several processes (Burgess, 2005). The development and use of a more robust measure would improve this study methodology, enhance reliability and lead to stronger conclusions. The limitations of this measure need to be considered when interpreting these findings.

There are some limitations in relation to the measure of socioeconomic status in this age group. Firstly, the sample size may have been too small to detect differences given the number of categories. Furthermore, there may be possible limitations of determining socioeconomic status by occupation in this particular age group. Some of the participants were undecided about their future career and were working in temporary employment. They may have much higher socioeconomic status than dictated by their occupation. In addition, if they were at University, their parent's occupation may not concur with their socioeconomic status. For the TBI group, they were asked their occupation at the time of the injury and some did not remember their parents' occupation therefore resulting in missing data. It also did not capture changes in SES or occupation since the injury. It may be more beneficial in future studies to capture the SES at both time points or to use another measure or incorporate a measure of pre-morbid individual and familial social and economic function.

In addition, the study used two self report measures, the DEX to capture executive function difficulties and the Empathy Quotient to measure empathy. The use of self report measures in brain injury populations has been criticised. It has been suggested that there can be problems with insight following a brain injury and as a consequence there is sometimes a distortion in an individual's awareness of difficulties (Bond, 2008). This study did not ask an independent rater to complete the EQ for the TBI group as previous studies have shown it to

be validated in the brain injury population without an independent rater (de Souza et al., 2010). In addition, another study did not report any significant difference between the self and independent rater in a brain injury group (Adlam et al., 2009). In this study there was no difference between the DEX self and independent rater. This may suggest they were aware of their situation and support the use of self report measures. An alternative view is that these findings may be due to the independent rater not fully understanding their relative's difficulties and a standardised objective measure of executive functioning may be a more valid assessment.

A further point is surrounding the reliability of the findings on the IRT in this study. A quarter of the TBI group terminated the task early and this resulted in missing data. Several participants in both groups criticised the measure for being slow and long. This may have affected the performance on the task as participants in the healthy comparison group described making guesses due to boredom and reduced concentration. The validation of this task provided participants with a small monetary token dependent on their outcome (Dunn et al., 2010) and this may have enhanced the performance. This study was unable to offer this. The possible loss of interest in the task may have reduced the optimal performance and may question the validity of the absence of significant differences between the groups and significant correlations with moral reasoning. Nevertheless, other measures of emotion-based decision making have limitations, the IGT is costly and has high cognitive load (Dunn et al., 2006), and an alternative, the BGT, has not demonstrated evidence of psycho-physiological correlates to performance. It may be worth re-examining the IRT in future studies, using monetary tokens or examining this measure in a shorter assessment battery, these modifications may overcome the difficulties in this study.

Another point for consideration is the selection of the moral reasoning measure, the SRM-SF. The methodology was strengthened by the use of this measure. It was a

production measure, thereby reducing the risk of social desirability bias (Langdon et al., 2010). It has also demonstrated reliability and validity across many different cultures and age groups (Gibbs et al., 2007), in a learning disability population (Langdon et al., 2010) and has been used in children with a brain injury (Couper et al., 2002). In addition, it can be delivered as an interview which enabled time and support. Scorable scripts were produced by every participant and this supports the use in the brain injury population. The researcher also achieved a high inter-rater reliability with an expert rater. There may, however, be some limitations. It may have been difficult for an individual with a brain injury to provide their full answer on the spot as a result of cognitive or language problems. The study tried to minimise the possible confounding problems by excluding individuals with language difficulties, however, there may have been some subtle difficulties and this must be considered when interpreting the results. Nevertheless, no measure of moral reasoning has been validated in the brain injury population and moral reasoning difficulties have been revealed in other studies where other measure have been used (Beauchamp et al., in press). The possible difficulties with the assessment may be similar to those encountered in everyday moral decision making. Another possible limitation is the fact this measure is based on Gibbs et al., (1992; 2010) theory. This may explain the absence of the correlation between the performance on this measure and emotion-based decision making. It may have been helpful to incorporate an additional measure of moral reasoning, i.e. the hypothetical scenarios measure which tapes into personal scenarios which may be more dependent on emotion processes.

Finally, the study would have benefited from assessments of social function. This would have enabled the relationship between the difficulties in moral reasoning and social function to have been explored in the TBI group. The assessments conducted in this session

took about two hours to complete and it was, therefore, not possible to be included, opening yet another avenue for future research.

4.5.4 Procedure

The study demonstrated a number of strengths. The assessments were counterbalanced to manage practice and fatigue effects which enabled other confounding variables to be controlled. In addition, breaks and number of sessions were determined by the individuals, who were visited at a place of convenience to them. This ensured the study measured the individual's best performance. This would have, however, created differences in the assessment sessions and may have limited the internal validity of the study.

4.5.5 Data analysis

Another strength of this study was the limited amount of missing data. Furthermore several of the variables met the assumptions for parametric tests. A couple of variables, however, did not meet the assumptions for parametric tests and these tests did not appear to have much variability in the data. For example, the data collected on the CWI lacked variability in the TBI group. Many participants underperformed on this subtest and this lack of variability may explain the non-significant correlations in the TBI group. In addition, violations in the parametric assumptions in the data meant non-parametric equivalent tests were used, these have been criticised for having less power to detect significant findings (Field, 2009). A larger sample size may have overcome this. The analysis failed to reveal significant findings in the TBI group. This is probably because there was not sufficient power to detect significant findings and hence a definite limitation in this study.

This study revealed a number of interesting findings but some of these need to be considered in the light of sample and data analysis limitations. Firstly a significant positive

correlation was revealed between age at injury and moral reasoning. This indicated that there were greater moral reasoning difficulties following an earlier injury. Caution needs to be applied, however, in interpreting this finding as the majority of the sample sustained their injury later in life and only two participants had early childhood injuries. This correlation was questionable, therefore, given the limited range of age at injury.

There were further limitations in relation to the secondary research question findings. The secondary research questions were exploratory as several correlations were conducted between moral reasoning and variables in small samples. Given the number of variables the sample size would have had to have been much bigger to accord with recommendations in this scenario. A sample size of 50 is recommended to examine relationships between two variables and it is suggested that this should be increased for each additional variable (Wilson, Van Voorhis & Morgan, 2007). Therefore the study did not meet the case variable ratio. Consequently, the small sample size due to recruitment difficulties may have compromised the reliability of the correlation coefficient as under these circumstances correlations can be unreliable possibly leading to larger results than the real effect (Field, 2003). In addition the small sample size may have increased the likelihood of inaccurate non-significant results due to insufficient power (type II error). Thus there were limitations in the correlations and the findings should therefore be treated as preliminary with caution applied in their interpretation. Nevertheless this was an exploratory study and the first to examine the relationships between moral reasoning and other variables in a TBI group. It has highlighted several areas for future research.

In summary, this section has reviewed several strengths in the study methodology. There are also some weaknesses, however, which need to be considered when making interpretations about the findings and may limit their generalisability whilst suggesting areas for further research.

4.6 Further research

The findings in this study have been consistent with previous research, that brain injury during childhood and adolescence impacts on moral reasoning development. The study assessed individuals during early adulthood. Some of the injuries were sustained within this period and, therefore, it has suggested that injury in early adulthood may lead to difficulties. It also indicated, however, that an earlier onset of the injury was associated with lower moral reasoning. This area needs to be explored further. It would be helpful to explore the differences in moral reasoning ability when injury is sustained at different ages which could be established by between group comparisons or by a longitudinal design. It would also be helpful to explore the different processes underpinning moral reasoning following childhood and adulthood injury.

The conclusions that could be drawn from this study have been limited by sample size and it would be helpful to consider these relationships in a larger sample which would enable more within group analyses. The study has suggested several possible areas to consider including localisation, age at onset, severity and the cause of injury. This would both help identify the factors which lead to moral reasoning deficits and help ensure assessment of those at highest risk, proving very beneficial given the demands on the current services.

This research area would benefit from a study comparing the different measures of moral reasoning and establishing the validity and reliability in this population. This would support future research and be useful to clinical practice.

The study has examined the relationship between moral reasoning and a few variables of cognitive and emotion processes. These variables, however, did not appear to account for all the variance in moral reasoning. Furthermore, the selected measures may have impacted on the reliability of the findings. Further research is required to develop more robust assessments of executive function. The study would encourage future research to explore

other possible variables and may also benefit from future studies which examine these variables with other measures for emotion-based decision making and intuition.

The study makes some suggestions about other variables to explore in future research. These suggestions are in relation to pre- and post- injury personal and familial characteristics. In this study, there was variability in the degree of impact the injury had had on their social functioning and on their family in the TBI group. It may be helpful to consider the pre- and post- injury personal and familial impact on moral reasoning. These factors may be important to examine as they may alter the social opportunities for conflict and resolution. These social opportunities for conflict and resolution have been highlighted by the social perspective taking theory as being an important contribution to moral development. Similarly, another factor which may impact on social experience and may be important to capture is level support following the brain injury. A brain injury can create a lot of distress for individuals and their families which, without the correct guidance, may not be managed in the most effective way. One example of this could be over-protection. The level of support the family receive from outside agencies, therefore, may have an impact on factors, in this particular situation, moral reasoning. They may not have opportunities for conflict and resolution, which in addition to their cognitive difficulties, may hinder their moral development. Finally it may be helpful to examine the, the amount of rehabilitative support they have received as this may have an impact on the factors considered to underpin moral reasoning, including cognitive factors. It appears important, therefore, to capture the impact these familial and support factors have on the relationship between moral reasoning and brain injury. If these are found to be important they could highlight a specific area for intervention.

The study also presented differences between the relationships between TBI and domains of moral reasoning and the impact of IQ. This was the first study to explore the different domains following brain injury. It may be helpful to pinpoint the different areas of

moral reasoning and consider the difficulties in each domain and look at variables underpinning each domain. This may help indicate where the difficulties may be, inform clinical assessment and enable targeted interventions. Future research is suggested as this was beyond the scope of this study.

Another area for future research is to examine the relationship between brain injury, moral reasoning, and social difficulties and / or offending behaviour. It has been implied that moral reasoning difficulties are likely to impact negatively on social and behaviour functioning and are related to antisocial behaviour and offending behaviour. This study has revealed moral reasoning difficulties after a TBI which may contribute to the social and behavioural difficulties and possible offending behaviour reported after a TBI. This warrants closer examination and it would be helpful to explore the relationship between moral reasoning and social and behavioural functioning in the TBI population. It may also be helpful to explore the relationship between TBI and anti social and offending behaviour and examine the role for moral reasoning. This could be examined in the offending population. It is hypothesised that moral reasoning would be a predictor of this relationship and if this is found it will create an avenue for intervention for offenders and preventative work for non offenders with a TBI. It may be that programmes such as EQUIP (Gibbs et al., 1995) could be adapted to improve moral reasoning following brain injury. A study has revealed good outcomes when this has been unveiled to three survivors of brain injury (Manchester et al., 2007) and the study would encourage further exploration.

4.7 Conclusion

This study has revealed moral reasoning difficulties, as measured by the SRM-SF, in a group of young adults who have experienced a TBI when compared to healthy comparison group. These findings suggest that moral reasoning deficits may be likely following a TBI

during childhood, adolescence, and early adulthood. They were also suggestive of greater difficulties following a TBI sustained early in life. The difference between the groups could not be attributed to differences in age, sex, SES or general intellectual function. Further analysis has revealed intellectual functioning, inhibition, cognitive flexibility and empathy may explain some of the variance in moral reasoning.

These findings have theoretical and clinical implications. They provided some support for the cognitive developmental theories of moral reasoning and for involvement of the frontal lobe in moral reasoning. They also suggest the need to be aware of possible moral reasoning difficulties following a TBI. These difficulties in moral reasoning following a TBI may contribute to the behavioural and social difficulties commonly reported after TBI. Further studies are also encouraged to examine the relationship between TBI, moral reasoning and social functioning, in particular offending behaviour. These areas for future research may help identify targets for intervention.

The findings from this study are limited by methodological weaknesses, in particular a small sample size and selection of measures. Further studies with larger samples are suggested to help pinpoint the underlying factors of moral reasoning. Furthermore the factors measured in this study did not account for all the variance in moral reasoning which may be useful to explore in further studies. Other areas for consideration are suggested; pre and post social and behaviour factors and specific injury characteristics including age at injury, severity and localisation. Furthermore, exploratory analyses indicated that there may be differences in performance across the domains of moral reasoning, this requires further research.

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Appendix A Ethical Approval

This section includes the approvals from NHS Ethics. They also include an approval of the substantial amendment 2 to include extra documents for the Norfolk Community Health and Care Trust, Colman Centre. The study sought approval to widen the criteria to Acquired Brain Injury. This was not acted on. It also includes the approval from Brain Injury Rehabilitation Team (BIRT) ethics committee.

NHS
Health Research Authority
NRES Committee East of England - Hertfordshire
Victoria House
Capital Park
Fulbourn
Cambridge
CB21 5XB

Telephone: 01223 596806

31 August 2012

Miss Lucy Wigg
Trainee Clinical Psychologist
Cambridgeshire and Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

Dear Miss Wigg

Study title:	Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making.
REC reference:	12/EE/0391

Thank you for your email of 10th August 2012, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved by the sub-committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

1.The favourable opinion is subject to the following conditions being met prior to the start of the study.

1. The Information Sheet needs to provide a local telephone number and address for the PALS service.
2. The Consent Form, group one: the form needs to give the participant the option to decline to be contacted in the future, so the following changes need to be made:
(i) Add the word "optional" at the end of statement 10, after the words "Dr Anna Adlan's research team" and
(ii) Have both a "yes" and a "no" box, in place of the single box. So that participants ring, or tick one of those boxes. Please resubmit with a new date and version number ("version 3", or "version 2.1")

2. Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. Confirmation should also be provided to host organisations together with relevant documentation.

Approved documents

The documents reviewed and approved by the Committee are:

Document	Version	Date
Advertisement	Recruitment Poster 2	09 August 2012
Covering Letter	from Lucy Wigg	02 August 2012
GP/Consultant Information Sheets	1	25 June 2012
Investigator CV	Lucy Wigg	02 August 2012
Investigator CV	Anna Adlam - Academic Supervisor (1)	
Investigator CV	Peter Langdon - Academic Supervisor (2)	07 August 2012
Email correspondence between Angela Bentley, Taylor Whites and Headway Norfolk and Waveney		16 May 2012

Notice of Substantial Amendment#1 dated 10/08/2012		10 August 2012
Participant Consent Form : -Contact Details	2	09 August 2012
Participant Consent Form : Group 1 (TBI)	2	09 August 2012
Participant Consent Form : Group 2 (Control)	2	09 August 2012
Participant Consent Form : Relative	2	09 August 2012
Participant Information Sheet: Group 1 (TBI)	2	09 August 2012
Participant Information Sheet: Group 2 (Control)	2	09 August 2012
Participant Information Sheet: Relative	2	09 August 2012
Protocol	2	10 August 2012
Questionnaire : Social Reflection Questionnaire	(validated)	
Questionnaire : Empathy Quotient	(validated)	
REC application	IRAS Parts A&B 108103/350221/1/750	02 August 2012
Response to Request for Further Information	from Lucy Wigg	10 August 2012
Summary/Synopsis	1	28 June 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

Further information is available at National Research Ethics Service website > After Review

12/EE/0391	Please quote this number on all correspondence

With the Committee's best wishes for the success of this project

Yours sincerely

PP. Har Hari Kaur

Dr Steve Eckersall
Chair

Email: har.hari.kaur@eoe.nhs.uk

Enclosures: *"After ethical review – guidance for researchers"*

Copy to: Miss Lucy Wigg
[redacted]

Yvonne Kirkham
[redacted]

Beth Mubirew, Cambridge and Peterborough Foundation Trust
[redacted]

NHS
Health Research Authority
NRES Committee East of England - Hertfordshire
Victoria House
Capital Park
Fulbourn
Cambridge
CB21 5XB

Telephone: 01223 596306

16 October 2012

Miss Lucy Wigg
Trainee Clinical Psychologist
Cambridgeshire and Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

Dear Miss Wigg

Study title:	Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making.
REC reference:	12/EE/0391

Thank you for your email of 10th October, confirming the new documents. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 31 August 2012.

Documents received

The documents received were as follows:
List of revised documents:

Document	Version	Date
Covering Letter	Email from CI Lucy Wigg	10 September 2012
Participant Consent Form: Contact Details	Version 3	12 September 2012
Participant Consent Form: Group 1	Version 3	12 September 2012
Participant Information Sheet: CCS	Version 3	12 September 2012
Participant Information Sheet: NCHC	Version 3	12 September 2012
Participant Information Sheet: CPFT	Version 3	12 September 2012

Approved Documents

The final list of approved documentation for the study is therefore as follows:

Document	Version	Date
Advertisement	Recruitment Poster 2	09 August 2012
Covering Letter	from Lucy Wigg	02 August 2012
GP/Consultant Information Sheets	1	25 June 2012
Investigator CV	Lucy Wigg	02 August 2012
Investigator CV	Anna Adlam - Academic Supervisor (1)	
Investigator CV	Peter Langdon - Academic Supervisor (2)	07 August 2012
Email correspondence between Angela Berlo, Taylor Whites and Headway Norfolk and Waveney		16 May 2012
Notice of Substantial Amendment#1 dated 10/08/2012		10 August 2012
Participant Consent Form : -Contact Details	2	09 August 2012
Participant Consent Form : Group 2 (Control)	2	09 August 2012
Participant Consent Form : Relative	2	09 August 2012
Participant Information Sheet: Group 2 (Control)	2	09 August 2012
Participant Information Sheet: Relative	2	09 August 2012
Protocol	2	10 August 2012
Questionnaire : Social Reflection Questionnaire	(validated)	
Questionnaire : Empathy Quotient	(validated)	
REC application	IRAS Parts A&B 108103/350221/1/750	02 August 2012
Response to Request for Further Information	from Lucy Wigg	10 August 2012
Summary/Synopsis	1	28 June 2012
Covering Letter	Email from CI Lucy Wigg	10 September 2012
Participant Consent Form : Contact Details	Version 3	12 September 2012
Participant Consent Form : Group 1	Version 3	12 September 2012
Participant Information Sheet: CCS	Version 3	12 September 2012
Participant Information Sheet: NCHC	Version 3	12 September 2012
Participant Information Sheet: CPFT	Version 3	12 September 2012

You should ensure that the sponsor has a copy of the final documentation for the study. It is the sponsor's responsibility to ensure that the documentation is made available to R&D offices at all participating sites.

12/EE/0391	Please quote this number on all correspondence

Yours sincerely

pp. Har Hari Kaur

Ms Har Hari Kaur
Assistant Committee Co-ordinator

NHS
Health Research Authority

NRES Committee East of England - Hertfordshire
Victoria House
Capital Park
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22 January 2013

Miss Lucy Wigg
Trainee Clinical Psychologist
Cambridgeshire and Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

Dear Miss Wigg

Study title:	Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making.
REC reference:	12/EE/0391
Amendment number:	Amendment #2
Amendment date:	18 December 2012
IRAS project ID:	108103
Amendment Summary:	I have been asked by one of my recruitment sites to provide a script to be used by their therapists to inform the individuals about the study. The Colman Centre, Norwich have asked for a script to aid this process. They will then leave the participant information sheet with the individual to review. They will see if the participant is interested on the next visit and if so they will seek consent to share contact details. In addition this same recruitment site has asked for a flow diagram to assist them with the process. They would also like to keep a record of who in their service has been asked to participate; this is to avoid the same individual being asked several times. This would be kept on their shared drive which is protected by NHS password systems. They will operate this and the researcher will have no access to it. I have attached both of these documents for ethical review. In addition I submit a further amendment to seek ethical approval to widen my inclusion criteria to individuals who have experienced an Acquired Brain Injury. This is based on the rationale that frontal dysfunction is hypothesized to be a core deficit following

brain injury in childhood due to the 'developing' frontal lobes. Therefore it is hypothesized that there will still be a disruption to the development of the frontal lobes following ABI and as a consequence these individuals will display difficulties in moral reasoning in comparison to participants in the comparison group. I have made adaptations to my proposal and therefore submit Proposal version 3 09.11.12. There have not been any alterations to participant information sheets as these refer to brain injury and do not specify the type of brain injury.

The above amendment was reviewed at the meeting of the Sub-Committee held on 18 January 2013 by email correspondence.

Ethical opinion

None

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

Approved documents

The documents reviewed and approved at the meeting were:

Document	Version	Date
Summary/Synopsis : - Flow diagram for recruitment 1		09 November 2012
Letter of Invitation to participant : Introductory Script (Colman Centre) 1		09 November 2012
Notice of Substantial Amendment (non-CTIMPs) : Amendment#2		18 December 2012
Covering Letter : - Email from Lucy Wigg		19 December 2012

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

R&D approval

All investigators and research collaborators in the NHS should notify the R&D office for the relevant NHS care organisation of this amendment and check whether it affects R&D approval of the research.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

12/EE/0391:	Please quote this number on all correspondence

Yours sincerely

PP

Dr Steve Eckersall
Chair

E-mail: melanie.johnson@eoe.nhs.uk

Enclosures: *List of names and professions of members who took part in the review*

Emailed To: *Beth Muldrew,* :
Yvonne Kirkham :
Miss Lucy Wigg:

Miss Lucy Wigg
Trainee Clinical Psychologist
Cambridgeshire and Peterborough NHS
Foundation Trust
Department of Psychological Sciences,
Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

17th October 2012

Dear Lucy,

Research Proposal: Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making

Investigators: Lucy Wigg, Dr Anna Adlam and Dr Pete Langdon

Thank you for providing detail of the above proposal for scrutiny by a panel of our Ethics Committee.

I am pleased to confirm that the panel supports your proposal.

Yours sincerely,

Iain Mackrory-Jamieson
Company Secretary

Direct Tel: 01444 237297
E-mail: Iain.Mackrory-Jamieson@TheDTGroup.org

cc Prof Mike Oddy

Appendix B Permissions

This appendix section contains the letters of approval from the Research and Development departments for Norfolk Community Health and Care NHS trust, Cambridge and Peterborough NHS Foundation trust, Cambridge Community Services NHS trust and Addenbrookes, Cambridge University Hospitals NHS foundation trust (scanned versions). I have also added a copy of permission from Oak Farm, Select Healthcare Group.

Norfolk Community NHS Health and Care NHS Trust

Ref:2012GC10

Research & Development
NHS Norfolk & Waveney
Lakeside 400
Old Chapel Way
Broadland Business Park
Thorpe St Andrew
Norwich
NR7 0WG

Tel: 01603 257293
Fax: 01603 257292
E-mail: paul.mills@norfolk.nhs.uk
www.norfolk.nhs.uk/research

Miss Lucy Wigg
University of East Anglia
Department of Psychological Sciences
University of East Anglia
Norwich
NR4 7TJ

5 October 2012

Dear Miss Lucy Wigg

Re: 2012GC10. Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion-based decision making.

REC Number: 12/EE/0391

Chief Investigator: Miss Lucy Wigg

Sponsor: University of East Anglia

Further to your submission of the above project to the R&D office at NHS Norfolk & Waveney your project has now been reviewed and all the mandatory research governance checks have been satisfied. I am therefore pleased to inform you on behalf of Norfolk Community Health & Care NHS Trust that NHS permission (R&D approval) was granted on 5th October 2012 for your study to take place at the following sites:

- Norfolk Community Health & Care NHS Trust

You may now begin your study at the above sites. Please note also, if you wish to extend approval to any sites other than those listed above you must apply for this through the R&D office at NHS Norfolk.

Please note the following suggestions:

- It is suggested that an invitation letter for relatives is devised and included with the information sheet and questionnaire. If you decide to do this, please submit an amendment for this.
- It is suggested that the version number and date on the Group 1 Participant Consent Form is updated to Version 3, 12th September as per the electronic filename.

NHS Permission is granted on the basis of the information supplied in the application form, protocol and supporting documentation, if anything subsequently comes to light that would cast doubts upon, or alter in any material way, any information contained in the original application, or a later amendment application there may be implications for continued NHS Permission.

Permission is granted on the understanding that the study is conducted in accordance with the Research Governance Framework and the terms of REC favourable opinion.

If you have any queries regarding this or any other project please contact Paul Mills, R&D Officer, at the above address. Please note, the reference number for this study is 2012GC10 and this should be quoted on all correspondence.

Yours sincerely

Dr Augustine Pereira
Consultant in Public Health Medicine and Research & Development Lead
NHS Norfolk & Waveney
Signed on behalf of Norfolk Community Health & Care NHS Trust

cc: Alison Woods, Norfolk Community Health & Care NHS Trust
Sue Steel, Sponsor Representative, University of East Anglia
Anna Adlam, Academic Supervisor, University of East Anglia
Peter Langdon, Academic Supervisor, University of East Anglia
File

Enc

Conditions of NHS Permission
Please note the following conditions of NHS Permission - it is your responsibility to ensure that these conditions are disseminated to all parties involved in this project at the above sites.

You must notify the R&D Office at NHS Norfolk & Waveney of:

- All proposed changes to this study, whether minor or substantial
- All Serious Adverse Events relevant to the above sites
- Any deviations from the protocol or protocol breaches including any urgent safety measures that are required to be taken in order to protect research participants against any immediate hazard to their health or safety
- All incidents[1] or complaints in relation to the research project at the above sites
- Any Sponsor or funder initiated audits, or any regulatory inspections to be conducted in relation to this study at the above sites
- The study conclusion and/or termination of the study; where smartcards have been issued, this notification must be made on a site by site basis to allow deactivation of smartcards at that site.
- All publications relating to the study

Recruitment of Community Teams:
You are responsible for ensuring an appropriate assessment is made of the suitability and capacity of community teams to undertake the study at the point they are recruited.

- You are expected to put in place an agreement or delegation of authority to ensure clarity of roles and responsibilities between yourself and the site.
- You are responsible for oversight of the project at each participating practice to ensure compliance with the protocol and any study related SOPs or work instructions

[1] An incident is defined as any event or circumstance that could have, or did, lead to harm, loss or damage and includes loss of data, confidentiality breaches, harm to researchers or staff or damage to property.

Cambridge University Hospitals NHS
NHS Foundation Trust

Research and Development Department

R&D ref: A092880

26 March 2013

Box 277
Addenbrooke's Hospital
Hills Road
Cambridge
CB2 0QQ

Direct Dial: 01223 596371 Ext 6371

Switchboard: 01223 245151

E-mail:rachel.kyd@addenbrookes.nhs.uk
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www.addenbrookes.org.uk

Professor David K Menon
University of Cambridge
Division of Anaesthesia
Box 93, Addenbrooke's Hospital

Dear Professor Menon

Re: 12/EE/0391 Exploring the impact of traumatic brain injury on moral reasoning.

In accordance with the Department of Health's Research Governance Framework for Health and Social Care, all research projects taking place within the Trust must receive a favourable opinion from an ethics committee and approval from the Department of Research and Development (R&D) prior to commencement.

I am pleased to confirm that Cambridge University Hospitals NHS Foundation Trust has reviewed the above study and agree to act as a **Participant Identification Centre (PIC)** referring potential participants to the relevant research teams based in University of East Anglia.

Please note that as a PIC the Trust does not provide indemnity for this study.

Sponsor: University of East Anglia

Funder: No Funding

End date: 03/06/2013

Protocol: version 3 dated 09/11/2012

The project must follow the agreed protocol and be conducted in accordance with all Trust Policies and Procedures especially those relating to research and data management.

Please ensure that you are aware of your responsibilities in relation to The Data Protection Act 1998, NHS Confidentiality Code of Practice, NHS Caldicott Report and Caldicott Guardians, the Human Tissue Act 2004, Good Clinical Practice, the NHS Research Governance Framework for Health and Social Care, Second Edition April 2005 and any further legislation released during the time of this study.

Members of the research team must have appropriate substantive or honorary contracts with the Trust prior to the study commencing. Any additional researchers who join the study at a later stage must also hold a suitable contract.

If the project is a clinical trial under the European Union Clinical Trials Directive the following must also be complied with:

- the EU Directive on Clinical Trials (Directive 2001/20/EC) and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Regulations 2004;

- the EU Directive on Principles and Guidelines for Good Clinical Practice (EU Commission Directive 2005/28/EC); and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Amendment Regulations 2006;

Amendments

Please ensure that you submit a copy of any amendments made to this study to the R&D Department.

Annual Report

It is obligatory that an annual report is submitted by the Chief Investigator to the research ethics committee, and we ask that a copy is sent to the R&D Department. The yearly period commences from the date of receiving a favourable opinion from the ethics committee.

Please refer to our website www.cuh.org.uk/research for all information relating to R&D including honorary contract forms, policies and procedures and data protection.

Should you require any further information please do not hesitate to contact us.

Yours sincerely

Louise Stockley
Research Governance Manager

V5 Feb 09

Cambridgeshire and Peterborough NHS
NHS Foundation Trust

Understanding mental health, understanding people

Research and Development Department

Joint Research Office
Box 277
Addenbrooke's Hospital
Hills Road
Cambridge
CB2 0QQ

Direct Dial: 01223 596472 ext 6472
E-mail: beth.muldrew@cpft.nhs.uk
www.cpft.nhs.uk

17 September 2012

R&D Ref: M00506

Ms Lucy Wigg
Department of Psychological Sciences
Norwich Research Park
University of East Anglia
Norwich NR4 7TJ

Dear Ms Wigg

Exploring the impact of traumatic brain injury on moral reasoning (MOO506)

In accordance with the Department of Health's Research Governance Framework for Health and Social Care, all research projects taking place within the Trust must receive a favourable opinion from an ethics committee and approval from the Department of Research and Development (R&D) prior to commencement.

R&D have reviewed the documentation submitted for this project, and has undertaken a **site specific assessment** based on the information provided in the SSI form, and I am pleased to inform you that we have no objection to the research proceeding within Cambridgeshire and Peterborough NHS Foundation Trust.

Sponsor: University of East Anglia

Funder: University of East Anglia

End date: 03/06/2013

Protocol: Version 2.0 dated 10 August 2012

Conditions of Trust Approval:

- The project must follow the agreed protocol and be conducted in accordance with all Trust Policies and Procedures especially those relating to research and data management. Any mobile devices used must also comply with Trust policies and procedures for encryption.

- You and your research team must ensure that you understand and comply with the requirements of the NHS Confidentiality Code of Practice and the Data Protection Act 1998 and are aware of your responsibilities in relation to the Human Tissue Act 2004, Good Clinical Practice, the NHS Research Governance Framework for Health and Social Care, Second Edition April 2005 and any further legislation released during the time of this study.

- Members of the research team must have appropriate substantive or honorary contracts with the Trust prior to the study commencing. Any additional researchers who join the study at a later stage must also hold a suitable contract.

If the project is a clinical trial under the European Union Clinical Trials Directive the following must also be complied with:

- the EU Directive on Clinical Trials (Directive 2001/20/EC) and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Regulations 2004;

- the EU Directive on Principles and Guidelines for Good Clinical Practice (EU Commission Directive 2005/28/EC); and UK's implementation of the Directive: The Medicines for Human Use (Clinical Trials) Amendment Regulations 2006;

Amendments
Please ensure that you submit a copy of any amendments made to this study to the R&D Department.

Annual Report
It is obligatory that an annual report is submitted by the Chief Investigator to the research ethics committee, and we ask that a copy is sent to the R&D Department. The yearly period commences from the date of receiving a favourable opinion from the ethics committee.

Please refer to our website www.cpft.nhs.uk for all information relating to R&D including honorary contract forms, policies and procedures and data protection.

Should you require any further information please do not hesitate to contact us.

Yours sincerely

Stephen Kelleher
Senior Research and Development Manager

Cc Sue Steel, Contracts Manager, Research and Enterprise Services West Office, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ

Cambridgeshire Community Services NHS
NHS Trust

19 September 2012

Miss Lucy Wigg
Cambridgeshire and Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

RMG Office
Lockton House
Clarendon Road
Cambridgeshire
CB2 8FH
camstrad@cambridgeshire.nhs.uk

Direct dial: 01223 725466

Dear Miss Wigg

Re: L01216 Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion based decision making

Re: 12/EE/0391, Evelyn Community Head Injury Service

Your proposal has been reviewed by the Medical Director of Cambridgeshire Community Services NHS Trust.

I am pleased to inform you that Cambridgeshire Community Services NHS Trust has given permission for the following research to take place.

This permission is subject to the enclosed standard terms and conditions and conditional upon you notifying the research governance team of any changes to the study-related paperwork.

Unless we hear from you within a month of this letter, we will assume that you are abiding by these conditions.

The project must follow the agreed protocol and be conducted in accordance with Trust policy and procedures in particular in regard to data protection, health & safety and information governance standards. The research team are required to follow the reasonable instructions of the research site manager and can contact the RMG office for RMG advice or the Trust RMG lead in relation to queries on local policy.

On completion of clinical trials of interventional medicinal products/devices participants need to be aware that local Trust prescribing policy and formulary applies therefore participants cannot expect to continue on the research trial product/device on completion of the trial.

Approval is subject to adherence to the Data Protection Act 1998, NHS Confidentiality Code of Practice, the Human Tissue Act 2004, the NHS Research Governance Framework for Health and Social Care, (2nd edition) April 2005, the Mental Capacity Act and any further legislation released during the time of this study. Approval for Clinical Trials is on the basis that they are conducted in accordance with European Union Directive and the Medicines for Human Use (Clinical Trials) Regulations 2004 principles, guidelines and later revisions, and in accordance ICH Good Clinical Practice.

Members of the research team must where instructed have appropriate substantive or honorary research contracts or letters of access with the Trust prior to commencing work on the study.

additional researchers who join the study must also hold a suitable contract or letter of access before they start.

You will be required to complete monitoring information during the course of the research, as requested by the RMG office. Cambridgeshire Community Services NHS Trust reserves the right to withdraw research management approval for a project if researchers fail to respond to audit and monitoring requests.

Should any adverse incidents occur during the research, Cambridgeshire Community Services NHS Trust Incident and Near Miss Reporting Policy should be used, the RMG Office informed and incident procedures adhered to at the research site.

If you make any amendments to your project, please ensure that these are submitted to the research ethics committee and the RMG office and that any changes are not implemented until approval has been received.

We welcome feedback about your experience of this review process to help us improve our systems. May I take this opportunity to wish you well with your research and we look forward to hearing the progress and outcomes for the study.

Please contact the RMG team should you have any queries.

Yours sincerely,

Dr David Vickers
Medical Director
Cambridgeshire Community Services NHS Trust

cc: Yvonne Kirkham

Cambridgeshire Community Services NHS
NHS Trust

11 September 2012

Miss Lucy Wigg
Cambridgeshire and Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

RMG Office
Lockton House
Clarendon Road
Cambridgeshire
CB2 8FH
camstrad@cambridgeshire.nhs.uk

Direct dial: 01223 725466

Dear Miss Wigg

Re: L01216 Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion based decision making

Re: 12/EE/0391, Community Brain Injury Team in Peterborough

Your proposal has been reviewed by the Medical Director of Cambridgeshire Community Services NHS Trust.

I am pleased to inform you that Cambridgeshire Community Services NHS Trust has given permission for the following research to take place.

This permission is subject to the enclosed standard terms and conditions and conditional upon you notifying the research governance team of any changes to the study-related paperwork.

Unless we hear from you within a month of this letter, we will assume that you are abiding by these conditions.

The project must follow the agreed protocol and be conducted in accordance with Trust policy and procedures in particular in regard to data protection, health & safety and information governance standards. The research team are required to follow the reasonable instructions of the research site manager and can contact the RMG office for RMG advice or the Trust RMG lead in relation to queries on local policy.

On completion of clinical trials of interventional medicinal products/devices participants need to be aware that local Trust prescribing policy and formulary applies therefore participants cannot expect to continue on the research trial product/device on completion of the trial.

Approval is subject to adherence to the Data Protection Act 1998, NHS Confidentiality Code of Practice, the Human Tissue Act 2004, the NHS Research Governance Framework for Health and Social Care, (2nd edition) April 2005, the Mental Capacity Act and any further legislation released during the time of this study. Approval for Clinical Trials is on the basis that they are conducted in accordance with European Union Directive and the Medicines for Human Use (Clinical Trials) Regulations 2004 principles, guidelines and later revisions, and in accordance ICH Good Clinical Practice.

Members of the research team must where instructed have appropriate substantive or honorary research contracts or letters of access with the Trust prior to commencing work on the study,

additional researchers who join the study must also hold a suitable contract or letter of access before they start.

You will be required to complete monitoring information during the course of the research, as requested by the RMG office. Cambridgeshire Community Services NHS Trust reserves the right to withdraw research management approval for a project if researchers fail to respond to audit and monitoring requests.

Should any adverse incidents occur during the research, Cambridgeshire Community Services NHS Trust Incident and Near Miss Reporting Policy should be used, the RMG Office informed and incident procedures adhered to at the research site.

If you make any amendments to your project, please ensure that these are submitted to the research ethics committee and the RMG office and that any changes are not implemented until approval has been received.

We welcome feedback about your experience of this review process to help us improve our systems. May I take this opportunity to wish you well with your research and we look forward to hearing the progress and outcomes for the study.

Please contact the RMG team should you have any queries.

Yours sincerely,

Dr David Vickers
Medical Director
Cambridgeshire Community Services NHS Trust

cc: Yvonne Kirkham

select
HEALTHCARE GROUP

28th March 2013

Miss Lucy Wigg
Trainee Clinical Psychologist
Cambridgeshire & Peterborough NHS Foundation Trust
Department of Psychological Sciences, Norwich Research Park
University of East Anglia
Norwich
NR4 7TJ

Dear Miss Wigg

Re: Exploring the impact of traumatic brain injury on moral reasoning

Further to the approval by the NRES Committee East of England REC Ref: 12/EE/0391, we confirm that Select Healthcare Group are in agreement for you to conduct the research on our premises at Oak Farm Clinic, 276 Fakenham Road Taverham Norfolk NR8 6AD in accordance with the session times agreed with Sue Hudson, occupational therapist, Oak Farm.

I understand that during your visits to Oak Farm, Sue Hudson will be your main point of contact and will assume overall clinical responsibility for the research visits made to the client for the purpose of the above project.

Please do not hesitate to contact me if you require further information.

Yours sincerely,

Brett Bernard
Director

Head Office: Select Healthcare Group, Victoria Lodge, 32 Victoria Street, Brierley Hill, West Midlands, DY5 1RD Tel: 01384 70275 Fax: 01384 79658
www.selecthealthcaregroup.com Email: info@selecthealthcaregroup.com

Appendix C Participant information sheets

This section contains the participant information sheets for the TBI group, healthy comparison group and the information sheet for relatives. They had the appropriate trust logo and patient advice liaison service details for each site.

This section also includes the study summary requested by the Colman Centre for recruitment.

Norwich Medical School
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Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Information Sheet

"Exploring the impact of brain injury on thinking and reasoning"

My name is Lucy Wigg. I am a trainee clinical psychologist at the University of East Anglia who is undertaking a doctorate in clinical psychology. As part of this I am required to conduct a research study. I would like to invite you to take part. Before you decide whether or not you would like to participate, please take time to read this information sheet. It will tell you why the study is being done and what you can expect if you take part. Please talk to others about it if you wish and feel free to ask any questions.

Part 1 tells you about why this study is happening and what would be asked from you.

Part 2 gives you more information about the conduct of the study.

Part 1

What is the purpose of this study?

Sometimes when individuals experience a brain injury there can be changes to the way they reason or think about topics and situations. I am interested in understanding this further. In particular whether there are changes and what may influence these. I plan to do this by comparing individuals who have had a brain injury with a group of individuals of a similar age that have not had a brain injury.

Why have I been invited to participate?

You have been invited to participate in this study because you have experienced a brain injury. I am inviting anyone between the ages of 17 and 25 years who has experienced a brain injury to participate in this study.

Do I have to participate?

No. It is entirely up to you to decide whether or not you wish to take part. This information sheet is to give you more information about the study to help you make a decision either way. You will be asked to sign a consent form if you decide to participate in the study. If you do decide to participate in the study, you will be free to change your mind, withdraw your consent at any time, without giving a reason. Your decisions will not affect your standard of care.

What happens to me if I take part?

If you decide you would like to participate you will be asked to sign a consent form for your clinical team to share your contact details with me. I will then contact you and give you an opportunity to ask any further questions about the study. If you would like to participate we will arrange a convenient time and place for the one-off session.

In the session you will be asked to complete a range of tasks. These involve answering questions, filling in questionnaires and participating in tasks pinpointing your thinking skills. The session will take between 90 and 120 minutes. It would be helpful for the researcher to gather some more details about your injury, the date on which it occurred and the severity and with your permission she would like to contact your clinical team to answer these questions and to inform them you have participated in this study. Also with your consent, she would also like to contact a close relative to ask them to fill in a short questionnaire.

On completion the information collected will be kept locked in a filing cabinet at the university. This will be transported by the researcher in a locked brief case. The data will be entered onto a database protected by university password protected systems. If it is accessed on another computer it will done so through an encrypted memory stick. The data will never be saved to another computer. This data will not be identifiable, your responses will be entered under a number not by name. Your clinical care will not be affected due to this study.

Will my taking part be kept confidential?

Yes. All the information about you will be kept confidential. Any data entered onto a computer will be done so under a unique code given to you. Your consent form and the list which links codes to people's identity will be locked separately from the completed assessment measures. No identifiable data will be collected. In accordance with publishing guidelines, the data needs to be kept securely for 5 years.

What are the possible benefits of taking part?

This study aims to contribute to understanding of whether changes occur in thinking processes following a brain injury. It aims to do this to inform rehabilitation programmes. Whilst this study may not help you, the information from the study will contribute to an understanding of impact of brain injury on individuals. The researcher is happy to complete a short report on the session for your clinical team if you would like this.

Risks and Burdens

The researcher cannot envisage any disadvantages or risks for taking part. In the unlikely event that you experience any distress completing the questionnaires the session will be terminated, reasons explored, and the researcher will inform your clinical team.

What happens when the research stops?

The data collected in this study will be analysed and a report detailing the findings will be produced. If you would like a summary of the report – I am happy to send you one after the work has been completed.

You will be asked if you would like to be added to a Research Volunteer Register hosted by Dr Anna Adlam (Clinical Senior Lecturer) at the University of East Anglia to inform you of opportunities to participate in ethically approved studies conducted by her and her team. This is voluntary and you can withdraw this consent at any time. All data will be kept on local encrypted disk drives as per University of East Anglia data protection policy (see http://www.uea.ac.uk/is/strategies/infregs/dp) and they will contact you after 5 years elapses to ask if you wish to remain on the Register.

If the information in part 1 has interested you and you are considering participation please read the additional information in part 2 before making a decision.

Part 2

What will happen if I don't want to carry on the study?

You are free to withdraw your consent at any time. You have to just let us know but you do not have to give a reason. You can decide whether you are happy for data already collected to be processed or if you would like it to be destroyed.

What if there is a problem?

If you have a concern about any aspect of this research please contact me and I will do my best to answer your questions. Alternatively you can contact my supervisor. If you remain unhappy and wish to complain formally, you can do this through the University of East Anglia. Each of these actions can be taken by telephoning the number under the address on the first page. You can also use the NHS formal complaints procedure, for more advice on this process you can contact Patient Advice and Liaison Service at Elliott House, 130 Ber Street, Norwich, Norfolk, NR1 3FR or telephone 0800 088 4449 or POhWER on 0300 456 2370.

Who is organising and funding the research?

This research is being conducted as part of a Doctorate of Clinical Psychology course at the University of East Anglia (UEA). There is no additional funding for this research.

Who has reviewed the study?

This study has been reviewed by the East of England, Hertfordshire NHS ethics committee and relevant research governance for participating agencies.

Further information and contact details

Lucy Wigg (Trainee Clinical Psychologist)
Supervised by Dr Anna Adlam (Clinical Psychologist and tutor on UEA Doctorate)
Room 2.30, Elizabeth Fry Building
Norwich Medical School
Norwich Research Park
University of East Anglia
Norwich. NR4 7TJ
Tel: 01603 593076 Email: l.wigg@uea.ac.uk

Thank you very much for the time you have taken to read this information sheet it is much appreciated!!

Norwich Medical School
Postgraduate Research Office
2.30 Elizabeth Fry Building
University of East Anglia
Norwich Research Park
Norwich. NR4 7TJ
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Information Sheet

"Exploring the effects of brain injury on thinking and reasoning"

My name is Lucy Wigg. I am a trainee clinical psychologist at the University of East Anglia where I am undertaking a doctorate in clinical psychology. As part of this I am required to conduct a research study. I would like to invite you to take part. Before you decide whether or not you want to participate, please take time to read this information sheet. It will tell you why the study is being done and what you can expect if you take part. Please talk to others about it if you wish and feel free to ask any questions.

Part 1 tells you about why this study is happening and what would be asked from you.

Part 2 gives you more information about the conduct of the study.

Part 1

What is the purpose of this study?

Sometimes when individuals experience a brain injury there can be changes to the way they reason or think about topics and situations. I am interested in understanding this further, in particular whether there are changes and what may influence these. I plan to do this by comparing individuals who have had a brain injury with a group of individuals of a similar age that have not had a brain injury.

Why have I been invited to participate?

You have been invited to participate in this study because you are within the age range of my selected brain injury group. I am seeking individuals between the ages of 17 and 25 years who have not had a brain injury to act as my comparison group.

Do I have to participate?

No. It is entirely up to you to decide whether or not you wish to take part. This information sheet is to give you more information about the study to help you make a decision either way. You will be asked to sign a consent form if you decide to participate in the study. If you do decide to participate in the study, you will be free to change your mind and withdraw your consent at any time, without giving a reason.

What happens to me if I take part?

If you decide you would like to participate you will be invited to attend a one off session with the researcher at a time and place that is convenient to you. At this session you will have an opportunity to ask any further questions about the study. If you are happy to participate you will be asked to sign a consent form. You will be asked your age and sex.

In the assessment session you will be asked to complete a range of tasks. These involve answering questions, filling in questionnaires and participating in tasks pinpointing your thinking skills. The session will take between 90 and 120 minutes. I will ask you for your consent to send a letter to your GP to inform them of your participation in this research but no further details. On completion of these tasks, the information collected will be kept locked in a filing cabinet at the university. This will be transported by the researcher in a locked brief case. The data will be entered onto a database protected by university password protected systems and saved on an encrypted memory stick if accessed on other computers. The data will never be saved to another computer. This data will not be identifiable as your responses will be entered under a number not by name.

Will my taking part be kept confidential?

Yes. All the information about you will be kept confidential. Your data will be given a code number and will be entered using this onto the computer. Your consent form and the list which links codes to people's identity will be locked separately from the completed assessment measures. No identifiable data will be collected. In accordance with publishing guidelines, the data needs to be kept securely for 5 years.

What are the possible benefits of taking part?

This study is seeking to explore changes in thinking following a brain injury. It aims to do this to inform rehabilitation programmes. Whilst this study may not help you, the information from the study may contribute to an understanding of impact of brain injury on individuals.

Risks and Burdens

The researcher does not envisage any disadvantages or risks through taking part. In the unlikely event that you experience any distress completing the questionnaires the session will be terminated, reasons explored, and the researcher will inform your GP.

What happens when the research stops?

The data collected in this study will be analysed and a report detailing the findings will be produced. If you would like a summary of the report – I am happy to send you one after the work has been completed.

If the information in part 1 has interested you and you are considering participation please read the additional information in part 2 before making a decision.

Part 2

What will happen if I don't want to carry on the study?

You are free to withdraw your consent at any time. You have to just let us know but you do not have to give a reason. You can decide whether you are happy for data already collected to be processed or if you would like it to be destroyed.

What if there is a problem?

If you have a concern about any aspect of this research you can contact me and I will do my best to answer your questions. Alternatively you can contact my supervisor. If you remain unhappy and wish to complain formally, you can do this through the University of East Anglia. Each of these actions can be taken by telephoning the number under the address on the first page. You can also use the NHS formal complaints procedure, for more advice on this process you can contact Patient Advice and Liason Service on www.pals.nhs.uk or POhWER on 0300 456 2370.

Who is organising and funding the research?

This is being conducted as a thesis, as part of a Doctorate of Clinical Psychology course at the University of East Anglia (UEA). There is no additional funding for the research.

Who has reviewed the study?

This study has been reviewed by the East of England Hertfordshire NHS ethics committee and relevant research governance for participating agencies.

Further information and contact details

Lucy Wigg (Trainee Clinical Psychologist)
Supervised by Dr Anna Adlam (Clinical Psychologist and tutor on UEA Doctorate)
Norwich Medical School
Postgraduate Research Office, 2.30 Elizabeth Fry Building
University of East Anglia
Norwich Research Park
Norwich. NR4 7TJ
Email: l.wigg@uea.ac.uk

Thank you very much for the time you have taken to read this information sheet, it is much appreciated!

Norwich Medical School
Postgraduate Research Office,
2.30 Elizabeth Fry Building
University of East Anglia
Norwich Research Park
Norwich. NR4 7TJ
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Information Sheet

"Exploring the impact of brain injury on thinking and reasoning"

My name is Lucy Wigg. I am a trainee clinical psychologist at the University of East Anglia who is undertaking a doctorate in clinical psychology. As part of this I am required to conduct a research study. I would like to invite you to take part. Before you decide whether or not you want to participate, please take time to read this information sheet. It will tell you why the study is being done and what you can expect if you take part. Please talk to others about it if you wish. Feel free to ask any questions.

Part 1 tells you about why this study is happening and what would be asked from you.

Part 2 gives you more information about the conduct of the study.

Part 1

What is the purpose of this study?

Sometimes when individuals experience a brain injury there can be changes to the way they reason or think about topics and situations. I am interested in understanding this further in particular whether there are changes and what may influence these. I plan to do this by comparing individuals who have had a brain injury with a group of individuals of a similar age that have not had a brain injury. This also involves collecting some information from a close relative of the individual with the brain injury.

Why have I been invited to participate?

You have been invited to participate in this study because you are a close relative of an individual who has experienced a brain injury and has agreed to participate in this study.

Do I have to participate?

No. It is entirely up to you to decide whether or not you wish to take part. This information sheet is to give you more information about the study to help you make a decision either way.

You will be asked to sign a consent form if you decide to participate in the study. If you do decide to participate in the study, you will be free to change your mind, withdraw your consent at any time, without giving a reason.

What happens to me if I take part?

If you decide you would like to participate, you will be asked to complete the consent form and the questionnaire that I have sent you. The questionnaire asks about behaviours that can occur after a brain injury and you will be are asked to answer the questions in relation to your relative. It asks you to rate whether they engage in the suggested behaviour and if so how often. This should take you between 5 and 10 minutes and on completion I would ask that you return the questionnaire in the stamped addressed envelope.

On receipt of this information, it will be kept in a locked filing cabinet at the university. This will be transported by the researcher in a locked brief case. The data will be entered onto a database protected by University password protected systems. If accessed on other systems it will be done through an encrypted memory stick if accessed on other computers. The data will never be saved to another computer. This data will not be identifiable as your responses will be entered under the number assigned to your relative.

Will my taking part be kept confidential?

Yes. All the information about you will be kept confidential. Your data will be linked to that of your relative and entered under their unique assigned code number. Your consent form and the list which links codes to people's identity will be locked separately from the completed assessment measures. No identifiable data will be collected. In accordance with publishing guidelines, the data needs to be kept securely for 5 years.

What are the possible benefits of taking part?

This study is aiming to explore changes in thinking following a brain injury compared to individuals of the same age without a brain injury. It aims to do this to inform rehabilitation programmes. Whilst this study may not help you, the information from the study will contribute to an understanding of impact of brain injury on individuals

Risks and Burdens

The researcher does not envisage any disadvantages or risks for taking part. In the unlikely event that you experience any distress completing the questionnaires, please stop and if it continues please contact your GP.

What happens when the research stops?

The data collected in this study will be analysed and a report detailing the findings will be produced. If you would like a summary of the report – I am happy to send you one after the work has been completed.

If the information in part 1 has interested you and you are considering participation please read the additional information in part 2 before making a decision.

Part 2

What will happen if I don't want to carry on the study?

You are free to withdraw your consent at any time. You have to just let us know but you do not have to give a reason. You can decide whether you are happy for data already collected to be processed or if you would like it to be destroyed.

What if there is a problem?

If you have a concern about any aspect of this research you can contact me and I will do my best to answer your questions. Alternatively you can contact my supervisor. If you remain unhappy and wish to complain formally, you can do this through the University of East Anglia. Each of these actions can be taken by telephoning the number under the address on the first page. You can also use the NHS formal complaints procedure, for more advice on this process you can contact Patient Advice and Liason Service on www.pals.nhs.uk or POhWER on 0300 456 2370.

Who is organising and funding the research?

This research is being conducted as part of a Doctorate of Clinical Psychology course at the University of East Anglia (UEA). There is no additional funding for this research.

Who has reviewed the study?

This study has been reviewed by an NHS ethics committee and relevant research governance for participating agencies.

Further information and contact details

Lucy Wigg (Trainee Clinical Psychologist)
Supervised by Dr Anna Adlam (Clinical Psychologist and tutor on UEA Doctorate)
Norwich Medical School
Postgraduate Research Office, 2.30 Elizabeth Fry Building
University of East Anglia
Norwich Research Park
Norwich. NR4 7TJ
Email: l.wigg@uea.ac.uk

Thank you very much for the time you have taken to read this information sheet, it is much appreciated!

"Exploring the effects of brain injury on thinking and reasoning"

You have been invited to participate in a research study. I have been asked to give you this (participant information sheet) which tells you about the study. I will give you a brief summary about it. This is not connected to your treatment here.

The study is hoping to understand the impact of brain injury a little further. It is being run by Lucy Wigg, a trainee Clinical Psychologist at the University of East Anglia. It looks at whether brain injury affects how people reason and think about things. She hopes this will help inform future rehabilitation programmes.

She is looking for volunteers, aged between 17 and 25 years to help with her study, so that's why I am asking you. She would visit them at home or wherever is easiest. She should only need to visit once and it will take about 2 hours. In the session you would be asked to participate in a range of tasks – paper and pen tasks, computer task.

Your performance on these tasks would be anonymised and it would not be identifiable that it was you. Your data would also be kept securely in a locked filing cabinet at the University of East Anglia. If you were happy, she could inform us how you did on these tasks.

Would you be interested in hearing more about this study?

Would you be happy in me giving Lucy your contact details so she could contact you?

Contact details

Email: l.wigg@uea.ac.uk

Telephone number: 01603 591507

Appendix D Consent forms

This section includes the consent to share contact details form for TBI group and the consent forms for the TBI group, healthy comparison group and relatives.

Norwich Medical School
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Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Number:

Consent Form

Title of project: Exploring the impact of brain injury on thinking and reasoning.

Name of researcher: Lucy Wigg

(Please initial boxes)

1) **I confirm that I have read the information sheet dated the 12th September 2012, version 3.** ☐

2) **I give my consent for my clinical team to share my contact details with the researcher.** ☐

Name of participant	Date	Signature
Name of person taking consent	Date	Signature

Norwich Medical School
Postgraduate Research Office
University of East Anglia
Norwich NR4 7TJ
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Number:

Consent Form

Title of project: Exploring the impact of brain injury on thinking and reasoning.

Name of researcher: Lucy Wigg

(Please initial boxes)

1) **I confirm that I have read the information sheet dated the 12th September 2012, version 3. I have asked any questions and had these answered satisfactory.** ☐

2) **I understand my participation is voluntary and that I am free to withdraw at any time without my care being affected.** ☐

3) **I give my consent for my clinical team to be contacted to obtain the relevant information as detailed in the information sheet.** ☐

4) **I give my consent for a close relative to be contacted and provide their details.** ☐

5) **In the event that I no longer have capacity to consent to this study, I consent to data collected prior to this time being used in this study.** ☐

6) **I give my consent for my clinical team to be provided with a short summary of the session.** ☐

7) **I give my consent to receive a study summary at the end of the study.** ☐

8) **I understand relevant section of my medical notes and data collected during the study may be looked at by individuals from regulatory authorities or from the NHS Trust where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.** ☐

9) **I give my consent to take part in this study** ☐

10) **I agree for my contact details, date of birth, sex, and nature/date of injury to be kept on a secure Volunteer Research Participant Register, hosted by the UEA and Dr Anna Adlam, so that I can be contacted about future research studies conducted by Dr Anna Adlam's research team (optional)** Yes / No (Please circle)

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Name of person taking consent	Date	Signature

Norwich Medical School
Postgraduate Research Office
University of East Anglia
Norwich NR4 7TJ
United Kingdom
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Number:

Consent Form

Title of project: Exploring the impact of brain injury on thinking and reasoning.

Name of researcher: Lucy Wigg

(Please initial boxes)

1) **I confirm that I have read the information sheet dated the 9th August 2012, version 2. I have asked any questions and had these answered satisfactory.** ☐

2) **I understand my participation is voluntary and that I am free to withdraw at any time without giving a reason.** ☐

3) **I give my consent for the researcher to send a letter to my GP to inform them of my participation in this study.** ☐

4) **I give my consent to receive a study summary report at the end of the study summarising the main group findings.** ☐

5) **I understand relevant data collected during the study may be looked at by individuals from regulatory authorities or from the NHS Trust where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.** ☐

6) **I give my consent to take part in this study** ☐

Name of participant	Date	Signature
Name of person taking consent	Date	Signature

Norwich Medical School
Postgraduate Research Office
University of East Anglia
Norwich NR4 7TJ
United Kingdom
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
Fax: +44 (0) 1603 591132
Web: www.uea.ac.uk/foh

Participant Number:

Consent Form

Title of project: Exploring the impact of brain injury on thinking and reasoning.

Name of researcher: Lucy Wigg

Name of relative: _____

(Please initial boxes)

1) **I confirm that I have read the information sheet dated the 9th August 2012, version 2. I have asked any questions and had these answered satisfactory.** ☐

2) **I understand my participation is voluntary and that I am free to withdraw at any time without giving a reason.** ☐

3) **I give my consent to take part in this study** ☐

4) **I understand relevant section of my data collected during the study may be looked at by from regulatory authorities or from the NHS Trust where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records** ☐

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Name of person taking Consent	Date	Signature

Appendix E – Recruitment poster

University of East Anglia

Can you help

Are you aged between 17 and 25 years?

Would you like to be part of a study hoping to develop our understanding of how people reason?

I would like to recruit healthy volunteers to compare the way they reason to a group of individuals who have experienced a brain injury.

Are you willing to participate in a one-off session at a time and place convenient to you?

If you are interested, please contact

Lucy Wigg (Trainee Clinical Psychologist) on l.wigg@uea.ac.uk

Appendix F – GP letter.

A copy of this letter was sent to GPs for the participants in the healthy comparison group.

Department of Psychological Sciences

Postgraduate Research Office

University of East Anglia
Norwich NR4 7TJ
United Kingdom
Email:clinpsyd@uea.ac.uk
Tel: +44 (0) 1603 593076
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Dear [insert GP/ clinical team]

I am writing to you to inform you that [insert name] has participated in a research study. The research study is entitled "Exploring the impact of traumatic brain injury on moral reasoning and how this relates to executive functioning, empathy and emotion based decision making". They participated in a one off assessment session on the [insert date].

This research is being conducted as my thesis project which is part of my Doctorate of Clinical Psychology at the University of East Anglia. It is supervised by Dr Anna Adlam. If you require any further information about the research please feel free to contact myself on the details above or by email on l.wigg@uea.ac.uk.

Yours sincerely,

Lucy Wigg

Trainee Clinical Psychologist

University of East Anglia.

Appendix G

This section contains a scanned copy of the SRM-SF reflection measure and the Empathy Quotient.

Social Reflection Questionnaire

Name: _____ Date: _____

Birth-date: _____ Sex (circle one): Male Female

Instructions

In this questionnaire, we want to find out about the things you think are important for people to do, and especially why you think these things (like keeping a promise) are important. Please try to help us to understand your thinking by WRITING AS MUCH AS YOU CAN TO EXPLAIN–EVEN IF YOU HAVE TO WRITE OUT YOUR EXPLANATIONS MORE THAN ONCE. Don't just write "same as before". If you can explain better or use different words to show what you mean, that helps us even more. Please answer all the questions, especially the "why" questions. If you need to, feel free to use the space in the margins to finish writing your answers.

SRM-SF (code #: _____)

1. Think about when you've made a promise to a friend of yours. How important is it for people to keep promises, if they can, to friends?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

2. What about keeping a promise to anyone? How important is it for people to keep promises, if they can, even to someone they hardly know?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

3. How about keeping a promise to a child? How important is it for parents to keep promises, if they can, to their children?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

4. In general, how important is it for people to tell the truth?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

5. Think about when you've helped your mother or father. How important is it for children to help their parents?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

6. Let's say a friend of yours needs help and may even die, and you're the only person who can save him or her. How important is it for a person (without losing his or her own life) to save the life of a friend?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

7. What about saving the life of anyone? How important is it for a person (without losing his or her own life) to save the life of a stranger?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

8. How important is it for a person to live even if that person doesn't want to?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

9. How important is it for people not to take things that belong to other people?

   Circle one: Very Important Important Not Important

   WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

   _____

   _____

   _____

   _____

10. How important is it for people to obey the law?

Circle one: Very important Important Not important

(WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

_____

_____

_____

_____

11. How important is it for judges to send people who break the law to jail?

Circle one: Very important Important Not important

(WHY IS THAT VERY IMPORTANT/ IMPORTANT/ NOT IMPORTANT (WHICHEVER ONE YOU CIRCLED)?

_____

_____

_____

_____

Empathy Quotient

Below are a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer. There are no right or wrong answers, or trick questions.

1. I can easily tell if someone else wants to enter a conversation.	strongly agree	slightly agree	slightly disagree	strongly disagree
2. I prefer animals to humans.	strongly agree	slightly agree	slightly disagree	strongly disagree
3. I try to keep up with the current trends and fashions.	strongly agree	slightly agree	slightly disagree	strongly disagree
4. I find it difficult to explain to others things that I understand easily, when they don't understand it first time.	strongly agree	slightly agree	slightly disagree	strongly disagree
5. I dream most nights.	strongly agree	slightly agree	slightly disagree	strongly disagree
6. I really enjoy caring for other people.	strongly agree	slightly agree	slightly disagree	strongly disagree
7. I try to solve my own problems rather than discussing them with others.	strongly agree	slightly agree	slightly disagree	strongly disagree
8. I find it hard to know what to do in a social situation.	strongly agree	slightly agree	slightly disagree	strongly disagree
9. I am at my best first thing in the morning.	strongly agree	slightly agree	slightly disagree	strongly disagree
10. People often tell me that I went too far in driving my point home in a discussion.	strongly agree	slightly agree	slightly disagree	strongly disagree
11. It doesn't bother me too much if I am late meeting a friend.	strongly agree	slightly agree	slightly disagree	strongly disagree
12. Friendships and relationships are just too difficult, so I tend not to bother with them.	strongly agree	slightly agree	slightly disagree	strongly disagree
13. I would never break a law, no matter how minor.	strongly agree	slightly agree	slightly disagree	strongly disagree
14. I often find it difficult to judge if something is rude or polite.	strongly agree	slightly agree	slightly disagree	strongly disagree
15. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.	strongly agree	slightly agree	slightly disagree	strongly disagree
16. I prefer practical jokes to verbal humour.	strongly agree	slightly agree	slightly disagree	strongly disagree
17. I live life for today rather than the future.	strongly agree	slightly agree	slightly disagree	strongly disagree
18. When I was a child, I enjoyed cutting up worms to see what would happen.	strongly agree	slightly agree	slightly disagree	strongly disagree
19. I can pick up quickly if someone says one thing but means another.	strongly agree	slightly agree	slightly disagree	strongly disagree
20. I tend to have very strong opinions about morality.	strongly agree	slightly agree	slightly disagree	strongly disagree
21. It is hard for me to see why some things upset people so much.	strongly agree	slightly agree	slightly disagree	strongly disagree
22. I find it easy to put myself in somebody else's shoes.	strongly agree	slightly agree	slightly disagree	strongly disagree
23. I think that good manners are the most important thing a parent can teach their child.	strongly agree	slightly agree	slightly disagree	strongly disagree

24. I like to do things on the spur of the moment.	strongly agree	slightly agree	slightly disagree	strongly disagree
25. I am good at predicting how someone will feel.	strongly agree	slightly agree	slightly disagree	strongly disagree
26. I am quick to spot when someone in a group is feeling awkward or uncomfortable.	strongly agree	slightly agree	slightly disagree	strongly disagree
27. If I say something that someone else is offended by, I think that that's their problem, not mine.	strongly agree	slightly agree	slightly disagree	strongly disagree
28. If anyone asked me if I liked their haircut, I would reply truthfully, even if I didn't like it.	strongly agree	slightly agree	slightly disagree	strongly disagree
29. I can't always see why someone should have felt offended by a remark.	strongly agree	slightly agree	slightly disagree	strongly disagree
30. People often tell me that I am very unpredictable.	strongly agree	slightly agree	slightly disagree	strongly disagree
31. I enjoy being the centre of attention at any social gathering.	strongly agree	slightly agree	slightly disagree	strongly disagree
32. Seeing people cry doesn't really upset me.	strongly agree	slightly agree	slightly disagree	strongly disagree
33. I enjoy having discussions about politics.	strongly agree	slightly agree	slightly disagree	strongly disagree
34. I am very blunt, which some people take to be rudeness, even though this is unintentional.	strongly agree	slightly agree	slightly disagree	strongly disagree
35. I don’t tend to find social situations confusing.	strongly agree	slightly agree	slightly disagree	strongly disagree
36. Other people tell me I am good at understanding how they are feeling and what they are thinking.	strongly agree	slightly agree	slightly disagree	strongly disagree
37. When I talk to people, I tend to talk about their experiences rather than my own.	strongly agree	slightly agree	slightly disagree	strongly disagree
38. It upsets me to see an animal in pain.	strongly agree	slightly agree	slightly disagree	strongly disagree
39. I am able to make decisions without being influenced by people's feelings.	strongly agree	slightly agree	slightly disagree	strongly disagree
40. I can't relax until I have done everything I had planned to do that day.	strongly agree	slightly agree	slightly disagree	strongly disagree
41. I can easily tell if someone else is interested or bored with what I am saying.	strongly agree	slightly agree	slightly disagree	strongly disagree
42. I get upset if I see people suffering on news programmes.	strongly agree	slightly agree	slightly disagree	strongly disagree
43. Friends usually talk to me about their problems as they say that I am very understanding.	strongly agree	slightly agree	slightly disagree	strongly disagree
44. I can sense if I am intruding, even if the other person doesn't tell me.	strongly agree	slightly agree	slightly disagree	strongly disagree
45. I often start new hobbies but quickly become bored with them and move on to something else.	strongly agree	slightly agree	slightly disagree	strongly disagree

46. People sometimes tell me that I have gone too far with teasing.	strongly agree	slightly agree	slightly disagree	strongly disagree
47. I would be too nervous to go on a big rollercoaster.	strongly agree	slightly agree	slightly disagree	strongly disagree
48. Other people often say that I am insensitive, though I don't always see why.	strongly agree	slightly agree	slightly disagree	strongly disagree
49. If I see a stranger in a group, I think that it is up to them to make an effort to join in.	strongly agree	slightly agree	slightly disagree	strongly disagree
50. I usually stay emotionally detached when watching a film.	strongly agree	slightly agree	slightly disagree	strongly disagree
51. I like to be very organised in day to day life and often make lists of the chores I have to do.	strongly agree	slightly agree	slightly disagree	strongly disagree
52. I can tune into how someone else feels rapidly and intuitively.	strongly agree	slightly agree	slightly disagree	strongly disagree
53. I don't like to take risks.	strongly agree	slightly agree	slightly disagree	strongly disagree
54. I can easily work out what another person might want to talk about.	strongly agree	slightly agree	slightly disagree	strongly disagree
55. I can tell if someone is masking their true emotion.	strongly agree	slightly agree	slightly disagree	strongly disagree
56. Before making a decision I always weigh up the pros and cons.	strongly agree	slightly agree	slightly disagree	strongly disagree
57. I don't consciously work out the rules of social situations.	strongly agree	slightly agree	slightly disagree	strongly disagree
58. I am good at predicting what someone will do.	strongly agree	slightly agree	slightly disagree	strongly disagree
59. I tend to get emotionally involved with a friend's problems.	strongly agree	slightly agree	slightly disagree	strongly disagree
60. I can usually appreciate the other person's viewpoint, even if I don't agree with it.	strongly agree	slightly agree	slightly disagree	strongly disagree

Appendix H

5 condition balanced Latin Square Design

1- WASI II
2- SRM-SF
3- VF
4- CWI
5- IRT

Participant	Order				
1	1	2	5	3	4
2	2	3	1	4	5
3	3	4	2	5	1
4	4	5	3	1	2
5	5	1	4	2	3
6	4	3	5	2	1
7	5	4	1	3	2
8	1	5	2	4	3
9	2	1	3	5	4
10	3	2	4	1	5

This was repeated in each group.

Appendix I - Results from Shapiro-wilk and Levine's test for both groups

Variables	HC		TBI			
	S-W	P	S-W	P	Levine's	p
Age	**.93**	**.05**	.95	.30	0.12	.73
Age at injury	-	-	**.74**	**.001**	-	-
Time since injury	-	-	**.84**	**.01**	-	-
SRM SF	.96	.18	.94	.21	0.96	.33
Contract	.97	.41	.94	.21	0.003	.96
Truth	**.92**	**.02**	**.74**	**.001**	**4.38**	**.04**
Affiliation	.94	.31	.94	.08	0.001	.98
Life	.93	.16	**.91**	**.01**	**3.97**	**.01**
Property	**.83**	**.001**	.92	.09	**5.58**	**.02**
Law	**.87**	**.001**	.94	.28	0.56	.46
Legal	**.89**	**.03**	**.81**	**.001**	1.89	.18
WASI FSIQ	.96	.18	.94	.26	**6.57**	**.05**
WASI VCI	.97	.50	.95	.31	**7.51**	**.01**
VF	.96	.20	.99	.69	.11	.74
CWI	**.93**	**.05**	**.86**	**.01**	**12.98**	**.001**
CWI colour Naming	.96	.22	.91	.07	**5.03**	**.03**
DEX	.99	.43	.98	.96	1.44	.24
DEX EC	.95	.13	.93	.13	1.75	.28
DEX BE	.96	.19	.96	.65	2.65	.11
DEX MC	.96	.31	.96	.65	**5.18**	**.03**

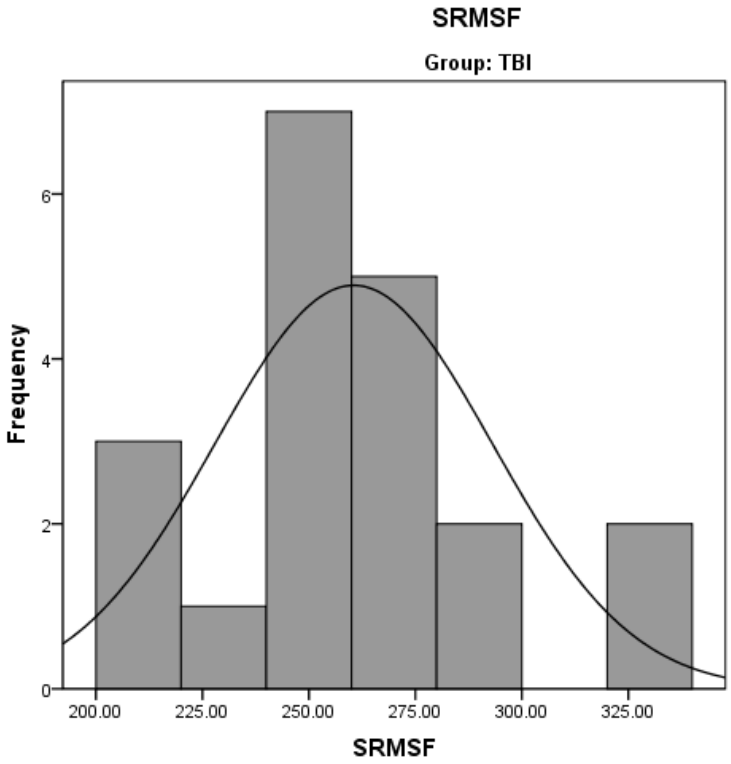
DEX other	-	-	.94	.41	-	-
EQ	.99	.98	.97	.74	0.47	.50
IRT total	**.85**	**.001**	.90	.11	0.84	.37
Block 1	.95	.10	.83	.05	3.03	.09
Block 2	**.91**	**.01**	.95	.45	0.34	.56
Block 3	**.91**	**.009**	**.87**	**.03**	1.24	.27
Block 4	**.89**	**.002**	**.88**	**.04**	1.29	.26
Block 5	**.93**	**.02**	.93	.27	0.06	.81

HC = Healthy Comparison Group. TBI = Survivors of traumatic brain injury group. S-W = Shapiro wilks. P = significance level. SRM-SF (Sociomoral Reflection – short form, Gibbs et al., 1992); WASI FSIQ (Wechsler Abbreviated Scale of Intelligence, full scale composite score); WASI VCI (Wechsler Abbreviated Scale of Intelligence, verbal comprehension composite score); VF (Verbal Fluency, DKEFS); CWI (Color word inference, DKEFS, Delis et al., 2001); DEX (Dys-executive questionnaire, BADS, Wilson et al., 1996); DEX EC (DEX Executive Cognition); DEX BE (DEX Behavioural-emotional self-regulation); DEX MC (DEX Metacognition); DEX OTHER (DEX proxy rater); EQ (Empathy Quotient, Baron-Cohen & Wheelwright, 2004); IRT (Intuitive Reasoning Task, Dunn et al., 2010)

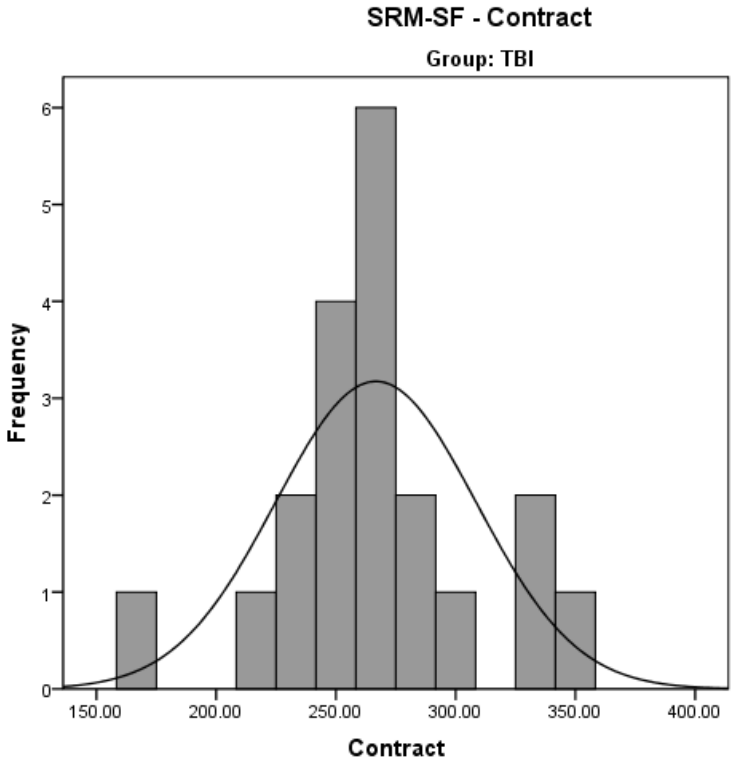
Significant results are in bold.

Appendix J - Histograms for each variable in TBI group

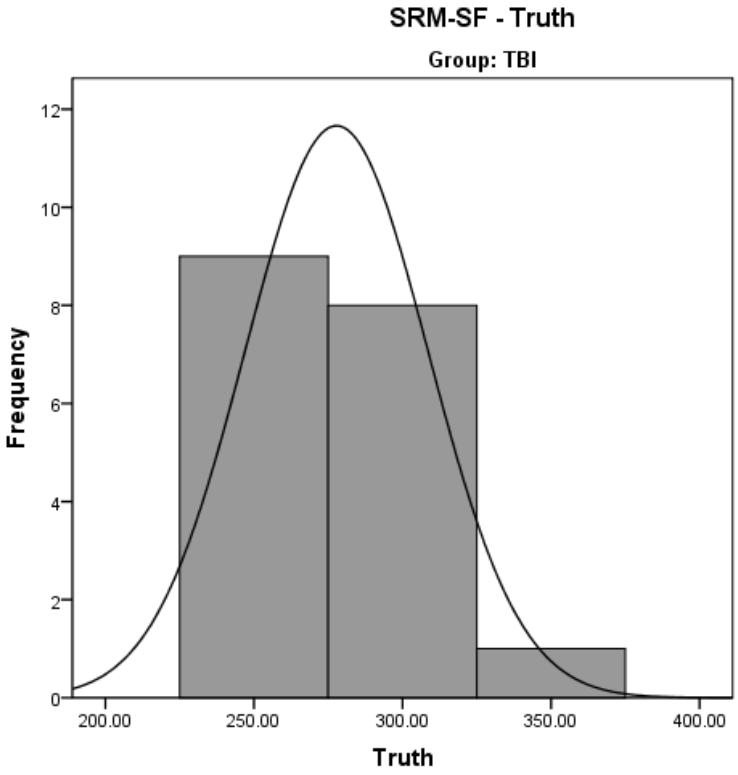
SRM-SF



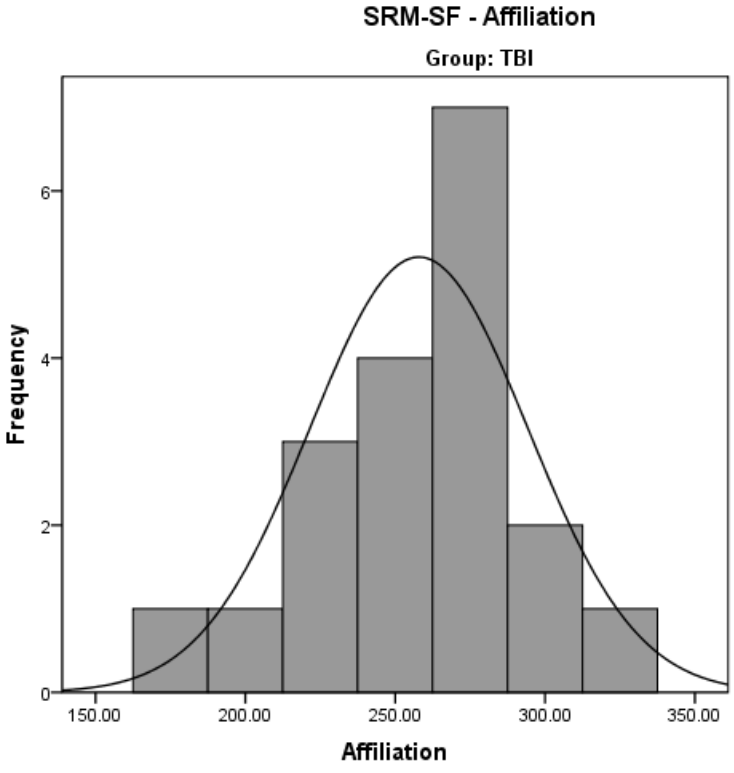
SRM-SF Contract domain



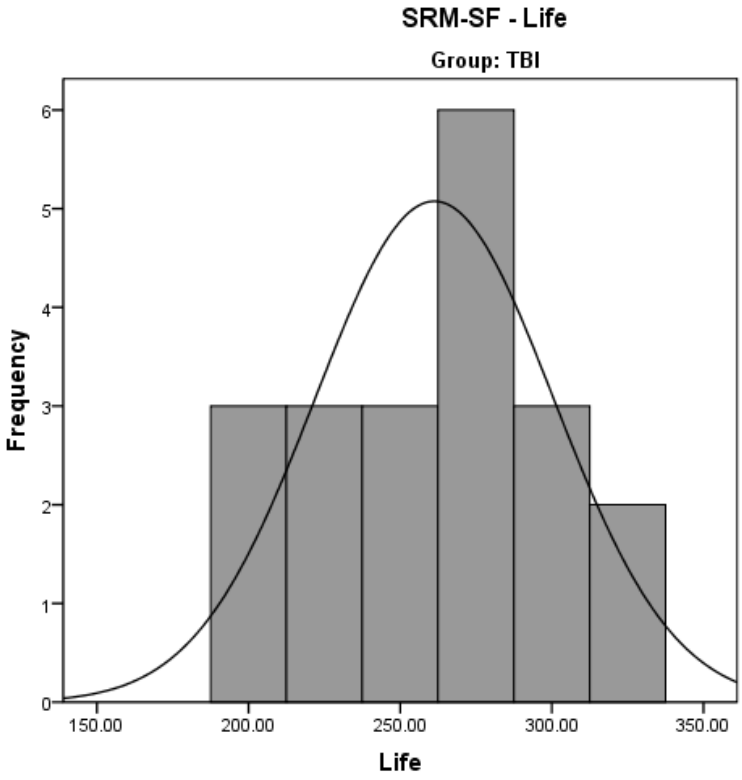
SRM-SF Truth domain



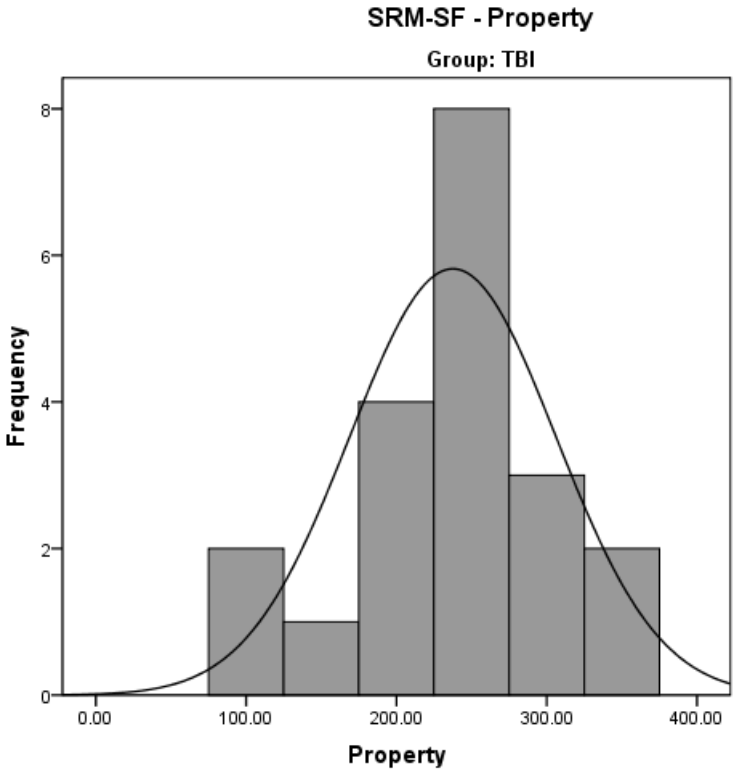
SRM-SF Affiliation domain



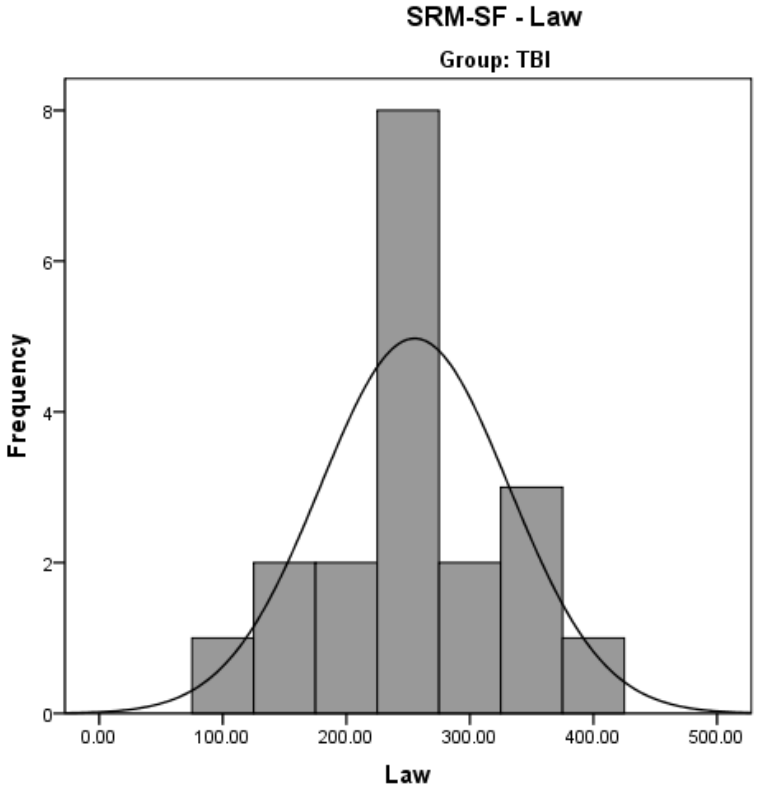
SRM-SF Life domain



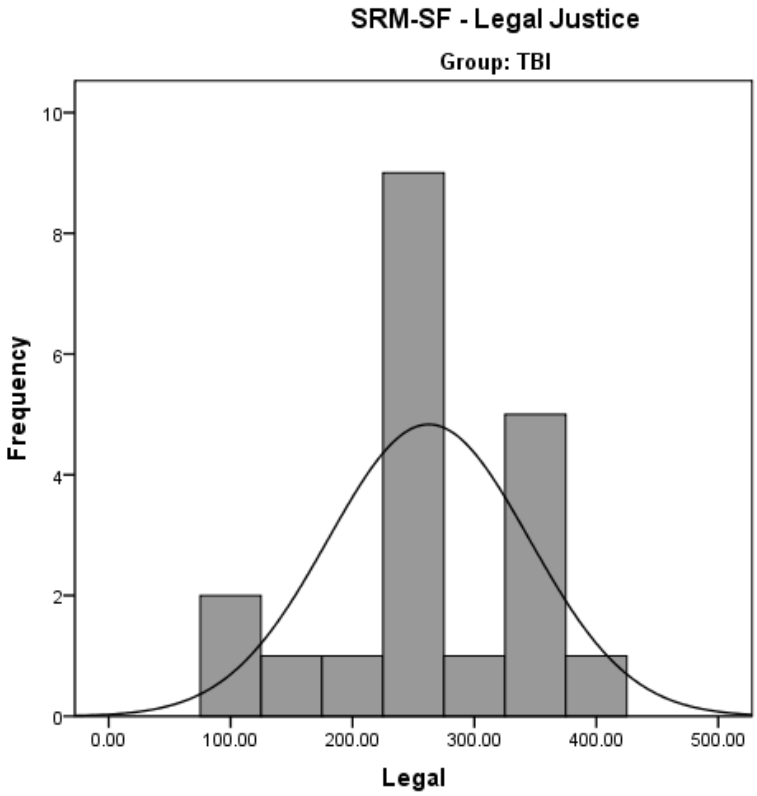
SRM-SF Property domain



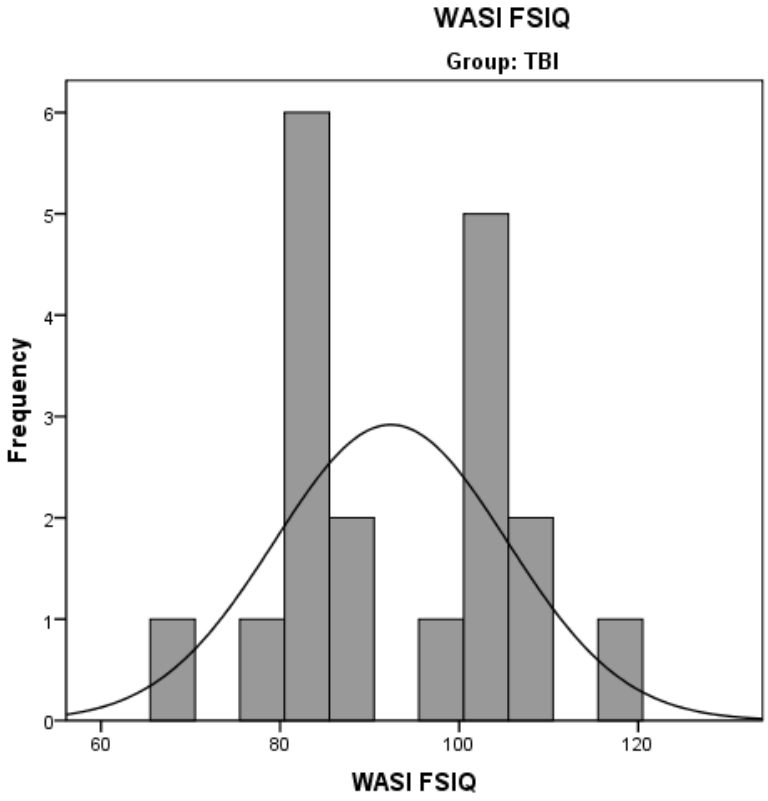
SRM-SF Law domain



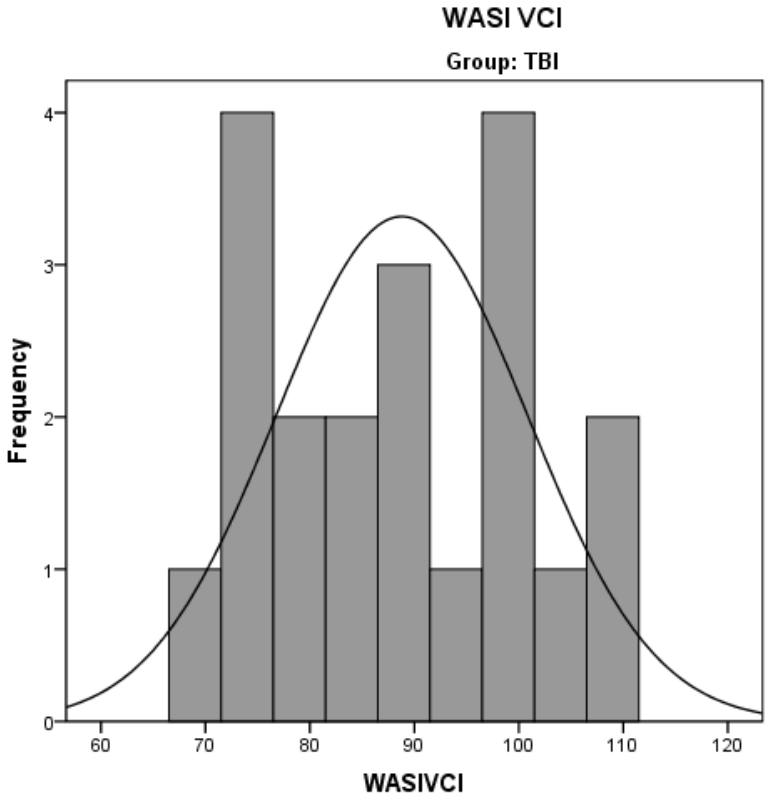
SRM-SF Legal Justice domain



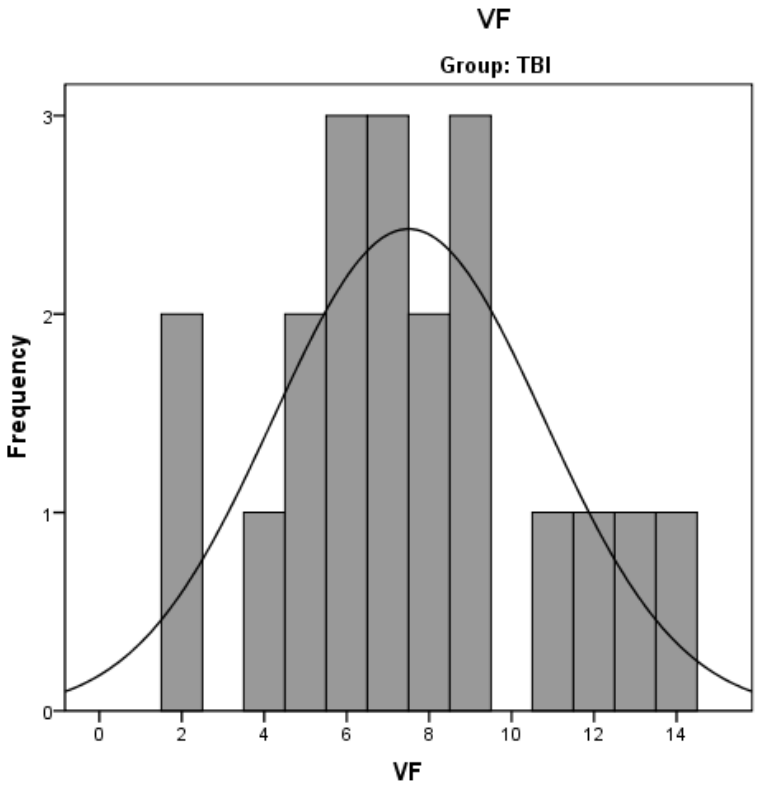
WASI-FSIQ



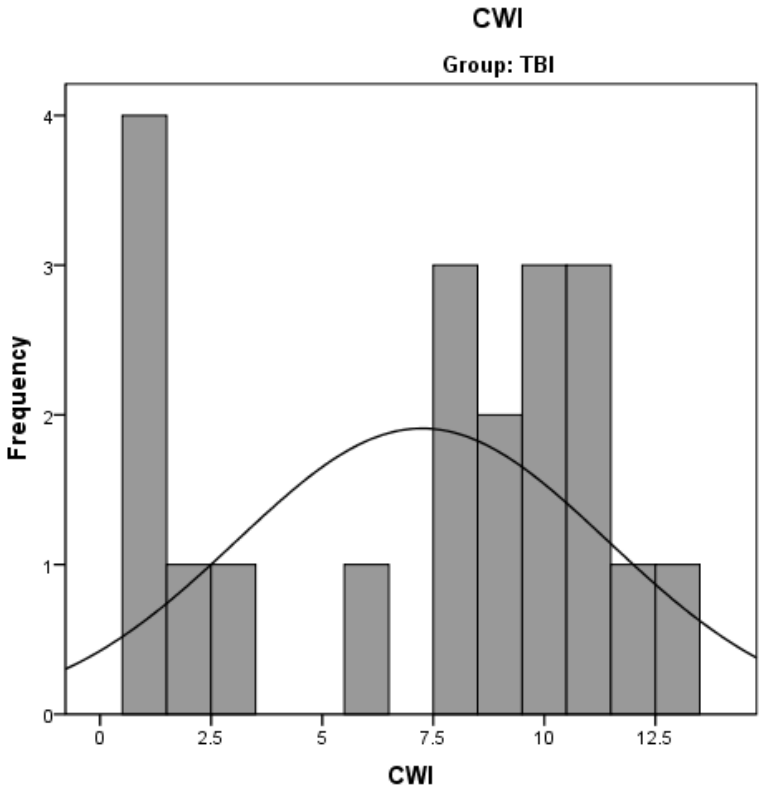
WASI VCI



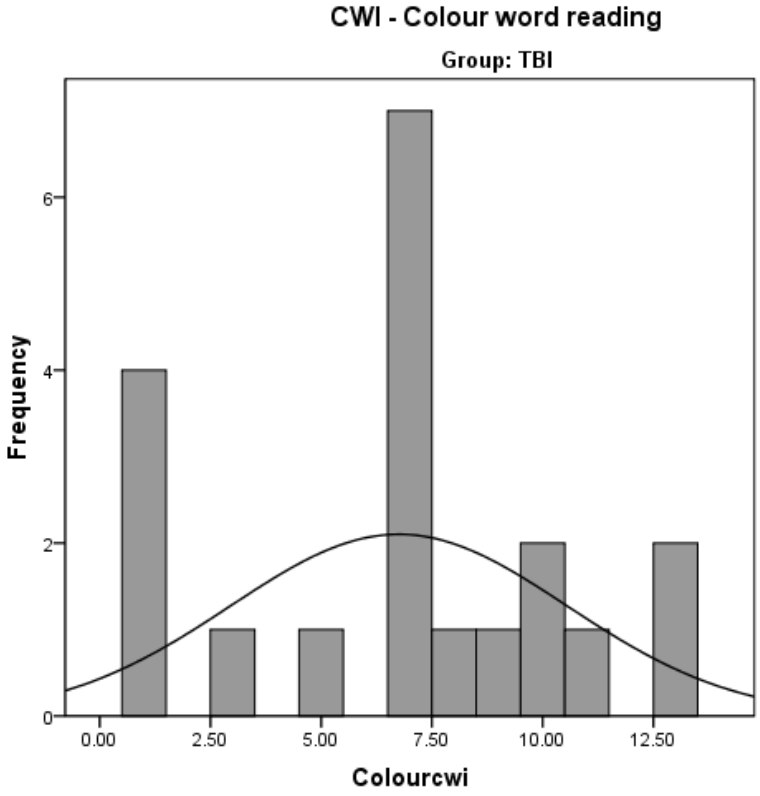
VF


VF
Group: TBI
Frequency
VF
0
1
2
3
0
2
4
6
8
10
12
14

CWI


CWI
Group: TBI
Frequency
CWI
0
1
2
3
4
0
2.5
5
7.5
10
12.5

CWI – Colour Word Reading



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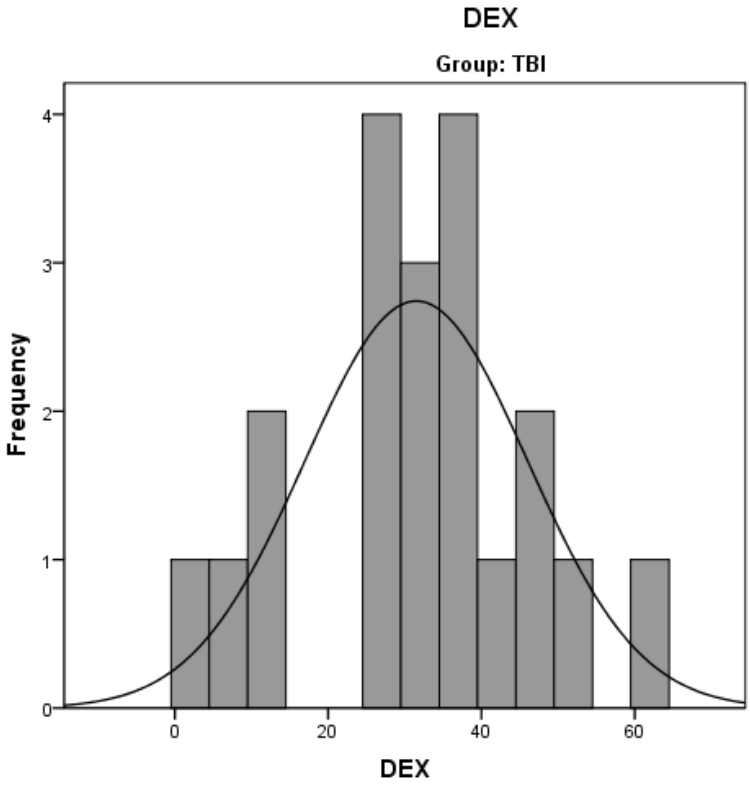
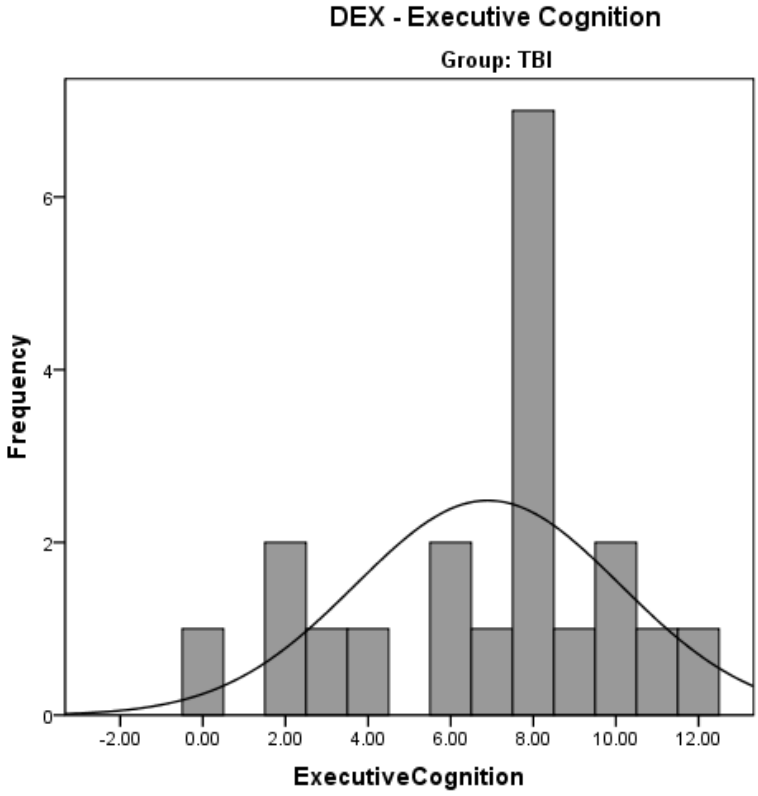
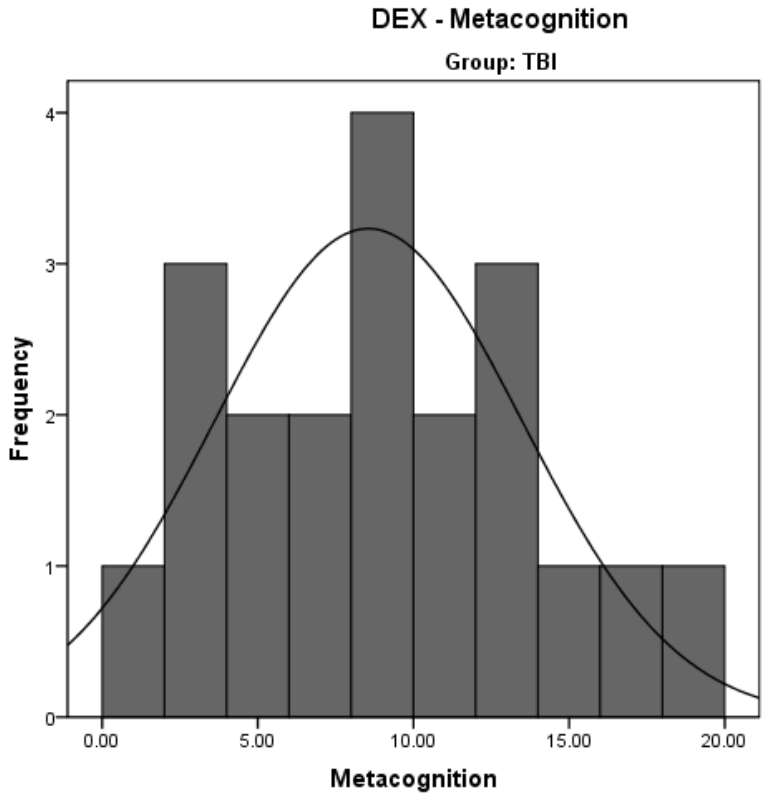


DEX – Executive Cognition domain

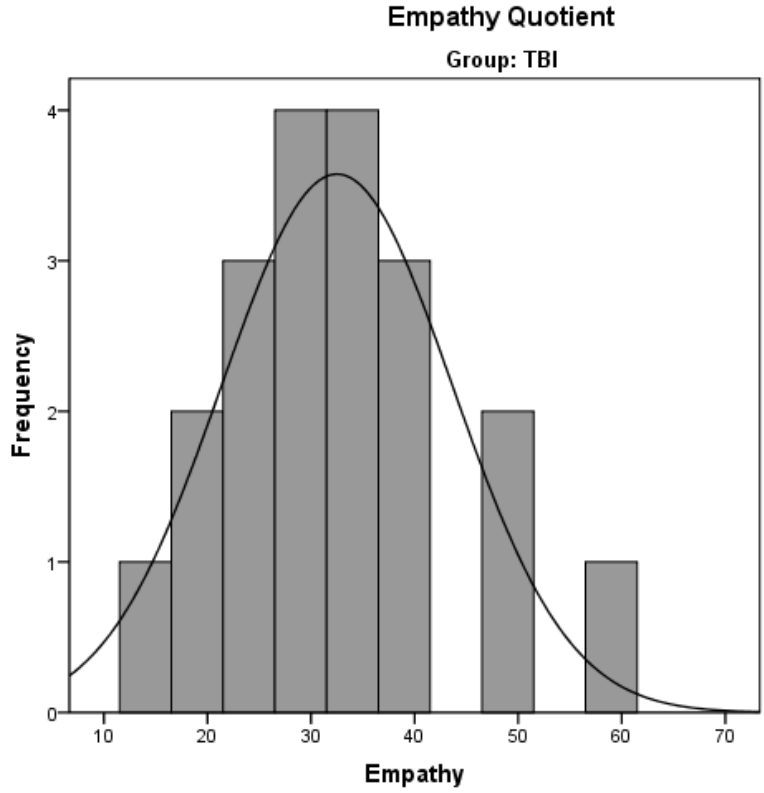


DEX – Behavioural-emotional self-regulation domain

DEX – Metacognition domain



Empathy Quotient



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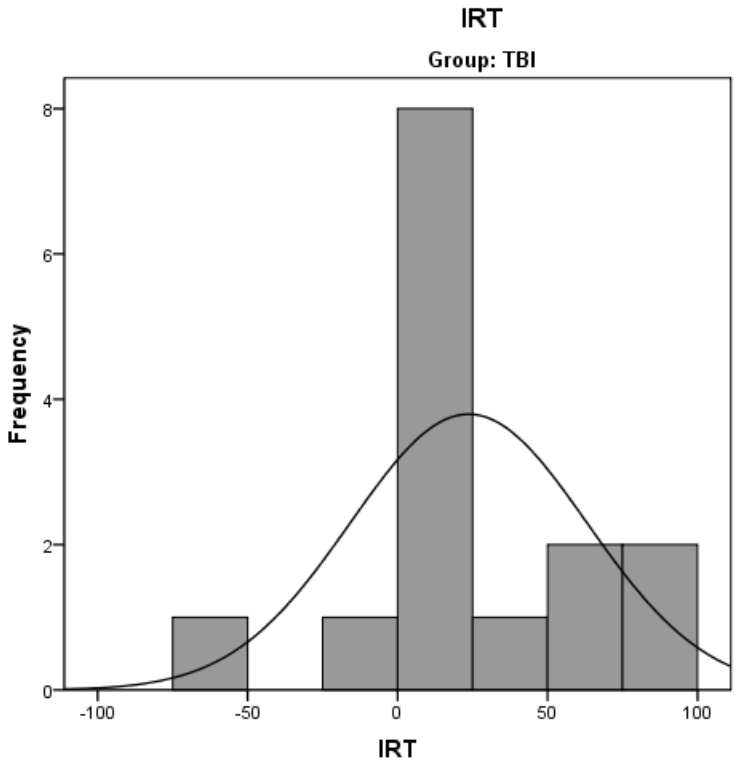

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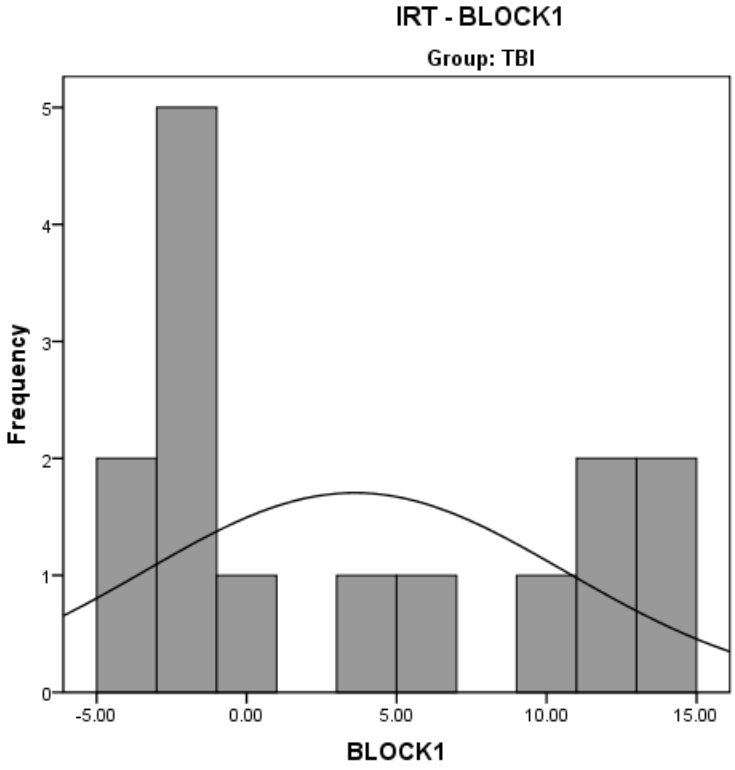

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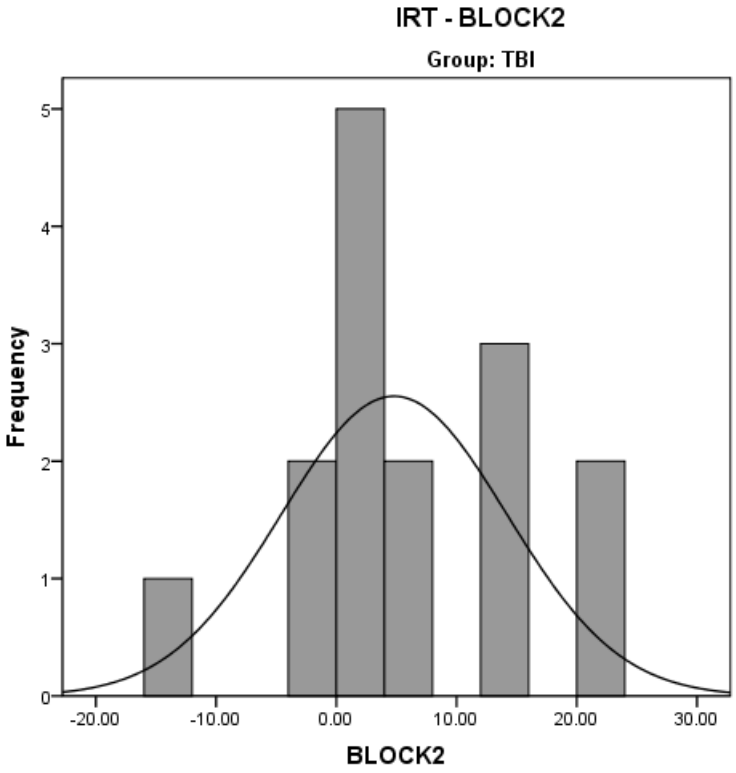

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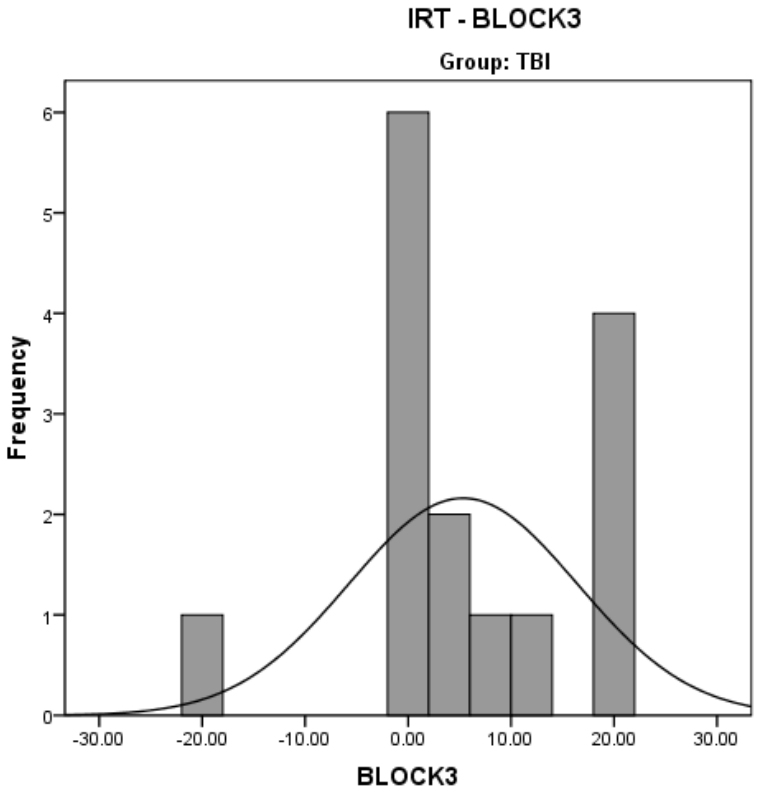

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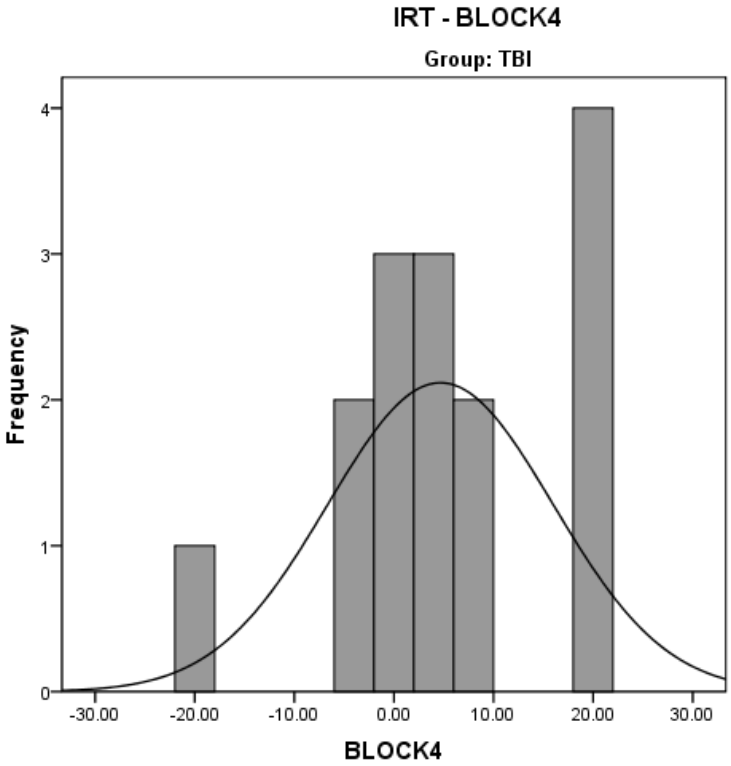

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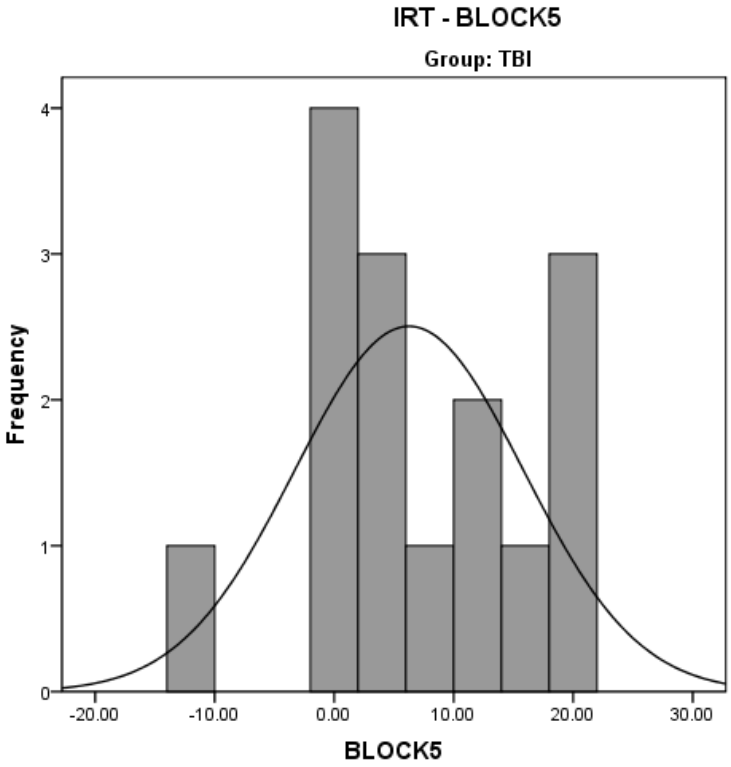
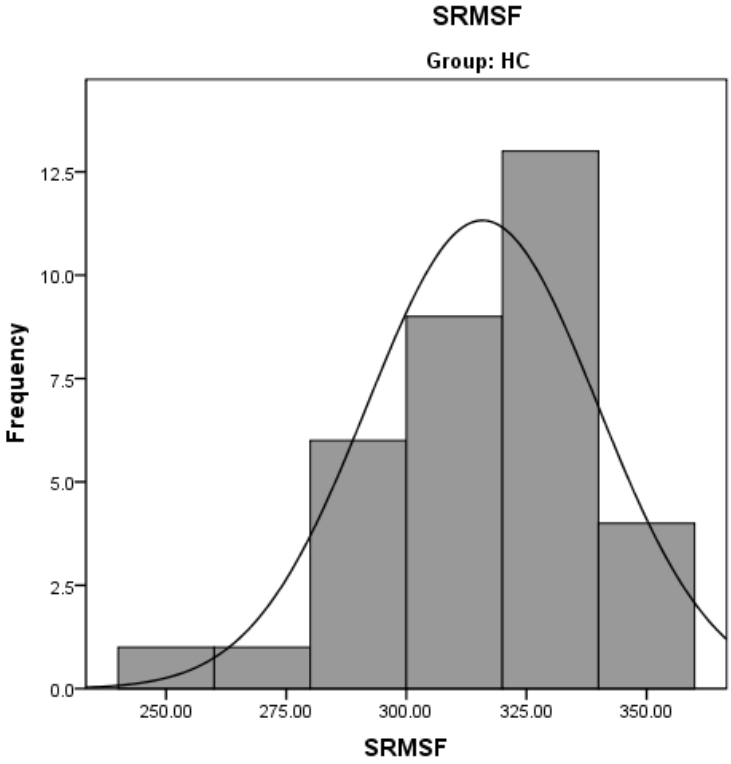


Appendix K - Histograms of variables in the Healthy Comparison group

SRM-SF



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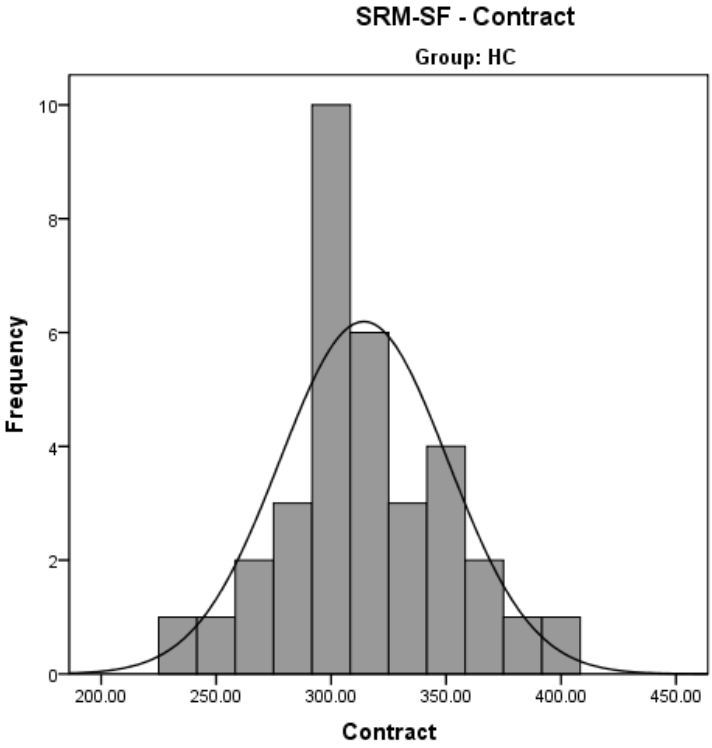

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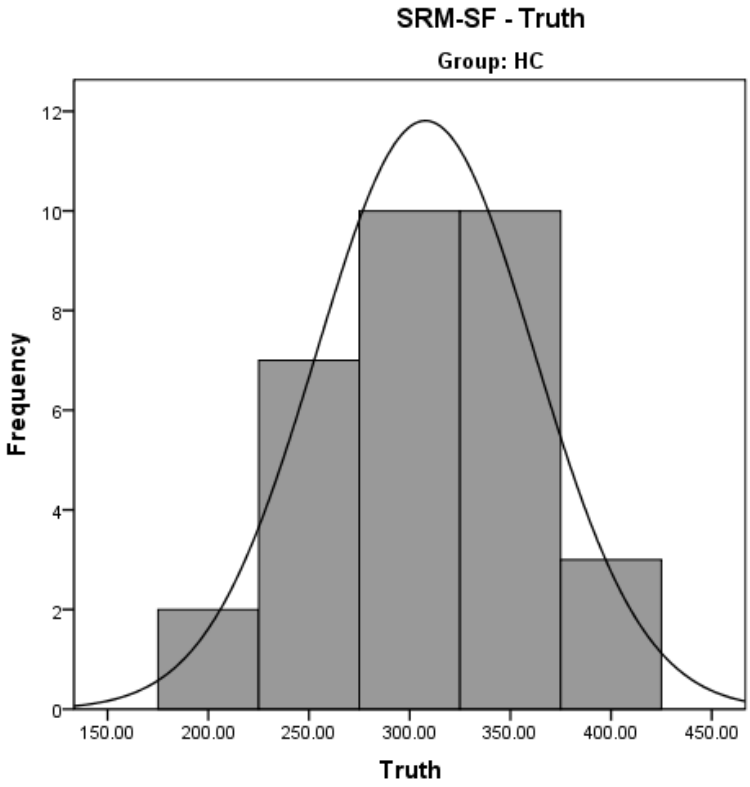

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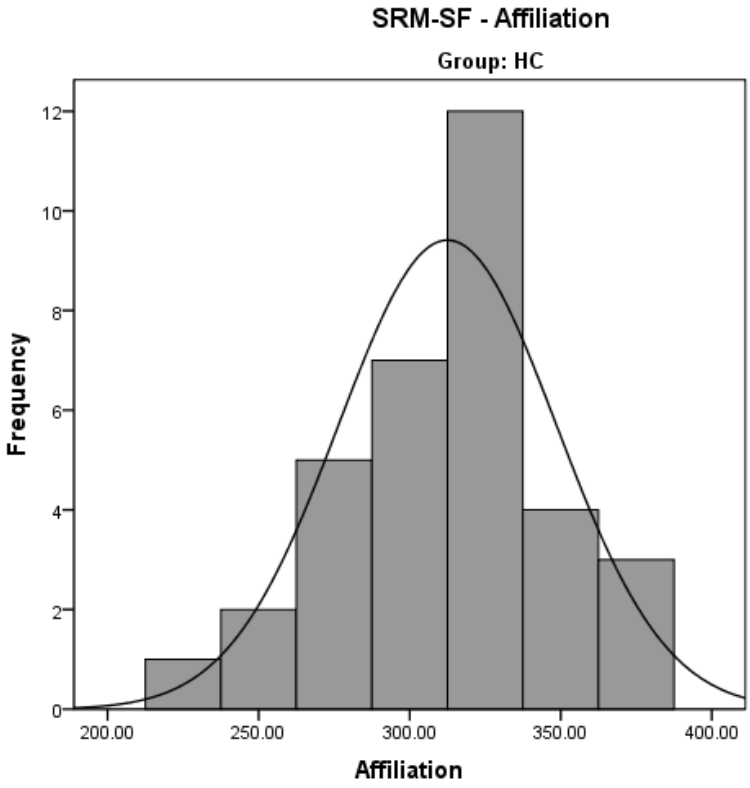
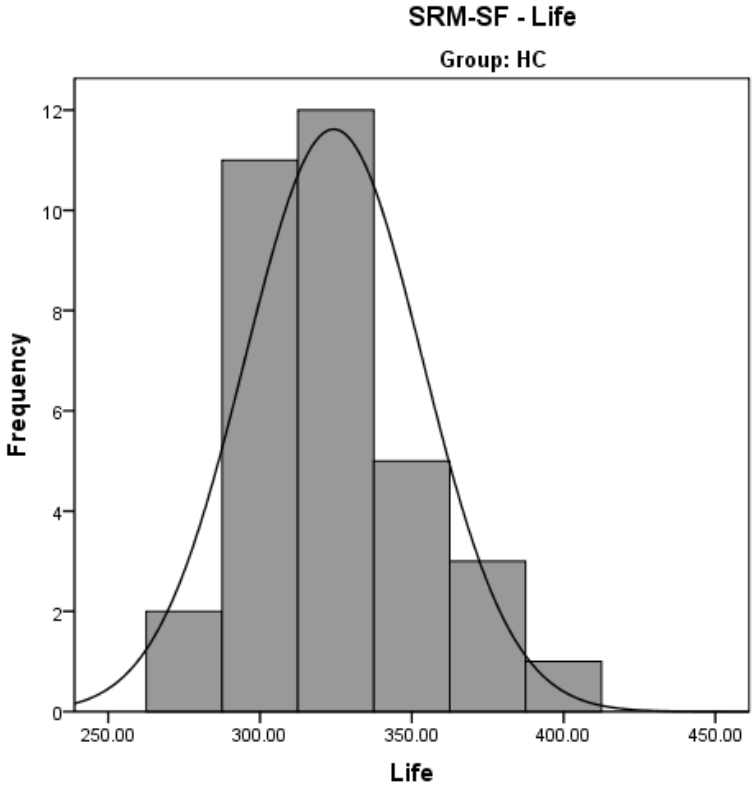


SRM-SF Life domain



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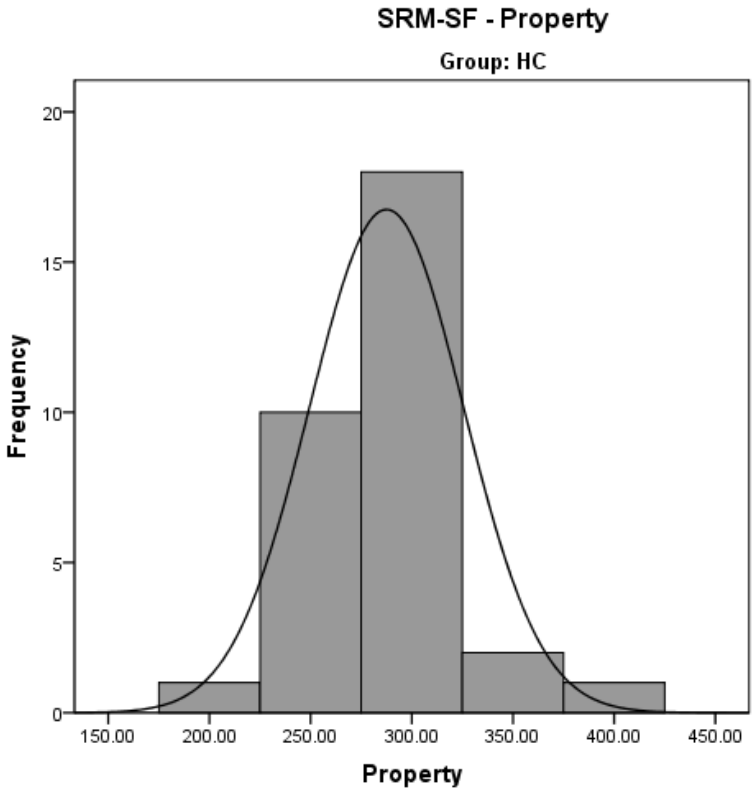

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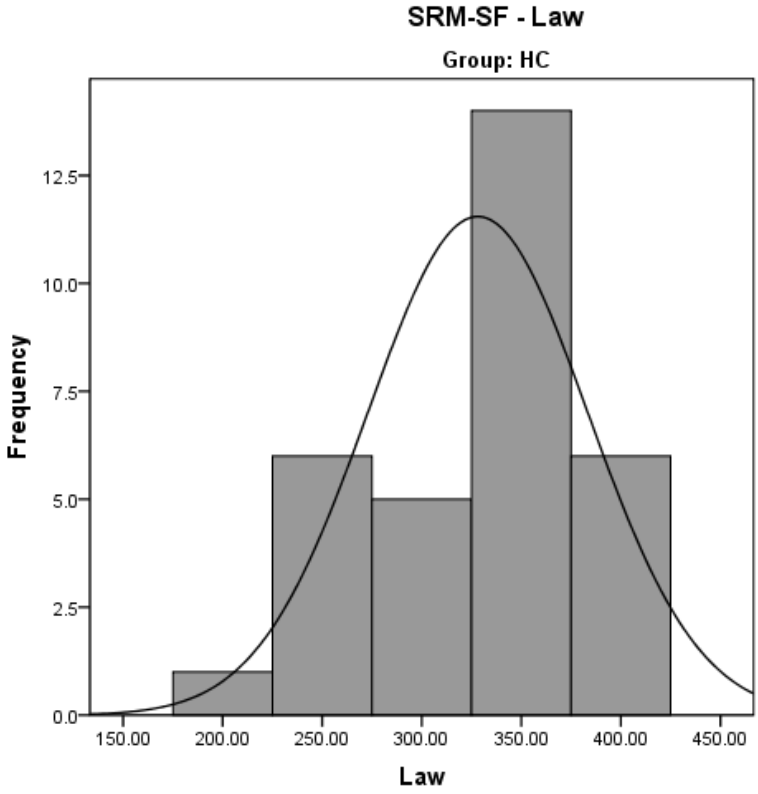

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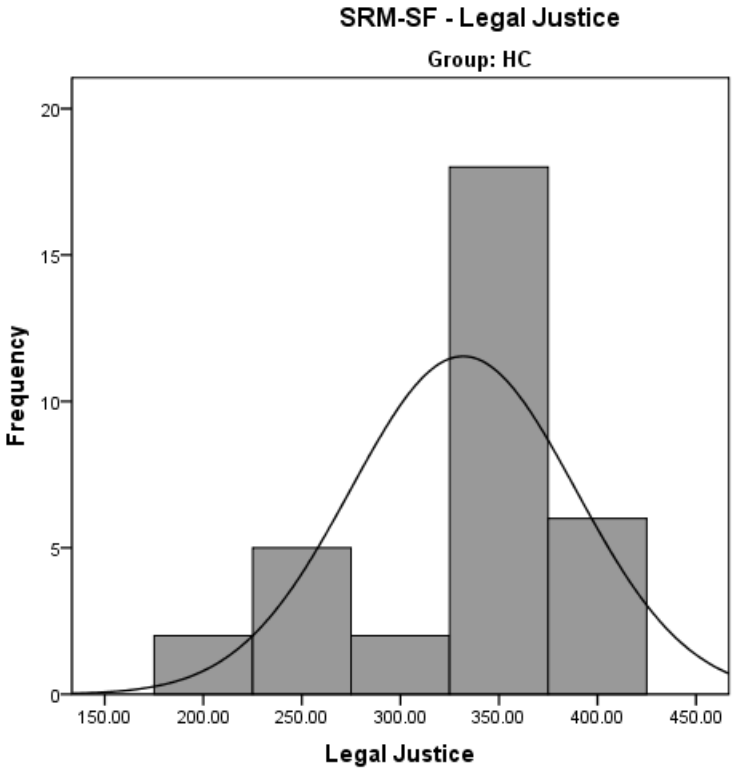

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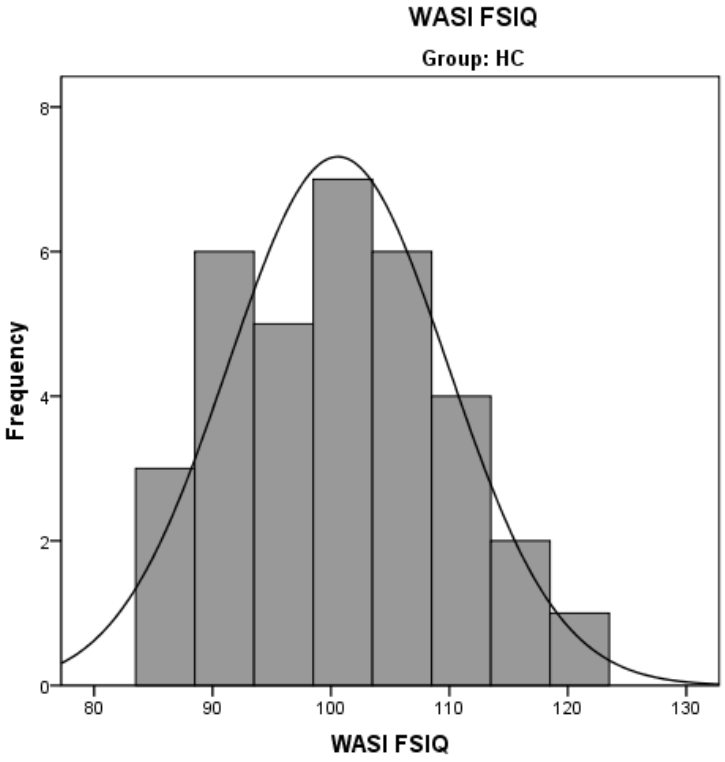

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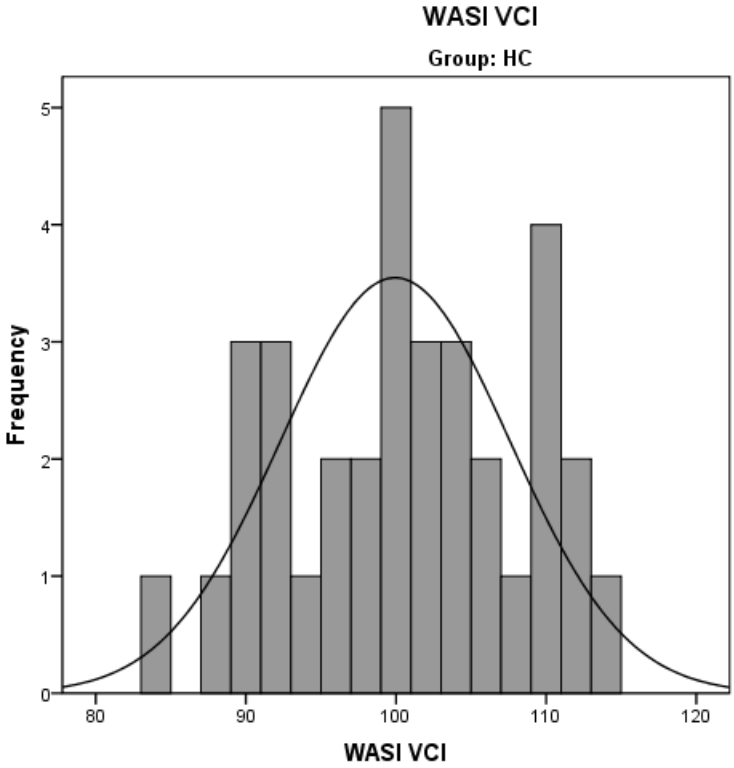

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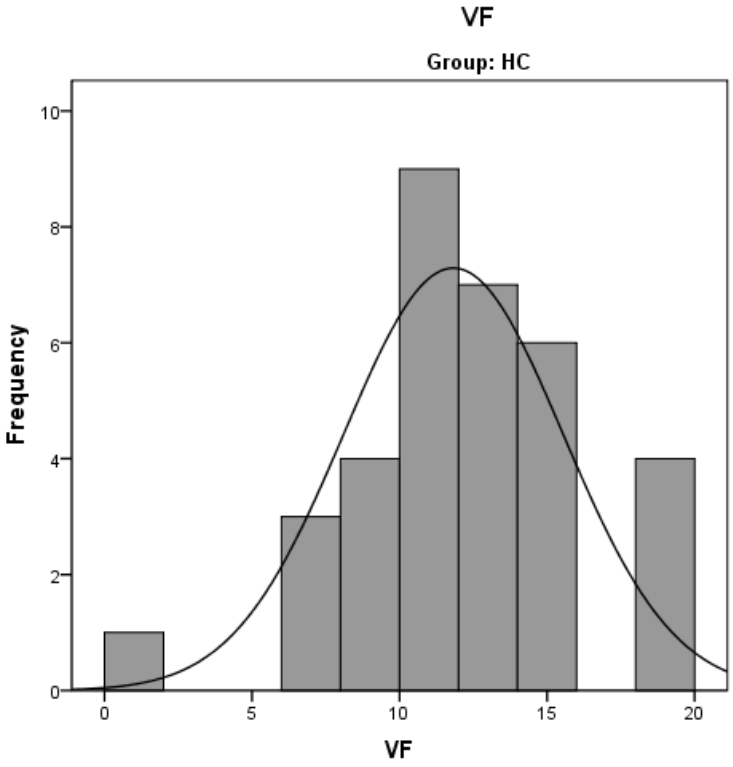
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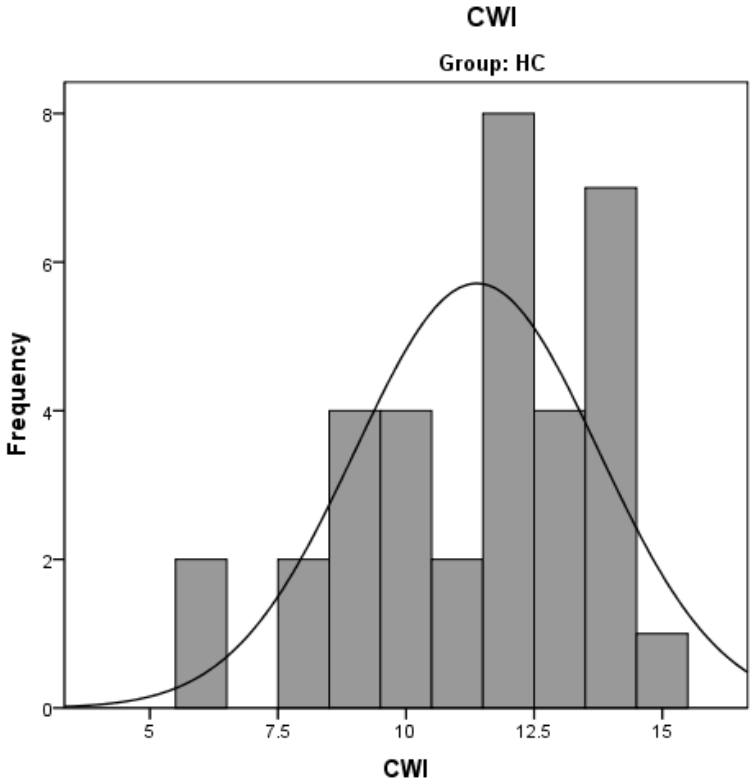
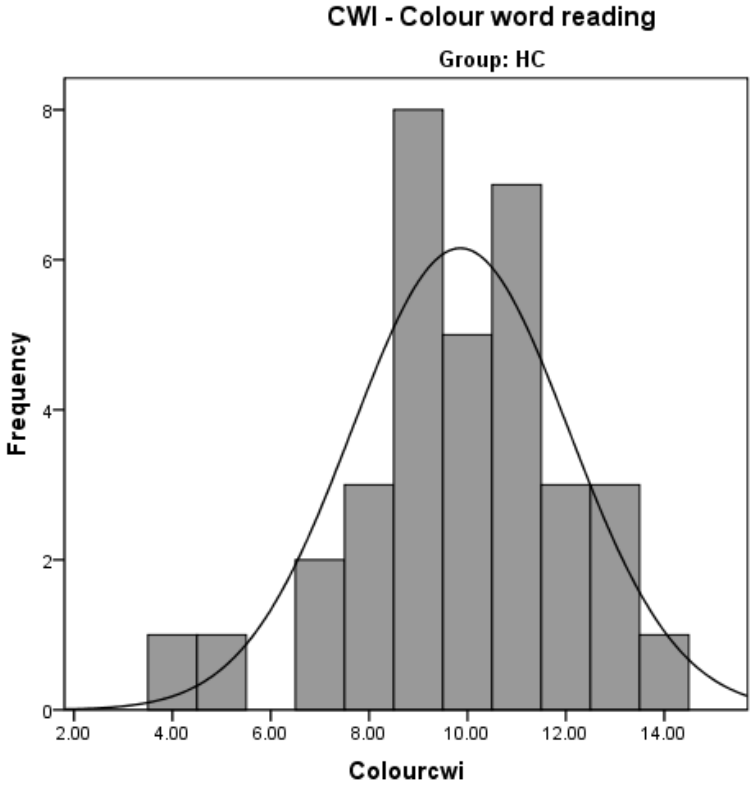
Group: HC
Frequency
VF
0
2
4
6
8
10
0
5
10
15
20

CWI


CWI
Group: HC
Frequency
CWI
0
2
4
6
8
5
7.5
10
12.5
15

CWI – Colour Word Reading



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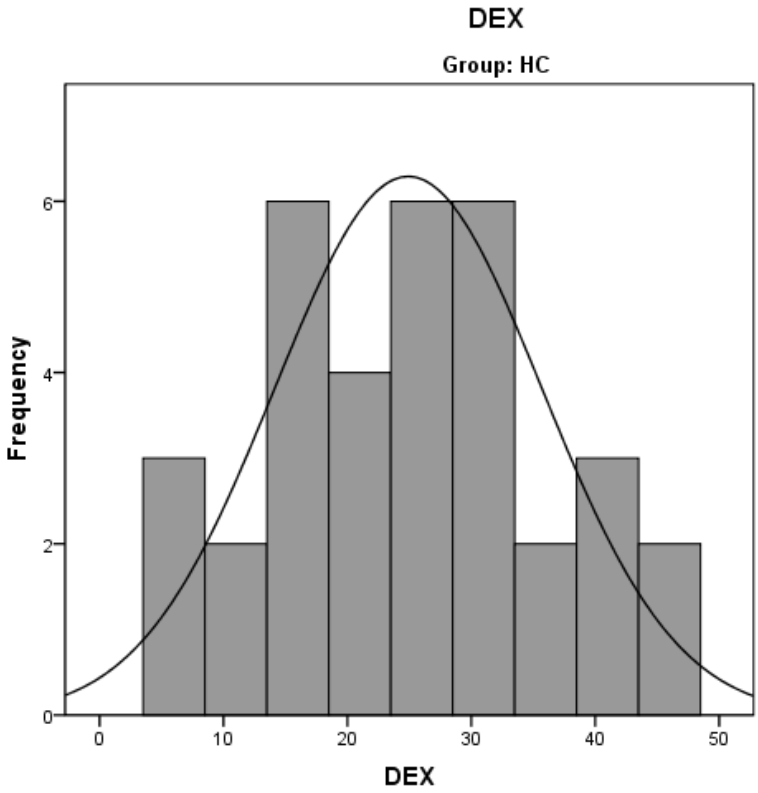
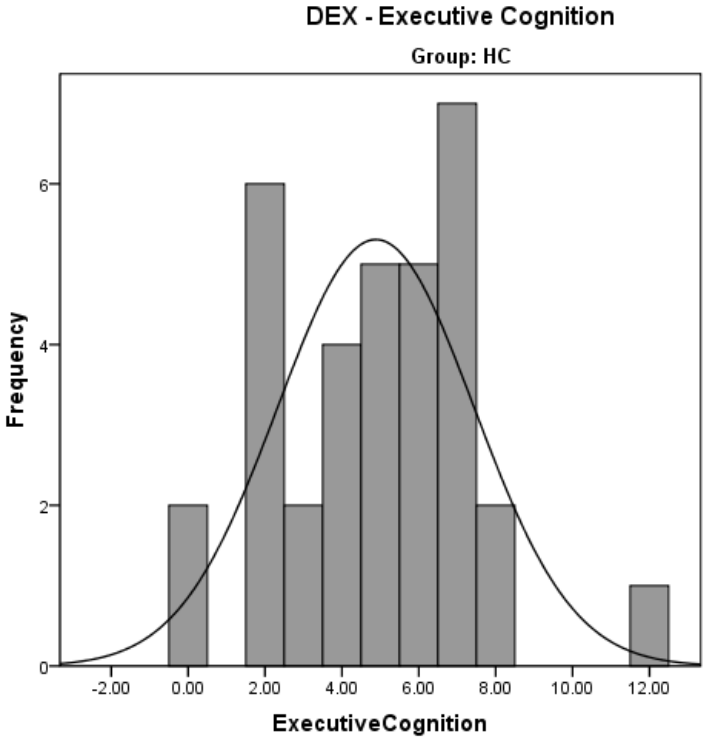
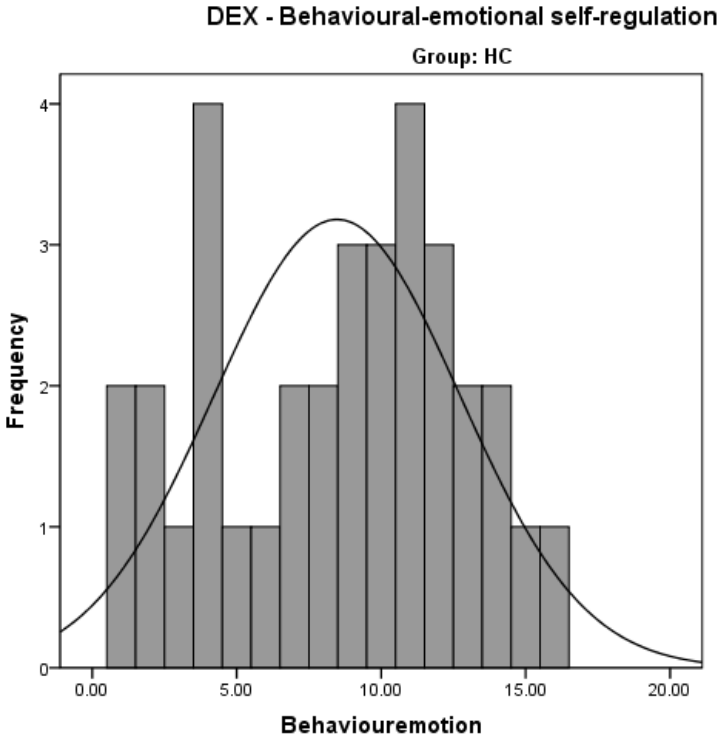


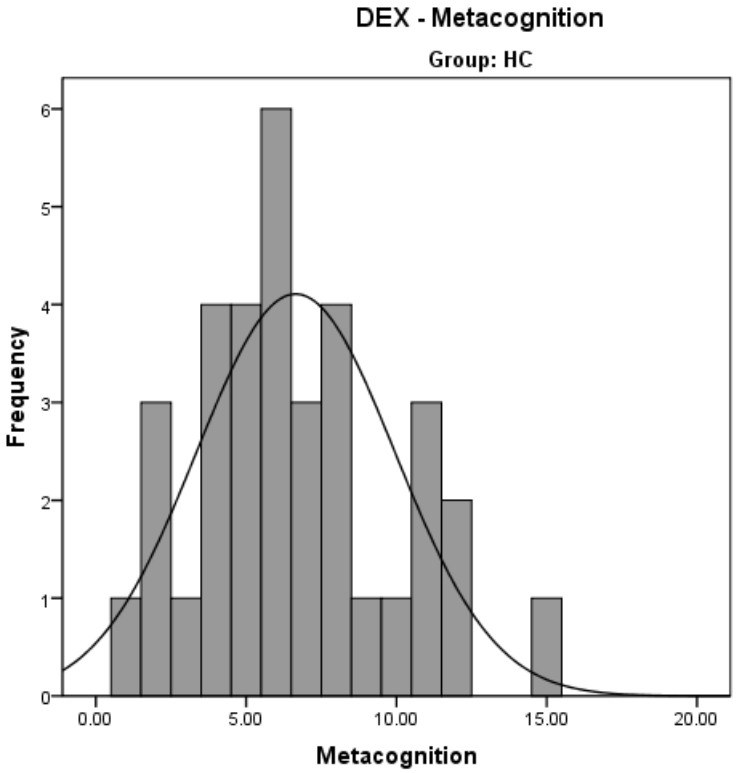
DEX – Executive cognition domain



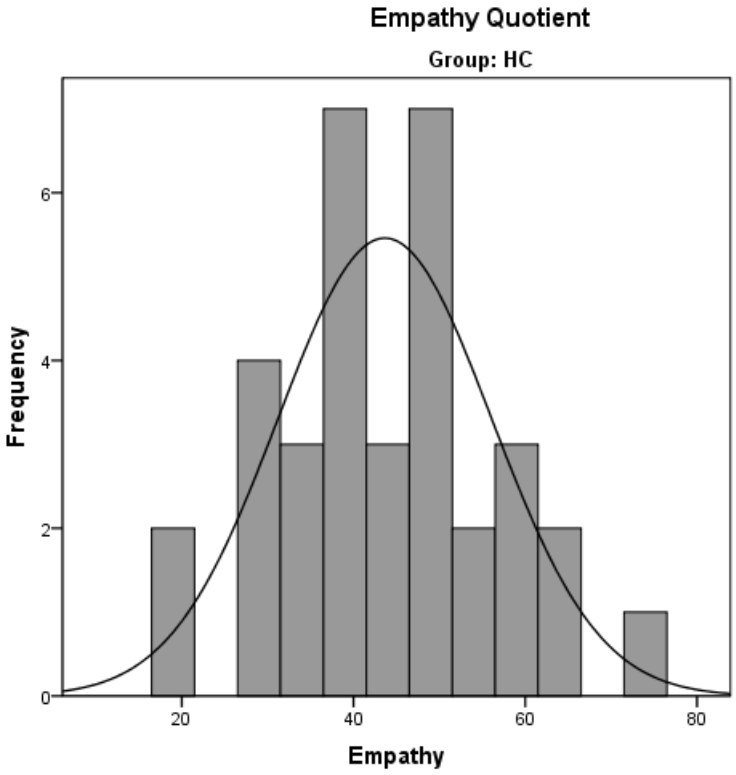
DEX – Behavioural-emotional self-regulation domain



DEX – Metacognition domain



Empathy Quotient



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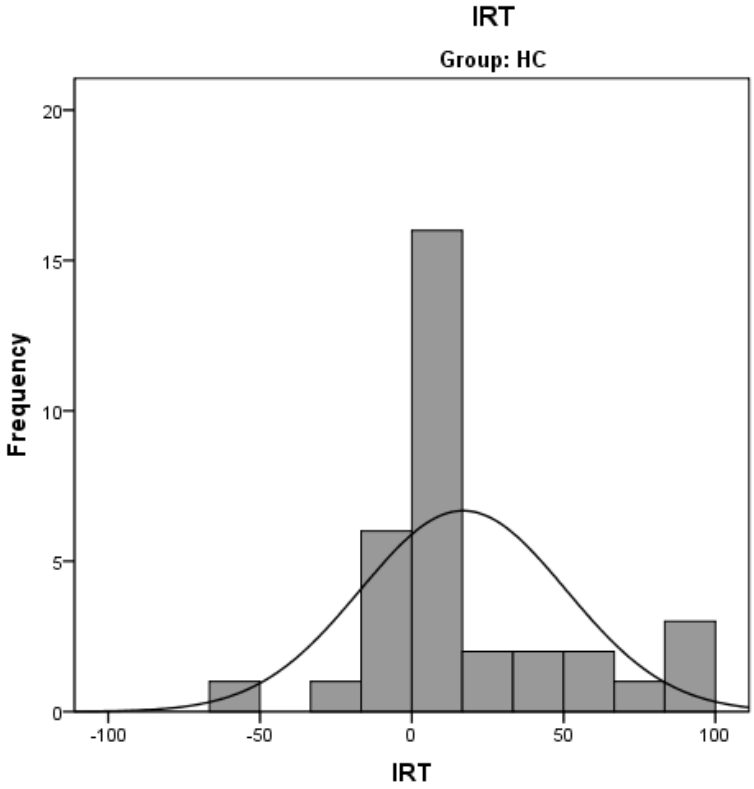

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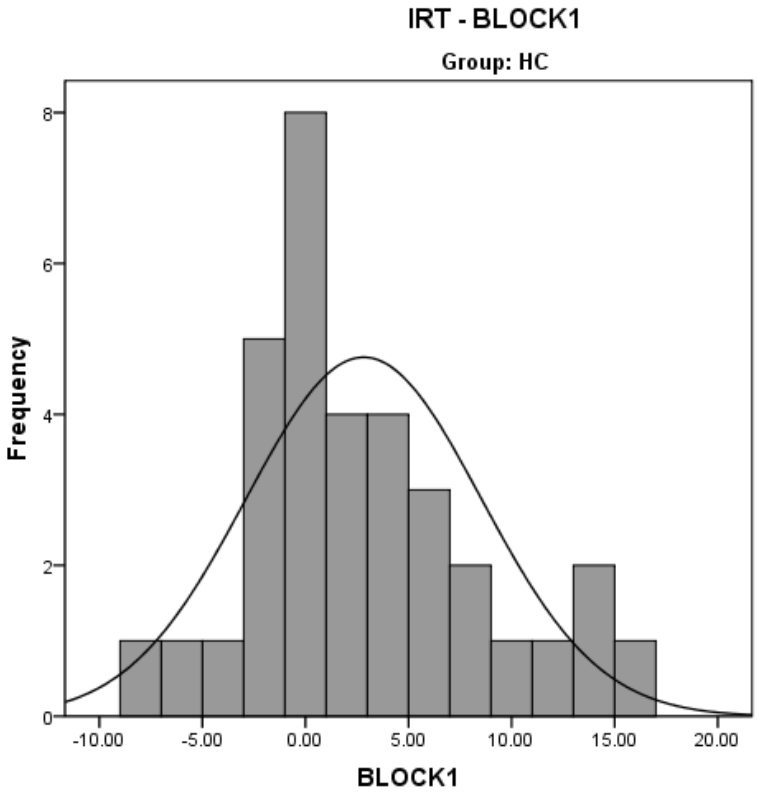

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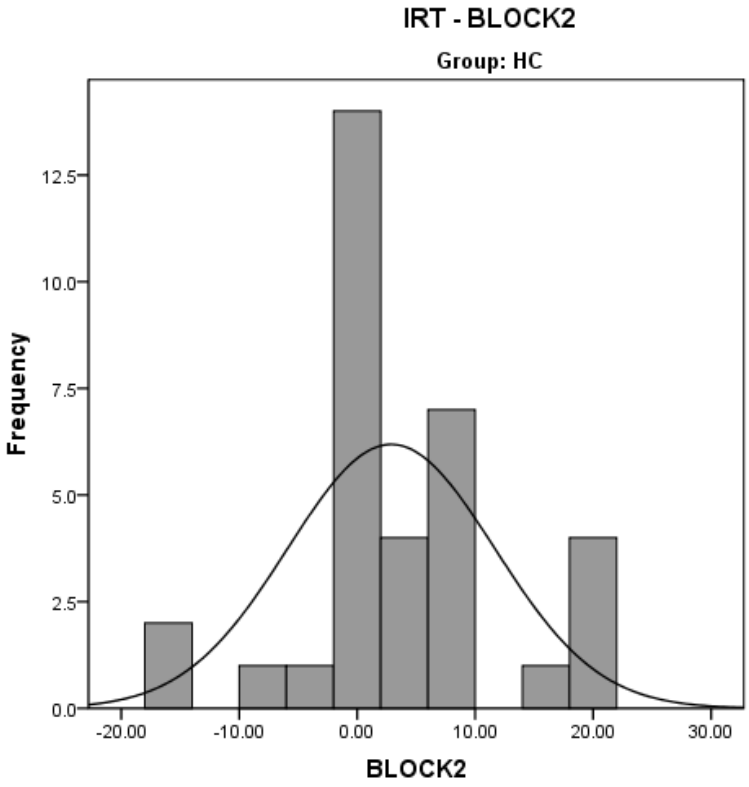

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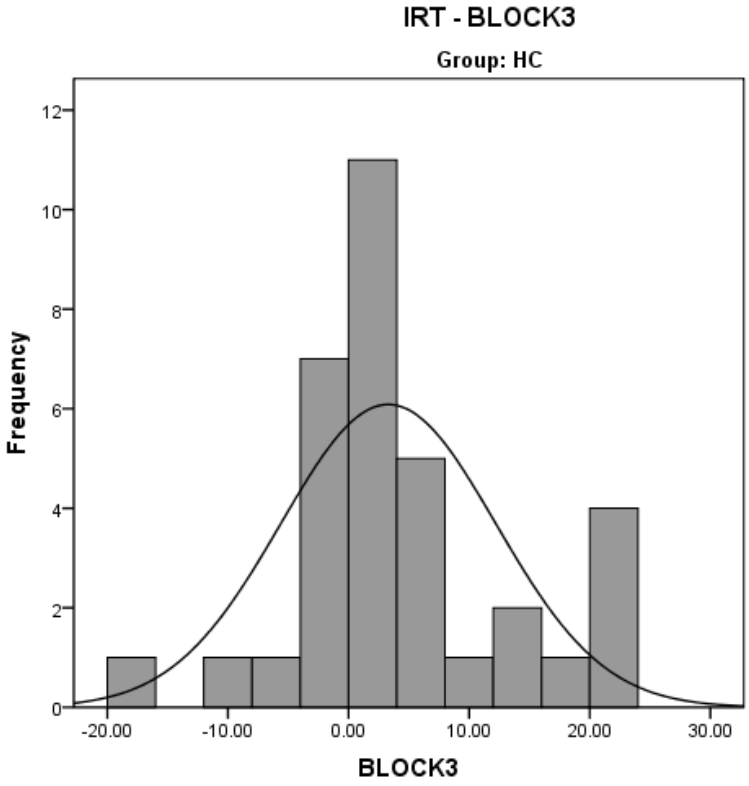

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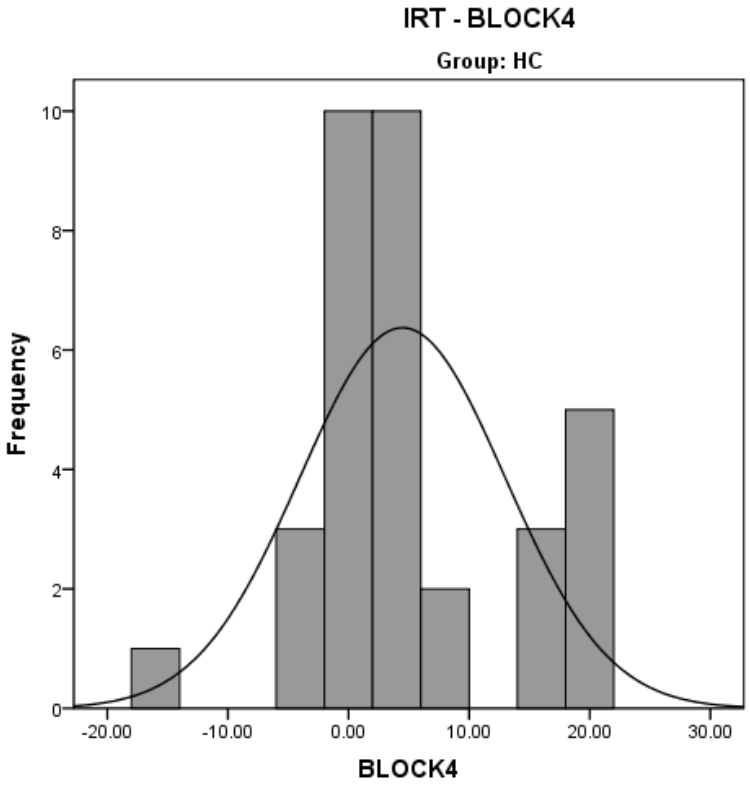

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