Rehabilitation of Executive functioning following pediatric traumatic brain injury: Evaluating a Goal Management Training intervention

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NRMAQE001

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DECLARATION

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Abstract

Background and aims. Executive function (EF), defined as a set of interrelated skills and behavioural competencies required for independent, purposeful, goal-directed activity, are particularly susceptible to impairment following traumatic brain injury (TBI). Despite this knowledge, data concerning the rehabilitation of executive dysfunction in pediatric populations is lacking to date. A Goal Management Training (GMT) intervention, based on Duncan et al.'s (1996) theory of goal neglect, has been successfully implemented for the remediation of EF in adults. The current study adapted the GMT to a healthy South African sample and evaluated the efficacy in a pediatric TBI sample.

Method. The study comprised of 3 parts. Part 1 involved the translation and adaptation of the pediatric GMT (pGMT) intervention so that it was suitable for use with South African children. This included the implementation of various health professionals' evaluations of these adaptations. Part 2 involved evaluating the pGMT by implementing the programme with 3 healthy control participants. Lastly, Part 3 involved evaluating the efficacy of the revised pGMT with 3 children who had sustained a moderate to severe TBIs. For Parts 2 and 3 I employed a multiple case study approach. Data for parts 2 and 3 were analyzed using the Reliable Change Index (RCI; Jacobson & Truax, 1991). The RCI distinguished between three levels of change, each at confidence levels of 68.2%, 95% and 99%. Outcomes were based on neuropsychological test outcomes, changes in everyday behaviour, self-report measures, and reports from parents and teachers.

Results. Regarding the cognitive measures for the TBI group, all three participants did not show improvement on the same domains. Positive changes from pre- to post-intervention on a number of attention and executive function measures at confidence intervals of 68.26% to 99% were evident. Regarding the behavioural measures parents/guardians and/or teachers reported significant positive changes for all of the participants on at least one index at confidence intervals of 68.26% to 99%. In terms of real world generalization, only one participant's teacher and parents commented on her improvements academically, behaviourally, and socially. No significant real world behavioural changes were reported for the other two participants. Results indicated that the adapted pGMT was successfully applied to the South African context for both healthy and TBI samples, although levels of success, in terms of post-intervention outcomes, varied with each TBI individual.

Conclusions. These results suggest that the pGMT intervention could be an efficacious cognitive rehabilitation tool for the remediation of everyday behaviours associated

with executive dysfunction in South Africa. However, the variability in the results do not provide conclusive evidence at this stage. Individual, injury-related and familial factors need to be considered and may affect outcome. In addition, limitations such as the small sample size and uncontrolled confounding effects (e.g., practice or maturation effects) could also contribute to seemingly positive effects. Greater evidence from future, larger and more controlled studies, is required.

Introduction

Traumatic Brain Injury (TBI)

TBI can be described as "a physiological disruption of brain function that results when the head is struck, strikes an object or undergoes acceleration/deceleration movement" (Demery, Larson, Dixit, Bauer & Perlstein, 2010, p. 1292). Brain injury often results in confusion, altered states of consciousness, seizures, comatose states and sensory or motor deficits (Bruns & Hauser, 2003). Brain regions that are particularly vulnerable to damage during a TBI include pre-frontal regions, the frontal lobes and polar areas of the temporal lobes (Catroppa & Anderson, 2006; Demery et al., 2010). The positioning of these neuroanatomical structures as well as the mechanism of insult, make these areas more vulnerable to damage. The mechanism of insult in a TBI involves acceleration/deceleration movements and the compression of the brain (Catroppa & Anderson, 2006). The brain then shifts within the skull causing neural pathways to either stretch or tear either within the brain or the brainstem leading to a myriad of cognitive and behavioural impairments (Catroppa & Anderson, 2009; Davis & Vogel, 2005). In particular, insult to the frontal lobes result in widespread damage in the domains of cognition, behaviour and emotion due to its interrelations with the cortical, sub-cortical and limbic regions of the brain (Demery et al., 2010; Catroppa & Anderson, 2006).

TBI: classification and severity

TBI is often classified using categories such as mechanism of injury (i.e. closed versus open (penetrating) injuries), morphology/structural damage (shown with imaging) and clinical severity (Astrand & Romner, 2012; Van Baalen et al., 2003; Maas, Stocchetti & Bullock, 2008). The duration of post traumatic amnesia (PTA; acute confusional state <60 minutes=mild; 60 minutes to 24 hours=moderate; >1 day= severe) (Rao & Lyketsos, 2000) and loss of consciousness are important indicators of the severity of TBI (Van Baalen et al., 2003; Malec et al., 2007). Regarding the level of severity, TBIs are usually defined as mild, moderate or severe (Saatman et al., 2008).

The Glasgow Coma Scale (GCS; Teasdale & Jennet, 1974) is a widely used assessment tool is measuring levels of TBI severity. According to this scale, mild TBI is classified as a GCS of 13-15, moderate TBI as a GCS of 9-12, and severe TBI as a GCS of 3-8. These scores are calculated using three subscales i.e. eye response, verbal response and motor response (Astrand & Romner, 2012; Van Baalen et al., 2003; Maas, Stocchetti & Bullock, 2008). A pediatric version of the GCS was created by Simpson and Reilly (1982) due to the inability to apply the original GCS to nonverbal children and the obvious

differences in which adults and children respond to verbal commands (Astrand & Romner, 2012). Some adjustments made with the pediatric GCS was the inclusion of social smiles, babbling/cooing, crying, moans to pain, irritablity and agitation to represent verbal responses (Simpson & Reilly, 1982; Reilly et al., 1988; Astrand & Romner, 2012). These modifications have been shown to accurately reflect severity of TBI in children (Holmes et al., 2005).

Linked to the levels of severity in TBIs, is the expected cognitive outcome post-TBI. A dose-response relationship between TBI severity and cognitive impairment has been demonstrated by various researchers (see Dikman et al., 1995; Kobeissy, 2015; Rohling, Meyers & Millis, 2003). Hence, it is postulated that the more severe the injury, the more extensive the cognitive fallout (Muscara, Catroppa & Anderson, 2008; Carone, 2013).

Although these categories of severity and the associated dose-response relationship applies to children and adults alike, the effects associated with the age at which injury occurs is an important distinction between adult and child populations (Lord-Maes & Obrzut, 1996; Bauer & Fritz, 2004). According to Giza, Mink and Madikians (2007), both the TBI mechanism of injury as well as TBI pathology vary with age. For example, toddlers commonly acquire a TBI after a fall and older children and adolescents may be injured as a result of motor vehicle accident (MVA) or sports related injuries. There is often a delay in treatment because young children may only display difficulties at a later stage.

TBI pathology may also vary with age. A younger age at injury is deemed to present with fewer contusions, but subdural hematomas and diffuse cerebral edema are more frequent (Giza, Mink & Madikians, 2007). In adolescence, TBI pathology is associated with more contusions as well as diffuse axonal injury and these features are similar to presentations of adult TBI (Giza, Mink & Madikians, 2007). Additionally, there are structural differences that should be noted between adult and child populations, the most obvious reason being that the child brain is still in the process of development compared to a mature adult brain. The consideration of structural differences is an important factor as it influences the manner in which the child and adult brain differ in response to injury (Bauer & Fritz, 2004). Hence, a higher water content, lower shear resistance, immature skull bone sutures and lack of calcification all make the developing brain vulnerable to more diffuse patterns of injury (see Bauer & Fritz, 2004).

Prevalence of TBI and mechanisms of injury

Around the world, TBI is a major public health concern, resulting in either death or disability for survivors. It has been described as a “silent epidemic” due to the ignorance of many societies regarding the massive impact of TBI on affected individuals (Roozenbeek,

Maas & Menon, 2013). The prevalence of TBI is rising in middle and low-income countries due to the increased use of motor vehicles (Maas, Stocchetti & Bullock, 2008).

For South Africa specifically, research that dates back over 20 years ago demonstrated that 17.1% of children aged 0 to 13 years old admitted to the Red Cross Children's Hospital (RXH) in Cape Town South Africa, had been receiving treatment after sustaining a TBI. Majority of the children had sustained their injury through a pedestrian MVA (83%). The rest of the injuries were due to falls (11%), passenger MVAs and assaults (6%) (Semple, Bass, & Peter, 1998). Another more recent study conducted in South Africa in 2010 reported on head injuries sustained for a range of patients admitted to a Pietermaritzburg hospital who were aged from 8 to 78 years. Results show that 41% of patients reported sustaining a TBI due to associated violence, while 28% of patients sustained a TBI as a result of MVAs (Alexander et al., 2010).

There is a lack of research regarding more recent prevalence rates for the South African population to date (Levin, 2004; Schrieff, 2013). However, a previous study done on TBI prevalence in South Africa reported an incidence ratio of 316:100 000 for ages 15 and older in the year 1990 (Nell & Brown, 1991; Bruns & Hauser, 2003). Comparing this ratio to international rates, the prevalence of TBI in the United States was 101:100 000 (Shiroma, Ferguson, & Pickelsimer, 2010); which is remarkably lower than South Africa's statistics. The obvious discrepancy between the prevalence rates of these countries may be attributed to the higher susceptibility of brain injury in South Africa compared to other countries (Bruns & Hauser, 2003; Levin, 2004). Even so, prevalence rates are expected to be much higher in more recent years as most injuries sustained by any other mechanism than a motor vehicle accident (MVA), may be unreported (Levin, 2004).

In South Africa, mechanisms by which brain injuries are sustained are diverse, however the leading causes of pediatric TBI are MVAs, falls and violence inflicted on children (Hawley, Ward, Long, Owen, & Magnay, 2003; Levin, 2004).

Damage caused by TBI results in a spectrum of cognitive and behavioural deficits that impact on an individual's capacity to live an independent life. When prefrontal areas of the brain or its connections to other areas of the brain such as cortical, sub-cortical and limbic regions have been damaged, executive dysfunction is a common neuropsychological consequence (Anderson & Catroppa, 2006; Galvin & Mandalis, 2009).

Neuropsychological Sequelae of TBI

Widespread damage as described above has lifelong implications for pediatric patients who sustain TBIs as their social, emotional and academic functioning is often disrupted

(Brenner et al., 2007; Galvin & Mandalis, 2009; Giza, Mink & Madikians, 2007; V. Anderson et al., 2002). With regards to neuropsychological functioning, the diffuse injuries that result from many TBIs and damage to the prefrontal regions specifically, impair higher order skills such as executive functioning, information processing, self-regulation, memory (short and long term) including working memory, attention and verbal and nonverbal skills which are commonly associated consequences of TBI (Anderson, 2002; Catroppa & Anderson, 2006; Demery et al., 2010; Mathias, Beall & Bigler 2004; Rao & Lyketsos, 2000). These neuropsychological sequelae are evident in both children and adults who have sustained a TBI (Verger et al., 2000).

It has been well established that TBI causes impairment of executive functions (Catroppa & Anderson, 2006; Crowe et al., 2013; Muskara, Catroppa & Anderson, 2008; Nadebaum, Anderson & Catroppa, 2007; Rao & Lyketsos, 2000; Skendensen et al., 2010). Executive deficits that are evident following a TBI include impairment in attention, cognitive flexibility, planning and organization, problem solving, self-monitoring, set shifting, inhibitory responses, and reasoning skills (Anderson et al., 2002; McAllister, 2008; Nadebaum, Anderson & Catroppa, 2007; Rao & Lyketsos, 2000; Lehtonen, Stringer & Millis et al., 2005; Mattson et al., 1990; Mathias & Wheaton, 2007). Furthermore, several researchers have demonstrated impairment of these components of executive function after pediatric TBI (see Anderson & Catroppa, 2005; Catroppa & Anderson, 2006; Levin et al., 1997; Pentland, Todd & Anderson 1998; Todd, Anderson & Lawrence, 1996).

Several studies have investigated the effect of TBI on executive functions at different ages. For example, a recent study conducted by Crowe et al. (2013) examined executive difficulties in very young children who had sustained a TBI before the age of 3 years. Researchers found specific deficits regarding inhibitory control in particular and no impairment in the domains of processing speed and areas of attention such as selective and sustained attention. In another study, Slomine et al. (2002) examined executive difficulties one -year post injury with children who sustained a TBI between the ages of 7 and 15 years. Researchers found evidence of executive difficulties for all children within the age range; however, deficits in younger children were more pronounced. Furthermore, in a longitudinal study conducted by Muskara, Catroppa and Anderson (2008), results showed that adolescents and young adults who sustained severe TBIs as children, presented with significant executive difficulties especially in the domains of goal setting, abstract reasoning and cognitive flexibility. This finding was consistent with the results of other similar studies (Anderson & Catroppa, 2005; Jacobs & Anderson, 2002; Yeates et al., 2004). These deficits have been

shown to persist even 5 years post injury in a sample of children aged 6 to 12 years (Mangeot et al., 2002).

Executive deficits arising from the effects of brain injury will be focused on given their specific emergence after TBI. However, executive dysfunction is best understood in relation to optimal executive function.

Executive Function

Executive function (EF) is a term that encompasses a range of interrelated processes that are responsible for establishing competencies in independent, purposeful, goal-directed behaviour (Lezak, 2004; Gioia, Isquith & Guy, 2001). Key competencies include goal setting, planning ability, initiation of activity, self-regulation, the mental flexibility of the individual, deployment of attentional functions, utilization of feedback and the more general ability to cope with novelty (Crawford, 1998; V. Anderson, 1998; P. Anderson, 2002).

Several researchers have attempted to organize this range of EF competencies into categories and to provide a clearer understanding of the developmental profile of executive functioning from childhood through to adolescence. A model proposed by Miyake, et al., (2000) outlined three factors of EF: inhibition, working memory, and shifting. All three factors are important in the development of EF in young children. However as Anderson and Reidy (2012) emphasize, processes that have not been included in the Miyake et al. model, such as conceptual reasoning, planning ability and organizational skills are key features of EF too. Given the importance of these excluded domains, this study will make reference to P. Anderson's (2002, 2008) model of the Executive Control System (ECS), which is based on factor analytic studies and developmental studies in neuropsychological literature (Anderson & Reidy, 2012).

The ECS distinguishes between four domains of EF: attentional control, cognitive flexibility, goal setting, and information processing, each with specific subdomains. Together, these four domains comprise an overall supervisory system in which all processes are interdependent (see Fig. 1). While the domains of cognitive flexibility, goal setting and information processing are interrelated, these and other executive domains are mediated by the processes of attentional control; each receiving, processing and integrating input from multiple stimuli (P. Anderson, 2002). P. Anderson's (2002, 2008) ECS domains are illustrated in Fig.1 and will be discussed separately in the sections to follow.

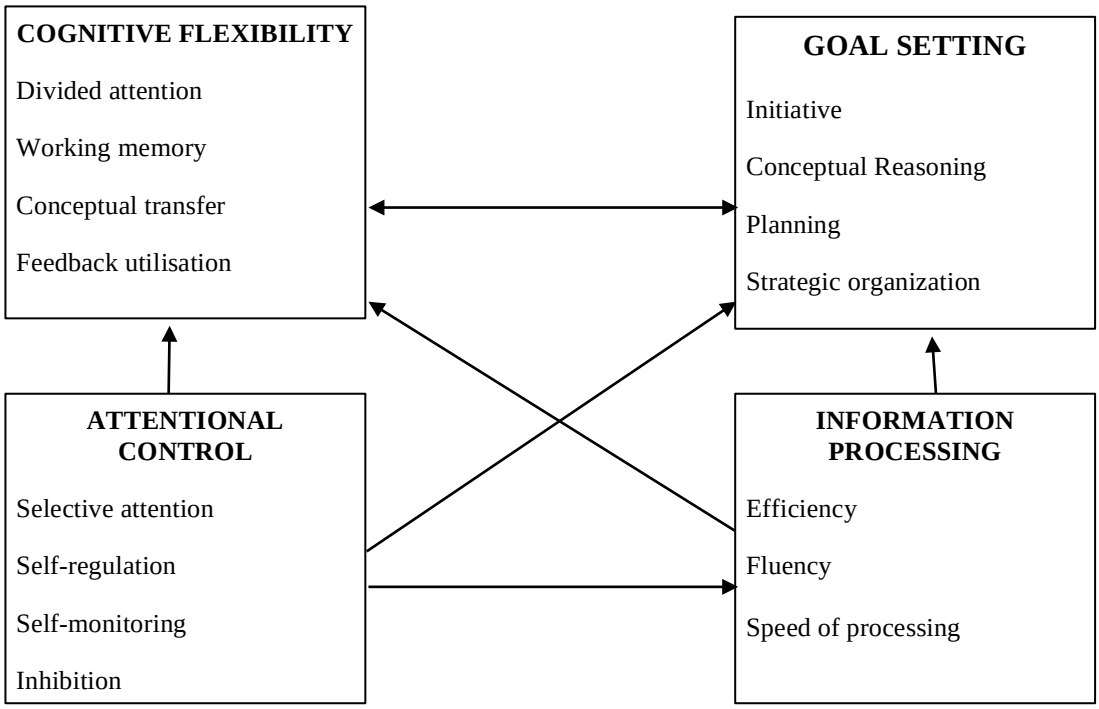

Fig. 1 The Executive Control System (Anderson 2002, 2008)

Attentional control refers to the ability to attend to specific stimuli, to maintain attention for longer periods of time, to regulate and monitor behaviour in order to carry out planned tasks in an accurate and orderly manner thereby achieving a goal, and to control impulses (P. Anderson, 2002; Anderson & Reidy, 2012). In the developing brain, this domain is the first to emerge (V. Anderson, et al., 2010). Between 9 and 12 months of age, infants have the ability to inhibit specific behaviours as well as shift to new response sets. By the age of 3 they are able to inhibit 'instinctive behaviours' (P. Anderson, 2002, p.76) and by age 6 the establishment of rapid impulse control is complete. At age 9 and older, children are able to self- monitor and regulate their own behaviours. Even though a period of impulsivity may occur at age 11, this is short-lived (P. Anderson, 2002).

Cognitive flexibility requires an individual to be able to cope with changes in daily routine, learn from errors, develop alternate strategies, shift to new response sets, divide their attention, and multitask and process temporary information i.e. working memory (P. Anderson, 2002; Anderson & Reidy, 2012). According to Baddeley (1992), working memory is the process in which information is stored and manipulated in the mind. From the ages of 3 to 4 years, children are capable of mentally holding information and shifting their attention from one response set to another (P. Anderson, V. Anderson et al., 2010). Cognitive

flexibility is typically established by the age of 8. This capacity involves the ability to recognize mistakes and formulate alternative ideas or plans. It emerges in early childhood and continues to development into middle childhood. Perseveration occurs when the child repeatedly makes the same mistakes or continues to break rules (P. Anderson, 2002). Perseverative tendencies are a common occurrence in early childhood, declines during middle childhood and is rare in adolescence.

Information processing refers to competencies related to fluency, speed and efficiency of completing tasks and producing output (Anderson & Reidy, 2012). Information processing can be defined as the rate or speed at which information is controlled and reproduced in the mind (Crowe et al., 2013; Ginstfeldt & Emanuelson, 2010). In early childhood from the ages of 3 to 5, the child's ability to process information increases and their verbal fluency yields faster response times. Information processing and verbal fluency continue to develop into middle childhood (P. Anderson, 2002). A significant increase in processing speed is seen between 9 and 11 years of age, whereas improvements in fluency occur in adolescence but stabilize after the age of 15.

Within the *Goal setting* domain individuals are expected to demonstrate the ability to formulate new initiatives and concepts, pre-plan ideas to achieve goals and attempt to complete tasks in a systematic, efficient and logical manner (P. Anderson, 2002; Anderson & Reidy, 2012). In children, the capacity to organize simple actions and simple conceptual reasoning emerges at age 4 (P. Anderson, 2002). Goal setting skills mature at a steady rate from middle childhood until late adolescence (V. Anderson, et al., 2010). Considerable improvement in planning and organizational skills is evident from the ages of 7 to 11, with more gradual increases in organizational efficiency expected in adolescence. Improved decision making and refinement of strategies continues during adolescence. Notably, more cautious and conservative strategies tend to emerge around age 12-13, where children regress from 'conceptual strategies to piecemeal strategies' (P Anderson, 2002, p. 77).

Thus, the developmental profile of EF can be summarized as follows. Attentional control emerges earliest in young childhood and is reasonably mature by middle childhood. While the domains of cognitive flexibility, information processing and goal setting follow different developmental trajectories, these skills are all relatively mature by the age of 12, although these domains are not considered fully established until late adolescence or early adulthood. When these developmental trajectories are interrupted by a TBI, the typical development of EF in children is adversely affected (Galvin & Mandalis, 2009; V. Anderson et al., 2010). These adverse effects may be termed as executive dysfunction.

Executive Dysfunction

Executive dysfunction is among the deficits that emerge as a consequence of a TBI and can be elicited on neuropsychological tests and in everyday life. Such dysfunctions are evidenced by poor planning, reasoning and organization, difficulty generating, implementing and moderating strategies for problem solving, impulsivity, perseveration, rigid thought processes and poor utilization of feedback (V. Anderson, 1998; P. Anderson, 2002; Brenner et al., 2007). Executive dysfunction is not only limited to the abovementioned cognitive domains, but is also evident in social, emotional and behavioural dysregulation. Common sequelae following injury to the frontal brain regions thus extend to disruptions in mood, affect, initiative, motivation, level of energy, and behavioural disturbances such as hyperactivity and aggression (Kehle, Clark, & Jenson, 1996; P. Anderson, 2002). These executive deficits are conceptualized as not only directly responsible for the sequelae of TBI, and may be undermined by disturbances in executive control over other cognitive processes such as attention and working memory (Limond & Leeke, 2005; Slomine & Locascio, 2009). Research shows that these and other aspects of executive function included in P. Anderson's (2002, 2008) model are often impaired following pTBI.

Information Processing. Information processing or processing speed, is known to be impaired following a pediatric TBI (Mathias, Beall & Bigler 2004; Crowe et al., 2013; P. Anderson, 2002; Ponsford et al., 2001; Recla et al., 2013). Since efficient information processing depends on the integrity of the white matter of the frontal lobes, slow processing speed results when the neural transmission of this area is affected (Mathias, Beall & Bigler 2004). Several studies have reported evidence of slowed processing speed with children who have sustained TBIs across the range of severity (Comerford et al., 2002; Mathias, Beall & Bigler 2004; Waterloo, Ingebrigsten, & Romner, 1997) (Recla et al., 2013).

Processing speed underpins the efficiency of ***attentional control*** processes (P. Anderson, 2002; Crowe et al., 2013). In light of this relationship, a study done by Crowe et al. (2013) examined processing speed and attentional control processes in 55 children. Thirty-five children had sustained mild and moderate TBIs before the age of 3 years and 20 children formed a healthy control group. All children were 3 weeks to 2 years and 11 months at the time of injury and were assessed at least 2 years post injury (aged from 3 years, 10 months to 5 years, 11 months). Results showed significant impairment of attentional control in the mild TBI group, compared to the healthy control group. In contrast, no impairment was noted for information processing for the TBI group. To account for this finding, researchers suggested the possibility that children injured under the age of 3 years do not present with impaired

information processing, as attentional control develops before information processing (Crowe et al., 2013; Smidts et al., 2004; Muscara, Catroppa & Anderson, 2008). However, this finding is inconsistent with previous studies that found impaired processing speed in children with TBI (Ewing-Cobbs et al., 1998; Mathias, Beall & Bigler 2004; P. Anderson, 2002; Ponsford et al., 2001; Recla et al., 2013) and alludes to the idea of children 'growing into their deficits' (Limond & Leeke, 2005). In other words, impairment of processing speed will emerge when these children are expected to reflect a standard of competency for their age group, as the normal development of these processes were interrupted when their injury occurred (Crowe et al., 2013; Schrieff, 2013).

Impaired information processing and attentional control skills have practical implications for a classroom setting. A normal rate of information processing and intact attentional control is crucial for children to succeed academically (e.g. completing their homework/classwork on time) and in the acquiring of new skills (Crowe et al., 2013; Recla et al., 2013).

Working Memory. As with information processing, damage to the white matter and frontal cortices also produce working memory impairments following a TBI (Ganesalingam et al., 2011; Levin et al., 2004; Nadebaum, Anderson & Catroppa, 2007). Deficits in working memory are evident in children who have sustained a TBI from a young age (Nadebaum, Anderson & Catroppa, 2007). In a study conducted by Levin et al. (2004), researchers hypothesized that severe TBI disrupts the development of working memory, whereas mild TBI does not. Additionally, researchers hypothesized that the severity of the impairment following a severe TBI is linked to the amount of effort that memory requires and that left frontal lesions are more likely to impair working memory. Results showed improved working memory regardless of age or severity of injury over the first 3 months post injury. However, working memory capacity deteriorated between 1 and 2 years post injury in children who sustained severe TBIs, although this was not seen with the mild to moderate TBI groups (Levin et al., 2004).

Working memory is a crucial function that subserves complex cognitive and academic skills such as reading and writing, audioverbal language comprehension and arithmetic (Bull & Scerif, 2001; Levin et al., 2004; Swanson, 1999).

Planning, problem solving and goal setting. The ability to plan, problem-solve and set goals are among the executive skills that are impaired post-TBI (Catroppa & Anderson, 2006; Jacobs & V. Anderson, 2002; Levin et al., 1997; Pentland, Todd & Anderson, 1998; Wade et al., 2010). Beauchamp et al. (2011) termed these abilities as "macro skills" (p. 579)

of executive function due to their emergence later on during the developmental trajectory. Several studies have demonstrated that the degree of impairment regarding these skills corresponds with the severity of the injury i.e. the greater the TBI severity, the greater the deficit (Anderson & Catroppa, 2005; Muscara, Catroppa & Anderson, 2008; Yeates et al., 2004). Furthermore, deficits in planning, problem solving and goal setting are skills that have implications for real world educational and societal integration from childhood through to adulthood (Catroppa & Anderson, 2006; Beauchamp et al., 2011; Bull, Espy & Wiebe, 2008; Ownsworth & Fleming, 2005).

The abovementioned domains of the executive system are dependent on intact neuronal networks. Disruptions to specific neural connections produce associated impairments typically seen with TBIs. Consequently, executive dysfunction has a lifelong impact on the abilities of both children and adults across various functional domains; however, this impacts differently for children (Galvin & Mandalis, 2009).

Plasticity and the developing brain

This lifelong impairment due to executive dysfunction that children may be faced with contradicts the long-standing assumption that "younger (age at injury) is better" (Giza et al., 2007, p.148). The developing brain was traditionally thought to have a greater level of functional plasticity, hence a greater capacity for recovery and regeneration and therefore, it would be better for injuries to be sustained at a younger age (V. Anderson et al., 2010). Furthermore, the Kennard Principle purported that the immature brain would 'bounce back' more easily to a more functionally intact state than the more mature brains of older patients due to the gradual formation of neural networks in children (Verger, et al., 2000). However, an increasing amount of evidence argues that early insult may in fact be more detrimental than damage to a mature brain. The early vulnerability theory posits that damage during critical stages of development may cause permanent impairment in skills that are dependent on the damaged region (Anderson, Morse, Catroppa, Haritou, & Rosenfeld, 2004; Chapman & McKinnon, 2002). In a study done by Asikainen et al (1998), children aged 7 and younger had worse predicted outcomes than patients aged between 8 and 40 after sustaining a TBI. Similarly, in V. Anderson et al., (2010), results were supportive of this theory demonstrating that children sustaining an early brain injury before the age of 3 reported more generalized and severe deficits specifically in the domain of cognitive flexibility/working memory than children with injury at age 7 and older who performed at almost normal and age appropriate levels. These issues are important when considering the remediation of these deficits in executive function.

Pediatric Rehabilitation of Executive Dysfunction

Due to the latent effects associated with pediatric TBI (pTBI), monitoring cognitive skills across their developmental trajectories are essential to facilitate the remediation of EF. In spite of the obvious need for such intervention, there is, however, a dearth of literature pertaining to the rehabilitation of EF among children and adolescents. There are two mechanisms of recovery, which provide the basis for these approaches to remediation.

Mechanisms of recovery: Theories of Restitution versus Substitution

Following pTBI, spontaneous and compensatory mechanisms of recovery may be activated in the brain (Catroppa & Anderson, 2006; Catroppa, Anderson & Muscara, 2009). These mechanisms are based on restitution and substitution theories of recovery (Rothi & Horner, 1983). Restitution refers to spontaneous physiological recovery of damaged brain tissues thus, enabling the restoration of cognitive functions. Substitution denotes restoration of functions from damaged areas by transferring these functions to healthy tissues, either anatomically or through behavioural compensation. During the acute phase of recovery these two mechanisms overlap, but by 6 months post-injury only the substitution mechanism persists, provided there is learning potential. The role of these mechanisms in the recovery process is thus relevant to the application of rehabilitation strategies.

The abovementioned theories provide a basis for different types of cognitive rehabilitation strategies for neuropsychologists, including: (i) direct remediation of deficits, (ii) behavioural compensation in order to train children to develop new strategies, (iii) behavioural modification to overcome deficits, (iv) modification of the child's environment, and (v) instructional/psychoeducational approaches (Limond & Leeke, 2005; Catroppa et al., 2009). Clinicians may either utilize one of these approaches, or a combination of multiple strategies.

The rehabilitation of executive function post-TBI

A limited number of studies have reported on the remediation of executive dysfunction post-pTBI. First, Crowley and Miles (1991) employed an individually tailored, behavioural approach to cognitive remediation. The methods utilized in this strategy included monitoring the individual's progress in order to facilitate increased self-awareness, training and practicing of self-executed cues, and checking procedures. A case study describing an adolescent male aged 16 years demonstrated an improvement in goal accomplishment, and some generalization to academic skills. Despite the above-mentioned positive outcomes, non-significant improvements were reported for mathematics test scores and accuracy of daily homework assignments.

A second study involved direct instruction techniques implemented over a six-week tutoring programme (Glang, Singer, Cooley & Tish, 1992). The intervention involved task analysis, modeling and shaping to target reasoning and aimed to develop problem-solving strategies. For the three case studies reported, based on participants aged 6, 8 and 10 years, results showed progress in the domain of school function, which encompassed language, reading, reasoning, and mathematics. Further, a self-monitoring technique considerably reduced aggressive outbursts in one child. In summary, the direct instruction rehabilitation technique demonstrated improvement in both academic and behavioural domains in these three children post-TBI.

In a third study, a multi-component cognitive-behavioural programme was used that served to imitate rehabilitation strategies employed in children sustaining TBI. As such, the programme integrated training in self-instruction, self-regulation, metacognition, and attribution as well as reinforcement (Suzman, Morris, Morris, & Milan, 1997). This multi-component programme was implemented in an effort to rehabilitate 5 children who sustained a TBI, with participants' ages at intervention being 6, 7, 8, 9 and 11 years. The researchers reported a notable decrease in errors on trained problem-solving tasks, as well as significant improvement on two of the four standardized problem-solving tests for all 5 participants.

The fourth pediatric rehabilitation study that focused on executive dysfunction following TBI utilized external aids as a compensatory strategy. This intervention aimed to reduce everyday failures of planning and memory by means of a paging system (Wilson, Emslie, Quirk, & Evans, 2001). Participants included 143 individuals who sustained a TBI, with age at intervention ranging from 8 to 83 years. The participants, along with their caregivers and the researchers, identified problematic areas in memory and organization. The intervention targeted identified areas of difficulty through a system of reminders recorded on a pager. The researchers reported significant reductions in everyday failures of planning and memory across all ages and all severities of injury.

Finally, in a pilot intervention study, Catroppa et al. (2009) aimed to rehabilitate EF skills in adolescents and young adults. The intervention was based both on elements of a cognitive-behavioural approach, and a psycho-educational or instructional approach. These approaches were aimed at increasing knowledge and facilitating the development of EF skills required for everyday functioning such as attentional control, problem-solving, cognitive flexibility and abstract reasoning. Catroppa et al. (2009) reported on 3 case studies of individuals aged at 9, 10 and 11 years old at the time of injury, with intervention occurring during the chronic phase of recovery at ages 20, 13 and 22 respectively. Results of the six-

week intervention varied across participants; improvements were evident in the adaptive and ecological (i.e., functional) measures of EF in 2 cases, while little significant change was apparent from pre- to post-intervention on many standardized measures of EF across all cases.

Many of the summarized studies show support for the notion that remediation of executive dysfunction requires an emphasis on everyday behaviours and functions (Limond & Leeke, 2005). Further, dedicated familial or caregiver involvement is also thought to be imperative in pediatric neurorehabilitation (Braga, Da Paz Junior, & Ylvisaker, 2005; Corbett, 2008; Galvin & Mandalis, 2009). Including the participants' families and schools in the intervention process allows for improvements in everyday functioning to be generalized to other areas of life. These two aspects (i.e. a focus on everyday behaviours and familial involvement) are important contributors to the success of rehabilitation strategies for EF skills.

Pediatric rehabilitation facilities in South Africa

Although access to high quality medical facilities in the acute stage of TBI, followed by aftercare in a pediatric ward through to home-based support and care (Blosser & De Pompei, 2003; Levin, 2004) may be the standard of international health care facilities, many South African children do not have these privileges. This lack of accessibility to quality care is due to factors such as socioecomic status (SES), lack of available rehabilitation units for children with TBI and restrictions on funding for rehabilitation. Further, service delivery in the public sector is inconsistent and transport systems to cater for people with disabilities inadequate, making it difficult for parents to access the few available resources in hospitals and clinics. In addition, South African schools are not equipped to deal with the special needs of children with a TBI due to limited resources and insufficient training of educators (Levin, 2004). Thus, the possibility for children with TBI to be re-integrated into South African society remains a challenge. On this premise, there is a need for rehabilitation programmes to facilitate this process of reintegration by addressing the deficits (e.g. executive dysfunction) that created this need in the first place. One such programme that aims to remediate goal setting and attainment in relation to activities of daily living is Goal Management Training (GMT).

Goal Management Training (GMT)

Studies that have focused on rehabilitation strategies for adult populations regarding executive dysfunction are often not based on a clear theoretical framework (Grant, Ponsford & Bennett, 2012). GMT, developed by Robertson, Levine, and Manly (2005), is however

grounded in the theory of g*oal neglect* (Duncan, Emslie, Williams, Johnson, & Freer, 1996). *Goal neglect* refers to the disregarding of a task requirement by an individual, despite the requirement being both understood and remembered by that individual. Subjectively, what is considered as disregarded by the individual appears to "slip the subject's mind" (p. 257). As EF skills include goal-setting capabilities, this phenomenon of disregard, where information "of disregard, where info is associated with executive dysfunction. GMT is thus considered advantageous, because the programme places particular emphasis on rehabilitating everyday behaviour in order to facilitate improved goal management in everyday activities.

The administration of GMT has mostly been limited to the cognitive rehabilitation of adult populations, with the exception of recent pediatric studies (discussed below). Two studies were implemented with older adults from non-clinical populations, who reported a decline in executive functioning (van Hooren, et al., 2006; Levin et al., 2007). Results from one study indicated that GMT improved the management of executive failures such as carrying out activities according to a plan, multi-tasking, and being able to estimate the time needed to carry out a task. In turn, these improvements on planning, multitasking and cognitive estimation significantly decreased the anxiety levels of the participants (van Hooren, et al., 2006). The other study demonstrated significant improvement in real-life goal attainment and executive functioning (Levin et al., 2007).[1]

GMT interventions have also been implemented within clinical populations. Levine et al. (2000) documented two such interventions. First, performances in GMT was compared to performances in motor skills training with adult participants post-TBI, with the GMT group showing improvement on paper-and-pencil tasks sensitive to goal neglect. Second, a case study of a post-encephalitic participant was reported (Levine et al., 2000). Results indicated significant improvements on two paper-and-pencil tasks that evaluated goal neglect. Furthermore, there were positive reports by the participant (aged 35 years) and administrator regarding increased efficiency on a classic task dependent on EF, that is, meal preparation. The participant also reported generalisation of GMT to other aspects of life that had nothing to do with a cooking situation used during the intervention training. The generalisation of the GMT concepts was mostly applied to her workplace and included activities such as pricing a new consignment of stock and completing a mountaineering expedition (Levine et al., 2000).

[1] van Hooren et al. (2006) implemented GMT in the cognitive neurorehabilitation of 69 healthy individuals over the age of 55, while Levine et al. (2007) administered an adapted version of the GMT programme to 49 healthy older adults between the ages of 71 and 87. The reported results originated from a combination of examiner-rated and self-rated executive function, tabletop simulated real-life tasks, and a dysexecutive questionnaire. Maintenance of these improvements was reported at 6 months post-intervention.

Schweitzer et al. (2008) provide further evidence for GMT in a clinical setting. These researchers reported a case study of a 41-year-old male with focal cerebellar damage that resulted in decreased information processing speed and organizational difficulties. These difficulties prevented the participant from returning to work. Typically, cerebellar lesions are associated with motor functions, including balance and coordination. However, cerebellar damage may also result in executive and attentional dysfunction. The association between the cerebellum and executive function is evidenced by functional neuroimaging studies (Baddeley, Emslie & Nimmo-Smith, 1992; Robertson, Ward, Ridgeway et al., 1994). These studies showed that during a cognitive task, activations of prefrontal cortex with concurrent activations of the cerebellar cortex were present. The GMT was conducted over 7 weeks and each week consisted of one 2-hour session. Outcome measures for the efficacy of the GMT included various standardized neuropsychological tests. This participant demonstrated improved neuropsychological test performance in EF and attentional domains, and reported subjective enhancement of everyday executive tasks, confirmed by a significant other. Finally, the participant returned to his previous occupation.

In a controlled trial conducted by Levin et al. (2011), an expanded version of GMT was compared to an alternate intervention, namely the Brain Health Workshop. The sample consisted of 19 individuals with chronic deficits following acquired brain injuries (mainly strokes) that had affected their frontal lobe functioning. Results indicated positive effects of GMT through improved performances of participants from pre-to-post testing on the Sustained Attention to Response Task and the Tower of London Test (Culbertson & Zillmer, 2001; Robertson, Manly, Baddeley & Yiend, 1997). Overall, the data provided conclusive evidence in support of GMT for the rehabilitation of EF deficits.

Grant, Ponsford and Bennett (2012) carried out the most recent adult study evaluating GMT by exploring the efficacy of the programme with patients who had sustained a TBI. In this study, the targeted behaviours were the participants' daily financial management (planning and organizing). A modified GMT (used by Levine et al., 2000) was administered to four participants with severe TBI and their performance was assessed using the Goal Attainment Scale. Minor modifications that were made included replacing the abstract pencil and paper-training activity sessions with training in applying the principles of GMT to hypothetical activities of daily living tasks. Additionally, a GMT session was included to discuss strategies to assist with goal attainment and the entire GMT programme was administered over seven sessions (Grant, et al., 2012). Five participants served as a control group for comparisons on the Multiple Errands task that was used as a measure of

generalizability. Overall, results demonstrated that the GMT was effective in improving the performance of financial management tasks for some of the participants with evidence of generalisation to untrained tasks, but not others. This finding was attributed to the subjective differences of each individual's underlying cognitive deficits. For example, the participant with significantly slow processing speed was unable to generalize the GMT concepts after 3 sessions (Grant, et al., 2012, p.871). More importantly, researchers pointed out that these results extend Levine et al's. (2000) findings that GMT improves performance on discrete tasks such as weekly household shopping and meal preparation to more open-ended tasks that require goal directed behaviour such as establishing and meeting a budget (Grant et al., 2012). However, researchers did highlight the limitations of the small sample size and recommended the further examination and generalizability as requirements for future research.

In a current, ongoing study, Bertens et al. (2013) aims to examine the efficacy of the GMT using an errorless learning technique in which errors during the acquisition of learning is prevented. The study is designed to compare the original content of the GMT intervention to a second group, in which the GMT will be administered using the errorless learning approach. Both groups include 32 patients with acquired brain injuries (ABIs) such as TBI and strokes. The authors hypothesize that the GMT in conjunction with the errorless learning approach will prove to be more efficacious in the remediation of executive deficits specifically during complex daily tasks (Bertens et al, 2013).

As illustrated above, GMT has been considered a valuable and effective approach in the rehabilitation of adults with executive dysfunction. However, the results from the abovementioned studies should be interpreted with caution due to the limitations of small sample sizes and its implications for generalizability. However, despite the importance of rehabilitating children with executive difficulties, there is little evidence of GMT being applied to child populations. A pilot study done by Corbett (2008) attempted to address this gap in the literature by adapting and evaluating the GMT programme for South African children. This adaptation was then evaluated on three children with executive dysfunction after a mild, moderate and severe TBIs and yielded varied results. Several limitations of the study were noted and recommendations for future research were outlined. For example, the author suggested that the original 7 modules be implemented instead of 5; that combined interviews are conducted with both parents and teachers and that the utility of a control group would be beneficial for comparative purposes.

Following this, a study conducted by Krasny-pacini et al (2014) adapted the GMT for use with 5 French children. Two of the children were 11 years old, the other 3 children were aged 8, 13 and 14 years. Researchers shortened and re-designed the original programme, and included aspects of the Corbett (2008) adaptation producing a more colourful and engaging version. In a previous systematic review of the effectiveness of the GMT, Krasny-pacini, Chevignard and Evans (2014) concluded that the pGMT was feasible, but not as a stand-alone intervention. Therefore, the pGMT programme was used in conjunction with Ylvisaker's Principles to remediate executive dysfunction (Krasny-pacini et al, 2014). The current study made use of this French version of the pGMT only as a foundation for the further adaptation and evaluation of the programme with South African adolescents. More specific aims are outlined in the section to follow.

Rationale

Research studies that have investigated executive dysfunction and TBI have primarily focused on the assessment and intervention strategies of adult populations post- injury and these strategies are high priority as a component of any neuro-rehabilitation plan (Lewis, Babbage & Leathem, 2011). With children and adolescents, investigations into consequences of TBI are not as clear-cut. Research studies that have been conducted in the domain of neuropsychological assessment of EF in children and adolescents are inadequately reported (Archibald & Kerns, 1999). Furthermore, effective evaluations of intervention strategies for the rehabilitation of children (using direct approaches to improve skills) who have sustained a TBI are lacking compared to adult populations (Catroppa, Anderson & Muscara, 2009). An increasing number of studies have acknowledged the importance of the use of developmentally appropriate measures and highlighted the need to evaluate intervention programmes tailored to the needs of children and adolescents (Catroppa & Anderson, 2006; Spikman, Boelen, Lamberts, Brouwer & Fasotti, 2010; Archibald & Kerns, 1999; Anderson & Reidy, 2012). Rehabilitation and management strategies of EF make different demands on child and adolescent populations compared to adult populations due to the nature of the developing brain compared to the mature brain. Despite these realizations, many studies continue to employ techniques that have been developed for adults on children and adolescents without considering the limitations of adult interventions on these populations (Galvin & Mandalis, 2009).

The issue of applying rehabilitation techniques to inappropriate populations is particularly important in South Africa due to the country's economic and socio-political

history that may serve to exacerbate the challenges of neurorehabilitation for children and adolescent populations. Levin (2004) emphasized that South African children who have sustained a TBI have different needs and experiences to those in more developed countries. Despite contextual differences, most of the research published on rehabilitation is based on cases and trials in developed countries, which encompass a very different dynamic. Compounding issues such as socioeconomic systems, cultural and educational factors as well as superior health care facilities in more developed countries render research findings less credible for use in South Africa (Levin, 2004). For children who have sustained a TBI, there are inadequate neuropsychological rehabilitation facilities in South Africa. This renders the possibility of reintegrating brain-injured children into South African society a challenging one. Therefore, this study hoped to contribute to efforts aimed at improving the process of reintegration by adapting and evaluating a pediatric intervention programme for the remediation of executive dysfunction of South African children who have sustained a TBI. Early intervention is crucial for minimizing long-term consequences of TBI. If adequately adapted, results obtained in the pGMT programme may replicate the successful outcomes of the programme with adults.

Specific Aims

Damage to the frontal regions of the brain as a consequence of TBI often leads to executive dysfunction. The ability to plan, organize and problem solve (i.e., intact EF) is fundamental to successful development in childhood and adolescence. Thus, rehabilitation following TBI should include programmes designed to remediate EF. Limited studies of this nature exist. This study thus aimed to contribute the much needed knowledge gap surrounding the rehabilitation of EF in child and adolescent populations. The main aims of this study were two-fold. The first aim was to adapt the pGMT programme for South African children and the second aim was to investigate the efficacy of the newly adapted pGMT with children who have sustained a TBI.

Design and Method

Research Design and Setting

This study consisted of three parts. Part 1 involved the adaptation of the pGMT program based on information and feedback received from various health and educational professionals who reviewed the programme. Part 2 involved the implementation of the adapted pGMT program with three healthy children. Their feedback regarding the experience of the program as well as general observations were used to shape the program further.

Results are presented as 3 brief case studies. Part 3 involved the implementation of the newly adapted pGMT with three demographically matched participants who had sustained TBIs. Investigations for part 3 of the study were undertaken using a case study approach (Baxter & Jack, 2008).

The pGMT intervention and neuropsychological testing sessions were conducted on a one-on-one basis in a private room either at the participants' schools, at the department of Psychology at UCT, or at the Red Cross War Memorial Children's Hospital (RXH), in Cape Town.

Sample

The collective sample consisted of six English-speaking children aged from 11 to 14 years. More specifically, two distinguished groups were formed consisting of 3 participants in each group.

I included the three healthy control participants (from hereon referred to as the Healthy Control group), in order to obtain feedback of the pGMT program before it was implemented with children who had sustained TBIs. These participants were of lower to middle SES and English-speaking. Exclusion criteria for this group was no previously sustained TBIs as well as any previously diagnosed neurological or psychiatric conditions such as of mental retardation, epilepsy, learning disabilities and premorbid attention-deficit/hyperactivity disorder (ADD/ADHD). This Healthy Control group was crucial to the study as the input and results received from this group (regarding, for example, whether concepts were understood or the stories were engaging, and the overall structure of the program) was used to adapt the pGMT programme further before implementing it with the TBI group.

The three participants for Part 3 included individuals who had sustained moderate to severe TBIs and who were more than 1-year post injury. This 1-year timeframe is deemed as a reliable and stable period of assessment post recovery, as recovery tends to plateau during this time (Ginstfeldt & Emanuelson, 2010; Yeates et al., 2002). This group also received the pGMT intervention and was referred to as the TBI group. However, at times, some of the modules of the pGMT were re-worked and applied to this group based on the performance of, and feedback from, the Healthy Control group on each module. Inclusion criteria were that participants were English-speaking and that they were from a lower to middle SES background. Exclusion criteria included any previously sustained TBIs (i.e. TBIs prior to the moderate to severe injury noted for the current study) as well as any previously diagnosed

neurological or psychiatric conditions such as mental retardation, epilepsy, learning disabilities and premorbid attention-deficit/hyperactivity disorder (ADD/ADHD).

Sample Recruitment

Healthy Control Group. Participant recruitment for part 2 took place concurrently with the adaptation phase. The Healthy Control group consisted of 3 participants, all of whom were recruited from a junior school in Cape Town via convenience sampling (Mann, 2003). Convenience sampling is a type of non-probability sampling that involves including participants without randomization procedures (Lavrakas, 2008). After I consulted with the relevant teacher based on my age group, she identified five participants that met the criteria of the study (three participants from her class and 2 in consultation with another teacher).

TBI group. Participant recruitment for part 3 took place concurrently with recruitment for part 2. Participants who had sustained moderate to severe TBIs were identified through Red Cross Hospital (RXH) medical records. The parents or guardians were contacted telephonically to explain the study and request participation. The nature of the study, confidentiality throughout the study, the number and duration of sessions and the required participation on behalf of the parents and children were detailed during this call. The potential degree of familial involvement was also established through these preliminary interviews.

Upon agreement to participate, either a telephonic or an initial semi-structured interview was scheduled with the parents and children. This meeting initially served as a brief history taking session as well as an information session, allowing for discussion of the nature of TBIs, and the cognitive and behavioural difficulties commonly experienced by children following TBI.

Measures

The pre- and post-intervention neuropsychological test battery included measures of general intellectual functioning and neuropsychological functioning in the domains of attention, memory and EF. These domains that were measured using the neuropsychological tests detailed are in Appendix D. All these tests have been standardized for children and are of sound reliability and validity (Achenbach, 2001; Cohen, 1997; Delis et al., 2001; Gioia et al., 2000; Malloy & Grace, 2005; Korkman et al., 2007; Llorente et al., 2003; Shunk, Davis & Dean, 2006; Sparrow, Cicchetti & Balla, 2005; Wechsler, 1999).

Procedure

The study was carried out in three phases: (1) further adaptation of the pGMT intervention as used in the pilot study (Corbett, 2008) as well as translation and adaptation of the French pGMT (Krasny-pacini et al., 2014), (2) evaluating the intervention with healthy children, and (3) evaluating the intervention with children who have sustained TBI.

Part 1: Adaptation of the French pGMT to the South African context

The GMT intervention was originally designed for use in the rehabilitation of EF in adult populations. Because much of the success of the pGMT intervention was determined by the appropriateness of the materials used, the adaptation phase was designed to ensure that the intervention is both age- appropriate and relevant within the South African context. The intervention was adapted for children from the original adult GMT Programme (Robertson, Levine, & Manly, 2005). The initial adaptation was conducted with permission from one of the developers, (B. Levine, personal communication, May 20, 2008) as a pilot study (Corbett, 2008).

Although adaptations were made in the South African pilot study (Corbett, 2008), further adaptations were needed. The pilot study (Corbett, 2008) revealed that despite the original adaptations, the materials presented in the pGMT might have been too difficult for pediatric participants to fully benefit from the programme. The French version of the pGMT was based on the original adult programme, as well as the Corbett (2008) adaptation and was re-designed and shortened. These changes produced a more colourful and engaging intervention (Krasny-Pacini et al., 2014).

The current study built on the adaptations made by Krasny-Pacini et al. (2014). There is continued contact with the developers regarding these additional changes. The first step involved forward translation of the programme into English. A native, mother-tongue French speaker, who was working in South Africa as a special education teacher at the time, translated the French version of the pGMT into English. However, due to copyright laws, I could not send the programme to the researcher to work with independently. Hence, I converted the French content into English as the translator verbally dictated it.

The adaptations made in this translation phase was presented to, and evaluated by, a group of professionals in the field before the intervention phase commenced. This group allowed for input from a pediatric neuropsychologist, an educational psychologist, a clinical psychologist and two developmental psychology specialists on the efficacy of the translated programme. Notably, all but one of the members of the group have been working in their respective fields for at least 10 years. I presented the translated programme to each of the

health professionals and consulted with each of them independently for approximately 2 to 3 hours regarding the suggested changes. The information gained from these evaluations was used to make any necessary final adjustments to the pGMT programme before commencing with Part 2 of the project.

Part 2: Intervention with the Healthy Control group

The relevant assent and consent forms were sent to the parents/legal guardians of all these participants via their class teacher. Thereafter, I contacted parents/legal guardians telephonically to explain the content of the forms and request participation. The nature of the study, confidentiality throughout the study, the number and duration of sessions and the required participation on behalf of the parents and children were discussed during this call. The potential degree of familial involvement was also established through these preliminary interviews. Based on this information, I selected 3 participants that were able to get to the sessions that took place during the school holidays.

Conducting the intervention with healthy children allowed for the evaluation of the newly adapted pGMT, and the appropriateness of the adaptations for administration with TBI participants. Further, inclusion of healthy control participants was to account for any confounding natural maturation (i.e. age-related development of the brain) of the TBI participants.

The intervention was administered once a week for 10 consecutive weeks. I discussed each of the sessions and the feedback I received with my supervisor, which informed how I would proceed with the participants in the TBI group.

Part 3: Intervention with children who have sustained TBIs

The relevant consent and assent forms (Appendices G, H & I) were presented to the parents, teachers and participants. The forms were presented in person for one of the participants and sent home via the class teacher for the other two participants. I then contacted their parents telephonically to ensure that they had understood what was required of them.

Additionally, these interviews facilitated the assessment of the participants' behaviour and specific areas of executive dysfunction to be focused on during administration of the intervention. This session also accommodated the administration of the BRIEF, CBCL, *Vineland* II, pre- GMT questionnaires and the demographic questionnaire where possible.

A second semi-structured interview was then conducted with the participants' teachers in order to assess the child's school functioning. This interview was conducted mostly in person, with the exception of one of the participant's teachers whom I contacted

telephonically. The teacher *BRIEF, CBCL* and the *VABS* was administered during this session and was sent home via the children in some instances. In the case of a telephonic interview, all three questionnaires were sent to the teacher and returned via the parent.

Parallel to the interview process, the pre-intervention battery of neuropsychological tests was administered to the participant at a time that met both the parent and teacher's convenience. The pGMT intervention was then conducted over a 10-week period and consisted of a weekly 45-60 minute session. Aspects of the pGMT programme were tailored to the specific areas of executive impairment identified during the interview process as much as possible. For example, if the parent identified forgetfulness and the child being unable to cope with homework, I used the pGMT steps to illustrate how the participant can plan and organize him or herself better. In addition, in the final practical module using PECS, the children were asked to bring an aspect of their classwork that they struggled with. I then helped them understand how to apply the pGMT steps to things that they found difficult. In the final session, the post-intervention neuropsychological battery was administered and the *CBCL, BRIEF* and *VABS* were re-administered shortly after the completion of the pGMT programme.

Upon completion of these 3 phases, the degree of improvement in academic performance, everyday behaviour at home and in school, and neuropsychological test performance within the treatment group was examined in relation to the efficacy of the intervention in remediating executive functioning.

I conducted all three phases outlined above in consultation with my supervisor, Dr. L.E. Schrieff-Elson. However, to avoid researcher bias, various clinical neuropsychology masters students at UCT conducted all neuropsychological testing. All assessors were sufficiently trained and supervised by Dr. L.E. Schrieff-Elson. The same assessors were used to conduct both the pre and post intervention neuropsychological testing. However, these assessors did not assess the same child that they had tested during pre-testing. Instead, they were assigned a different child to test with the exception of one assessor, due to time constraints and availability at that time. However, in retrospect, this did not contaminate the test data in any way.

Data Analysis

Reliable Change Index (RCI)

Pre- and post-intervention measures of EF were compared statistically and the data analyzed was used for parts 2 and 3. According to Parsons, Notebaert, Shields, & Guskiewics (2009), a valuable method of establishing whether the differences between pre- and post-

intervention scores after neuropsychological testing are clinically significant is using the Reliable Change Index (*RCI*). An *RCI* model was developed by Jacobson and Truax (1991) to examine change in an individual's level of functioning. More specifically, the extent to which an individual has improved during the course of intervention e.g. from pre to post testing is a vital indicator (*RCI*; Jacobson & Truax, 1991). Furthermore, Hinton-Bayre (2012) suggested that the choice of *RCI* model to be used should have strong reliability properties as well as appropriately matched controls due to the possibility of different *RCI* models yielding variable outcomes.

In this study, the Jacobson and Truax (1991) *RCI* model was used. This model distinguished between three levels of change, each at confidence levels of 68.2%, 95% and 99%. The formula that underlies the *RCI* is:

$$\boldsymbol{SEd = \sqrt{2}(Se)^2, \text{ where } Se = s(\sqrt{1} - rxx)},$$

where ***s*** represents the standard deviation and ***rxx*** is the test-retest reliability coefficient. The standard error of difference (***SEd***) represents the change between the time periods of pre-test and post-test and uses the test-retest reliability coefficient.

Case Studies

Published studies of pediatric rehabilitation of executive skills have mostly taken a case study approach (Catroppa et al., 2009; Crowley & Miles, 1991; Glang, Singer, Cooley & Tish, 1992; Suzman, Morris, Morris & Milan, 1997). Owing to the intensive and comprehensive nature of the intervention, I used brief and more in depth case studies to document the results and observations obtained from participants in parts 2 and 3 of this study, respectively. This included data from behavioural, academic, and neuropsychological measures. Adopting a case-controlled multiple-case study approach, allowed for both within-case data analysis and cross-case synthesis (Baxter & Jack, 2008). This approach to analysis is considered robust and reliable, and has allowed for a greater depth of insight into the evaluation of the efficacy of the pGMT programme.

Ethical Considerations

I obtained ethical approval from the University of Cape Town's Psychology Department's Research Ethics Committee, the Faculty of Health Sciences Human Research Ethics Committee (HREC REF 662/2013; see Appendix A), Red Cross Hospital Research Review Committee (to access TBI participants' medical folders; see Appendix B) and from the Western Cape Education Department (see Appendix C).

Assent and Consent. The research involved a special population of minors that have sustained a TBI. As such, a consent form (see Appendices H and I) explaining the research process was given to each parent, guardian and teacher before data collection commenced. Similarly, the participants involved in the intervention were also given assent forms (see Appendix G).

Confidentiality and voluntary participation. All parties were informed of the confidential nature of the study and their ability to withdraw from the study at any time during the intervention. Information given by the participants, parents/guardians, and teachers remained confidential throughout the research process. All the data is stored securely on my personal computer with security passwords, and only made available to my supervisor, Dr. L.E Schrieff-Elson.

Benefits and Risks. The Healthy Group benefitted directly from the intervention as they were exposed to complimentary strategies to aid their planning and organizational skills in general. The same can be postulated for the TBI group as they learned the same strategies, however these were compensatory for them. In addition, the parents of the TBI participants benefitted indirectly as they were equipped with how to implement these steps with their children for future use. Furthermore, the parent of the TBI child who was required to travel to UCT for their sessions was compensated to cover travel costs. All parents were also compensated with ZAR500 for their participation. Participants were given juices and snacks in their break time during their sessions and rewarded with sweets on completion of a module (with parental permission).

There were no physical or emotional risks for participants during the intervention. However, due to the intensive nature of the intervention sessions, participants may have become rather irritable or fatigued. As such, participants were given a break during the session or when they needed additional breaks.

Debriefing and Feedback. After the intervention and post-testing, I debriefed both healthy and TBI participants. Participants were allowed to ask me questions and requested information pertaining to the intervention strategies. Feedback regarding their child's general progress was discussed with the parents telephonically upon completion of the intervention and their questions about the intervention were answered.

Results

In this section, I describe the results of the 3 parts of the study. First, the adaptation of the French pGMT is outlined (Part 1). Second, the evaluation of the newly adapted pGMT

programme using the three healthy children is described in brief case studies (Part 2). Lastly, three individual cases are presented to illustrate the implementation of the final version of the pGMT programme with three children with moderate to severe TBI (Part 3).

Part 1: The adaptation of the French pGMT into the South African Context

After the translated version of the French pGMT (Krasny-pacini et al., 2013) was presented to each member of the health professional team (as described in the methods section) in one-on-one, private meetings, the unanimous and constructive feedback received could be classified under two broad areas: 1) suggested changes related to the structure, and 2) those related to the content of the pGMT programme.

1. Suggested changes to the structure of the pGMT programme

Krasny-Pacini et al.'s (2013) pGMT programme included 8 modules that comprised the entire intervention. Each module included over 50 Power Point slides that needed to be covered in one 2-hour session per week. Additionally, the programme was designed to allow for the practical application of the theoretical concepts covered the previous week. The theoretical aspect was presented to the participants first and the practical application of the specific concepts followed in the week that followed. Cumulatively, all 8 theoretical modules and the 7 practical application modules were administered over a period of 15 consecutive weeks.

All members of the professional team were in agreement that the arrangement of this programme was not practical for the pediatric population in general. They suggested that each session should be reduced to duration of 45-60 minutes. We concurred and administered each module in the suggested timeframe.

Further, they expressed a strong preference to combining both the theoretical and practical components of the pGMT, as well as shortening each module to cover only important and overarching concepts. In addition, the pediatric neuropsychologist emphasized that the key to effective rehabilitation is repetition. Hence, it was advised that the core concept of the pGMT programme (i.e. the 5 pGMT steps: STOP and THINK- "what am I doing now?", "say your goal", "write your plan", "do it!" and "check it") should be repeated as much as possible during the intervention and over an extended period of time. After careful consideration and planning, the 8 original theoretical modules were reduced to 4 modules to address the first suggestion and then restructured and repeated over the remaining modules, with the intention of creating a more practical experience for the children in line with the pediatric neuropsychologist's suggestion. I outline this process in detail in the sections to follow.

Another suggestion was that the activities in the pGMT programme should be kept constant and become more complex gradually instead of using unrelated activities of increased difficulty. Hence, the concepts that were too complex or were not conducive to the main idea of the module were removed and where relevant, placed appropriately within a module that covered that specific concept. For example, the "automatic pilot" concept used to illustrate inhibitory control was too complex for the children to understand. We removed the "automatic pilot" concept from the original module 4 and replaced it with the simplified concept of routines. For example, I presented a typical school morning routine i.e. "waking up, brushing your teeth, getting dressed for school, combing your hair, eating your breakfast, taking the school bus/taxi" etc. Using this routine, the children were required to sort the laminated cards in order of their personal routine every morning. Thereafter, I introduced two additional, hypothetical tasks that the children had to include into their morning routine to illustrate the interruption of their "automatic pilot" or routine. These hypothetical tasks were: 1). "Dad is late for work, so you have to feed the dog this morning" and 2). "It's [friend's name] birthday, I need to take her gift to school today".

In addition, four complex activities i.e. card sorting, spot the differences, identify and circle the names of colours in a piece of text, and a maze ("find your way by following the cat's footprints after the horse's footprints") were replaced with simpler versions i.e. a less dense and more colourful picture to spot the differences, a word grid instead of the text, and categories of items to identify colours, animals, foodstuff etc., instead of the maze. These activities were removed from the original module 5 and the new, more basic activities were placed in the new module 1. The same activities were then modified slightly to become more complex later sessions in the programme. This was also a suggestion made by Mr. Moss, the pediatric neuropsychologist, who stated that the activities should be kept consistent, but the level of difficulty be increased (A. Moss, personal communication, March 5, 2014).

It was also suggested by one of the developmental psychologist specialists, Prof. Dawes, that the programme commence with a rapport building session focusing on a positive topic, rather than starting off by identifying "OOPS mistakes" (as per the French pGMT programme), in order to establish a good foundation for the lengthy journey ahead. We concurred and began the intervention with a rapport building session with each child.

2. Suggested changes to the content of the pGMT programme

All professionals that were consulted expressed their concern that the language used in the translated pGMT programme was too complicated and that certain concepts were too abstract for children to relate to or to understand. There were too many simultaneous

ideas that were trying to be conveyed in each module and as a whole. Various members therefore suggested that the language be simplified substantially to suit a pediatric population as a solution to the complexity issue. One member also suggested that the concept of the notepad in “mental notepad” be changed to “ipad” and that the word “mental” be omitted due to its negative connotation. In response to these suggestions, as we merged the modules, we first modified and simplified the language used. Thereafter, the most important concept of the module was identified and expanded on, and the repetitive slides and pictures were removed.

Further, the first module that served as an introduction to the programme was titled and based on “OOPS Mistakes”- one of the members of the professional group thought that this concept was too negative as an introductory starting point. It was suggested that the “OOPS Mistake” introductory module should be removed as well as ‘mission tables’ (tables used to record OOPS mistakes) and homework exercises used in the pGMT to facilitate parental involvement. This suggestion was made in light of the already intensive nature of the pGMT programme. Hence, we removed the “OOPS mistake” concept as well as the introduction of the mission and homework tables as suggested, and decided to start off the programme on a more positive note with the concept of goals instead.

Additionally, the health professionals suggested that the stories and examples used to convey important pGMT concepts should be revised and adapted to the South African context. For example, one of the suggestions was that we consider replacing the Albert Einstein figure in the module about making OOPS mistakes, with one of Nelson Mandela. Originally, Albert Einstein was used as a famous figure to illustrate that even intelligent people make mistakes. We decided to get feedback from the healthy group in terms of being able to recognize Einstein, however, the healthy children were unaware of who Einstein was. As a result, we removed the Einstein story and focused on the mistakes that children had identified themselves. We did, however, use the story of Nelson Mandela in the new module 2 to replace a story that was unsuited to the South African context i.e. the Trojan horse.

Additionally, it was suggested that Mr. STOP, who is used in the pGMT as a cue to inhibit automatic responses, should be a concrete figure instead of an abstract one. In response to this, we used a laminated picture of Mr. STOP as a cue to prompt the children when necessary.

Repetition of the modules using a Picture Exchange Communicating System (PECS) concept

In keeping with the intention of creating a more practical experience for the children, a variation of the PECS system was used for the remaining modules. Laminated cards of the

pGMT steps were made in addition to a PECS board. I created a PECS board using an A4 clip file and strips of Velcro. Using this board, the children were required to first identify each step i.e. the laminated cards as they applied the examples and activities to the pGMT steps. Thereafter, they were required to stick the correct step onto the board before continuing to the next step. In this way, the pGMT steps became more concrete for the children as they trained to "STOP and THINK, say their goal, write their plan, do it and check it" using the cards. Most importantly, as noted earlier, the crucial element within these modules was the repetition of the pGMT steps. Mr. Moss suggested this as he stated, "repetition is the key to effective rehabilitation" (A. Moss, personal communication, March 5, 2014). Therefore, each module was designed to emphasize only the pGMT steps and apply the theoretical concepts already covered in the first 4 modules to real world activities.

The actual adaptations made to the pGMT programme are presented in Appendix E.

Part 2: Evaluation of the revised pGMT using the Healthy Control sample

The participants in this group consisted of 3 healthy, English-speaking children aged from 11 to 14 years. After each module was completed, the module was modified for the TBI group based on the performance and qualitative feedback received from the healthy participants.

A summary of the children's' individual performances is described below as well as their changes in behavioural and academic functioning in the form of brief case studies.

Case study 1: PM

Demographic Information

Date of birth: 16 October 2002

Sex: Female

School grade: 6

Age at neuropsychological pre-assessment: 11 years, 5 months

Background Information. PM lives with her mother, who is a stylist, and her older sibling, who is in high school. Their annual household income is between ZAR5001 and ZAR25000. Her mother's highest level of education is matric. According to their financial resources and asset index, PM's family have a microwave oven and a flush toilet in their home. They shop at supermarkets but do not have ATM cards or accounts at retail stores. Regarding PM, her mother reported normal developmental milestones and stated that she had no complications during her pregnancy or in the postnatal period. According to her mother, PM has no medical or emotional problems. She described PM as a happy child. She plays

three types of sports i.e. netball, soccer and volleyball and enjoys playing cards, reading books and running. She also belongs to a kids club. At home, PM's chores involve sweeping, washing the dishes and cooking. PM has many friends that she socializes with outside school of hours.

According to PM's teacher, PM is a hard-working, responsible and respectful learner. Academically, her performance in mathematics, social science, natural science and life skill subjects are at grade level. However, her English and Afrikaans subjects are slightly below grade level. These ranges were obtained from the CBCL.

Performance and feedback on the revised pGMT intervention. PM, the youngest participant of the Healthy Control group, was an eager little girl who tried her best throughout the programme. PM managed to complete all exercises within the required time limits quite comfortably. However, she failed the first prospective memory task and when I had reminded her of the ask i.e. that she needed to ask me something, she became anxious. In all subsequent prospective memory tasks, PM remembered the instruction without any prompting. When I asked PM about the name that we should use to refer to the *mental notepad*, she stated that she preferred the name the *brain whiteboard* instead of the *brain ipad* (a potential name suggested by a member of the focus group). In the end though, we decided to use the term I had suggested i.e. *brain notepad*[2]. She had initially found the *brain notepad* concept difficult to understand, however, after some additional explanation, she understood the concept. This pattern was consistent for concepts that were new to PM throughout the programme.

Furthermore, PM enjoyed the stories and was consistently able to recall at least parts of the stories each week. Overall, PM enjoyed the theoretical modules as she stated "nothing was difficult because you explained it to me". Additionally, when I conducted the practical modules with PM, she stated "this is more better than the other days…its fun". PM was able to generalize and apply the pGMT steps to both the stories and her real world experiences very well. For example, she described using the pGMT steps when she had to complete a project for school. In addition, PM stated that she uses the pGMT steps when planning a Dodge ball game where her goal was to teach her friends how to play the game. Notably,

[2] In the process of discussing the best way to refer to the *mental* notepad, I suggested the name *brain notepad*. I found that all three children related to it much better than to the terms they had offered. A name that was easily identifiable for the children was important to facilitate understanding towards the already complex nature of the concept

when we did the “checking” step together and we identified OOPS mistakes, PM would become rather anxious and immediately self-correct.

Case study 2: HD

Demographic Information

Date of birth: 04 May 2002

Sex: Female

School grade: 6

Age at neuropsychological pre-assessment: 12 years, 0 months

Background Information. HD lives with both her parents and her older sibling. Her father is a doctor and her mother is a secretary. Their monthly household income is between ZAR5001 and ZAR25000. Her mother has a tertiary education. According to her financial resources and asset index, HD’s family have a refrigerator/ freezer, a television, a microwave oven and a washing machine in their home. In addition, they have access to running water, a domestic servant, a car, a flush toilet and an electric stove/plate in their household. They shop at supermarkets and have ATM cards but do not have accounts at retail stores. Regarding HD, her mother reported a normal pregnancy and no problems in her postnatal period. She also reported normal developmental milestones for HD. Although HD’s mother reported no emotional or behavioural problems for HD, she did describe HD as reserved and quiet child. HD enjoys playing sports such as netball, soccer and hockey. In her spare time, she enjoys playing cards, video games and board games. She is also part of the school netball team. At home, HD’s chores involve sweeping and washing the dishes. PM has a few friends that she socializes with outside of school hours.

According to HD’s teacher, HD is a quiet and responsible learner. Academically, her performance in mathematics, social science, natural science and life skill subjects are at grade level. However, her English and Afrikaans subjects are slightly below grade level. These ranges were obtained from the CBCL.

Performance on the revised pGMT intervention. HD was a pleasant but shy girl. It had taken approximately 4 sessions before HD began to feel comfortable in my presence. Despite her shyness, HD always maintained her pleasant demeanor and responded appropriately during our interactions. From the fifth session onwards, which was the beginning of the practical modules, HD’s confidence grew and she was much more comfortable during the sessions.

Although HD managed to complete all of the exercises within the required time limits, she was slower to grasp the instructions than PM was and had to be frequently reminded of

what was required of her. Furthermore, as with PM, she failed the first prospective memory task but was able to carry out all subsequent prospective memory tasks without any prompting. When I had asked HD about the name that we should use to refer to *mental notepad*, she stated that she had preferred to call it the *brain whiteboard* instead of the *brain ipad*. In the end, we decided to use the term *brain notepad* for the reasons described before. Unlike PM, HD understood the *brain notepad* concept without much explanation. As we progressed through the sessions each week, HD would more easily identify what she found difficult and started to complete the sessions in less time.

Furthermore, HD enjoyed the stories but needed prompting to be able to recall some of these (e.g. Cathy's story about writing down all that she has to do in different places as well as the story of Nelson Mandela) each week. Overall, HD enjoyed the theoretical modules as she expressed that the content was easy for her. As with PM, when I conducted the practical modules with HD, she stated that these sessions were "a bit fun" because of the "games". HD was able to generalize and apply the pGMT steps to both the stories and her real world experiences (e.g. homework) relatively well, however she needed more help at times than PM. For example, regarding Alex's story- the children were asked to provide the reason why Alex was late for his soccer game and what he could have done to avoid missing the game. PM immediately and correctly identified Alex's mistake and provided an alternative for Alex. In contrast, HD needed to be reminded of Alex's actions and taken through the story more carefully.

Case study 3: EM

Demographic Information

Date of birth: 29 July 2000

Sex: Female

School grade: 7

Age at neuropsychological pre-assessment: 13 years, 10 months

Background Information. EM lives with her grandmother, her older sister and sister's partner. Her sister and sister's partner are her guardians. Her father passed away in 2005 and her mother is a domestic worker. Her mother does not live with EM as she sleeps at her employer's house. Their annual household income is between ZAR5001- ZAR25000. Both her guardians have a tertiary education. According to their financial resources and asset index, EM's family have a refrigerator/ freezer, a television, a vacuum cleaner, a microwave oven and a washing machine, a DVD player and a hi-fi in their home. However, they do not have access to running water, a domestic servant, a flush toilet or a telephone in their home.

They do have a car and an electric stove/plate in their household. Furthermore, they shop at supermarkets but do not have ATM cards and do not have accounts at retail stores.

EM's sister was unsure of her developmental milestones, however her grandmother reported no difficulties during her daughter i.e. EM's mother's, pregnancy. She was unable to provide any further details regarding EM's developmental milestones, but stated, "everything was ok". EM plays three types of sports i.e. netball, volleyball and tennis. EM enjoys playing cards, reading books and playing computer games. At home, EM's chores involve sweeping, washing the dishes and occasionally cooking for her grandmother. EM has a few friends that she only socializes with during school hours.

According to EM's teacher, EM is focused, hard working and responsible. Academically, her performance in all her learning areas such as social science, natural science and life skills subjects are at grade level. However, her mathematics skills are far above grade level. These ranges were obtained from the CBCL.

Performance on the revised pGMT intervention. EM was the oldest participant in the Healthy Control group. EM displayed a level of maturity during most of the sessions and was quite outspoken. Although EM managed to complete all exercises within the required time limits, she tended to rush through the final two modules without self- checking stating, "this is too easy". However, she would frequently make OOPS mistakes as a result, which I tried to bring her attention to. Notably, this behaviour began shortly after she had turned 14 years old.

I had decided to use this behaviour to further emphasize the pGMT steps. For example, I would say, "remember that you need to STOP and THINK first and then CHECK so that you don't make any OOPS mistakes". Furthermore, as with PM and HD, EM failed the first prospective memory task but was able to carry out all subsequent prospective memory tasks without any prompting. When I had asked EM which name she preferred for the *mental notepad*, she stated that she had preferred *brain ipad* instead of the *brain whiteboard*. We decided to use the term I had suggested i.e. *brain notepad*, for reasons previously stated. Much like HD, she understood the *brain notepad* concept without much explanation.

Furthermore, EM enjoyed the stories and overelaborated when asked to recall some of the stories and activities each week. EM enjoyed the theoretical modules as she expressed that it was "pretty good". As with PM and HD, when I conducted the practical modules with EM, she stated that these sessions were "really nice" and that "it feels like it takes a second" i.e. that the module takes her a very short time to complete. EM was able to generalize and apply the pGMT steps to both the stories and her real world experiences very well (e.g.

cooking rice, homework i.e. a book review) however she needed slightly firmer instruction towards the final sessions of the pGMT intervention.

In general, some important areas of note were that all three healthy participants seemed to identify with the term that I had suggested i.e. *brain notepad* better than the other terms put forward i.e. *brain ipad* and *brain whiteboard.* In addition, all three healthy participants did not know who Albert Einstein was and all three children preferred laminated cards to concrete figures for the implementation of the pGMT steps. Lastly, they had been using Mr. STOP and THINK in their daily routines both at home as well as at school.

Qualitative Observations Post-pGMT

After I had completed the pGMT programme with PM and HD, I conducted a brief interview with their current schoolteacher, Mrs. J. PM and HD share the same teacher so it proved interesting to obtain her general impressions on both her learners after the intervention. Mrs. J had already begun reporting to me about the children's gradual improvements that she had observed from the beginning of the third and fourth school terms. Mrs. J stated that both children had shown an improvement in their content subjects. Furthermore, she stated:

> *"They both seem to have put what you taught them to use as they were able to recall information very easily. Both did particularly well in their History and Natural Science exam which was a lot of content work. PM has gained more confidence in her writing as well. HD has gained more confidence in all areas which has been awesome as a teacher as she was very quiet beforehand...You'll be able to see the improvement from their second term, third term and fourth term marks."*

Regarding EM's teacher, I had tried to make contact with him several times to obtain feedback on EM's progress. He was unavailable and it had become increasingly difficult to make contact with him at the time of completion of the intervention.

Changes in Neuropsychological Performance: RCI Analyses

Tables 1 and 2 present a summary of the positive changes from the RCI analyses for cognitive and behavioural domains, respectively, for the Healthy Control group at the time of their post- assessment. The table provides a summary of significant improvements in the assessment scores for each individual participant within the group.

Table 1: RCI Analyses: Domains: Healthy Control Group (N=3)

Domain		Subtest	PM	HD	EM
Attention		Numbers Forward		ΔΔΔ	Δ
Executive Functions		Numbers Backward	ΔΔΔ		
	Verbal Fluency	Condition 1: Letter Fluency			ΔΔ
	Design Fluency	Condition 1: Filled Dots	Δ	Δ	
		Condition 2: Empty Dots			Δ
	Tower	Total Achievement Score		Δ	Δ
	Inhibition	Inhibition-Naming CT (Sustained attention)		ΔΔΔ	Δ
		Inhibition-Inhibition CT			ΔΔΔ
		Inhibition-Switching CT (Cognitive Flexibility)	ΔΔ		ΔΔΔ
		Inhibition-Errors	Δ		Δ
	Colour Trails	CCTT 1 CT	Δ		

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. CT = Completion time; MI = CCTT = Children's Colour Trails Test

RCI Analyses: Cognitive Results

PM showed significant change in the *Numbers Backward* and *Inhibition-Switching CT* subtests. Furthermore, PM showed some change from pre- to post- intervention testing in *Design Fluency condition 1* subtest, *Inhibition-Errors and CCTT 1* subtests.

For **HD**, a significant change was seen from pre- to post- intervention testing in the *Numbers Forward* and *Inhibition-Naming* subtests. Additionally, some change was seen in *Design Fluency Condition 1* and in the total achievement score of the *Tower* subtest.

For **EM**, a significant change was seen in the *Inhibition-Inhibition CT, Inhibition-Switching CT* and the *Verbal Fluency Condition 1* subtests from pre- to post- intervention testing. Furthermore, some changes were evident in the *Numbers Forward, Design Fluency Condition 2, Inhibition-Naming, Inhibition-Errors* subtests as well as the total achievement score of the *Tower* subtest.

Table 2: RCI Analyses: Behavioural Domains: Healthy Control Group (N=3)

	Domain	Subtest	PM	HD	EM
BRIEF Parent Report		Inhibit	Δ		
		Shift			Δ
		Initiate	Δ		
		Working Memory			Δ
		Plan	ΔΔ		
		Monitor	ΔΔΔ		
		MI	Δ		
BRIEF Teacher Report		Shift			Δ
		Initiate			ΔΔΔ
		GEC			Δ
		MI			Δ
CBCL Parent Report	Internalizing		Δ	Δ	
		Anxious/Depressed	ΔΔ		
	Externalizing		ΔΔΔ		
		Rule Breaking	ΔΔΔ	Δ	
		Aggressive Behavior	ΔΔΔ		
	Total problems		ΔΔΔ	Δ	
CBCL Teacher Report	Internalizing		Δ	Δ	Δ
		Anxious/ Depressed		Δ	ΔΔ
		Somatic Complaints		ΔΔΔ	
	Domain	Subtest	PM	HD	EM
	Total Problems		ΔΔΔ	Δ	
CBCL Youth Self Report	Internalizing		Δ		
		Anxious/Depressed	Δ		
		Somatic Complaints	Δ		
	Total Problems		ΔΔ		
VABS		Receptive		ΔΔΔ	
		Written		ΔΔΔ	
		Communication		ΔΔ	
		Domestic		ΔΔΔ	ΔΔΔ
		Community		Δ	
		Daily Living Skills		Δ	

Domain	Subtest	PM	HD	EM
	Interpersonal Relationships			Δ
	Play and Leisure time		ΔΔ	Δ
	Coping Skills			ΔΔΔ
	Socialization			Δ
	Adaptive Behaviour Composite		ΔΔΔ	Δ

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. CT = Completion time; MI = Metacognition Index; GEC= Global Executive Composite; CCTT = Children's Colour Trails Test; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Behavioural Results

Regarding **PM**, her BRIEF parent report indicated significant change in both the monitor and plan indices and some positive change on the inhibit, initiate and the metacognition indices. Notably, however, there was no reliable change indicated on any of the indices listed on the teacher's report of the BRIEF from pre- to-post intervention testing.

Further, regarding this participant's CBCL results from pre-to-post intervention testing, significant reliable change was seen on her internalizing and externalizing scales for her CBCL parent report. Moreover, some reliable change was evident on the internalizing problem domain. On the CBCL teacher report, significant change was noted on the total problem indices and some change was evident on the internalizing scales. On the youth self report, reliable change was seen on the internalizing scales listed and internalizing problems, whereas more significant change was reported on her total problems scale.

Regarding the VABS scales, there was no evidence of reliable change noted in any of the behavioural domains for this participant.

Regarding **HD**, there was no reliable change evident on both the parent and teachers' reports of the BRIEF from pre- to-post intervention testing. However, there was reliable change evident on the CBCL parent report on externalizing scales listed in Table 2 as well as internalizing and total problems. Notably, her teacher's CBCL report noted some reliable change on her listed internalizing scales i.e. anxious/depressed and significant change on her somatic complaints scale. Furthermore, her teacher noted some change on her internalizing and total problem scales. However, on the youth self report, HD noted no reliable change on any of the behavioural indices.

Furthermore, on the VABS scales for this participant, significant reliable change was noted on most of the behavioural domains listed in Table 2, with the exception of interpersonal relationships, coping skills and socialization domains of functioning.

Regarding **EM**, there was some change noted by her guardian on both the shift and working memory indices of the BRIEF. Furthermore, the teacher's report of the BRIEF noted some change on the shift and initiate indices, as well as on her metacognition index and global executive composite. Notably, her most significant change occurred with her 'initate' index.

Further, on both the CBCL parent report and the youth self report there was no change evident on any of the behavioural indices. On the teacher's report however, there was reliable change noted on the internalizing behaviour scales as well as the internalizing problem scale.

Regarding the VABS scales for this participant, reliable change was seen on four subdomains namely, interpersonal relationships, play and leisure time, socialization and the adaptive behaviour composite. Additionally, significant reliable change was evident for the domestic and coping skills subdomains.

Part 3: Evaluation of the revised pGMT using a TBI sample

In this section I again present 3 case studies. However, these are presented more in depth than those presented in Part 2, given the clinical nature of this group and in terms of these participants representing the group for whom the intervention is ultimately being investigated. The cognitive and behavioural test scores are also compared to the matched Healthy Control participants, as part of these case studies.

Case Study 1: CB

Demographic Information, Socioeconomic Status (SES) and Asset Index

CB is a female, is of mixed race and is English-speaking. She was 11 years, 5 months old at the time of her pre-assessment. As seen in Table 3, CB's parents' household income bracket indicates a low socioeconomic background. Regarding their material and financial resources as indicated on their asset index, they do however have all but one of the items listed on the questionnaire in their home such as a refrigerator, a television, a hi-fi, a microwave oven, a washing machine and a DVD player in working order. Furthermore, they have access to running water, a car, a flush toilet, a built in kitchen sink, an electric stove / hotplate in their home, but do not have access to a domestic worker or a working telephone. CB's asset index further indicated that they shop at supermarkets, have ATM cards and bank accounts. They do not, however, have accounts at retail stores.

Regarding CB's healthy control, PM, differences were noted on race, home language and the asset index, although these participants were matched on age, sex and socioeconomic status (Table 3). Notably, even though PM's first language is Sesotho, she was proficient in English. Furthermore, she has low material and financial resources, whereas CB shows a high asset index, even though their annual household incomes are similar.

Table 3: Demographic characteristics, SES and Asset index for CB and her healthy control, PM (N=2)

Variables		Group	
		TBI	Healthy Control
		CB	PM
Sex		Female	Female
Race		Mixed race	Black African
Home language		English	Sesotho[3]
Age at assessment (years: months)		11:5	11:5
Annual household income (ZAR)		1-5000	1-5000
Parental education	Mother	12 years	0 years
	Father	8-11 years	Unknown
Parental employment	Mother	Unemployed	Unskilled, domestic worker
		CB	PM
	Father	Unemployed	Unknown
Material and financial resources (Asset index)		13 assets (high)	3 assets (low)

Injury-related History

CB's injury related details were obtained from her parents as well as her RXH medical folder. CB was 6 years, 6 months old at the time of her injury. She sustained a severe head injury according to her GCS score i.e. 6/15. CB sustained a severe TBI after a truck had collided with their vehicle in an MVA. CB was an unrestrained passenger traveling in the back seat. CB's examination notes on admission stated that she had a laceration on her left cheek, bilateral raccoon eyes and CSF and blood leaking from her nose.

[3] PM was however proficient in English.

CB's CT brain scan showed generalized oedema with features of a diffuse axonal injury with punctate hemorrhage i.e. right frontal, left temporal, left caudate (head) and corpus callosum contusions were reported. Furthermore, her cisterns and ventricles were reported to be small and appeared compressed. Lastly, her left sylvian fissure was partially effaced.

According to CB's parents, she was in a comatose state for one week and was discharged from RXH after 3 months. For three years following the accident, CB attended speech and physical therapy sessions regularly. In 2010, CB was transferred to Tygerberg Hospital after her family had relocated to another suburb. File notes from Neurosurgery at RXH reported excellent recovery at this stage.

Developmental and Social History

CB's developmental history was obtained from her parents and reports included in her RXH medical folder by her occupational and speech therapists before she was transferred to Tygerberg Hospital. CB was 3.7 kg at birth and her mother reported no complications during her pregnancy or in the newborn period. CB's developmental milestones were reported to be normal and her parents stated that CB had no difficulties prior to the accident.

However, CB's parents reported that she had been experiencing behavioural and emotional difficulties since the accident in 2009. During CB's first occupational therapy session, which was 3 months after her MVA, CB's parents reported "inconsistent concentration" and that she was emotionally labile (burst into tears for no apparent reason). Furthermore, the occupational therapist noted social difficulties regarding the family's finances as well as their living arrangements. CB's parents reported that they were living with CB's grandparents at the time, who, according to them had been unsupportive and unhelpful with the children.

Furthermore, during CB's initial occupational therapy session, her speech therapist noted that CB was slower than before in general and seemed demotivated. Furthermore, the speech therapist examined CB's comprehension and auditory processing skills. The report concluded that CB was slow to respond, but when encouraged, she was able to answer correctly.

During a telephonic interview that I had conducted with CB's parents before the intervention had commenced, they had described CB as very aggressive and overly sensitive in her interactions with her siblings. In addition to CB's difficulties mentioned above, she frequently throws tantrums during which she throws objects and has mood swings.

CB lives with both her biological parents and 2 younger sisters. Both her parents are currently unemployed. Her mother completed matric and her father did not complete high school.

Academic History

CB's MVA occurred halfway through her grade 1 year at a primary school in Cape Town. She returned to school one month after her accident. CB was then placed into grade 2 at a primary school closer to where they had relocated to and was in grade 6 at the same school at the time of this study. According to CB's mother and current teacher, she has not repeated any grades. A note in CB's medical folder from the speech therapist noted some difficulties that CB was experiencing at the school when she started in grade 2 i.e. CB was struggling at school and complained that the teacher at the time was not allowing her sufficient time to complete activities. There were no additional notes in the folder thereafter, as CB was transferred to Tygerberg Hospital.

CB's current teacher described her as "shy" and scholastically weak across all learning areas. She also mentioned that CB was slower than other children and informed me that CB was placed in a special class that received extra learning support after school hours i.e. on a Saturday morning.

Pre Intervention: Cognitive, Behavioural and Affective functioning

General Intellectual Functioning. On the Vocabulary subtest, CB's scores were in the low average range as she provided mostly 1-point responses. On her Similarities subtest, she performed in the average range. Furthermore, on the Block Design and Matrix Reasoning subtests, she performed in the average range for both subtests. CB's test scores result in a Verbal IQ of 92 (average), a Performance IQ of 98 (average), and a Full-Scale IQ of 95 (average).

Regarding CB's healthy control, PM, on the Vocabulary and Similarities subtests; she performed in the average range for both subtests. Furthermore, on the Block Design subtest she performed in the low average range, whereas on the Matrix Reasoning subtest, she performed in the average range. PM's test scores result in a Verbal IQ of 103 (average), a Performance IQ of 86 (low average), and a Full-Scale IQ of 94 (average).

Table 4: General intellectual functioning: WASI scores for CB and her healthy control, PM (N=2)

	Group	
Measure	TBI	Healthy Control
	CB	PM
Vocabulary[a]	41	53
Similarities[a]	49	51
VIQ[a]	92	103
Block Design[a]	49	35
Matrix Reasoning[a]	49	47
PIQ[b]	98	86
FSIQ[b]	95	94

Note: [a]T-scores are presented. [b]IQ index scores are presented. WASI=Wechsler Abbreviated Scale of Intelligence.

Attention, Concentration and Working Memory. As shown in Table 5, on the Numbers Forward subtest, CB performed in the average range. Of note, PM performed in the low average range. Similarly, on the Numbers Backward subtest, CB performed in the average range and PM performed in the borderline range for this subtest. PM was an anxious child in general, and this could have resulted in her lower attention score as well as undermined her performance on the Numbers Backward subtest. She did, however, grasp the rule regarding saying the numbers in reverse order, easily.

Table 5: Attention, concentration and executive functioning: scaled scores for CB and her healthy control, PM (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	CB	PM
Attention and Concentration Executive Functions		Numbers Forward	9	6
Working Memory		Numbers Backward	9	4
Cognitive Flexibility	Colour Trails	Colour trails 1	29	≤19
		Colour trails 2	39	43
Generativity	Verbal Fluency	C1: Letter Fluency	9	10
		C2: Category Fluency	9	16
		C3: Category Switching	8	14
	Design Fluency	C 1: Filled dots	7	7
		C 2: Empty dots	5	7
		C 3: Switching	7	7
Inhibition	Naming	Total errors (percentile)	11-25	11-25
		Completion time scaled	8	9

		score		
		Combined scaled score	7	7
	Inhibition	Total errors (percentile)	6-10	11-25
		Completion time scaled score	7	8
		Combined scaled score	5	7
	Switching	Total errors (percentile)	11-25	11-25
		Completion time scaled score	11	8
		Combined scaled score	8	5
	Errors		6	4
Planning and problem solving		Total achievement	8	10
		Time-per-move	9	13
		Move-accuracy	7	7
		Rule violations	11	10

Note: C1= condition 1; C2= condition 2; C3= condition 3. Scores presented are scaled scores, unless otherwise specified in parantheses.

Cognitive Flexibility. On the first condition, CCTT 1, CB obtained higher scores than PM even though her scores were in the moderately impaired range (T-score of 29) regarding the speed at which she completed the subtest (Table 5). CB made no errors and completed the subtest without additional prompting. PM performed in the severely impaired range (T-score of ≤19) regarding the speed at which she completed the subtest and also made no errors and completed the subtest without additional prompting. Notably, PM paused during the subtest and her approach was slow and more careful, compared to CB's approach. Hence PM obtained a score in the severely impaired range regarding her speed.

On the second condition, CCTT 2, however, CB performed more poorly than PM. She obtained a T-score of 39, which is in the mildly impaired range regarding the speed at which she completed the subtest. CB once again made no errors and completed the subtest without additional prompting. PM obtained a T-score of 43 (below average) regarding the speed at which she completed the subtest (due to her careful approach) and also made no errors. However, she required additional prompting once again.

Generativity. On CB's verbal fluency test, she performed more poorly than PM (Table 5). CB's scores were in the average range for her letter fluency, category fluency, category switching responses and category switching accuracy. PM, however, performed in the

average range for only her letter fluency condition. PM performed in the superior range for category fluency, category switching correct responses and switching accuracy.

CB's design fluency test, however, was more comparable to her healthy control. Her composite score was in the low average range and PM performed in the same range as CB.

Planning and Problem Solving. CB's performance in this subtest is comparable to PM's, with both performing in the average range for this subtest. Of note, CB made no rule violations but PM made 2 violations. Furthermore, PM's approach involved moving quickly through the test at the expense of her accuracy, but CB was more careful. CB performed in the average range regarding her Time-Per-Move ratio and in the low average range regarding her Move Accuracy Ratio. She made no rule violations during the test and her overall performance on this subtest was in the average range.

Inhibition. CB and PM performed similarly on the naming and inhibition components of the task. However, CB performed in the borderline range on the inhibition combined scaled score and PM in the borderline range on the switching combined scaled score (Table 5). Further, CB's scaled score for her total number of errors in the task was in the low average range, whereas PM's was in the borderline range (Table 5). PM's approach was rushed resulting in her error prone performance and very quick response times.

Table 6 presents T-scores, v-scaled scores and domain standard scores for CB and her healthy control on the CBCL, BRIEF and VABS indices respectively.

Table 6: Behavioural and Affective Functioning: T-scores, v-scaled scores and domain standard scores for CB and her healthy control, PM (N=2)

	Scales	Subscales	TBI	Healthy Control
			CB	PM
CBCL Parent Report	Internalizing	Anxious/depressed	65	74
		Withdrawn/depressed	68	66
		Somatic complaints	76	57
		Internalizing problems	73	70
	Externalizing	Rule-breaking behaviour	55	73
		Aggressive behaviour	68	75
		Externalizing problems	65	75
	Total problems		70	74

	Scales	Subscales	TBI	Healthy Control
			CB	PM
CBCL TRF	Internalizing	Anxious/depressed	73	51
		Withdrawn/depressed	81	53
		Somatic complaints	50	50
		Internalizing problems	72	47
	Externalizing	Rule-breaking behaviour	55	50
		Aggressive behaviour	58	50
		Externalizing problems	58	43
	Total problems		66	48
CBCL YSR	Internalizing	Anxious/depressed	54	66
		Withdrawn/depressed	61	58
		Somatic complaints	68	63
		Internalizing problems	62	65
	Externalizing	Rule-breaking behaviour	51	50
		Aggressive behaviour	63	51
		Externalizing problems	58	46
	Total problems		60	57
BRIEF Parent Report		Inhibit	65	52
		Shift	63	66
		Emotional control	68	59
		BRI	68	60
		Initiate	66	46
		Working memory	65	52
		Plan/Organize	55	51
		Org. of materials	58	46
		Monitor	61	40
		MI	87	47
		GEC	65	52
BRIEF Teacher Report		Inhibit	49	49
		Shift	105	49
		Emotional control	77	46
		BRI	80	48
		Initiate	88	50
		Working memory	92	51
		Plan/Organize	77	46

	Scales	Subscales	TBI	Healthy Control
			CB	PM
		Org. of materials	46	52
		Monitor	80	49
		MI	83	49
		GEC	85	48
VABS	Subdomains	Receptive	6	7
		Expressive	7	4
		Written	16	8
	Domain	Communication	70	54
	Subdomains	Personal	3	2
		Domestic	15	16
		Community	10	8
	Domain	Daily living skills	68	65
	Subdomains	Interpersonal Relationships	6	5
		Play and leisure time	4	7
		Coping Skills	13	21
	Domain	Socialization	61	78
		Adaptive Behaviour Composite	65	64
Maladaptive Behaviour Index			14	16
		Internalizing	20	22
		Externalizing	18	13

Note: CBCL= Child behaviour checklist; TRF= Teacher's report form; YSR= Youth Self Report; BRI= Behaviour Regulation Index; MI = Metacognition Index; GEC= Global Executive Composite;VABS = Vineland Adaptive Behaviour Scale. CBCL T-scores of 60-65= borderline range; CBCL T-scores above 65= clinical range (Achenbach & Rescorla, 2001). BRIEF scores >65= clinical range (Gioia, Isquith, Guy, & Kenworthy, 2000); Both standard and v-scaled scores are presented for the VABS indices. VABS v-scaled scores of 1-9= low adaptive levels; 10-12=moderately low adaptive levels; 13-17=adequate adaptive levels; 18-20=moderately high adaptive levels; 21-24=high adaptive levels. VABS standard scores of 20-70= low adaptive levels; 71-85= moderately low adaptive levels; 86-114= adequate adaptive levels; 115-129= moderately high adaptive levels; 130-160= high adaptive levels. Maladaptive Behaviour indices: v-scale scores 21-24= clinically significant; 18-20=elevated; 1-17=average (Sparrow, Cicchetti & Balla, 2005).

CBCL. As shown in Table 6, CB's Internalizing behaviour scores were all in the borderline to clinical range for girls aged 6 to 11. Notably, PM's internalizing scales, with the exception of somatic complaints, were also in the clinical range. However, PM's scores were higher and in the clinical range compared to CB's lower borderline to clinical scores. These results indicate that CB's parents reported more problems than are typically reported by parents of girls aged 6 to 11, particularly problems of anxiety or depression, withdrawn or depressed behavior, somatic complaints, and problems of an aggressive nature. However, PM's anxiety or depression and level of aggression nature were reportedly higher (Table 6).

TRF. On the Teacher's Report Form (TRF), differences are evident between CB's and PM's Internalizing behaviour scores, which are inconsistent with that of the parent report. CB's anxious/depressed, withdrawn/depressed and internalizing problems were in the clinical range. These scores were higher than PM's, whose scores were in the normal range. These results indicate that CB's classroom teacher reported more problems than are typically reported by teachers of girls aged 6 to 11, particularly problems of anxiety or depression and withdrawn or depressed behavior. PM's teacher, however, did not report any problems.

YSR. On the YSR problem scales, PM reported higher levels of anxiety and internalizing problems than CB, which were in the clinical range for her age group. However, CB reported higher levels of aggressive behaviour in the borderline range. Furthermore, her score on the Somatic Complaints syndrome was in the clinical range. These results indicate that both CB and PM reported more problems than are typically reported by girls aged 11 to 18, particularly somatic complaints. Of note, PM also reported somatic complaints, but her score was in the borderline range.

BRIEF. CB's parent version of the report indicated a Behaviour Regulation Index (BRI), a Metacognition Index (MI), and a Global Executive Composite (GEC) all in the clinical range. Furthermore, her teacher's report also indicated that these indices were all in the clinical range. Overall, CB's scores were higher than her healthy control, with PM's parent and teacher reporting mostly normal indices (Table 6).

VABS. As shown in Table 6, CB's parent rating form indicated that within the Communication domain of functioning, her receptive and expressive functioning was in the low adaptive range, however, her written ability was adequate. CB's overall communication domain was in the low adaptive range. Notably, PM's receptive, expressive and written abilities were in the low adaptive range, hence her overall communication domain was also in the low adaptive range. Regarding the Daily Living Skills domain, there were no major differences noted here, as both CB and PM's standard domain scores indicated mild deficits (Sparrow, Cicchetti & Balla, 2005). Although both CB and PM's scores indicate low adaptive functioning on the socialization domain, these scores may be classified as being on the mild spectrum (Sparrow, Cicchetti & Balla, 2005). No other significant differences were noted between CB and PM in relation to their adaptive functioning.

Pre- GMT Questionnaires

The teacher pre-GMT questionnaire indicated that CB had moderate to severe executive dysfunction with most responses ranging from 5 to 8 out of 10 (where 1 is indicative of no problem at all and 10 is indicative of a really major problem). The parent pre-

GMT questionnaire indicated some executive dysfunction, as the majority of responses were a 5 out of 10.

The pGMT Intervention

During session 1, which was a rapport building session, CB presented as shy and reserved. She responded only when asked a question and seemed nervous at the prospect of meeting every week to work together. Overall, as we progressed through the programme every week, CB's demeanor began to change and she became more expressive. She had started to have more spontaneous conversations with me and shared details about her life at home and at school. CB's personality began to emerge gradually as she became more comfortable with me and her anxiety was greatly reduced.

Regarding the theoretical modules, CB was generally slow to grasp the concepts and she required additional repetition of explanations as well as more time to apply the instruction to the activities. Furthermore, each week, when she was required to recall what was covered in the previous sessions, she had difficulty doing so. When I had reminded her of at least one story/activity, CB would remember the gist of what was covered and needed help in remembering the pGMT steps. During the last session of the theoretical modules, I had to re-teach CB the pGMT steps.

On the practical modules, CB responded well. She was able to successfully apply the pGMT steps to the activities and stories as well as to her real-world experiences both at home and at school. She did, however, require additional time to think about a plan for each task and at times, made OOPS mistakes at the planning step. When CB and I did the "checking" step, she would often pick up on her errors and self- correct. By the end of the programme, CB was much more motivated and performed better on the problem-solving activities. During the final revision session, CB was able to recall and apply all the pGMT steps as well as explain to me what she understood by previous concepts such as the *brain notepad* that we had covered during the theoretical modules.

Changes in Neuropsychological Performance: RCI Analyses

Tables 7 and 8 present a summary of the significant positive changes from the RCI analyses for cognitive and behavioural domains, respectively, for CB and PM at the time of their post-assessment. Post-assessment scores are presented in appendices M and N.

Table 7: RCI Analyses: Cognitive Domains: Matched participants CB and PM (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	CB	PM
Attention and concentration		Numbers Forward		
Executive Functions		Numbers Backward		ΔΔΔ
Generativity	Verbal Fluency	Condition 1: Letter Fluency		
	Design Fluency	Condition 1: Filled Dots		Δ
		Condition 2: Empty Dots	Δ	
Planning and Problem solving	Tower	Total Achievement Score		
Inhibition	Naming	Inhibition CT		
	Inhibition	Inhibition CT	ΔΔ	
	Switching	Inhibition CT	Δ	ΔΔ
		Inhibition-Errors	Δ	Δ
Cognitive Flexibility	Colour Trails	CCTT 1 CT		Δ

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. CT = Completion time; CCTT 1 = Children's Colour Trails Test: Condition 1.

RCI Analyses: Cognitive Results

As shown in Table 7, CB showed reliable change on *condition 2 of* the *design fluency* subtest, while PM did not. However, on the *inhibition-switching CT* and *inhibition-errors* subtests, both CB and PM showed a reliable change. Furthermore, a significant change on inhibition-inhibition CT subtest was evident for CB; however her matched control did not reflect this change. Regarding PM, she showed positive changes on Numbers Backward, condition 1 of Design Fluency and CCTT, whereas, CB did not show any change.

Table 8: RCI Analyses: Behavioural Domains: Matched participants CB and PM (N=2)

		Group	
		TBI	Healthy Control
Domain	Subtest	CB	PM
BRIEF Parent Report	Inhibit		Δ
	Shift		
	Initiate		Δ
	Working Memory		
	Plan		ΔΔ
	Org. of materials	ΔΔΔ	
	Monitor		ΔΔΔ
	MI		Δ
BRIEF Teacher Report	Shift		
	Initiate		
	Org. of materials	Δ	
	GEC		
CBCL Parent Report	Internalizing		Δ
	Anxious/Depressed		ΔΔ
	Externalizing		ΔΔΔ
	Rule Breaking	Δ	ΔΔΔ
	Aggressive Behavior		ΔΔΔ
	Total Problems		ΔΔΔ
CBCL Teacher Report	Internalizing		Δ
	Withdrawn/ Depressed	Δ	
	Total Problems		ΔΔΔ
CBCL Youth Self Report	Internalizing		Δ
	Anxious/Depressed		Δ
	Somatic Complaints		Δ
	Total Problems		ΔΔ

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. MI = Metacognition Index; GEC Global Executive Composite; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Behavioural Results

BRIEF. As shown in Table 8, on CB's BRIEF indices, her parent report noted significant reliable change on 'organization of materials', while there was no reported change

for PM in this domain. Notably, CB's teacher reported reliable change in the very same domain of functioning, while PM's teacher reported no change. Conversely, PM's parent reported positive change on inhibit, initiate, plan, monitor and her MI, but CB's parents did not report these changes.

CBCL. Regarding the CBCL, even though reliable change was seen in the 'rule breaking domain' for both CB and PM, CB's change was less pronounced, compared to PM's significant change. Regarding the teacher's report of the CBCL, reliable change was evident for 'withdrawn/depressed' scales for CB, while no change was reported in these domains for PM. Lastly, on the CBCL youth self report, CB reported no change on any of her internalizing scales, whereas PM noted reliable change on her internalizing behaviours i.e. anxious/depressed, somatic complaints and in terms of her total problems.

VABS. Regarding the VABS scales for these participants, the VABS was excluded from the table altogether due to the lack of change reported on all areas of adaptive functioning by all respondents.

Case Study 2: AK

Demographic Information, Socioeconomic Status (SES) and Asset Index

AK is a Black African male. His home language is IsiXhosa, although he is proficient in English. He was 11 years, 9 months old at the time of his pre-assessment. As seen in Table 9, AK's household income bracket indicates a low socioeconomic background. Their annual household income is in the ZAR5001-ZAR25000 range.

Regarding their material and financial resources as indicated on their asset index (Myer at et al., 2008), they have a refrigerator, a television and a microwave oven in their home. They do not, however, have a vacuum cleaner, a washing machine, a DVD player or a hi-fi in their household. Furthermore, they do have access to running water, a flush toilet, an electric stove/ hotplate and a working telephone in their home, but do not have access to a domestic worker, a car or a built-in kitchen sink. AK's asset index further indicated that they do not shop at supermarkets but do have ATM cards and a bank account. They also, have accounts at retail stores.

AK and his healthy control, HD were matched on race, sex and home language. Furthermore, there was no significant difference regarding their age at assessment. Notably, both participants material and financial resources were in the same range, however, HD's annual household income is higher (see Table 9).

Table 9: Demographic characteristics, SES and Asset index for AK and his healthy control, HD (N=2)

Variables		Group	
		TBI AK	Healthy Control HD
Sex		Male	Female
Race		African	African
Home language		IsiXhosa	IsiXhosa
Age at assessment (years: months)		11:9	12:0
Annual household income (ZAR)		1-5000	5000-25000
Parental education	Mother	8-11 years	13+ years
	Father	13+ years	Unknown
Parental employment	Mother	Business managers of medium sized businesses, lesser (social worker)	Business managers of medium sized businesses, lesser (secretary)
	Father	Skilled manual, student	Unknown
Material and financial resources (Asset index)		9 assets (medium)	10 assets (medium)

Injury-Related History

AK's injury related history was obtained from his mother as well as his RXH medical folder. AK sustained a moderate TBI after he was hit by a motor vehicle when he was 8 years and 11 months old. He was flung into the air and had landed some distance away from the vehicle. AK's GCS was not assessed at the scene but his recorded GCS on admission was 8/15. AK's examination notes on admission stated that AK had an abrasion on his forehead and right cheek as well as lower lip lacerations. Furthermore, AK's right lower canine tooth was avulsed.

AK's CT brain scan showed a small punctate hemorrhage and the neurosurgeon involved in AK's examination assessed him as having sustained diffuse axonal injury.

During follow up visits at RXH, neurosurgery reports stated that AK was doing well (according to his guardian), however, he was forgetful and some behavioural changes were reported. Additionally, he was demoted to grade 2 from grade 3 in school at the time.

According to AK's mother, he was unconscious on the scene and for 3 to 4 days thereafter. He was admitted to RXH for 3 to 4 weeks and attended speech, occupational and physical therapy sessions at both Groote Schuur Hospital and Tygerberg Hospital.

Developmental and Social History

AK's developmental history was obtained from his mother during the initial semi-structured interview. AK's mother was unable to recall his birth weight but reported no complications during her pregnancy or in the newborn period. AK's developmental milestones were reported to be normal (although she was unsure) and she stated that AK had no difficulties prior to the accident.

However, AK's mother reported that he had been experiencing physical, behavioural and emotional difficulties since the accident. She reported that AK has frequent headaches since the accident and is easily fatigued. Additionally, AK forgets easily and is more childish. He is teased at school because he is older than the other children in his class. At home, his mother described instances in which AK "pulls the strings off the mat while he is thinking". His mother replaced the mat, but AK had done the same thing once again.

AK's mother reported that since the accident, he is aggressive and prefers to talk to younger children. She also stated that he gets teased and beaten up at school and that AK does nothing to stop bullies targeting his little brother. In addition, AK scares easily when he hears any noise, and checks that the doors and windows are locked. AK has also been reported to "cry for small things like a baby" by his mother and is unable to carry out basic activities of daily living (ADLS) without his younger brother's help. She also stated that AK's younger brother "does everything for him every day like he is the older brother" and that AK tells lies frequently.

AK lives with his biological mother and his younger brother. His mother did not complete high school and currently works as a Human Immunodeficiency Virus (HIV) counselor. AK's father lives in Johannesburg. He works as a technician and is currently studying part-time at a college. Although AK is unable to see his father, they do have regular telephonic contact and AK sometimes spends his school holidays with his father in Johannesburg.

Academic History

AK's pedestrian vehicle accident (PVA) occurred 7 months into his grade 2 year. According to AK's mother, he was demoted to grade 2 from grade 3 after the accident, and was repeating grade 4 at the time of this study. Since the accident, AK has been struggling academically at school and his mother's main concern was his forgetfulness and his behavioural problems described above. Furthermore, his mother was worried about whether he needs to be placed in a special needs school or he will be promoted to grade 5.

According to AK's current grade 4 teacher, AK was "unable to concentrate and take in information…his attention span is 10-15 seconds and he is very forgetful…he needs constant repetition".

Pre Intervention Cognitive, Behavioural and affective functioning

General Intellectual Functioning. AK's FSIQ was higher than his healthy control, HD's. As seen in Table 10, HD's PIQ was lower than AK's. AK's verbal performance is more comparable to HD's. On the Vocabulary subtest, AK performed in the borderline range, whereas on his Similarities subtest, he performed in the extremely low range. Furthermore, on the Block Design and Matrix Reasoning subtests, he performed in the average range for both subtests. AK's test scores result in a Verbal IQ of 73 (borderline), a Performance IQ of 99 (average), and a Full-Scale IQ of 82 (low average).

AK's control, i.e. HD, performed in the borderline range on the Vocabulary and Similarities subtests. Furthermore, on the Block Design subtest she performed in the low average range, whereas on the Matrix Reasoning subtest, she performed in the average range. HD's test scores result in a Verbal IQ of 73 (borderline), a Performance IQ of 84 (low average), and a Full-Scale IQ of 76 (borderline to low average).

Table 10: General intellectual functioning: WASI scores for AK and his healthy control, HD (N=2)

	Group	
Measure	TBI	Healthy Control
	AK	HD
Vocabulary[a]	29	32
Similarities[a]	28	30
VIQ[a]	71	73
Block Design[a]	51	40
Measure	TBI	Healthy Control

	AK	HD
Matrix Reasoning[a]	48	39
PIQ[b]	99	84
FSIQ[b]	82	76

Note: [a]T-scores are presented. [b]IQ index scores are presented. WASI=Wechsler Abbreviated Scale of Intelligence.

Attention, Concentration and Working Memory. On the Numbers Forward subtest (see Table 11), AK performed in the extremely low range compared to HD, who performed in the borderline range. Notably, HD was an anxious child and since this was her first encounter in this type of setting, this likely impacted her performance generally. On the Numbers Backward subtest, AK's scores were in the extremely low range and HD performed in the average range for this subtest.

Table 11: Attention, concentration and executive functioning: scaled scores for AK and his healthy control, HD (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	AK	HD
Attention and Concentration Executive Functions		Numbers Forward	3	5
Working Memory		Numbers Backward	2	10
Cognitive Flexibility	Colour Trails	Colour trails 1	≤19	44
		Colour trails 2	42	32
Generativity	Verbal Fluency	C1: Letter Fluency	4	9
		C2: Category Fluency	4	8
		C3: Category Switching	6	10
	Design Fluency	C 1: Filled dots	7	8
		C 2: Empty dots	8	7
		C 3: Switching	5	9
Inhibition	Naming	Total errors (percentile)	11-25	51-75
		Completion time scaled score	6	10
		Combined scaled score	6	11
	Inhibition	Total errors (percentile)	6-10	26-50
		Completion time scaled score	8	8
		Combined scaled score	6	8
	Switching	Total errors (percentile)	11-25	51-75

Domain	Subtest	Component	AK	HD
		Completion time scaled score	5	12
		Combined scaled score	6	8
	Errors		5	8
Planning and problem solving		Total achievement	6	10
		Time-per-move	13	11
		Move-accuracy	1	8
		Rule violations	11	11

Note: C1= condition 1; C2= condition 2; C3= condition 3. Scores presented are scaled scores, unless otherwise specified in parantheses.

Cognitive Flexibility. On the first condition, CCTT 1, AK's scores were lower than HD i.e. in the severely impaired range (T-score of ≤19) regarding the speed at which he completed the subtest. AK made no errors but required an additional prompt. HD performed in the below average range (T-score of 44) regarding the speed at which she completed the subtest. As with AK, HD also made no errors and completed the subtest without additional prompting.

As shown in Table 11, on the second condition, CCTT 2, AK's scores were higher than HD. He obtained a T-score of 42 (below average range) regarding the speed at which he completed the subtest. AK once again made no errors and completed the subtest without additional prompting. HD obtained a T-score of 32 (mild to moderately impaired range) regarding the speed at which she completed the subtest and also made no errors and completed the subtest without additional prompting. Once again, it is likely that HD experienced performance anxiety.

Generativity. On AK's verbal fluency test his scores were in the borderline range for both his letter fluency and category fluency conditions and in the low average range in terms of his category switching total correct responses, and average range in terms of his total category switching accuracy. HD's scores, however, were in the average range for both her letter fluency and category fluency conditions. Furthermore, her scores were in the average range in terms of her category switching total correct responses as well as in terms of her total category switching accuracy.

Regarding AK's design fluency test, his scores are somewhat comparable to HD's. His composite score suggested a low average performance overall. HD, however, performed in the average range on her design fluency composite score.

Planning and Problem Solving. AK performed very poorly compared to HD, who performed in the average range for all components of this subtest. AK's scores were in the high average range regarding his Time-Per-Move ratio and in the extremely low range regarding his Move Accuracy Ratio. This indicates poor strategy as he was quick to complete the tasks, but at the expense of accuracy. He made one rule violation during the test and his overall performance on this subtest was in the low average range.

Inhibition. AK performed more poorly than HD in general, with scores ranging from borderline to average (see Table 11). HD's scores were mostly in the average range.

Table 12 presents T-scores, v-scaled scores and domain standard scores for AK and HD on the CBCL, BRIEF and VABS indices respectively.

Table 12: Behavioural and Affective Functioning: T-scores, v-scaled scores and domain standard scores for AK and his healthy control, HD (N=2)

	Scales	Subscales	TBI	Healthy Control
			AK	HD
CBCL Parent Report	Internalizing	Anxious/depressed	88	59
		Withdrawn/depressed	82	69
		Somatic complaints	78	62
		Internalizing problems	83	66
	Externalizing	Rule-breaking behaviour	71	60
		Aggressive behaviour	81	67
		Externalizing problems	75	66
	Total problems		81	68
CBCL TRF	Internalizing	Anxious/depressed	59	67
		Withdrawn/depressed	67	63
		Somatic complaints	62	68
		Internalizing problems	67	70
	Externalizing	Rule-breaking behaviour	50	59
		Aggressive behaviour	50	55
		Externalizing problems	41	56
	Total problems		60	60

	Scales	Subscales	TBI	Healthy Control
CBCL YSR	Internalizing	Anxious/depressed	69	50
		Withdrawn/depressed	60	58
		Somatic complaints	67	51
		Internalizing problems	68	49
	Externalizing	Rule-breaking behaviour	51	50
		Aggressive behaviour	54	51
		Externalizing problems	52	46
	Total problems		65	34
BRIEF Parent Report		Inhibit	71	47
		Shift	74	63
		Emotional control	61	54
		BRI	71	54
		Initiate	70	46
		Working memory	73	52
		Plan/Organize	72	41
		Org. of materials	63	55
		Monitor	60	52
		MI	71	49
		GEC	73	54
BRIEF Teacher Report		Inhibit	57	49
		Shift	60	57
		Emotional control	48	50
		BRI	56	52
		Initiate	84	65
		Working memory	88	58
		Plan/Organize	83	58
		Org. of materials	67	63
		Monitor	67	56
		MI	80	61
		GEC	73	58
VABS	Subdomains	Receptive	3	3
		Expressive	4	4
		Written	7	8
	Domain	Communication	45	47
	Subdomains	Personal	1	3
		Domestic	10	13
		Community	7	9
	Domain	Daily living skills	54	63
	Subdomains	Interpersonal Relationships	4	5

	Scales	Subscales	TBI	Healthy Control
	Domain	Play and leisure time	6	4
		Coping Skills	10	13
		Socialization	55	59
		Adaptive Behaviour Composite	51	56
Maladaptive Behaviour Index			18	15
		Internalizing	21	19
		Externalizing	21	15

Note: CBCL= Child behaviour checklist; TRF= Teacher's report form; YSR= Youth Self Report; BRI= Behaviour Regulation Index; MI = Metacognition Index; GEC= Global Executive Composite;VABS = Vineland Adaptive Behaviour Scale. CBCL T-scores of 60-65= borderline range; CBCL T-scores above 65= clinical range (Achenbach & Rescorla, 2001). BRIEF scores >65= clinical range (Gioia, Isquith, Guy, & Kenworthy, 2000). Both standard and v-scaled scores are presented for the VABS indices. VABS v-scaled scores of 1-9= low adaptive levels; 10-12=moderately low adaptive levels; 13-17=adequate adaptive levels; 18-20=moderately high adaptive levels; 21-24=high adaptive levels. VABS standard scores of 20-70= low adaptive levels; 71-85= moderately low adaptive levels; 86-114= adequate adaptive levels; 115-129= moderately high adaptive levels; 130-160= high adaptive levels. Maladaptive Behaviour indices: v-scale scores 21-24= clinically significant; 18-20=elevated; 1-17=average (Sparrow, Cicchetti & Balla, 2005).

CBCL. As shown in Table 12, AK's scores indicate an elevated clinical range compared to HD's. However, HD's mother did report some internalizing and externalizing behaviour in the clinical range. AK's mother reported problems of anxiety or depression, withdrawn or depressed behavior, somatic complaints, problems with rule-breaking behavior, and problems of an aggressive nature. Similarly, HD's mother reported withdrawn or depressed behavior, aggressive behaviour and externalizing problems, although these were less pronounced than AK's problems.

TRF. On the TRF problem scales, the obvious inconsistencies should be noted between AK's mother and teacher reports. AK's teacher reported his problems in the borderline range, whereas AK's mother reported his problems in a much higher clinical range. Similarly, for HD, her teacher reported higher internalizing problems than her mother.

YSR. On the YSR problem scales, AK reported his anxious/depressed and internalizing scores in the clinical range, and his withdrawn/depressed scores in the borderline range. HD did not report any problems on these scales.

BRIEF. AK's parent version of the report indicated that his BRI, MI, and GEC were all in the clinical range. Similarly, his teacher's report indicated that AK's MI and his GEC were in the clinical range. HD's BRIEF indices were in the normal range.

VABS. As shown in Table 12, no significant differences were noted between AK and HD on their communication domain as both their scores indicated low adaptive functioning.

However, in terms of AK's maladaptive behaviour, his scores are clinically significant compared to HD's scores, which are elevated (see Table 12).

Pre GMT Questionnaires

The teacher pre-GMT questionnaire indicated that AK had severe executive dysfunction with most responses ranging from 7 to 10 out of 10 (where 1 is indicative of no problem at all and 10 is indicative of a really major problem). Similarly, the parent pre-GMT questionnaire indicated executive dysfunction, as the majority of responses ranged from 6 to 9 out of 10. The participant pre-GMT questionnaire was not taken into consideration as AK had completed the questionnaire without much thought and simply circled random responses. When I attempted to ask AK the questions verbally, his answers rendered the questionnaire results inconclusive.

The pGMT Intervention

During session 1, which was a rapport building session, AK presented as a very pleasant, polite and quiet boy. He was very eager to start the programme and was affectionate almost immediately in his interactions with me.

Regarding the theoretical modules, AK was generally slow to grasp the concepts (as with CB) and he required extensive additional repetition of instructions as well as on the explanation of the concepts (e.g. the "brain notepad"). Like CB, he required more time to apply the pGMT to the activities. However, he was frequently unable to keep up with the content that we were covering and I had to move at a much slower pace with him. However, AK was consistently unable to apply the pGMT steps in the correct sequence to the tasks at hand. Each week, when he was required to recall what was covered in the previous sessions, he had great difficulty doing so. When I had reminded him of at least one story/activity, AK was able to remember very basic information on what was covered and needed constant reminding of the pGMT steps. For example, with regards to Lisa's story, he was unable to recall the story as a whole. As I gave him clues, he recalled that the characters were talking about Nelson Mandela and was able to provide more detail regarding that story.

On the practical modules, AK's performance was inconsistent - at times, he would remember the sequence of the steps using the laminated cards, however, he would also get confused about which card would come next. Despite this, using concrete cards with AK seemed to help him focus better and keep him engaged. He was able to apply the pGMT steps to the activities and stories with additional prompting. However, he struggled to apply the concepts to his real-world experiences both at home and at school. More specifically, AK struggled with the "write your plan" step and required assistance to plan for most tasks. When

AK and I did the "checking" step, I would have to explicitly point out and re-explain his errors to him. Notably, as we progressed to sessions 7 and 8, AK began to apply the pGMT steps more independently with minimal assistance from me. During sessions 9 and 10 however, I had to revise the concepts with AK in more detail and remind him of the pGMT steps. AK's did not attend the interventions sessions regularly, especially towards the latter parts of the programme.

Changes in Neuropsychological Performance: RCI

Tables 13 and 14 present summaries of the significant positive changes from the RCI analyses for cognitive and behavioural domains, respectively, for AK and HD at the time of their post- assessment.

Table 13: RCI Analyses: Cognitive Domains: Matched participants AK and HD (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	AK	HD
Attention		Numbers Forward		ΔΔΔ
Executive Functions		Numbers Backward	ΔΔ	
Generativity	Verbal Fluency	Condition 3: Category Switching	Δ	
	Design Fluency	Condition 1: Filled Dots	Δ	Δ
		Condition 3: Category Switching	Δ	
Planning and problem solving	Tower	Total Achievement Score		Δ
Inhibition	Inhibition	Naming CT		ΔΔΔ
Cognitive Flexibility	Colour Trails	CCTT 1 CT	Δ	

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. MI = Metacognition Index; GEC Global Executive Composite; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Cognitive Results

As shown in Table 13, AK showed reliable change on *condition 3 of both* the *Design Fluency and Verbal Fluency* subtests, while HD, did not. However, on condition 1 of the *Design Fluency* subtest, both AK and HD showed some reliable change. Furthermore, change on the *Numbers Backward* subtest as well as some reliable change on the *CCTT 1* subtest was evident for AK; however, HD did not reflect these changes from pre-to-post intervention

testing. Notably, HD showed positive change on *Numbers Forward*, the *Tower* and *inhibition-naming* subtests, but AK did not reflect these changes.

Table 14: RCI Analyses: Behavioural Domains: Matched participants AK and HD (N=2)

		Group	
		TBI	Healthy Control
Domain	Subtest	AK	HD
BRIEF Parent Report	Emotional Control	ΔΔΔ	
	Monitor	Δ	
BRIEF Teacher Report	Inhibit	Δ	
	Shift	ΔΔΔ	
	Emotional Control	ΔΔΔ	
	Org. of Materials	Δ	
	Monitor	Δ	
	BRI	ΔΔΔ	
	GEC	ΔΔ	
CBCL Parent Report	Internalizing		Δ
	Anxious/Depressed	Δ	
	Somatic Complaints		ΔΔ
	Externalizing		
	Rule Breaking		Δ
	Aggressive Behavior	ΔΔ	
	Total Problems		Δ
CBCL Teacher Report	Internalizing		Δ
	Anxious/ Depressed		Δ
	Somatic Complaints		ΔΔΔ
	Total Problems		Δ
VABS	Domestic		ΔΔΔ
	Interpersonal Relationships		Δ
	Play and Leisure time		Δ
	Coping Skills		ΔΔΔ
	Socialization		Δ
	Adaptive Behaviour Composite		Δ

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. CT = Completion time; BRI = Behaviour Regulation Index; MI = Metacognition Index; GEC Global Executive Composite; CCTT = Children's Colour Trails Test; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Behavioural Results

As shown in Table 14, on AK's BRIEF indices, his parent report noted reliable change on 'emotional control' and some reliable change on 'monitor', while there was no reported change for HD in these domains. Notably, AK's teacher reported reliable change in various domains of functioning listed in Table 12, while HD's teacher reported no change on these indices. Furthermore, HD's parent reported significant change in internalizing, somatic complaints, rule breaking and Total problems, whereas AK's parent did not report these changes. Similarly, HD's teacher reported significant change on the internalizing scales (Table 14), but AK's teacher did not report these changes.

Regarding the CBCL indices, while AK's parents' noted reliable change in the, 'aggressive behaviour' scale and some change on the 'anxious/depressed' scale, no change was reported on these scales for HD. Furthermore, on both teacher and the youth self reports, there was no change reflected on any of the behavioural indices for AK, although change was noted for HD on the teacher report on her internalizing behaviours (anxious/depressed, somatic complaints, internalizing behaviour and total problems)(Table 14).

Similarly, regarding the VABS scales for AK, no change was reported on all areas of adaptive functioning from pre-to-post intervention testing, although reliable change was noted for HD on domestic, interpersonal relationships, play and leisure time, coping skills socialization and her adaptive behaviour composite (Table 14).

Case Study 3: TB

Demographic Information, Socioeconomic Status (SES) and Asset Index

TB is a male and is mixed race. His home language is Afrikaans although he was proficient in English. TB was 12 years, 9 months old at the time of his pre-assessment. As seen in Table 15, TB's parents' household income bracket indicates a low to middle socioeconomic background. Regarding their material and financial resources as indicated on their asset index they have all items listed on the questionnaire in their home such as a refrigerator, a vacuum cleaner, a television, a microwave oven, a washing machine and a DVD player in working order. They do not, however, have a hi-fi in their household. Furthermore, they do have

access to running water, a car, a flush toilet, a built in kitchen sink, an electric stove / hotplate and a domestic worker in their home, but do not have a working telephone. TB's asset index further indicated that they shop at supermarkets, have ATM cards and bank accounts as well as accounts or credit at retail stores.

Regarding TB's control, EM, differences were noted on race, home language and the asset index, although these participants were matched on age as closely as possible and socioeconomic status (see Table 13). Notably, even though both these participants are not first language English speakers, they were both proficient in English. Furthermore, TB has a higher asset index than EM, despite their matching SES bracket.

Table 15: Demographic characteristics, SES and Asset index for TB and his healthy control, EM (N=2)

Variables		Group	
		TBI	Healthy Control
		TB	EM
Sex		Male	Female
Race		Mixed race	African
Home language		Afrikaans	IsiXhosa
Age at assessment (years: months)		12:9	13:0
Annual household income (ZAR)		5000-25000	5000-25000
Parental education	Mother/ guardian	12 years	13 years (guardian)
	Father	12 years	
Parental employment	Mother/ guardian	Clerical and sales, technicians, small businesses	Skilled manual
	Father	Skilled manual	
Material and financial resources (Asset index)		15 assets (high)	9 assets (medium)

Injury-related History

TB's injury related details were obtained from his RXH medical folder. TB sustained a severe TBI, as indicated by his GCS score i.e. 3/15, after he was knocked over by a motor vehicle. He was 4 years, 9 months old at the time of his injury.

TB's CT brain scan revealed a depressed skull fracture on his right side with an enclosed haematoma, a severe diffuse axonal injury, brainstem lesions and brain swelling. More specifically, TB's radiology report on the day of the accident noted extensive scalp swelling over his right side with underlying parietal bone found through his right coronal suture. Furthermore, he presented with multiple bilateral, small parietal hemorrhagic contusions and a pericranial hemorrhage in his right basal ganglia. Additionally, there was evidence of a subarachnoid hemorrhage as well as a right frontoparietal subdural hemorrhage noted. TB had generalized brain swelling and a 1-2mm midline shift to the left. Lastly, TB's scan showed no evidence of hydrocephalus, however, his basal cisterns were effaced and he presented with a partial opacification of his enthorhinal sinuses. The radiologist's additional comment stated that TB presented with an extensive cranial injury.

A day after the accident had occurred and TB had been admitted to RXH, he underwent a unilateral (right) decompressive craniotomy. Four months thereafter, a cranioplasty was performed on TB before he had been discharged. During TB's follow up visits to the neurosurgery ward, the neurosurgeons involved in TB's care at the time noted TB's progress. In his first follow up visit which was 10 months post injury, it was noted that TB's speech had been improving, however, it had still been impaired. Furthermore, TB had been oriented to place, but not time, his memory was reported to be poor. Physically, TB presented with a left hemiparesis, which was improving, but TB still had a weak hemiplegic gait. During his second follow up visit to RXH, which was 16 months after his injury, neurosurgeons noted clear cognitive deficits but there was no further elaboration in this regard in his medical folder.

Lastly, three years after his injury, it was noted by the neurosurgery outpatient department that TB was in a stable condition, his speech was much better and that he was able to speak relatively well. Physically, TB walks with a limp. The most recent visit noted in his RXH medical folder was in 2012. TB had visited the Cerebral Palsy Clinic, orthopedics department.

Developmental and Social History

TB's developmental history was obtained from his mother during a very brief semi-structured telephonic interview. TB's mother reported no complications during her pregnancy

or in the newborn period. TB's developmental milestones were reported to be normal and she stated that TB had no difficulties prior to the accident and that he was a normal and happy toddler.

TB lives with both his biological parents and a younger sister. Both his parents completed matric. His mother currently works as a collections agent and his father is unemployed.

Academic History

TB was placed in a special needs school 10 months after his injury. TB began nursery school at the same school and received physiotherapy at the time. In 2010, TB began junior grade 3 and he is currently still at the same school in a junior class.

Pre Intervention Cognitive, Behavioural and affective functioning

General Intellectual Functioning. TB's FSIQ is extremely low, compared to EM's low average FSIQ. As shown in Table 16, most of EM's scores are significantly higher than TB's with the exception of the Block Design T-scores. EM performed in the borderline range for the task as she struggled with more complex items on this subtest and attempted to rotate the stimulus book. She also took some time to develop a strategy and often only completed an item once the required time had elapsed.

Table 16: General intellectual functioning: WASI scores for TB and his healthy control, EM (N=2

	Group	
Measure	TBI	Healthy Control
	TB	EM
Vocabulary[a]	20	49
Similarities[a]	21	54
VIQ[a]	57	102
Block Design[a]	25	33
Matrix Reasoning[a]	20	43
PIQ[b]	58	79
FSIQ[b]	54	89

Note: [a]T-scores are presented. [b]IQ index scores are presented. WASI=Wechsler Abbreviated Scale of Intelligence.

Attention and Working Memory. On the Numbers Forward subtest, both TB performed in the borderline range, while EM's scores were in the average range. On the Numbers Backward subtest, which is a measure of working memory, TB performed in the extremely low range and EM performed in the average range for this subtest.

Table 17: Attention, concentration and executive functioning: scaled scores for TB and his healthy control, EM (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	TB	EM
Attention and Concentration		Numbers Forward	4	10
Executive Functions				
Working Memory		Numbers Backward	2	9
Cognitive Flexibility	Colour Trails	Colour trails 1	≤19	32
		Colour trails 2	≤19	49
Generativity	Verbal Fluency	C1: Letter Fluency	1	11
		C2: Category Fluency	6	9
		C3: Category Switching	5	13
	Design Fluency	C 1: Filled dots	4	9
		C 2: Empty dots	3	10
		C 3: Switching	2	9
Inhibition	Naming	Total errors (percentile)	<2	51-75
		Completion time scaled score	1	12
		Combined scaled score	1	11
	Inhibition	Total errors (percentile)	<2	51-75
		Completion time scaled score	1	10
		Combined scaled score	1	10
	Switching	Total errors (percentile)	<2	51-75
		Completion time scaled score	1	10
		Combined scaled score	1	10
	Errors		1	11
Planning and problem solving		Total achievement	2	8
		Time-per-move	11	10
		Move-accuracy	19	8
		Rule violations	4	10

Note: C1= condition 1; C2= condition 2; C3= condition 3. Scores presented are scaled scores, unless otherwise specified in parantheses.

Cognitive Flexibility. On the first condition, CCTT 1, TB performed worse than EM, scoring in the severely impaired range (T-score of ≤19) in terms of the speed at which he completed the subtest. TB made four errors and completed the subtest with extensive additional prompting. EM, performed in the mild to moderately impaired range (T-score of

32) regarding the speed at which she completed the subtest (Table 17). She made no errors and completed the subtest without additional prompting.

On the second condition, CCTT 2, TB once again performed extremely poorly compared to EM. He obtained a T-score of ≤19 (severely impaired range) regarding the speed at which he completed the subtest. TB once again made four errors and completed the subtest with extensive additional prompting. EM obtained a T-score of 49 (average range) regarding the speed at which she completed the subtest. She made no errors and required no additional prompting.

Generativity. On TB's verbal fluency test, he performed in the extremely low range for his letter fluency condition. However, he performed in the low average range for his category fluency condition. Furthermore, in terms of his category switching total correct responses and total category switching accuracy, he performed in the borderline range for both subdomains of this condition (see Table 17). EM, however, performed in the average range for both her letter fluency and category fluency conditions. Furthermore, she performed in the high average range on her category switching correct responses but in the low average range for her total switching accuracy.

Regarding TB's design fluency test, his composite score suggested an extremely low performance overall. EM, however, performed in the average range on her design fluency composite score (see Table 17).

Planning and Problem Solving. TB performed in the extremely low range regarding both his Time-Per-Move ratio and his Move Accuracy Ratio. He made seven rule violations during the test (borderline range) and his overall performance on this subtest was in the extremely low range (Table 17).

Regarding EM, she performed in the average range regarding her Time-Per-Move ratio as well as her Move Accuracy Ratio. She made one rule violation during the test (average range) and her overall performance on this subtest was in the average range.

Inhibition. TB obtained scores in the extremely low range as compared to EM, who performed in the average range for all three components of the task (Table 17).

Table 18 presents T-scores, v-scaled scores and domain standard scores for TB and EM on the CBCL, BRIEF and VABS indices respectively.

Table 18: Behavioural and Affective Functioning: T-scores, v-scaled scores and domain standard scores for TB and his healthy control, EM (N=2)

	Scales	Subscales	TBI	Healthy Control
			TB	EM
CBCL Parent Report	Internalizing	Anxious/depressed	57	55
		Withdrawn/depressed	53	51
		Somatic complaints	50	56
		Internalizing problems	52	53
	Externalizing	Rule-breaking behaviour	51	51
		Aggressive behaviour	51	52
		Externalizing problems	48	51
	Total problems		53	51
CBCL TRF	Internalizing	Anxious/depressed	54	61
		Withdrawn/depressed	52	61
		Somatic complaints	58	50
		Internalizing problems	54	60
	Externalizing	Rule-breaking behaviour	53	50
		Aggressive behaviour	52	50
		Externalizing problems	52	43
	Total problems		54	52
CBCL YSR	Internalizing	Anxious/depressed	52	50
		Withdrawn/depressed	54	51
		Somatic complaints	55	51
		Internalizing problems	53	45
	Externalizing	Rule-breaking behaviour	50	51
		Aggressive behaviour	50	50
		Externalizing problems	37	46
	Total problems		50	44
BRIEF Parent Report		Inhibit	68	42
		Shift	74	42
		Emotional control	75	39
		BRI	76	40
		Initiate	62	43
		Working memory	62	40
		Plan/Organize	60	43

	Scales	Subscales	TBI	Healthy Control
		Org. of materials	46	41
		Monitor	63	46
		MI	60	41
		GEC	67	40
BRIEF Teacher Report		Inhibit	55	45
		Shift	49	49
		Emotional control	45	46
		BRI	50	46
		Initiate	63	46
		Working memory	62	48
		Plan/Organize	60	49
		Org. of materials	60	46
		Monitor	50	49
		MI	60	47
		GEC	57	47
VABS	Subdomains	Receptive	8	14
		Expressive	10	18
		Written	5	15
	Domain	Communication	61	106
	Subdomains	Personal	9	13
		Domestic	11	17
		Community	7	15
	Domain	Daily living skills	66	100
	Subdomains	Interpersonal Relationships	11	16
		Play and leisure time	5	17
		Coping Skills	11	17
	Domain	Socialization	68	91
		Adaptive Behaviour Composite	64	99
Maladaptive Behaviour Index			17	16
		Internalizing	18	19
		Externalizing	19	15

Note: CBCL= Child behaviour checklist; TRF= Teacher's report form; YSR= Youth Self Report; BRI= Behaviour Regulation Index; MI = Metacognition Index; GEC= Global Executive Composite;VABS = Vineland Adaptive Behaviour Scale. CBCL T-scores of 60-65= borderline range; CBCL T-scores above 65= clinical range (Achenbach & Rescorla, 2001). BRIEF scores >65= clinical range (Gioia, Isquith, Guy, & Kenworthy, 2000). Both standard and v-scaled scores are presented for the VABS indices. VABS v-scaled scores of 1-9= low adaptive levels; 10-12=moderately low adaptive levels; 13-17=adequate adaptive levels; 18-20=moderately high adaptive levels; 21-24=high adaptive levels. VABS standard scores of 20-70= low adaptive levels; 71-85= moderately low adaptive levels; 86-114= adequate adaptive levels; 115-129= moderately high adaptive levels; 130-160= high adaptive levels. Maladaptive Behaviour indices: v-scale scores 21-24= clinically significant; 18-20=elevated; 1-17=average (Sparrow, Cicchetti & Balla, 2005).

CBCL. As shown in Table 18, no significant differences were noted in terms of the parent reports of TB's and EM's internalizing scales. Their scores were both in the normal range.

TRF. This outcome was consistent for TB on his teacher report, but not for EM as her teacher rated her anxious/depressed, withdrawn/depressed and internalizing problem scales in the borderline range.

YSR. On the YSR problem scales, no significant differences were noted between TB and EM, as these reported scales were in the normal range.

BRIEF. TB's parent version of the report indicated that his GEC and BRI were in the clinical range. However, TB's teacher's report indicated scores for BRI, his MI and his GEC that were all below the clinical cut off. EM's BRIEF indices were reportedly in the normal range.

VABS. As shown in Table 18, TB's adaptive functioning was low compared to EM's adequate levels of functioning on all domains. Regarding their internalizing and externalizing maladaptive behaviour indices, both participants had scores in the elevated range (Table 18).

Pre GMT Questionnaires

The teacher pre-GMT questionnaire indicated mixed responses regarding TB's executive functioning with 10 of 25 responses being between 3 and 6 out of 10, 9 of these responses that scored 2/10 and 6 of these responses being between 7 and 8 out of 10 (where 1 is indicative of no problem at all and 10 is indicative of a really major problem). The parent pre-GMT questionnaire indicated severe executive dysfunction, as the majority of responses ranged from 8 to 9 out of 10. TB was unable to complete the participant pre-GMT questionnaire by himself and when I had attempted to verbally administer the questions, TB was unresponsive due to high levels of distractibility.

The pGMT Intervention

During session 1, which was a rapport building session, TB presented as a very friendly and talkative young man. At the beginning of the rapport building session, TB immediately asked to draw. As I had been aware of the severity of his injury, I had decided to allow TB the space to communicate with me at his own pace so that I could ascertain how best to proceed with the intervention thereafter. While drawing, TB had started to spontaneously converse with me and shared intimate details about his experience of his accident. According to TB, he stated that there "is nothing wrong with my brain…my brain is different. Jesus made everyone different."

Regarding the theoretical modules, it was a great challenge to keep TB engaged due to his high levels of distractibility. Furthermore, due to the severity of TB's injury, it was difficult for him to understand the concepts and apply the concepts to the steps. However, each week, when he was required to recall what was covered in the previous sessions, TB could remember that he "played games" and he was 'stuck' on the Mandela story.

Notably, TB was still able to learn the pGMT steps and their sequence and seemed to remember the steps better after I had repeated them in Afrikaans. So, I would teach him the steps as "STOP en DINK!!! Wat doen ek nou? — Se wat jy moet doen — Doen dit! — Kyk weer!" TB's attention had to be constantly re-focused to the task at hand.

On the practical modules, TB responded better than expected. Despite the challenges faced during the session, TB was able to recognize most of the pGMT steps using the laminated cards with the exception of the "Say your Goal" and "Check" cards. However, as we progressed through the intervention, TB was able to recognize the "Say your Goal" card. At session 7, TB was able to recognize and verbalize all the pGMT steps. In a final attempt to generalize the pGMT steps during the last session, I tried to apply the Mandela story to the steps since TB kept repeating his version of the story each week. So, I asked TB- "If Madiba forgot to take his medicine, what must he use to help him remember?" TB began to verbalize the steps, however, he was only able to apply the first two steps- he stated, "He must STOP and THINK!, then he must say what he must do…then he must go to bed".

Of interest, early on during the intervention i.e. session 5, whenever TB had seen me each week, the first thing that he had said to me was "hey, where's Mr. STOP…are we gonna do Mr. STOP and THINK?".

Changes in Neuropsychological Performance: RCI

Tables 19 and 20 present a summary of the significant positive changes from the RCI analyses for cognitive and behavioural domains, respectively, for TB and EM at the time of their post- assessment.

Table 19: RCI Analyses: Cognitive Domains: Matched participants TB and EM (N=2)

			TBI	Healthy Control
Domain	Subtest	Component	TB	EM
Attention		Numbers Forward		Δ
Executive Functions		Numbers Backward		
Generativity	Verbal Fluency	Condition 1: Letter Fluency		ΔΔ

			TBI	Healthy Control
	Design Fluency	Condition 1: Filled Dots		
		Condition 2: Empty Dots		Δ
Planning and problem solving	Tower	Total Achievement Score		Δ
Inhibition	Naming Inhibition	Inhibition CT	ΔΔ	Δ
	Switching	Inhibition CT		Δ
		Inhibition CT		Δ
		Inhibition-Errors		Δ
Cognitive flexibility	Colour Trails	CCTT 1 CT		

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. MI = Metacognition Index; GEC Global Executive Composite; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Cognitive Results

As shown in table 19, for TB, there was significant reliable change on the *Inhibition-naming* subtest only from pre-to-post intervention testing. Notably, this is primarily a measure of attention/processing speed and not a pure measure of executive function. There was, however, significant change from pre- to post-testing for EM on *Numbers Forward*, condition 1 of *Verbal Fluency*, condition 2 of *Design Fluency*, her total achievement score on the *planning and problem solving* task, and on the *naming*, *inhibition* and *switching* tasks of the *Inhibition* subtest. TB did not reflect these changes.

Table 20: RCI Analyses: Behavioural Domains: Matched participants TB and EM (N=2)

		TBI	Healthy Control
Domain	Subtest	TB	EM
BRIEF Parent Report	Inhibit		
	Shift		Δ
	Initiate		
	Working Memory		Δ
	Plan		
	Monitor		
	MI		
BRIEF Teacher Report	Shift	Δ	Δ
	Initiate	Δ	ΔΔΔ

Domain	Subtest	TB	EM
	Working Memory	ΔΔΔ	
	Org. of Materials	Δ	
	GEC	Δ	Δ
	MI	ΔΔ	Δ
CBCL Teacher Report	Internalizing		Δ
	Anxious/Depressed		ΔΔ
CBCL Youth Self Report	Internalizing	Δ	
VABS	Receptive		
	Written		
	Communication		
	Domestic		ΔΔΔ
	Interpersonal Relationships		Δ
	Play and Leisure time	ΔΔΔ	Δ
	Coping Skills	Δ	ΔΔΔ
	Socialization	ΔΔΔ	Δ
	Adaptive Behaviour Composite		Δ

Note: Δ=a positive change of at least 1 standard deviation with a confidence interval of 68.26%; Δ Δ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; Δ Δ Δ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. CT = Completion time; BRI = Behaviour Regulation Index; MI = Metacognition Index; GEC Global Executive Composite; CCTT = Children's Colour Trails Test; VABS = Vineland Adaptive Behaviour Scale.

RCI Analyses: Behavioural Results

As shown in Table 20, on TB's BRIEF indices, his parent report noted no reliable change on any of the behavioural indices, however, TB's teacher reported some reliable change on the 'shift', 'initiate', 'organization of materials' indices and his global executive composite. Furthermore, his teacher reported significant reliable change in terms of his working memory and MI. Of interest, is TB's significant change in his working memory capacity compared to his matched healthy control- there was no change reported for EM's working memory domain by her teacher.

Regarding the CBCL indices, both TB and EM's parents reported no reliable change regarding their internalizing and externalizing scales, so these indices are not listed in Table 20. On TB's youth self-report, he noted (with help from his parent) a change in his internalizing problems. Although TB's teacher reported no change regarding his internalizing

and externalizing indices, EM's teacher reported change for her anxious/depressed and internalizing indices.

Similarly, regarding the VABS scales for TB, some significant change was reported on his coping skills and a significant change was reported for play and leisure time and socialization from pre-to-post intervention testing. Two of these changes were also noted for EM; however, the level of change was inverted i.e. a significant change was reported for EM's coping skills and some reliable change was reported for her play and leisure time. Furthermore, reliable change was reported for EM on domestic, interpersonal relationships, and her adaptive behaviour composite scales, but these changes were not reported for TB.

Discussion

Despite the fact that pTBI is a public health concern, largely as a result of MVAs and levels of violence in South Africa, there is a lack of resources in terms of cognitive rehabilitation available for South African children who have sustained a TBI (Levin, 2004; Schrieff, Thomas, Dollman, Rohlwink, & Figaji, 2013). In light of this inadequacy and the fact that executive dysfunction is commonplace after TBIs, this study focused on investigating a cognitive rehabilitation tool to help remediate the everyday executive functioning deficits associated with TBI among children and adolescents. The cognitive rehabilitation tool used to facilitate this process was the Goal Management Training intervention (GMT; Robertson, Levine, & Manly, 2005). The study was exploratory in nature; hence, there were no specific hypotheses. The results of the study will be discussed in line with the aims of the study i.e. the adaptation of the pGMT programme and in terms of the efficacy of the revised pGMT with a TBI sample. In addition I will discuss the feasibility of the programme in terms of the South African context.

The adaptation of the pGMT programme

In general, the newly adapted and implemented pGMT appears to be suitable for use with South African children. There were various factors that facilitated the successful implementation of the intervention.

The introduction of the PECS system and the repetition of the pGMT steps using this practical approach contributed significantly to the successful application of the pGMT steps to real-world tasks. Both the healthy and TBI samples were easily engaged (regardless of the severity of their injury) and enjoyed this practical aspect of the intervention as this appeared to increase their levels of motivation. Further, shortening and merging the modules allowed for more emphasis on the important concepts that needed to be trained. In turn, this

restructuring of the programme allowed for flexibility in terms of the time spent with each child and the individual tailoring of the pGMT to each child's real world experiences within their home and school life.

Hence the initial step regarding feedback from various health professionals (part 1 of the study) based on their wealth of experience (of at least 10 years in all but one case), proved very important in the adaptation process. The feedback received and incorporated, transformed the intervention. This model could be put forward as exemplary in future adaptations of interventions in specific contexts. The use of focus groups or consultations with health professionals in rehabilitation settings has been documented in the literature as a useful tool to guide evaluative studies (see Camden, Tétreault, & Swaine, 2012; Easton, 1999; Öhman, 2005; Velji, Baker & Fancott, 2008).

Implementation of the revised pGMT with the healthy sample

Regarding the cognitive measures, there were no instances where all three participants showed improvement on the same subtest or domain. However, there were domains where at least 2 children showed some improvement on the same measure. This was evident on the attention and concentration measure (Numbers forward), where EM and HD both showed levels of improvement. Notably, HD showed a more significant improvement than EM. This pattern of performance was evident with the same two participants i.e. EM and HD, on a measure of sustained attention (inhibition-naming subtest). In addition, EM and HD showed the same level of change on planning and problem solving abilities. PM and HD showed the same level of improvement on a measure of non-verbal generativity (condition 1 of design fluency), and PM and EM showed a significant level of change on cognitive flexibility. Of note, PM was the only participant to show significant improvement in working memory in terms of the cognitive measures.

In sum, there were positive changes from pre- to post-intervention on a number of attention and executive function measures at confidence intervals of 68.26% to 99%. There were however no positive changes from pre- to post-intervention on conditions 2 and 3 of Verbal Fluency (measure of verbal production/generativity), condition 3 of Design Fluency (measure of nonverbal production/generativity), and condition 2 of CCTT (measure of cognitive flexibility). Despite the lack of change seen on these conditions, there were more instances of positive changes across cognitive measures.

Regarding the behavioural measures, in general, EM was the only participant for whom significant positive changes were reported in both the BRIEF parent and teacher reports. PM's positive changes were reported in her parent report only. There were no

significant positive changes reported for HD by either her parent or her teacher. Further, positive changes were reported for both EM and PM on their ability to initiate or generate responses or ideas and in their MI. Individually, PM reportedly also improved in her planning and monitoring abilities. EM, on the other hand, also reportedly improved in terms of her ability to shift between responses, activities or situations as well as in her GEC (as per her teacher's report). Both EM's guardian (i.e. her sister) and her teacher reported this change. In addition, there was also significant clinical change reported in terms of EM's working memory.

In sum, parents/guardians and/or teachers reported significant positive changes for at least two of the participants at confidence intervals of 68.26% to 99% on some of the BRIEF indices. However, no significant positive change was reported on for both PM and EM regarding 'organization of materials' and the BRI, by either parents or teachers.

Regarding the CBCL indices, significant positive change was reported for all three participants in terms of internalizing problems at school. At home, these changes were only reported for PM and HD.

Regarding PM's performance more specifically, PM's parents reported significant positive change regarding her internalizing behaviours (anxious/depressed) and externalizing behaviours (rule-breaking and aggressive behaviour) at home. PM also reported positive change on her internalizing behaviours i.e. anxious/depressed and somatic complaints, and in terms of her externalizing problems and Total Problems subscale, in her self-report.

HD reportedly improved on an externalizing behaviour i.e. rule breaking, at home. Her teacher also reported positive change in terms of her anxious/depressed and somatic complaints internalizing behaviours.

Neither EM's self-reports, nor those of her guardian, reflected any significant positive changes on the CBCL.

In sum, parents/guardians and/or teachers of the CBCL reported significant positive changes for all three participants in at least one of the internalizing or externalizing behaviours at confidence intervals of 68.26% to 99%. However, no significant positive change was reported on for all three participants regarding the internalizing behaviour, 'withdrawn/depressed', by either parents or teachers.

Regarding the VABS, no significant improvements were reported for PM. However, significant positive changes were reported for HD and EM by their parents and guardians respectively, in the domestic domain. More specifically, the positive changes for HD were in her communication domain and some changes were reported in terms of her community,

daily living skills and play and leisure time domains. Significant positive changes were reported for EM by her parent on interpersonal relationships, play and leisure time, coping skills and socialization.

In sum, parents/guardians reported significant positive changes for at least two of the participants at confidence intervals of 68.26% to 99% on the VABS. However, no significant positive change was reported on for both HD and EM in the expressive and personal subdomains as well as in the internalizing or externalizing scales of the maladaptive behaviour index by parents.

In terms of real world behaviors, both PM and HD's teacher noticed improvement in their academic and behavioural functioning at school. EM's teacher was unavailable for comment. Both participants' grades increased over the third and fourth academic terms. HD's teacher reported that HD was working harder and gained more confidence in general. In addition, the teacher reported that PM was more careful in the completion of her schoolwork as she checked and self-monitored better. PM gained more confidence in her writing abilities.

These real world changes, which may be associated with the intervention, could also contribute to evidence of the efficacy thereof. The importance of applying cognitive rehabilitation interventions to real world behaviours have been highlighted in the literature and are deemed crucial to successful generalizability of results (Chevignard et al., 2010; Grant, Ponsford, & Bennett, 2012; Krasny-Pacini et al., 2013).

Overall, in terms of the behavioral measures, the parents and teacher of the 12- year-old, HD, did not report as many significant positive changes for her as compared the reports for the other two participants. HD's higher levels of anxiety and her withdrawn demeanor during the intervention programme, compared to PM and EM, could have impacted on her performance and engagement with the intervention process, hence the results.

The 11-year-old, PM, appeared to engage more with the materials and activities within the programme than HD and the 14-year-old, EM. This difference may have been due to PM's eagerness and ability to apply herself as best as she could throughout the programme. EM began to display slightly oppositional behaviour towards the end of the intervention, stating that the modules were too easy for her, and seemed bored. Notably, EM had just turned 14 years of age, during the latter part of the intervention and her behaviour began to reflect tendencies typically associated with adolescence (for example, she was excited about receiving a cell phone for her birthday and frequently fixated on this). The difference in performance between the youngest and the older participants suggests the possibility that younger age groups may find the revised pGMT intervention more stimulating than older

children and adolescent groups. This possibility should be further investigated.

Overall, PM, the youngest participant of the group demonstrated the greatest gain, in terms of significant positive changes reported, compared to HD and EM. EM showed a fair amount of improvement despite her behaviour towards the later parts of the intervention and HD showed the least gain on behavioural indices.

Despite these challenges, the pGMT intervention appeared efficacious and suitable, at least in part, in its implementation with healthy South African children. The healthy group was most useful to ascertain whether the revised pGMT programme i.e. the simplified language, the shifting and refining of concepts, the merging of modules and the PECS system worked together to create a sound South African-based intervention. Healthy samples as comparison groups have not previously been used in pediatric intervention studies of this nature. However, in an adult study focusing on Mild Cognitive Impairment and Dementia of the Alzheimer type, a similar model proved useful in distinguishing between specific outcomes as purported by researchers aims (see Petersen et al., 1991).

Efficacy of the revised pGMT with the TBI sample.

Regarding the cognitive measures, all three participants did not show improvement on the same domains. Individually, CB showed improvement on a measure of non-verbal generativity (condition 2 of design fluency) as well as on the time that she took to complete the inhibition and switching subtests. AK improved on working memory, both verbal and nonverbal category switching i.e. cognitive flexibility, as well as condition 1 of colour trails (measure of cognitive flexibility/ attentional control). Lastly, TB showed significant change on a measure of sustained attention within an executive function test. In sum, there were positive changes from pre- to post-intervention on a number of attention and executive function measures at confidence intervals of 68.26% to 99%. There were, however, no positive changes from pre- to post-intervention on condition 2 of both Verbal Fluency (generativity) and CCTT (cognitive flexibility). Despite the lack of change seen on these conditions, there were more instances of positive changes on the cognitive measures among the participants.

Regarding the behavioural measures, significant positive changes were reported for all three participants on their ability to organize materials on the BRIEF. Individually, significant positive change for AK positive change was reported on BRIEF indices of emotional control, and shifting between responses, situations or ideas, as well as self-monitoring and, inhibiting responses. His teacher also reported significant change on his BRI and GEC indices. Further, significant positive change was reported for TB regarding working memory in his parent and

teacher reports. His teacher reported change on shifting between responses, initiating behaviour or responses and on his MI and GEC. In sum, parents/guardians and/or teachers reported significant positive changes for all of the participants on at least one index at confidence intervals of 68.26% to 99%.

Regarding the CBCL, positive changes were reported on internalizing behaviours (withdrawn/depressed, anxious/depressed and internalizing problems) of the CBCL for all three participants on one or more of these indices. Further, significant positive changes on externalizing behaviours of the CBCL (rule-breaking and aggressive behaviour) were only reported for CB and AK. In sum, parents/guardians and/or teachers reported significant positive changes for all three participants on at least one of the internalizing or externalizing behaviours at confidence intervals of 68.26% to 99%, on the CBCL. However, no significant positive change was reported on for all three participants regarding the internalizing behaviour, 'somatic complaints', and 'externalizing problems' by either parents or teachers.

Regarding the VABS, TB was the only participant for whom significant positive changes were reported. These positive changes were reported in his play and leisure time, and coping skills domains by his parents. His teacher did not report any change. In sum, parents/guardians reported significant positive changes for TB at confidence intervals of 68.26% and 99%. However, no significant positive changes were reported on all VABS domains for both CB and AK by parents and teachers.

In terms of real world behaviour, CB's teacher and parents commented on her improvements academically, behaviorally, and socially. Academically, her teacher and parents reported that her school grades increased over the third and fourth terms (parallel to when the intervention began). Furthermore, her teacher reported that CB had become much more confident and motivated to learn. Behaviourally, her parents and teacher reported on her improved ability to plan and organize herself. Her father stated that she has also become much more independent in terms of her schoolwork and behaviour at home. Socially, CB was reported to be less reserved and had started to make friends at school (reported by her mother). These real world changes reported by her parents and teacher may be associated with the intervention and could further contribute to evidence of the efficacy thereof. TB and AK's parents and/or teachers reported no significant real world behavioural changes.

Matched pairs and overall outcome: Healthy Control vs. TBI groups.

Regarding the matched pair PM (Healthy Control Group) and CB (TBI Group), there were more instances of significant positive change for PM at confidence intervals of 68.26% to 99% than for CB on cognitive measures, but this was marginal. PM only showed positive

change on one additional measure. Both PM and CB showed positive change regarding the time taken on inhibition measures. Although PM showed greater gains on behavioural indices, in terms of real world applications, CB's reported gain by her parents and teacher both at home and at school was more significant. Notably, CB showed significant positive changes on condition 2 of design fluency (confidence interval of 68.26%) and the time that she took on her inhibition task, (confidence interval of 95%) whereas PM did not.

Regarding the matched pair HD (Healthy Control Group) and AK (TBI Group), AK showed greater gain regarding both his cognitive and behavioural measures and his reported functioning at school despite his teacher's inconsistent verbal feedback. In the case of EM (Healthy Control Group) and TB (TBI Group), greater reliable change was reported for EM than for TB across domains.

In general, significant positive changes were seen for members of both the Healthy Control and TBI groups. In terms of which group showed greater positive changes overall, this is not clear-cut. Participants of the Healthy Control Group showed more significant positive changes except in terms of real world behaviours, which a number of researchers highlight as an important indicator of efficacy (Chevignard et al., 2010; Grant, Ponsford, & Bennett, 2012; Krasny-Pacini et al., 2013). From the results it also appears that the youngest participants of both the Healthy Control and TBI groups i.e. PM and AK benefitted most from the revised pGMT intervention. As noted earlier, these participants may have found the materials more stimulating, resulting in better overall engagement on the programme.

Factors affecting outcome

There were various factors that may have played a role in the participants' outcomes and performance on the intervention across both the Healthy Control and TBI groups. Each factor will be briefly discussed below.

Injury-related factors. Overall, TB did not show significant positive changes on cognitive measures as the other two participants in the TBI sample did. Further, his parents and teacher did not report as many areas of significant positive change as for the other participants, which implies that the intervention may not have been as efficacious for TB.

Among the factors that predict outcome post-TBI, the nature and severity of TB's injury could have played a role in his outcomes following the pGMT intervention. TB's injury was much more severe, diffuse and extensive compared to CB's, whose injury was less severe and AK's, whose injury was moderate according to their GCS scores. Furthermore, TB's injury was sustained at a younger age, i.e. 4 years, 9 months of age, whereas CB's and AK's injuries occurred at 6 years, 6 months old and 8 years, 11 months, respectively. His

poorer performance due to his extensive impairment at a young age could present evidence of the idea that early brain insults produces more pronounced and harmful lifelong effects (Asikainen et al., 1998; Slomine et al. 2002; V. Anderson et al., 2010). A poorer outcome post-TBI could translate into more difficulties with, for example, keeping up with and engaging with, the content and tasks of the intervention. This was found in Corbett's (2008) study, where she was unable to administer the pGMT with the participant who had sustained a severe injury (GCS 3/15).

AK showed greater positive change than CB on both cognitive and behavioural measures. Two important and related predictors that could account for the differences between AK and CB as well as affected their outcomes on the intervention were the nature and the severity of injury. The nature of AK's injury differed from CB's. Regarding the mechanism of injury, AK was a pedestrian, while CB was a passenger. AK sustained abrasions and lacerations and on scanning, a small punctate hemorrhage and had a loss of consciousness for 3 to 4 days. He sustained a moderate injury (GCS 9/15). CB, on the other hand, was comatosed for 1 week and on scanning, showed generalized oedema with features of a diffuse axonal injury and sustained a severe injury (GCS 6/15). This finding is consistent with the well-established dose-response relationships purported in the literature (Dikman et al., 1995; Kobeissy, 2015; Rohling, Meyers & Millis, 2003; V. Anderson, Catroppa, Haritou, et al., 2001; V. Anderson et al., 2005). As with TB, a poorer outcome post-TBI could translate into more difficulties with, for example, keeping up with and engaging with, the content and tasks of the intervention.

Despite the fact that AK showed more instances of significant positive change, CB demonstrated greater gain the manner in which the pGMT intervention training translated to her real world behaviour. While AK seemed to show greater positive changes on behavioural measures, he was unable to apply himself at home and at school. This is in keeping with the lack of change reported qualitatively by both AK's teacher and mother. CB, on the other hand was able to apply herself well to both her school and home environments. This finding is in keeping with the positive and significant changes reported by CB's parents and schoolteacher.

Familial factors. CB's outcome in terms of real world generalizability was due to a very important predictor of outcome i.e. familial support. CB attended her sessions regularly and her both her family and school was constantly involved in her progress during the intervention. However, AK's mother and teacher were both minimally involved in his progress. This finding is in keeping with numerous studies that emphasized the role of

caregiver/parental and school support in pediatric neurorehabilitation for the successful generalization to the child's daily life (Braga, Da Paz Junior, & Ylvisaker, 2005; Corbett, 2008; Galvin & Mandalis, 2009).

In AK's case, the same predictor of outcome i.e. familial support, worked to his disadvantage in numerous ways. First, AK's mother was not as involved in his journey through the intervention as CB's parents were. Second, his mother did not return questionnaires timeously and was uncooperative. When AK's questionnaires were eventually returned, they were incomplete. Third, CB's parents were more easily accessible when I needed to communicate with them in comparison to AK's mother who was mostly unavailable. Lastly, CB's school was involved in her progress throughout the intervention period, whereas AK's teacher was much less involved. In addition, AK's irregular session attendance negatively impacted on his performance on the programme. Notably, however, CB's intervention sessions were conducted at school. AK was required to travel to UCT for his sessions.

Individual Characteristics. The individual characteristics of the children played a significant role in their performance throughout the programme. The children who were eager and willing to try their best on the tasks such as PM, CB and HD (during latter parts of the programme), seemed to be able to apply themselves better on the practical modules and made less OOPS mistakes. Conversely, the children who were more reserved, attended the sessions irregularly and were slightly oppositional such as AK and EM, performed more poorly and made more OOPS mistakes due to their disinterest or haste.

Feasibility of the revised pGMT

In general, the newly adapted and implemented pGMT is suitable for use in a South African context, even in light of the lack of infrastructure for cognitive rehabilitation in the country. Factors that facilitated the implementation of the intervention included the design, setting and mobility of the programme. The pGMT intervention did not include any heavy materials or items that could not be moved around. The creation of the PECS materials was inexpensive, easily accessible and effective. The introduction of the PECS system and the repetition of the pGMT steps using this practical approach significantly contributed to the successful application of the pGMT steps to real-world tasks. Restructuring the programme by shortening and merging the modules allowed for more emphasis on the important concepts that needed to be trained. In turn, this allowed for flexibility in terms of the time spent with each child and the individual tailoring of the pGMT to each child's real world experiences within their home and school life. Further, a crucial factor that contributed to the feasibility of

the pGMT intervention was its implementation at schools. I conducted the pGMT intervention with all the participants at their respective schools, except for AK. This ensured consistency and stability for the participants each week and eliminated the possibility of participants withdrawing from the study during the intervention. Furthermore, because the intervention was conducted at the schools, this facilitated regular contact between teachers and staff involved. Lastly, this setup was more convenient for the parents as they did not have to transport their children to their sessions outside of regular school hours.

Limitations and Future Directions

The primary limitation of this study was its small sample size, which has implications for the generalizability of the results. However, given the nature and requirements for the completion of the study, it was very intensive and this created time constraints. Hence, the original 12-week plan for the intervention was restructured to 10 weeks. In retrospect, however, this reduction from 12 to 10 weeks worked better given the level of commitment that the pGMT intervention required from parents and teachers.

It was also extremely challenging to find suitable children who had sustained TBIs from the RXH database due to outdated contact details of the patients and in terms of meeting the inclusion criteria. Future research endeavors should implement the South African pGMT to larger sample sizes and strive to apply the intervention to an array of pathologies.

A second limitation of the study was the absence of a TBI control group. Although the inclusion of a control group was originally intended for this study, we had to continue with the revised pGMT intervention without this group due to factors related to the inaccessibility of the TBI sample as well as time constraints. Among these factors were the inclusion criteria of the sample, such as language and age, which many TBI children that I had access to, did not meet. Furthermore, I would have had to match these participants to my intervention group. The use of a control group would have proved beneficial to facilitate better comparison between TBI groups. Despite the challenges with the sample and time constraints that I had encountered, I acknowledge the importance of a control group and aim to include this group in any future research that I endeavor to undertake.

A third limitation of the study is related to the challenges of matching participants. Ideally, participants should be matched on a variety of factors including home language and general intellectual functioning, in order to make sound comparisons. However, with IQ measures, this was only obtained after the selection of participants due to time constraints and limited access to participants. In future studies, where time constraints and accessibility to a sample would not be hindering factors, participants should be screened and their IQ tested

first and then matched accordingly. Furthermore, the fact that these scores are based on norms developed in the United States of America should be taken into account as the use of Westernized norms in non-Westernized countries lends itself to the possibility of underestimating true levels of general intellectual functioning (Ferrett, 2011; Foxcroft, 1997).

Regarding home language, there was only one mother tongue English- speaker in the sample, even though all participants were proficient in English. Since most neuropsychological test batteries are in English, this is a limitation given the mediating role that language plays in a child's performance on cognitive testing, especially if no norms exist for that language (Anderson, 2001; Casas, et al., 2012). Future studies should endeavor to translate and adapt cognitive and behavioural measures into the mother tongue language of the participants to prevent the implications of this limitation.

Another limitation of the study related to the possibility of unreliable reporting in self-report parent and teacher behavioural questionnaires. Using self-report measures can have an impact on the validity of the information being reported on (Huang, Liao, & Chang, 1998; Van de Mortel, 2008). Some of the implications of using self-report measures include social desirability biases, distorted and inconsistent reports of mood and behaviour as well as difficulties with incomplete data as a consequence of lack of responses included in the questionnaire (Holden & Troister, 2009; Hunsley, 2009; Williamson, 2007; Van de Mortel, 2008). However, I used these measures due to their psychometric properties as well as their consistent use in cognitive literature. In follow up studies, I will aim to complete the questionnaires with the parents in an interview-type setting instead of providing the questionnaires to them to complete independently.

Pre- and post-testing using the same measures results in learning and may have rendered participants susceptible to practice effects (Beglinger, Gaydos, Tangphao- Daniels et al., 2005). Future studies should endeavor to account for practice effects by making use of alternative forms of neuropsychological measures as far as possible or including a no intervention control group.

Another limitation, related to test measures is academic performance. No formal measures of pre and post intervention academic performance were employed for participants of the study. The CBCL was used as an indication of the level of performance using categories such as: Failing, Below Average, Average and Above Average but there were no formal scores. Future studies should include a formal measure of academic performance.

A final limitation of the study was that the pGMT was only translated using forward translations given time and resource constraints. Future studies should ensure that both

forward and back translations as well as an authentication process are done when conducting a study of this nature.

Conclusion

The main aims of this study were two-fold. Firstly, to adapt the pGMT, a cognitive rehabilitation programme for South African children and secondly, to investigate the efficacy of the newly adapted pGMT with children who have sustained a TBI. There are inadequate neuropsychological rehabilitation facilities in South Africa. Hence, the need to develop and implement cognitive rehabilitation tools for the remediation of executive deficits for South African children.

The study included a small sample of both healthy children and those who had sustained TBIs. Regarding the Healthy Control Group, there were positive but inconsistent changes from pre- to post-intervention on a number of attention and executive function measures across all participants and for two of the three participants on the behavioural measures. Regarding the TBI group, there were also positive but inconsistent changes from pre- to post-intervention on a number of attention and executive function measures and on at least one behavioural index for each participant. Parental and teacher anecdotal reports of positive real world behaviour change were limited to one participant. Hence the results were mixed in the end.

The varying levels of success that this study has illustrated tentatively suggest that the revised pGMT could be an efficacious cognitive rehabilitation tool for the remediation of executive dysfunction in children who have sustained TBIs in South Africa. However, given the noted limitations such as the small sample size and uncontrolled confounding effects (e.g., practice or maturation effects) greater evidence is required from future, larger studies. More importantly, regarding these limitations, future studies should endeavour to include a non-intervention TBI control group. The most enduring aspect of the revised pGMT lies in its flexibility in tailoring each child's deficits and real world experiences to the intervention. This aspect, together with findings of suggested efficacy for the translated and adapted pGMT programme, renders the revised pGMT intervention a potentially unique cognitive rehabilitation tool to be used in the South African context.

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APPENDIX A
ETHICAL APPROVAL FOR THE STUDY FROM THE UNIVERSITY OF CAPE TOWN'S FACULTY OF HEALTH SCIENCES

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/research/humanethics/forms

14 April 2014

HREC REF: 662/2013

Ms L Schrieff
Psychology
Humanities Graduate School Building
Upper Campus

Dear Ms Schrieff

PROJECT TITLE: REHABILITATION OF EXECUTIVE FUNCTIONING FOLLOWING PAEDIATRIC TRAUMATIC BRAIN INJURY: EVALUATING A GOAL MANAGEMENT TRAINING INTERVENTION

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

- Please confirm that the two masters students assisting with data collection will submit independent protocols to the HREC for review.

Approval is granted for one year until the 30th April 2015

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC reference no in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

HREC 662/2013

APPENDIX B
PERMISSION TO ACCESS RXH MEDICAL FOLDERS

Western Cape Government
Health

DR T A BLAKE
MANAGER MEDICAL SERVICES
thomas.blake@westerncape.gov.za
0216585788/0828225553
23 April 2014

MS A MAHOMED

NEUROPSYCHOLOGY

UCT

Dear Ms Mahomed,

RE: RESEARCH: REHABILITATION OF EXECUTIVE FUNCTIONING FOLLOWING A PAEDIATRIC TRAUMATIC BRAIN INJURY

Approval is hereby granted for you to commence this research

.

Yours faithfully,

Tommy Blake

DR T A BLAKE

CHAIRPERSON

HOSPITAL RESEARCH REVIEW COMMITTEE

APPENDIX C
PERMISSION TO ACCESS SCHOOLS FROM THE WESTERN CAPE EDUCATION DEPARTMENT

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard2@pgwc.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20140203-24053
ENQUIRIES: Dr A T Wyngaard

Ms Aqeela Noor Mahomed
Faculty of Humanaties / Psychology
UCT

Dear Ms Aqeela Noor Mahomed

RESEARCH PROPOSAL: REHABILITATION OF EXECUTIVE FUNCTIONING FOLLOWING PEDIATRIC TRAUMATIC BRAIN INJURY: EVALUATING A GOAL MANAGEMENT TRAINING INTERVENTION

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **03 February 2014 till 29 August 2014**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 03 February 2014

APPENDIX D
MEASURES

I measured behaviour and affect using the self-reported Behaviour Rating Inventory of Executive Function (BRIEF; Malloy & Grace, 2005), the Child Behaviour Checklist (CBCL; Achenbach, 2001) questionnaires, and adaptive behaviour using the Vineland Adaptive Behaviour Scales (*Vineland-II*; Sparrow, Cicchetti & Balla, 2005). Parent/teacher versions of all these measures were administered accordingly. Specific GMT questionnaires were administered to the child, teacher and parent/s before the intervention commenced (see Appendices K and L). I used a demographic questionnaire and asset index (Myer et al., 2008) as measures of SES (see Appendix J).

Glasgow Coma Scale (GCS)

I used the *GCS* scores (Teasdale & Jennet, 1974) from the TBI participants' medical notes to indicate the severity of injury, as mild, moderate and severe TBI. As noted earlier, a GCS of 13-15 is considered a mild TBI, a GCS of 9-12 is a moderate TBI, and a GCS of 3-8 is a severe TBI.

Socioeconomic Status (SES)

SES was approximated by means of a demographic questionnaire that includes an asset index (Appendix J). In the demographic questionnaire, SES is estimated through information about the characteristics of the participants' residence, the neighbourhood in which they reside, the parents' occupation, level of income, and education level obtained. The asset index includes measures of material resources present in the household (with examples including running water, a flush toilet, a washing machine, a television, and a domestic worker) and the financial resources available to the family (e.g., bank accounts, retail accounts, and ATM or credit cards) (Myer et al., 2008).

General Intellectual Functioning

I used the Wechsler Abbreviated Scale of Intelligence (*WASI*; Wechsler, 1999) to measure general intellectual functioning. The *WASI* has been standardized and normed for populations in the United States and is suitable for ages 6-89 years. The *WASI* contains four subtests: Vocabulary, Similarities, Block design, and Matrix reasoning, all of which was administered in this study.

Of the four subtests, the Block design and Matrix reasoning subtests were used to measure participants' Performance IQ (PIQ), and the Vocabulary and Similarities subtests to measure participants' Verbal IQ (VIQ). Cumulatively, a Full Scale IQ (FSIQ) was then obtained (Wechsler, 1999).

PIQ subtests. The *Block Design* subtest is used to measure perceptual organization, visual-motor coordination, visualization of spatial ability and the ability of the individual to conceptualize the abstract. The participant is required to replicate, within a time limit, modeled or printed 2D geometric patterns using red and white coloured cubes. This subtest contains 13 items with reliability coefficients ranging between .86 and .93.

The *Matrix Reasoning* PIQ subtest is used to measure non-verbal fluid reasoning. Here the participant is required to identify one of five possible missing pieces in order to complete a series of incomplete gridded patterns. This test contains 35 items with reliability coefficients ranging between .86 and .96.

VIQ subtests. The *Similarities* subtest is used to measure abstract verbal reasoning. This task involves the presentation of two words that represent common objects or concepts, requiring a description of how they are similar. This test contains 26 items with reliability coefficients ranging between .81 and .91.

The *Vocabulary* subtest is used to measure the degree to which one has learned and can express vocabulary. This subtest is considered a strong correlate of general intellectual ability (*g;* Wechsler, 1999). In this test the participant is required to name the picture items presented in a stimulus book. For verbal items, the participant is required define the words that the examiner reads aloud. This subtest contains 42 progressively challenging items.

Psychometric properties. In terms of validity, the content validity of the *WASI* was established by considering similar items of subtests that correspond to subtests of other Wechsler batteries such as the *WISC-III*. The Vocabulary, Block design and Similarities subtests are included in both the *WASI* and the *WISC-III* and demonstrate significant correlations of .72, .87, and .69 respectively. The *FSIQ, PIQ* and *VIQ* correlation coefficients for both batteries are .87, .76 and .82 respectively. Thus, it can be assumed that the IQ scales and subtests of the above-mentioned batteries measure similar constructs (Wechsler, 1999).

Furthermore, construct validity is determined by factor analyses and the correlations between IQ scores and other subtests. The *Vocabulary* and *Similarities* subtests as well as the Matrix Reasoning subtests all demonstrate significant correlations of between .55 and .85 and .36 to .70 respectively. The *WASI* comprises of a two-factor model due to the battery consisting of two verbal and two performance subtests. This is appropriate for the normative samples of both adults and children aged 17-89 years and 6-16 years respectively (Wechsler, 1999).

South African / cross cultural applications. The *WASI* has been used in both published and unpublished research work using South African populations (e.g., Ferret,

Carey, Thomas, Tapert, & Fein, 2010; Hoare et al., 2012, Malgas, 2010; Thornton et al., 2008; Slack, 2009; Van Wyhe, 2009).

Working Memory and Attention

The *CMS* (Cohen, 1997) is an instrument that has been standardized and normed for American populations and is suitable for both children and adolescents aged 5 to 16 years.

I used the *CMS Numbers* subtest to measure attention/concentration and working memory; which corresponds with the Attentional Control and Cognitive Flexibility domains of Anderson's (2002) EF model. In the first part that is used to measure attention/concentration, the participant is required to repeat a sequence of digits in the same order as read by the examiner (*Numbers Forward*). In the second part that is used to measure working memory, the participant is required to repeat the sequence of digits as read by the examiner in reverse order (*Numbers Backward*).

Psychometric properties. Reliability coefficients for Numbers Forward range from .71 to .83 and for the Numbers Backward component of the subtest, from .66 to .82 (Cohen, 1997). Structure and content validity ranged from .06 to .96 for all age groups (Cohen, 1997).

South African / cross cultural applications. The CMS battery is increasingly being used in clinical settings in South Africa as well as pediatric research (Corbett, 2008; Ferrett et al., 2010; Ferrett, 2011; Malgas, 2010; Van de Merwe, 2009). Pediatric TBI research abroad, however, has documented the use of the CMS more frequently (Cash, 2007; Hawley, 2004; Hawley, 2005; Schroder, 2005; Pivonka-Jones et al., 2014; Vella et al., 2007).

Executive Function

The domain of focus, EF, was assessed using 5 instruments specifically designed to assess the four aspects of EF as per Anderson's (2002) model. These tests include the *Children's Color Trails Test* (*CCTT;* D'Elia, Satz, Uchiyama, & White, 1996), the *Inhibition* subtest of the *NEPSY-II* (Korkman, Kirk & Kemp, 2007) and three subtests from the *Delis-Kaplan Executive Function System* (*DKEFS;* Delis, Kaplan & Kramer, 2001) namely, the *Tower, Verbal Fluency,* and *Design Fluency* subtests.

Children's Color Trails Test (CCTT)

The *CCTT* is an instrument that has been standardized and normed for American populations and is suitable for both children and adolescents aged 8 to 16 years.

I used both the conditions of the *CCTT* to measure sequencing, flexibility and switching, which correspond with the Goal Setting and Cognitive Flexibility domains of Anderson's (2002) EF model. In the first condition, the participant is asked to draw lines between a sequence of numbers scattered around a stimulus sheet (i.e., from 1 to 2, 2 to 3,

and so forth). The second condition follows the same format; however, in this instance, two series of numbers are presented on the stimulus sheet - each series in a different colour. Here the participant is required to join the numbers with alternate colours (i.e., pink 1 to yellow 2, yellow 2 to pink 3, and so forth).

Psychometric Properties. Due to the nature of the *CCTT* i.e. that outcome is based on speed, alternative forms of reliability and temporal stability serve as estimates of consistency for the measure (Llorente et al., 2003). Condition 1 of the *CCTT (CCTT1)* demonstrated a high correlation of .85 on alternate forms (K and X). Similarly, condition 2 of the (*CCTT2)* revealed a correlation of .90, which is also in the high range for alternate forms (K and X) (Llorente et al., 2003). Temporal stability or test-retest reliability is computed through examination of the correlation coefficient obtained at two points in time. This includes either pre- and post-testing or later administration of the test to the same group of participants. For *CCTT1,* test-retest reliability coefficients were .46, .45 and .68 at 0-2 months, 2-4 months and 0-4 months respectively. For *CCTT2,* retest reliability coefficients were .66, .56 and .60 at 0-2 months, 2-4 months and 0-4 months respectively.

Concurrent, factorial and construct validity was established for both *CCTT1* and *CCTT2.* In addition, discriminant validity was also established for both conditions of the *CCTT,* however, *CCTT2* emerged more sensitive to distinguishing between population groups than *CCTT1* (Llorente et al., 2003).

South African / cross cultural applications. The use of the *CCTT* has been documented in South African research (Corbett, 2008; Corbett et al., 2009; Cuzen et al., 2015; Ferrett, et al., 2010; Ferrett, 2011), as well as research abroad (Chan et al., 2012; Lima, Azoni & Ciasca, 2011; Oberg & Lukomski, 2015).

Delis-Kaplan Executive Function System (DKEFS)

The *DKEFS* is an assessment battery that has been standardized and normed for American populations and is suitable for both children and adults aged 8 to 89 years. I used 3 subtests of the *DKEFS* to assess specific domains within Anderson's (2002) EF model.

First, I used the *DKEFS Tower* to measure problem- solving and planning skills; which correspond to the Goal Setting domain in Anderson's (2002) EF model. The test stimuli include one board with pegs and a 5 blue discs. The examiner arranges the discs on the pegs of the board and presents it to the participant, who must then reproduce the arrangement in as few moves as possible from a starting position. Each problem-solving task increases in the level of complexity and has a time limit of increasing length ranging from 30 seconds to 4 minutes. In addition, participants are required to adhere to two specific rules:

that only one of discs can be moved at a time, and that larger discs may not be placed on top of smaller discs.

Second, I used the *DKEFS Verbal Fluency* test to measure supervisory processes, verbal retrieval and recall, self-monitoring and inhibition; skills which correspond with the Attentional Control and Information Processing domains in Anderson's (2002) EF model. The *Verbal Fluency* task requires the participant to generate as many words as possible, within a specified category, in a given time limit. The test comprises of three tasks; a phonemic fluency task (where the participant is required to generate words beginning with a specified letter), the semantic fluency task (where the participant is required to generate words within a specific category, for example, animals) and the switching task in which participants are required to switch between stimuli such as furniture and fruit.

Lastly, I used the *DKEFS Design Fluency* subtest to measure behavioural generativity; which corresponds to the Information Processing domain of Anderson's (2002) EF model. The test requires the participant to construct unique designs by connecting up to five dots using four straight lines (presented in either a symmetric or an asymmetric array). The participant must create as many different designs as possible within a time limit of 60 seconds.

Psychometric Properties. Internal consistency, test-retest reliability and validity have been established for each of the *DKEFS* subtests (Delis et al., 2001). In general, test-retest coefficients were in the moderate range with great variability among all subtests. Internal consistency scores for some subtests were low, with the exception of *Verbal Fluency*, which was in the range of .32 to .90 (Shunk, Davis & Dean, 2006). Of interest, in a study done by Schmidt (2003), it was demonstrated that only 17% of the reliability coefficients of the *DKEFS* subtests were above .80. Although developers of the DKEFS have been criticized for this, researchers posited that variable performances were expected due to the cognitive processes that are mediated by executive functions (Delis et al., 2001; Shunk, Davis & Dean, 2006). In addition, validity was assumed for many of the subtests due to its emergence from already established and valid measures (Shunk, Davis & Dean, 2006).

South African / cross cultural applications. The use of the *Tower, Verbal fluency* and *Design Fluency* tasks have been documented in both published and unpublished work and has been used with various pediatric samples including TBI (Baufeldt, 2009; Cava, 2008; Corbett, 2011; Dennis et al., 2015; Luu et al., 2011; O'Hara & Holmbeck, 2013; Parrish et al., 2007; Pulsipher et al., 2009; Wodka et al., 2008).

NEPSY- II

The *NEPSY-II* is an instrument that has been standardized and normed for American populations and is suitable for both children and adolescents aged 5 to 16 years.

I used the *Inhibition* subtest from the *NEPSY-II* to measure the inhibition of automatic responses and switching between responses, which correspond to the Attentional Control and Cognitive Flexibility domains in Anderson's (2002) EF model. For the *Naming* condition participants are required to simply name the shapes presented to them. For the *Inhibition* condition, participants are asked to give an alternate response to the shapes being presented to them. For example, on the stimulus sheet, which has shapes and circles, participants are required to say "circle" when they see a square and "square" when they see a circle. Thereafter, for the *Switching* condition, participants are required to switch between response types. For example, when participants see black circles, they are required to name its correct shape i.e. "circle", but when they see a white shape- regardless of whether it is a circle or a square- they are required to say the other shapes name. Both conditions are applied to two sets of black and white items namely, shapes (i.e. circles and squares only) and arrows (up and down only). Conditions have a time limit of either 180 seconds (*Naming*) or 240 seconds (*Inhibition* and *Switching*).

Psychometric Properties. Developers of the *NEPSY-II* demonstrated the stability of the battery across time and age groups (coefficients between .62 and .89). Both content and construct validity for this battery was illustrated by studies done on clinical samples (Korkman et al., 2007).

South African / cross cultural applications. The *NEPSY* as well as the *NEPSY-II* has been used in both published and unpublished South African research (Hoare et al., 2012; Slack, 2009; Schoeman, 2011). Furthermore, the *NEPSY* has been utilized in a published African study on a Zambian sample (see Mulenga, Ahonan & Aro, 2001).

Behavioural and Affective Questionnaires

Behaviour Rating Inventory of Executive Function (BRIEF)

I used the *BRIEF* (Gioia, Isquith, Guy & Kenworthy, 2000) to assess behavioural aspects of executive function. It is suitable for children aged 5 to 18 years. The *BRIEF* is also designed for administration with both parents and teachers, and was used to assess the participants' level of executive functioning, in the home and at school (Malloy & Grace, 2005). The questionnaire comprises 86 items of non-overlapping clinical scales that produce two indexes consisting of several subscales. The Behavioral Regulation Index includes the Inhibit, Shift, and Emotional Control subscales, while the Metacognition Index includes the

Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor subscales. A Global Executive Composite score, incorporating all scales, is recommended for use when there is little variability in subscales.

Psychometric properties. The *BRIEF* is reported to have a high internal consistency (from .80 to 98) and test-retest reliability (from .72 to .92), while low inter-rater reliability has been attributed to expected behavioural differences across research settings (Gioia et al., 2000; Malloy & Grace, 2005).

South African / cross cultural applications. The *BRIEF* has been used among South African samples in unpublished research (Corbett 2008; Gelderblom, 2007) and is being increasingly used in clinical settings.

Child Behaviour Checklist (CBCL)

The *CBCL* (*CBCL*; Achenbach, 2001) is a set of questionnaires that consist of youth self- report, parent and teacher versions of the instrument. The parent and teacher forms require that the parent/guardian and teacher rate the child's behavioural competencies and problematic behaviours, respectively. This measure is suitable for children and adolescents aged 6 to 18 years. The *CBCL* comprises two subsections, including 20 items related to competence, and 120 items pertaining to behavioural and emotional problems. Each item, describing a particular behaviour, is scored on a Likert-type scale consisting of three possible responses: "very often true", "somewhat or sometimes true", or "never true". The *CBCL* generates three major behaviour scales: (1) Internalizing scales, measuring depression/withdrawal, anxiety and other somatic behaviours; (2) Externalizing scales, that identify the presence of cruel, aggressive or delinquent behaviours; and (3) Mixed scales, categorizing any other problematic behaviours, such as immaturity or hyperactivity (Achenbach & Rescorla, 2001).

Psychometric properties. The *CBCL* is reported to have well-established psychometric properties (test-retest reliability= .95 to 1.00; inter-rater coefficients= .93 to .96; internal consistency= .78 to .97), and is reliable and widely used.

South African / cross cultural applications. There are a growing number of published and unpublished research studies using the *CBCL* in South Africa (e.g., Cheesman, 2011; Cluver, Gardner, & Operario, 2007; Fischer, 2008; Shields, Nadasen, & Pierce, 2008). The *CBCL* has been used in an African (Ghanaian) sample (see Appoh, 2004).

Vineland Adaptive Behaviour Scales II (VABS)

The *Vineland-II* (VABS; Sparrow, Cicchetti & Balla, 2005) is a measure of personal and social skills needed for everyday living. The *VABS-II* measures behaviour in four

domains: communication, daily living skills, socialization, and motor skills. It also includes a Maladaptive Behaviour Index. The *VABS-II* is designed to measure adaptive behaviour in specific population groups, including TBI samples, and is suitable for individuals from birth to 90 years of age. There are teacher/ parent versions of the instrument to be used for individuals aged 3 to 21 years.

Psychometric properties. Across domains, the average reliability within groups ranges from .88 to .92 with the exception of 14 to 21 years in which the average reliability is .76. Furthermore, reliability coefficients for the adaptive behaviour composite is greater than .90 across age groups with the exception of the adolescent group (r = .83) (Sparrow, Cicchetti & Balla, 2005).

Regarding reliability coefficients for subdomains, most values exceed .85. Much like average domain coefficients, the average reliability across subdomains were .85 with the exception of the 14 to 21 year old age group. This lower reliability value was consistent with a lower internal consistency in the same age group Furthermore, construct validity has been established due to higher correlations on subdomains than between domains (Sparrow, Cicchetti & Balla, 2005).

South African / cross cultural applications. The *VABS-II* has been used in minimal published research with South African samples (see Ebersohn, Eloff, Finestone, Van Dullemen, Sikkema et al., 2012) as well as published African samples (e.g., Carter et al., 2005; Tan, Reich, Hart, Thuma, & Grigorenko, 2012). Although, the *VABS-II* has been used in pediatric rehabilitation studies abroad (see Dawson et al., 2010; Vos et al., 2013), there has been no use of the *VABS-II* among the already limited South African rehabilitation studies.

Pre-GMT Questionnaire

A pre-GMT questionnaire (supplied by the test developer) was administered to the participant. This questionnaire assessed the participants' experience of executive dysfunction in everyday life. The same questionnaire was also administered to a parent and the child's teacher in order to acquire collateral information (Appendices K and L).

The pGMT intervention

The intervention was adapted for children from the original adult GMT Programme (Robertson, Levine, & Manly, 2005). In the pilot study by Corbett (2008), adaptations to the intervention were made to ensure that children could relate to the examples presented in the form of short stories, engage with the exercises and understand the language of the content presented. The researcher attempted to maintain the integrity of the concepts taught within the adult version of the programme as far as possible. To this end, Levine provided feedback and

approval for all changes made (personal communication, June 16, 2008). A summary of Corbett's (2008) adaptations can be found in Appendix F.

In the 2008 adaptation the 7-module programme was condensed into 5 modules due to time constraints. The 5-module format was reported to be too intensive and rushed due to time constraints. Thus, in the current study, I planned to administer the programme in the original 7 sessions (i.e. before the adaptation process carried out in the current study). Each of the 7 modules discusses a component of executive dysfunction, includes practical exercises to illustrate the components identified, and concludes with homework assignments that are to be recorded in a workbook.

The components addressed in each module are briefly summarized as follows. Module 1 provides an overview of the programme, and introduces concepts such as 'goals, slips and absentmindedness'. These concepts were used to make patients aware of absent-minded errors in everyday behaviour in the Levine et al (2011) study. Module 2 presents the concept of 'automatic pilot' and how to interrupt this process. 'Automatic pilot' refers to inappropriate expressions of habit and the process is interrupted by the "STOP!" concept. Module 3 introduces the concept of the 'mental blackboard'. 'Mental blackboard' alludes to the patient's working memory and is constantly monitored by stopping due to the effects of distraction (Levine et al., 2011). Module 4 focuses on identifying and remembering goals at the present time (i.e. present-mindedness). Module 5 deals with the notions of conflicting goals and indecision. Levine et al (2011) conducted module 5 in the context of competing goals and the use of to- do lists. Module 6 teaches the splitting of tasks into sub-goals. Module 7 concludes the programme with discussion surrounding goal checking and how to make stopping [automatic pilot] a habit.

All modules are presented as MS PowerPoint slideshows. The sessions are designed to be interactive discussions rather than lessons, because the programme was applied to various daily activities of each participant. The workbook serves both to facilitate expression of the participants' understanding of the programme, and is a practical way for the child to remember the content presented in each module.

APPENDIX E
ACTUAL ADAPTATIONS MADE TO THE PGMT PROGRAMME

Combining the previous modules 1 and 2: New module 1

The revised module one had two parts. Part 1 began with the introduction of goals and the prospective memory task from the previous version of the programme was retained. Further, since the STOP man is crucial to the programme, we decided to introduce this figure at the beginning of the programme. However, we did not refer to him as the STOP man, instead he was introduced to the children as Mr. STOP and THINK. The exercises were retained but only the simpler ones were included in this module (i.e. the simpler versions of card sorting, spot the differences, identify and circle the names of colours in a piece of text, and the maze, described above). As per the suggestion by Mr. Moss (noted earlier), the exercises were kept constant but increased in complexity later in the programme instead of using unrelated activities of increased difficulty in the same module. Additionally, I changed the reward system- the points system was replaced with a reward chart. On completion of the activities, the children were rewarded with sweets of their choice (with parental permission) and the activities that they had completed were put up on their reward chart. The story on forgetting your goals was retained but simplified and adapted to the South African context. For example, the original story stated locations such as America and a trip to the United States. We changed the story to include local South African locations such as Johannesburg and the trip was to a popular tourist destination in Cape Town i.e. Table Mountain. The pictures were changed accordingly to include a picture of a cable car on Table Mountain. Furthermore, the Mental Notepad was renamed the Brain Notepad as the word “mental” had a negative connotation according to one of the professionals.

Part 2 was conducted in the same session with all the children and designed to introduce the OOPS mistakes concept. The story used in the original module 1 was retained, but shortened and simplified. Furthermore, the story was based on a Judo competition. My supervisor and I decided to change this to a Karate competition instead. The OOPS mistakes that they relayed to me at this stage from their real life experiences, was applied to the concepts throughout the programme as much as possible. For example, an OOPS mistake that was common among all the children included taking the incorrect books to school on a particular day. This example was frequently used through the modules and applied to concepts such as “look at your notepad”.

These modules were combined to form *Module 1* of the revised pGMT.

Combining the previous modules 3 and 4: New module 2

The revised module two had two parts. Part 1 included most of module 3 and remained similar to the original module with the exception of the simplification of the language (e.g. “verify” was replaced with “check”; “what should you think about after the meeting?” was replaced with “what should you think about after the session with me today?” and “like you finished the mission of finding the circles” was changed to “when you finish finding the circles in your head”). Repetitive slides were also removed. The prospective memory tasks and recap sections were retained as per the original modules. Additionally, the brain notepad, as we renamed it, and the story in module 3 was preserved and simplified. For example, one of the sentences in the story read: “At school, the librarian asks her for the 10th time to bring back a book she borrowed and Cathy writes it on
a piece of paper but later during break time, she uses
the paper when her friends try to make aeroplanes in paper”. The sentence was changed to: “Cathy needs to give back a library book tomorrow, so she writes it down on a piece of paper. When its break time, her friends take that paper and make an aeroplane with it”.

Part 2 was conducted in the same session as part 1. Part 2 of the new module 2 was based on module 4 and was renamed “Looking at our brain notepad”. The original story from module 4 was retained, however, we changed the Trojan horse aspect of the story to a narrative about Nelson Mandela. Furthermore, the automatic pilot concept was simplified and additional, colourful and basic pictures were included to demonstrate what habits and routines were for the children.

These modules were combined to form *Module 2* of the revised pGMT.

Combining the previous modules 5 and 6 (first half): New module 3

The original concepts of module 5 were retained to form part 1 of the new module 3. However, the application of each pGMT step to the story was presented clearly on a separate slide. Speech bubbles were included to help the children grasp the concepts better. The story used to teach the indecision aspect of the module was modified to the South African context. For example, “football match” was replaced with “soccer game”.

For part 2 of module 3, we modified the title of module 6 to “I write down my steps!” from “I write the steps”. We started off part 2 of the session with explaining what a “step” is. The original module began with a map to illustrate the concepts of steps. Prof. Dawes suggested that we use the idea of conventional steps instead. As per his suggestion, we used conventional steps and applied this idea to the stages of making a sandwich (which participants described rather than actually made). Thereafter, the 5-pGMT steps were used to

apply the idea of making a sandwich figuratively. The sub-steps aspects of the module as well as the story sums were removed due to the complexity of the concepts. The final aspect of the module was to encourage a discussion around when the steps can be used for difficult things. The children were required to provide examples of their own. As they did this, we applied the steps to their examples in an attempt to further generalize the pGMT steps to their real world situations.

These modules were combined to form *Module 3* of the revised pGMT.

Combining the previous modules 6 (second half) and 7: New module 4

The second half of Module 6 was renamed "I write down my steps for a birthday party!" and the main idea of organizing a birthday party using the pGMT steps was retained. Module 7 was renamed "Let's Check!" and we used the word "check" instead of "verify" throughout the programme as part of the language simplification process. We started off the module with training the children to use the checking concept to detect OOPS mistakes. Thereafter, we continued to use all the pGMT steps in the new module to train the children on how to help the character in the story check what his goals were. Furthermore, we removed the "describe the drawing" task and included the organization of a birthday concept to help the children practice the checking concept at each stage of planning the party. Each step was clearly outlined and emphasized with appropriate pictures and headings.

These modules were combined to form *Module 4* of the revised pGMT.

In the remaining 4 sessions, I implemented the PECS system. Using the laminated cards of the 5-pGMT steps, the children were required to apply the theoretical concepts already taught, to the activities within these sessions i.e. modules 5 to 9. In general, for each instruction within an activity, the child was required to first place the correct card on the PECS board before they could carry out the appropriate step.

The new module 5 using PECS

The new module 5 was based on the concepts covered in the new module 1. All activities were repeated, however, the activities were more complex and the pGMT steps were applied to each activity. The module consisted of 5 activities i.e. a card game, joining the points/numbers, a word grid; spot the differences, and identifying a specific sign amongst a pool of similar signs. On completion of the activities, a reward chart was used and the children were rewarded with a lollipop and a juice.

The new module 6 using PECS

The new module 6 was based on the concepts covered in the new module 2. The stories and the 'routines' concept were repeated and the pGMT steps were applied to each

activity. More specifically, the children were required to apply the steps to the stories. For example, for the first story about the girl who had multiple tasks to do for the day, the children were required to tell me how the girl would use the pGMT steps i.e. what the character should do first (STOP and THINK), what her goal is, they were required to write down her plan and check 'her' plan. Similarly, for the training of the habits/routines aspect of the module, the children were required to place the laminated cards in order of their morning routines while using the pGMT steps. However, there were two new tasks that were added to the activity to demonstrate how their routines could be disrupted and how they would use the steps to re-plan their morning.

The new module 7 using PECS

The new module 7 was based on the concepts covered in the new module 3. As with the previous module, the children were required to help the characters in the stories use the pGMT steps. For example, they had to help a character, Paul, feel less stressed by using the pGMT steps to help him get organized before the weekend. Similarly, for the next story, the children were required to help the character i.e. Alex, to make a decision regarding his soccer clothes (i.e. to either go home and fetch his own clothes because he was running late or walk to his friend's house, which is nearby, and borrow his friend's clothes) using the pGMT steps so that he does not miss his soccer match and is able to make a decision faster. Lastly, we made a sandwich together using the pGMT steps. For example, while making a sandwich, this was the process followed: 1). Place the STOP and THINK card first onto the PECS board as they begin to formulate ideas, 2). Then, place "say your goal" card and tell me what their goals were i.e. "to make a sandwich". 3). Place "Write your plan" card before writing down their steps to making their sandwich in their paper notepad. 4). Place "do it!" card and then begin to make the sandwich, following their plan as outlined in their paper notepad. 5). Place "lets check it" card before I go through their plans with them (checking that they have followed it correctly), as well as checking for OOPS mistakes and rectifying them together.

The new module 8 using PECS

Module 8 was based on the concepts covered in the new module 4. As previously stated, the problem solving activity in the original programme i.e. story sums involving money, was too complex for the children. Therefore, I included a simpler problem solving activity that involved shopping for various clothing and food items. The items were printed out on laminated cards and priced accordingly. Using the pGMT steps, the children had to solve some story sums that still involved money, however these amounts were lower and their story sums progressed from basic to more complex. For example, they had to place their first

STOP and THINK card while doing so, they then had to say their goal for each problem i.e. what they needed to solve and so forth. In the final section of the module, the children were required to plan a pGMT party for the following week. Once again, the children were given a series of laminated cards and they were required to use the pGMT steps to plan the party. Some of the aspects that they were required to consider while planning the party were: 1) Where the party would be, 2) who would be invited to the party, and 3) what foodstuff each person would bring.

The new module 9 using PECS

Module 9 was designed as a recap of the entire programme. We first revised when to use Mr. STOP and THINK and how we can make less OOPS mistakes. Thereafter, we revised using the pGMT steps to look at their brain notepad, to "check" if they had followed the instructions correctly between each activity/ task, to "check" that they had followed their plans and lastly, to "check" what they had written on their paper notepads.

Additional materials included in the programme

Additional materials were used in the programme to facilitate the practicality of the pGMT. With the exception of the PECS-related materials i.e. the PECS board and laminated cards (used for the practical modules i.e. modules 5-9 and each of the pGMT steps), additional laminated cards were made for each activity within each of the modules. Furthermore, for the "write your plan" and "check" steps, a paper notepad was given to each child to apply these steps practically. The notepad also served as a valuable resource for when the children needed reminders of what their plans were etc., they could refer to their notepad as intended with the pGMT. In order for each child to make the sandwich in module 7, I included plastic knives, paper plates, bread, butter, cheese, tomato slices and a packet of Simba chips.

APPENDIX F
SUMMARY OF ADAPTATIONS MADE IN THE PILOT STUDY IN 2008

Where changes were made to the text, pictures reflecting the adapted example replaced the original drawings. These are in the form of photos or cartoons. Any changes made to the PowerPoint presentations and workbooks are maintained throughout the modules.

Changes to the PowerPoint presentations:

Module 1:

1. The slide of introductions was removed as the intervention was administered individually to the child and parent, instead of in a group as with adults.
2. Professor Norbert Fertwinkle was changed to Teacher Fertwinkle and changed to a classroom scenario. Teacher Fertwinkle was distracted by the plants needing watering and a letter from a friend while he was tiding up the class for the children's arrival.
3. The example of consequences of slips was changed from the pilot example to that of a child absentmindedly riding his bicycle to school, not watching for the puddle he had been warned of, rides through the puddle and gets all his clothes wet.
4. The monitoring of slips assignment example (loosing keys in the fridge) was changed to a girl losing her school lunch box because she put it in the wrong bag.

Module 2

1. The card dealing task was adapted for one participant (no partner swapping).
2. The example of Roy Regals was changed to a Rugby match (similar to American Football) due to the South African context.
3. The automatic pilot error example was changed from a man misplacing his Boss's book in his briefcase to that of a girl misplacing her friend's sticker book in her school bag.

Module 3

1. The Gus and Mertyl example was changed to Gus and Kelly walking back from the shops, Kelly telling a story of drawing a dinosaur in class so distracting Gus from dropping off a loaf of bread and his Grandmother's house.

Module 4

1. The example of Gilbert Rushdale getting a call about a car was changed to Gavin a boy being distracted by a TV game so making him late for a soccer game.
2. The phrase "get the files to the printer by 5pm" was changed to getting eggs from the shops by 5pm.

Module 5

1. The goal conflict example of Nolan was changed to the conflict of needing to learn for a spelling test for the Friday, finishing a library book for Thursday and packing a bag for a sleep-over on Saturday.
1. The indecision example of Helen's conference was changed to Joe wanting to play soccer but not having his clothes with him and having to choose between going home to fetch clothes or going to a friend's to borrow clothes.
1. The scoring of the complex tasks has been changed to reflect the changes to the task in the workbook.

Module 6

1. The example of making a Beef Wellington was changed to making a sandwich.
2. The wedding task was changed to a birthday task.
3. The bookkeeping task is changed to a Jelly tot task.

Module 7

1. The example of Philip making a rabbit hutch was changed to Jen making a birthday card instead of a happy father's day card.
2. The second bookkeeping task was changed to another Jelly Tot task.
3. The example of having Frank over for dinner was changed to organising a picnic and cricket game in the park.
4. The third bookkeeping task was changed to another Jelly Tot task.

Workbook changes:

Module 1 workbook:

1. No changes.

Module 2 workbook:

1. No changes.

Module 3 workbook:

1. Reflects the changes of Gus and Kelly (distracted by dinosaur story thus forgetting to deliver a loaf of bread) made to the PowerPoint presentation.

Module 4 workbook:

1. Complex task 1- word search- a more colourful word search that only requires 8 words replaced the original. Spot the difference- a colourful, child-friendly picture replaced the original.

Module 5 workbook:

1. Complex task 2- word search- a more colourful word search that only requires words

replaced the original. Spot the difference- a colourful, child-friendly picture replaced the original. There are 4 differences.

2. The catalogue task was removed as too much was required from the children.

Module 6 workbook:

1. The tasks and subtasks exercise was changed to a sleep-over birthday party.
2. The Bookkeeping task was changed to a task that requires Jelly Tots (colourful sweets) to be divided among children according to their requests.
3. The second catalogue task was also removed.

Module 7 workbook:

1. The bookkeeping tasks were changed to Jelly Tot tasks.
2. The final Fertwinkle example was changed to reflect the initial changes to the example.

APPENDIX G
ASSENT FORM

ASSENT TO PARTICIPATE IN RESEARCH

We are inviting you to be in our research study because we would like to learn more about teenagers with head injuries and ways to help them.

If you agree to be in this study we will ask you to come to the University of Cape Town a few times a month to do some activities with us and learn new ways to do things like getting ready for school. For example, we may ask you to try to remember things, to draw or read things. We will also ask your family to do the activities with you at home, and your teacher to do them with you at school.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do feel tired you can stop and rest at any time.

If you sign this paper it means that you want to be in the study. If you don't want to be in the study, please don't sign the paper. No one will be angry if you don't sign this paper or if you change your mind later and want to stop.
You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 083 817 6300 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX H
CONSENT FORM- INTERVENTION

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. **Name of Participant ("Study Subject" – the child)**

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2. **Title of Research Study**

   Rehabilitation of executive functioning following pediatric traumatic brain injury: A Goal Management Training intervention.

3. **Principal Investigator(s) and Contact Detail(s)**

Leigh Schrieff, Ph.D.	Aqeela Mahomed (Masters Learner)
Department of Psychology	Department of Psychology
University of Cape Town	University of Cape Town
021-650-3708	aqeela.mahomed@gmail.com

4. **Source of Funding or Other Material Support**

None

5. What is the purpose of this research study?

The main purpose of this research is to investigate the effectiveness of the Goal Management Training (GMT) programme in the rehabilitation of executive functioning in adolescents following traumatic brain injury. This research was undertaken as the efficacy of this intervention has not been established for children under the age of 18.

6. What will be done if you take part in this research study?

Firstly, a number of neuropsychological tests will be carried out with your child to find out his/her strengths and weaknesses, for example in the way he/she remembers, pays attention, or solves problems. You, as the parent/caregiver, will also be asked some questions so that the investigator can know more about your child's performance at home or at school. An interview about your child's behaviour will then be conducted by the principal researcher and supervisor to establish in which everyday tasks the GMT intervention will be most effective.

Once these strengths and weaknesses are determined and the area of focus for the intervention has been identified, the researchers will adapt a training programme to match your child's needs. For example, if your child has problems getting ready for school, then the training programme will teach your child to organise more goal-directed behaviour that will aid his/her ability to get ready for school in a systematic way. These strategies will be discussed with you, the parent/caregiver, as well as with the child.

Once the training programme has been implemented, a neuropsychological assessment will be administered to your child, similar to the pre-training assessment.
We will also request your permission to obtain a comprehensive report from your child's school teacher.

A follow-up assessment, using neuropsychological tasks as before, will be performed one (1) month after the intervention.

The principal researchers and/or research assistants will implement these rehabilitation strategies. However, some of the intervention strategies will require your involvement as the parent/caregiver, depending on what the intervention strategy involves.

The researchers will monitor your children's progress over a maximum period of 4 months.

7. **If you choose to participate in this study, how long will you be expected to participate in the research?**

   In order to assess whether the interventions are effective, it will be necessary for some of the interventions to be monitored for at least 4 months. Thus, participation could last for up to 4 months.

   However, if at any time during the research period you feel that you do not wish to continue, you are free to discontinue your participation without penalty.

8. **How many people are expected to participate in the research?**

   9 children and their parents/guardians/caregivers.

9. **What are the possible discomforts and risks for you or your child?**

   There are no known risks associated with taking part in this study.

   During the testing period we may find that your child may need assistance in other areas of functioning not covered by the intervention service. If this happens, we will talk with you and give a referral for the necessary care.

   If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

10. What are the possible benefits to you and your child?

The general aim of the research is improvement in the quality of life for you and your child. More specifically, the intervention strategies chosen are aimed at improving specific areas of functioning for your child. As the aim of this study is to investigate how effective the GMT intervention will be for children, it is not guaranteed that the rehabilitation interventions will result in improved functioning or performance for your child.

11. What are the possible benefits to others?

Should the intervention strategies that are used prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything financially. However, some of the intervention strategies that need to be conducted at home will require your involvement and supervision.

13. Will you and your child receive compensation for taking part in this research study?

You will receive financial compensation of R150 to cover travel costs.

14. Can you and your child withdraw from this research study?

You are free to withdraw your consent and to stop participating in this research study at any time. If you do withdraw your consent, there will be no penalty.

If you have any questions regarding you or your child's rights as a research subject, you may phone the Psychology Department, University of Cape Town on 021-650-3430.

15. If you withdraw, can information about you and your child still be used and/or collected?

Information already collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only certain people have the right to review these research records. These people include the researchers for this study and certain University of Cape Town officials. Your research records will not be released without your permission unless required by law or a court order.

17. What information about you or your child may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and records of your child's progress in terms of the intervention strategies. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

In general, presenting research results helps the career of a scientist. Therefore, the Principal Investigators may benefit if the results of this study are presented at scientific meetings or in scientific journals. This study is being undertaken as part of Masters and Doctoral degrees being completed at the University of Cape Town.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

_____

APPENDIX I
CONSENT FORM- TEACHERS

Informed Consent for you and your learner to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your self reported data about the relevant learner, as well as other information necessary for the study. The parent/guardian of the learner is responsible for allowing the learner to take part in the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your participation is entirely voluntary. Please read the information below and ask questions about anything you do not understand.

15. Name of Participant ("Study Subject" – the learner)

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16. Title of Research Study

Rehabilitation of executive functioning following pediatric traumatic brain injury: A Goal Management Training intervention.

17. Principal Investigator(s) and Contact Detail(s)

Leigh Schrieff, Ph.D.
Department of Psychology
University of Cape Town
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Aqeela Mahomed (Masters Learner)
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18. Source of Funding or Other Material Support

None

19. What is the purpose of this research study?

The main purpose of this research is to investigate the effectiveness of the Goal Management Training (GMT) programme in the rehabilitation of executive functioning in adolescents following traumatic brain injury. This research was undertaken as the efficacy of this intervention has not been established for children under the age of 18.

20. What will be done if you take part in this research study?

Firstly, a number of neuropsychological tests will be carried out with your learner to find out his/her strengths and weaknesses, for example in the way he/she remembers, pays attention, or solves problems. You, as the educator, will also be asked some questions so that the investigator can know more about the learner's performance at school. An interview about the learner's behaviour will then be conducted by the principal researcher and supervisor to establish in which everyday tasks the GMT intervention will be most effective.

Once these strengths and weaknesses are determined and the area of focus for the intervention has been identified, the researchers will adapt a training programme to match the learner's needs. For example, if the learner has problems getting ready for school, then the training programme will teach the learner to organise more goal-directed behaviour that will aid his/her ability to get ready for school in a systematic way. These strategies will be discussed with you, as well as with the child.

Once the training programme has been implemented, a neuropsychological assessment will be carried out with the learner, similar to the pre-training assessment. Permission will be sought from the learner's parent/guardian for this assessment. At this stage, you will be interviewed about your observations regarding the learner's behaviour and functioning at school. You will also be required to fill out some forms about the learner's behaviour and social skills at school.

A follow-up assessment, using neuropsychological tasks as before, will be performed one (1) month after the intervention. You will once again be interviewed by the researcher about the learner's behaviour and functioning at school and will be required to fill out some forms about the learner's social skills, behaviour and functioning.

The principal researcher will implement these rehabilitation strategies. However, some of the intervention strategies will require your involvement as the educator, depending on what the intervention strategy involves.

The researchers will monitor the learner's progress over a maximum period of 4 months.

21. If you choose to participate in this study, how long will you be expected to participate in the research?

In order to assess whether the interventions are effective, it will be necessary for some of the interventions to be monitored for at least 4 months. Thus, participation could last for up to 4 months.

However, if at any time during the research period you feel that you do not wish to continue, you are free to discontinue your participation without penalty.

22. How many people are expected to participate in the research?

9 children and their parents / guardians and teachers.

23. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study.

During the testing period we may find that the learner may need assistance in other areas of functioning not covered by the intervention service. If this happens, we will talk with you and give a referral for the necessary care.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

24. What are the possible benefits to you and the learner?

The general aim of the research is improvement in the quality of life for you and the learner. More specifically, the intervention strategies chosen are aimed at improving specific areas of functioning for the learner. As the aim of this study is to investigate how effective the GMT intervention will be for teenagers, it is not guaranteed that the rehabilitation interventions will result in improved functioning or performance for the learner.

25. What are the possible benefits to others?

Should the intervention strategies that are used prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury.

26. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything financially. However, some of the intervention strategies that need to be conducted at school will require your involvement and supervision.

27. Will you receive compensation for taking part in this research study?

You will receive financial compensation of R150, R50 for each assessment.

28. Can you withdraw from this research study?

You are free to withdraw your consent and to stop participating in this research study at any time. If you do withdraw your consent, there will be no penalty.

If you have any questions regarding you or the learner's rights as a research subject, you may phone the Psychology Department, University of Cape Town on 021-650-3417.

15. If you withdraw, can information about you and the learner still be used and/or collected?

Information already collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only certain people have the right to review these research records. These people include the researchers for this study and certain University of Cape Town officials. Your research records will not be released without your permission unless required by law or a court order.

19. What information about you may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or the learner's performance on the neuropsychological tests, and records of the learner's progress in terms of the intervention strategies. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or the learner. For example, the limited data set cannot include your name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

20. How will the researcher(s) benefit from your being in the study?

In general, presenting research results helps the career of a scientist. Therefore, the Principal Investigators may benefit if the results of this study are presented at scientific meetings or in scientific journals. This study is being undertaken as part of Masters and Doctoral degrees being completed at the University of Cape Town.

Signatures

As a representative of this study, I have explained to the participant's (child's) educator the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your learner's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study:

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

_____

APPENDIX J
DEMOGRAPHIC AND ASSET INDEX

GENERAL INFORMATION

Full name (Parent):	
Telephone:	Work: ( ) Home: ( ) Cell:
Home Language:	
Full name (Child):	
Gender:	M F
Date of Birth:	
Grade:	

HOUSEHOLD INCOME: (Please circle appropriate number)

Household income per year:	1. R0 2. R1 - R5 000 3. R5001 - R25 000 4. R25 000 - R100 000 5. R100 001+

PARENTAL EDUCATION: (Please circle appropriate number)

	Biological mother	Biological father	Guardian
Highest level of education reached? Mark one response for each person as follows:			
1. 0 years (No Grades / Standards) = No formal education (never went to school)	1.	1.	1.
2. 1-6 years (Grades 1-6 / Sub A-Std 4) = Less than primary education (didn't complete primary school)	2.	2.	2.
3. 7 years (Grade 7 / Std 5) = Primary education (completed primary school)	3.	3.	3.
4. 8-11 years (Grades 8-11 / Stds 6-9) = Some secondary education (didn't complete high school)	4.	4.	4.
5. 12 years (Grade 12 / Std 10) = Secondary education (completed senior school)	5.	5.	5.
6. 13+ years = Tertiary education (completed university / technikon / college)	6.	6.	6.
7. Don't know	7.	7.	7.

PARENTAL EMPLOYMENT: (Please circle appropriate number)

Hollingstead categories:	Biological mother	Biological father	Guardian
1. Higher executives, major professionals, owners of large businesses)	1.	1.	1.
2. Business managers of medium sized businesses, lesser professions (e.g. nurses, opticians, pharmacists, social workers, teachers)	2.	2.	2.
3. Administrative personnel, managers, minor professionals, owners / proprietors of small businesses (e.g. bakery, car dealership, engraving business, plumbing business, florist, decorator, actor, reporter, travel agent)	3.	3.	3.
4. Clerical and sales, technicians, small businesses (e.g. bank teller, bookkeeper, clerk, draftsperson, timekeeper, secretary)	4.	4.	4.
5. Skilled manual - usually having had training (e.g. baker, barber, chef, electrician, fireman, machinist, mechanic, painter, welder, police, plumber, electrician)	5.	5.	5.
6. Semi-skilled (e.g. hospital aide, painter, bartender, bus driver, cook, garage guard, checker, waiter, machine operator)	6.	6.	6.
7. Unskilled (e.g. attendant, janitor, construction helper, unspecified labour, porter, unemployed)	7.	7.	7.
8. Homemaker			
9. Student, disabled, no occupation	8.	8.	8.
	9.	9.	9.

MATERIAL AND FINANCIAL RESOURCES (ASSET INDEX): (Please circle appropriate number)

Which of the following items, in working order, does your household have?

Items	Yes	No
1. A refrigerator or freezer	1.	1.
2. A vacuum cleaner or polisher	2.	2.
3. A television	3.	3.
4. A hi-fi or music centre (radio excluded)	4.	4.
5. A microwave oven	5.	5.
6. A washing machine	6.	6.
7. A video cassette recorder or DVD player	7.	7.

Which of the following do you have in your home?

Items	Yes	No
1. Running water	1.	1.
2. A domestic servant	2.	2.
3. At least one car	3.	3.
4. A flush toilet	4.	4.
5. A built-in kitchen sink	5.	5.
6. An electric stove or hotplate	6.	6.
7. A working telephone	7.	7.

Do you personally do any of the following?

Items	Yes	No
1. Shop at supermarkets	1.	1.
2. Use any financial services such as a bank account, ATM card or credit card	2.	2.
3. Have an account or credit card at a retail store	3.	3.

Note: Adapted from Myer, Stein, Grimsrud, Seedat & Williams, 2008.

APPENDIX K
PRE-GMT QUESTIONNAIRE

Participant Pre-GMT Questionnaires

This questionnaire is about problems that most people have from time-to-time. Please choose the number that best describes how much of a problem this has been for *you* in the *last two weeks.* The scale goes from 1 (not a problem at all) through to 10 (a big problem).

1	Finding that you don't finish everything that you want to in a day?	1	2	3	4	5	6	7	8	9	10
2	Walking into a room and forgetting what it was that you had come for?	1	2	3	4	5	6	7	8	9	10
3	Finding that you don't have time to stop and think?	1	2	3	4	5	6	7	8	9	10
4	Something that you needed to do just "slipped your mind" (e.g. forgetting to pack a school book, asking your parents to sign something for school)?	1	2	3	4	5	6	7	8	9	10
5	Not actually having a very clear idea of what you are trying to do?	1	2	3	4	5	6	7	8	9	10
6	Having to go back and re-read a paragraph because you didn't take the information in the first time	1	2	3	4	5	6	7	8	9	10
7	Not leaving enough time to finish things? (e.g. only leaving an hour to finish a project that will take 3 hours.)	1	2	3	4	5	6	7	8	9	10
8	Forgetting something that needed to be done at a certain time (e.g. a sports practice, a TV programme that you wanted to watch)?	1	2	3	4	5	6	7	8	9	10
9	Feeling like you aren't in control?	1	2	3	4	5	6	7	8	9	10
10	Trying to please everybody? Trying to make everyone happy?	1	2	3	4	5	6	7	8	9	10
11	Find that you haven't been listening to important information that someone is telling	1	2	3	4	5	6	7	8	9	10

	you?										
12	Making a mistake because you weren't thinking about what you were doing at the time?	1	2	3	4	5	6	7	8	9	10
13	Not remembering where you had got to in an assignment? (e.g. Not remembering whereabouts you had got to in a book.)	1	2	3	4	5	6	7	8	9	10
14	Worrying too much about things that you need to finish?	1	2	3	4	5	6	7	8	9	10
15	Find that you have done things in the wrong order (e.g. Getting dressed in smart clothes before washing the dog and then having to change again)?	1	2	3	4	5	6	7	8	9	10
16	Trying to do or think about too many things at once?	1	2	3	4	5	6	7	8	9	10
17	Taking too long to find things (e.g. homework diary, jersey)?	1	2	3	4	5	6	7	8	9	10
18	Not having what you need with you at the right time (e.g. swimming costume for practice or homework for school)?	1	2	3	4	5	6	7	8	9	10
19	Not remembering whether you had done an everyday activity or not (e.g. not remembering whether you had turned the light off, flushed the toilet)?	1	2	3	4	5	6	7	8	9	10
20	Feeling that others expect too much from you?	1	2	3	4	5	6	7	8	9	10
21	Taking too long to finish something? Not knowing how long you have been doing something for?	1	2	3	4	5	6	7	8	9	10
22	Getting distracted from an important activity by something that is less important?	1	2	3	4	5	6	7	8	9	10
23	Getting "carried away" with something, not stopping to think about it?	1	2	3	4	5	6	7	8	9	10
24	Avoided thinking about a problem because it just seems too difficult?	1	2	3	4	5	6	7	8	9	10

APPENDIX L
PRE-GMT QUESTIONNAIRE

Significant Other Pre- GMT Questionnaire i.e. parents and teachers

This questionnaire is about problems that most people experience from time-to-time. Sometimes it is useful to get another person's view on these things. Perhaps we feel that we have more problems than other people are aware of – or perhaps others might be able to spot areas of difficulty of which we are less aware. It can be difficult to rate someone you know on things that sound very negative. Remember, however, that we *all* experience the types of errors described below – the question is how much of a *problem* it is for the person you are rating. With his or her permission, please rate how much of a problem the following descriptions have been for the person that you are describing over the *last two weeks.* The scale goes from 1 (not a problem at all) through to 10 (a really major problem).

1	Not achieving everything that s/he wants to get done in a day?	1	2	3	4	5	6	7	8	9	10
2	Walking into a room and forgetting what it was that s/he had come for?	1	2	3	4	5	6	7	8	9	10
3	Finding that s/he doesn't have time to stop and think?	1	2	3	4	5	6	7	8	9	10
4	Something that s/he needed to do just "slips the mind" (e.g. forgetting to pack a school book, asking your parents to sign something for school?)	1	2	3	4	5	6	7	8	9	10
5	Often not appearing to have a very clear idea of what s/he is trying to achieve?	1	2	3	4	5	6	7	8	9	10
6	S/he doesn't always seem to take in written information the first time?	1	2	3	4	5	6	7	8	9	10
7	S/he is not realistic about how long something will take to complete?	1	2	3	4	5	6	7	8	9	10
8	S/he forgets something that needs to be done at a certain time (e.g. watching a TV programme)?	1	2	3	4	5	6	7	8	9	10
9	S/he feels too busy, hassled, not in control?	1	2	3	4	5	6	7	8	9	10
10	S/he tries to please everybody?	1	2	3	4	5	6	7	8	9	10
11	S/he sometimes doesn't appear to listen to	1	2	3	4	5	6	7	8	9	10

	important information that someone is telling him or her?										
12	Makes mistake because of not thinking about what s/he was doing at the time?	1	2	3	4	5	6	7	8	9	10
13	Forgetting where s/he has got to in a task?	1	2	3	4	5	6	7	8	9	10
14	Worrying too much about things that s/he needs to achieve?	1	2	3	4	5	6	7	8	9	10
15	Doing things in the wrong order (e.g. checking something that is needed when *arriving* at a destination, rather than *before* leaving)?	1	2	3	4	5	6	7	8	9	10
16	Trying to do or think about too many things at once?	1	2	3	4	5	6	7	8	9	10
17	Often searching for things (e.g. book, jersey)?	1	2	3	4	5	6	7	8	9	10
18	Not having what is needed at the right time (e.g. going to swimming practice without a costume and towel)?	1	2	3	4	5	6	7	8	9	10
19	Not remembering whether an everyday activity has been done or not (e.g. not remembering whether s/he has turned off the light)?	1	2	3	4	5	6	7	8	9	10
20	Feels that others expect too much of him or her?	1	2	3	4	5	6	7	8	9	10
21	Loses track of the time?	1	2	3	4	5	6	7	8	9	10
22	Gets distracted from an important activity by something that is less important?	1	2	3	4	5	6	7	8	9	10
23	Gets “carried away” with something, not stopping to think about it?	1	2	3	4	5	6	7	8	9	10
24	Avoids thinking about a problem because it just seems too complicated?	1	2	3	4	5	6	7	8	9	10
25	Feels worried about how well s/he is coping?	1	2	3	4	5	6	7	8	9	10

APPENDIX M
HEALTHY CONTROL GROUP: POST INTERVENTION SCORES

Table 21: Attention, concentration and executive functioning: post intervention scaled scores for the Healthy Control Group (N=3)

			Healthy Control Group		
Domain	Subtest	Component	PM	HD	EM
Attention and Concentration Executive Functions		Numbers Forward	6	8	8
Working Memory		Numbers Backward	12	8	9
Cognitive Flexibility	Colour Trails	Colour trails 1	27	49	33
		Colour trails 2	49	34	43
Generativity	Verbal Fluency	C1: Letter Fluency	11	8	16
		C2: Category Fluency	13	6	11
		C3: Category Switching	12	6	12
	Design Fluency	C 1: Filled dots	10	11	11
		C 2: Empty dots	9	11	15
		C 3: Switching	8	11	8
Inhibition	Naming	Total errors (percentile)	<2	51-75	51-75
		Completion time scaled score	7	12	12
		Combined scaled score	3	12	11
	Inhibition	Total errors (percentile)	11-25	<2	51-75
		Completion time scaled score	8	9	10
		Combined scaled score	7	4	10
	Switching	Total errors (percentile)	51-75	51-75	51-75
		Completion time scaled score	7	11	10
		Combined scaled score	9	11	10
	Errors		7	5	11
Planning and problem solving		Total achievement	12	14	13
		Time-per-move	13	12	12
		Move-accuracy	7	13	8
		Rule violations	11	11	10

Note: C1= condition 1; C2= condition 2; C3= condition 3. Scores presented are scaled scores, unless otherwise specified in parantheses.

Table 22: Behavioural and Affective Functioning: post intervention T-scores, v-scaled scores and domain standard scores for the Healthy Control Group (N=3)

	Scales	Subscales	Healthy Control		
			PM	HD	EM
CBCL Parent Report	Internalizing	Anxious/depressed	60	57	59
		Withdrawn/depressed	64	66	66
		Somatic complaints	66	53	62
		Internalizing problems	65	66	53
	Externalizing	Rule-breaking behaviour	50	54	57
		Aggressive behaviour	51	60	50
		Externalizing problems	47	63	51
	Total problems		56	64	51
CBCL TRF	Internalizing	Anxious/depressed	50	59	50
		Withdrawn/depressed	50	63	59
		Somatic complaints	50	50	50
		Internalizing problems	47	60	52
	Externalizing	Rule-breaking behaviour	50	59	50
		Aggressive behaviour	50	55	50
		Externalizing problems	43	56	43
	Total problems		48	56	49
CBCL YSR	Internalizing	Anxious/depressed	66	52	51
		Withdrawn/depressed	58	55	55
		Somatic complaints	63	52	57
		Internalizing problems	65	49	54
	Externalizing	Rule-breaking behaviour	50	52	52
		Aggressive behaviour	51	55	51
		Externalizing problems	46	46	49
	Total problems		57	46	46
BRIEF Parent Report		Inhibit	60	42	41
		Shift	56	38	51
		Emotional control	61	37	42
		BRI	61	37	43
		Initiate	53	36	43

			PM	HD	EM
		Working memory	47	40	48
		Plan/Organize	64	39	45
		Org. of materials	41	35	37
		Monitor	58	36	47
		MI	53	36	44
		GEC	57	36	43
BRIEF Teacher Report		Inhibit	49	49	46
		Shift	45	53	55
		Emotional control	50	54	46
		BRI	48	52	49
		Initiate	43	50	60
		Working memory	44	44	51
		Plan/Organize	43	55	53
		Org. of materials	46	46	46
		Monitor	45	56	51
		MI	43	51	53
		GEC	44	51	52
VABS	Subdomains	Receptive	3	4	3
		Expressive	5	5	2
		Written	10	8	9
	Domain	Communication	53	50	43
	Subdomains	Personal	3	3	1
		Domestic	17	19	15
		Community	8	11	6
	Domain	Daily living skills	68	76	59
	Subdomains	Interpersonal Relationships	7	5	6
		Play and leisure time	7	8	4
		Coping Skills	21	14	11
	Domain	Socialization	82	68	58
		Adaptive Behaviour Composite	66	63	53
Maladaptive Behaviour Index			12	14	14
		Internalizing	19	18	19
		Externalizing	13	15	17

Note: CBCL= Child behaviour checklist; TRF= Teacher's report form; YSR= Youth Self Report; BRI= Behaviour Regulation Index; MI = Metacognition Index; GEC= Global Executive Composite;VABS = Vineland Adaptive Behaviour Scale. CBCL T-scores of 60-65= borderline range; CBCL T-scores above 65= clinical range (Achenbach & Rescorla, 2001). BRIEF scores >65= clinical range (Gioia, Isquith, Guy, & Kenworthy, 2000); Both standard and v-scaled scores are presented for the VABS indices. VABS v-scaled scores of 1-9= low adaptive levels; 10-12=moderately low adaptive levels; 13-17=adequate adaptive levels; 18-20=moderately high adaptive levels; 21-24=high adaptive levels. VABS standard scores of 20-70= low adaptive levels; 71-85= moderately low adaptive levels; 86-114= adequate adaptive levels; 115-129= moderately high adaptive levels; 130-160= high adaptive levels. Maladaptive Behaviour indices: v-scale scores 21-24= clinically significant; 18-20=elevated; 1-17=average (Sparrow, Cicchetti & Balla, 2005).

APPENDIX N
TBI GROUP: POST INTERVENTION SCORES

Table 23: Attention, concentration and executive functioning: post intervention scaled scores for the TBI Group (N=3)

			TBI Group		
Domain	Subtest	Component	CB	AK	TB
Attention and Concentration Executive Functions		Numbers Forward	9	3	2
Working Memory		Numbers Backward	10	7	2
Cognitive Flexibility	Colour Trails	Colour trails 1	32	32	≤19
		Colour trails 2	31	≤19	≤19
Generativity	Verbal Fluency	C1: Letter Fluency	8	5	2
		C2: Category Fluency	8	5	5
		C3: Category Switching	9	9	1
	Design Fluency	C 1: Filled dots	9	12	3
		C 2: Empty dots	11	11	3
		C 3: Switching	9	10	2
Inhibition	Naming	Total errors (percentile)	26-50	<2	51-75
		Completion time scaled score	8	6	1
		Combined scaled score	8	3	7
	Inhibition	Total errors (percentile)	51-75	<2	<2
		Completion time scaled score	12	8	2
		Combined scaled score	11	4	1
	Switching	Total errors (percentile)	51-75	<2	<2
		Completion time scaled score	12	7	5
		Combined scaled score	11	3	2
	Errors		10	1	1
Planning and problem solving		Total achievement	10	8	2
		Time-per-move	11	12	1
		Move-accuracy	7	1	19
		Rule violations	11	11	1

Note: C1= condition 1; C2= condition 2; C3= condition 3. Scores presented are scaled scores, unless otherwise specified in parantheses.

Table 24: Behavioural and Affective Functioning: post intervention T-scores, v-scaled scores and domain standard scores for the TBI Group (N=3)

	Scales	Subscales	TBI		
			CB	AK	TB
CBCL Parent Report	Internalizing	Anxious/depressed	60	81	51
		Withdrawn/depressed	70	78	54
		Somatic complaints	76	83	50
		Internalizing problems	73	82	50
	Externalizing	Rule-breaking behaviour	59	73	50
		Aggressive behaviour	63	70	51
		Externalizing problems	62	72	46
	Total problems		70	83	50
CBCL TRF	Internalizing	Anxious/depressed	81	64	54
		Withdrawn/depressed	68	68	52
		Somatic complaints	50	69	58
		Internalizing problems	73	71	54
	Externalizing	Rule-breaking behaviour	59	50	50
		Aggressive behaviour	60	54	52
		Externalizing problems	60	52	49
	Total problems		66	63	56
CBCL YSR	Internalizing	Anxious/depressed	54	79	51
		Withdrawn/depressed	61	63	51
		Somatic complaints	68	80	50
		Internalizing problems	62	77	44
	Externalizing	Rule-breaking behaviour	51	62	50
		Aggressive behaviour	65	66	52
		Externalizing problems	60	65	49
	Total problems		60	74	48
BRIEF Parent Report		Inhibit	44	65	58
		Shift	59	67	56
		Emotional control	63	83	51
		BRI	63	76	55
		Initiate	63	62	53
		Working memory	62	67	56
		Plan/Organize	53	44	51
		Org. of materials	61	52	37
		Monitor	61	69	45
		MI	61	58	49
		GEC	62	65	51
BRIEF Teacher Report		Inhibit	53	64	53
		Shift	93	77	58
		Emotional control	69	66	45

				CB	AK	TB
			BRI	75	71	52
			Initiate	85	84	72
			Working memory	89	90	81
			Plan/Organize	77	83	64
			Org. of materials	52	77	67
			Monitor	73	74	55
			MI	81	84	69
			GEC	81	82	64
	VABS	Subdomains	Receptive	5	2	8
			Expressive	6	3	10
			Written	17	7	5
		Domain	Communication	69	42	61
		Subdomains	Personal	3	1	6
			Domestic	14	9	8
			Community	9	5	8
		Domain	Daily living skills	65	50	59
		Subdomains	Interpersonal Relationships	6	4	10
			Play and leisure time	4	4	13
			Coping Skills	13	10	14
		Domain	Socialization	61	51	85
			Adaptive Behaviour Composite	64	47	67
Maladaptive Behaviour Index				14	19	18
			Internalizing	20	22	20
			Externalizing	18	21	20

Note: CBCL= Child behaviour checklist; TRF= Teacher's report form; YSR= Youth Self Report; BRI= Behaviour Regulation Index; MI = Metacognition Index; GEC= Global Executive Composite;VABS = Vineland Adaptive Behaviour Scale. CBCL T-scores of 60-65= borderline range; CBCL T-scores above 65= clinical range (Achenbach & Rescorla, 2001). BRIEF scores >65= clinical range (Gioia, Isquith, Guy, & Kenworthy, 2000); Both standard and v-scaled scores are presented for the VABS indices. VABS v-scaled scores of 1-9= low adaptive levels; 10-12=moderately low adaptive levels; 13-17=adequate adaptive levels; 18-20=moderately high adaptive levels; 21-24=high adaptive levels. VABS standard scores of 20-70= low adaptive levels; 71-85= moderately low adaptive levels; 86-114= adequate adaptive levels; 115-129= moderately high adaptive levels; 130-160= high adaptive levels. Maladaptive Behaviour indices: v-scale scores 21-24= clinically significant; 18-20=elevated; 1-17=average (Sparrow, Cicchetti & Balla, 2005).