The Implementation of an Attention-training Intervention with Low Socio-economic Status Children in Cape Town, South Africa

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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Abstract

Background and aims: Attention is a core process underlying competence in higher-order cognitive abilities. It is therefore described as a gateway function which, if impaired, can lead to deficits in other cognitive domains. Research has shown that healthy, low socio-economic status (SES) children perform poorly, compared to higher SES children, in tasks of attention. These include being alert and orienting to stimuli, ignoring distracting stimuli and selecting target stimuli, inhibitory control and working memory. Therefore, we implemented an attention-training intervention to determine whether it would effectively improve the level of attention in a group of low SES children.

Method: We implemented a 10-week neuropsychological intervention, *Pay Attention!* with low SES children aged 7-12 years. We assessed all participants using a battery of neuropsycholgical tests before and after the intervention. The study included an intervention group (n = 5), a play control group (n = 5) and a test-only control group (n = 5), whereby each participant was matched with another participant in each group on age and SES.

Results: We evaluated statistically significant change in scores from pre- to post-test assessments using the Reliable Change Index for individual participants. We found some positive outcomes of reliable changes form pre- to post-assessments, but these were not exclusive to the intervention participants, however.

Discussion: Our findings demonstrate some tentative support for the implementation of the attention-training intervention. However, future research needs be conducted with a larger sample in order to determine with greater rigour, both the effectiveness and efficacy of the intervention.

Key words: attention; attention remediation; *Pay Attention!*; socio-economic status; children; South Africa

Attention is the process of orienting, focusing, and maintaining vigilance of relevant stimuli. It is a core process underlying competence in higher-order cognitive abilities, including learning, social processing, memory, perception, and problem solving (Sohlberg & Mateer, 1987, 1989). Therefore, it is regarded as a gateway function which, if impaired, can lead to deficits in other cognitive domains (Penkman, 2004). Attention deficits are frequently found in clinical populations, including those with attention-deficit hyperactivity disorder (ADHD) and traumatic brain injury (TBI; Slomine & Locascio, 2009, Vakil, Blanchstein, Sheinman, & Greenstein, 2009). However, attention deficits have also been found in non-clinical populations. Research indicates that healthy individuals from low socio-economic status (SES) backgrounds are at risk for attention deficits (Hackman & Farah, 2009; Mezzacappa, 2004; Sarsour, Sheridan, Jutte, Nuru-Jeter, Hinshaw, & Boyce, 2011). Attention remediation has been used to improve attention processing amongst people with TBI and ADHD (Penkman, 2004). However, attention remediation with low-SES individuals has not yet been attempted.

This review is divided into three sections. The first is an overview of the cognitive concept of attention including models of attention and the developmental trajectory of attention. The second presents research on the cognitive deficits associated with low-SES children. The third discusses cognitive rehabilitation as well as its application for paediatric use.

Attention

Models of attention. Attention is a higher-order cognitive function that operates in a hierarchical fashion facilitating various other cognitive processes (Galbiati et al., 2009; Penkman, 2004; Posner & Boies, 1971; Sohlberg & Mateer, 1987). Both clinical and neuroanatomical models of attention, such as those proposed by Sohlberg and Mateer (1987) and Posner and Petersen (1990), respectively; as well as executive function models (for example, Anderson, 2002), of which attention is a core component, consistently show that attention is not a unitary construct. Therefore, it is conceptualised as having multiple components (Posner & Petersen, 1990; Sohlberg & Mateer, 1987). This hierarchical and multi-faceted view of attention is included in the description of the clinical model of attention by Sohlberg and Mateer (1987, 1989). A brief review of the models introduced above is now presented.

Clinical model of attention. This model includes three basic components of attention: *focused*, *sustained* and *selective attention* as well as two higher-order components: *alternating* and *divided attention*. *Focused attention* is directing attention to, and responding to specific stimuli. *Sustained attention* is maintaining vigilance to stimuli over time. *Sustained attention* at a basic level involves a consistent response to repetitive activity, for example, reading silently; while at higher levels involves manipulating information in working memory, for example, performing mental transformations. *Selective attention* refers to activating or inhibiting a response set by discriminating between target and distracter stimuli, for example, maintaining focus on reading while others are speaking (Sohlberg & Mateer, 1987; Thomson, Kerns, Seidenstrang, Sohlberg, & Mateer, 2005).

The two higher components of attention are *alternating* and *divided attention*. *Alternating attention* refers to switching between tasks requiring different cognitive sets, for example, doing homework and watching a television program. *Divided attention* refers to the performance of multiple tasks simultaneously, for instance, taking notes during a lecture. The hierarchy is as follows: *focused*, *sustained*, *selective*, *alternating,* and *divided attention*. This multidimensional nature of attention is also demonstrated by the various neuroanatomical networks believed to subserve attention.

Posner's anterior and posterior model of attention. This model includes three systems each with specific underlying neuroanatomical networks which are conceptualised as subserving the functions of attention (Fernandez-Duque & Posner, 2001; Posner & Petersen, 1990). The *posterior orienting network* is involved in overt and covert orienting to sensory stimuli. The network is composed of the posterior partial lobe, superior colliculus and pulvinar nucleus (Zillmer, Spiers, & Culbertson, 2008). The *vigilance attention network* of the right frontal-parietal region, maintains alertness to target stimuli over time (Posner & Boies, 1971). The *executive* or *anterior attentional network* is a higher-order network delegating processing to the posterior system as needed (Posner & Petersen, 1990). The anterior cingulate, supplementary motor area and areas of the prefrontal cortex (PFC) control this system. Functions of this system are attention allocation, task alternation, error detection and inhibition. Thus, within this model there is an overlap between attention and executive functions (Fernandez-Duque & Posner, 2001), which models such as the one proposed by Anderson (2002) also demonstrate.

Anderson's model of executive function. There are four discrete systems to this model operating in an integrated fashion, namely; *attentional control, information processing, cognitive flexibility,* and *goal setting* (Anderson, 2002). This model illustrates the overlap inherent in attentional and executive functioning, and regards *attentional control* as largely influencing the functioning of the other components. *Attentional control* involves sustained attention, selection of specific stimuli for processing, and inhibition. *Information processing* refers to output speed as well as output efficiency and quality. *Cognitive flexibility* involves alternating between response sets or adjusting to task demands, as well as problem solving, learning from feedback, dividing attention, and working memory. The last component is *goal setting* which refers to the planning of actions in an efficient and strategic manner; and the development novel concepts.

Thus, the multi-dimensional nature of attention as well as its interrelatedness to executive function is demonstrated by the models above. The complexity of attention extends to the developmental trajectory of the various components of attention.

Development of attention. Attention has been found to develop along a step-wise trajectory (Klenberg, Korkman & Luhti-Nuutila, 2001; Klimkeit, Mattingley, Sheppard, Farrow, & Bradshaw, 2004; Vakil et al., 2009). The pattern of rapid change followed by a plateau is illustrated in a study using a selective reaching task. In this task 8 year olds made more inattentive, impulsive and distractibility errors, when compared to 10 and 12 year olds (Klimkeit et al., 2004). The 10 and 12 year old groups did not differ significantly, indicating that vigilance and set-shifting abilities increase with age until about 10, after which they plateau.

Vakil et al. (2009) report similar findings as 8 to 11 year olds were more dissociable than 12 to 17 year olds in attention tasks, suggesting that more attentional change occurs in the younger age group whereas in the older age group attention is more stable. It was also found that more complex tasks, such as those of working memory and strategic planning, had steeper changes across age groups (Vakil et al., 2009). Vakil et al.'s (2009) findings were supported by Klenberg et al. (2001) who also reported rapid change in focused attention until 10 years of age after which executive development occurred.

The non-linear nature of attention development has been supported by research showing similar periods of neuroanatomic change to that of cognitive change. Research using electroencephalographic (EEG) recordings of frontal lobe maturation found a period of neural development between the ages of 7 and 10 (Hudspeth & Pribram, 1990) which corresponds to the period of attentional development cited above (Klenberg et al., 2001; Klimkeit et al., 2004; Vakil et al., 2009).

Thus, there is both neuropsychological and neurological support for attention's developmental trajectory. With attention being such a core component of cognitive functioning, the emergence of attentional components at the correct times is essential. This development can be disrupted in many clinical populations leading to attention deficits. However, attention deficits have also been found in non-clinical populations.

Correlates of Attention and SES

A large body of research has illustrated the link between SES and children's cognitive abilities, indicating a cognitive deficit in association to low-SES. Specifically, attention deficits are reported for low-SES children (Desert, Preaux, & Jund, 2009; Hackman & Farah, 2009; Mezzacappa, 2004; Sarsour et al., 2011; Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003). This attention deficit is seen as early as infancy. This has been demonstrated, for example, in research where low-SES infants, compared to higher-SES infants, made less correct responses and more errors on an executive function task (Lipina, Martelli, Vuelta, & Colombo 2005).

In other research, SES had a significant impact on alerting and orienting to stimuli, and executive attention as assessed by the Attention Network Task (Mezzacappa, 2004). Low-SES children underperformed on all aspects of the test compared to higher-SES children. SES was measured at infancy in this study, showing the lasting effects of SES on cognitive performance. This research is consistent with Duncan, Yeung, Brooks-Gunn, and Smith's (1998) findings that low SES in early childhood more accurately predicts later cognitive achievement than SES at any other time in childhood.

Recent research strengthens the empirical relationship between SES and attention (Sarsour et al., 2011). Low-SES children had deficits in inhibitory control as well as cognitive flexibility. These higher-order attentional abilities, also included in Anderson's (2002) model discussed before, are necessary for everyday life in order to adjust to task demands and focus on relevant stimuli while ignoring distracters.

Taken together, this research suggests that low SES children are at risk of developing both basic and higher-order attention deficits. As attention subserves other cognitive functions, deficits in attention can lead to high-order cognitive impairments, such as those necessary for behavioural, social and academic functioning (Sarsour et al., 2011). Attention remediation, which forms part of cognitive rehabilitation, has been used with different clinical populations but has not yet been attempted with low-SES children.

Cognitive Rehabilitation

Cognitive rehabilitation is a systematic intervention designed to reduce and compensate for neuropsychological deficits, for example, to improve everyday functioning following a TBI (Sohlberg & Mateer, 1989). However, literature has tended to focus on deficits without the concomitant focus on intervention design and implementation to alleviate these deficits, especially amongst children (Butler & Copeland, 2002; van't Hooft et al., 2005).

Approaches for managing or improving cognitive impairment are differentiated into externally and internally focused interventions (Mateer, Kerns, & Eso, 1996). Externally focused interventions are not designed to improve the underlying cognitive impairment but rather use strategies and techniques to manage and lessen the effects of cognitive impairment. External strategies include environmental modification, for example, decreasing distracters; and adjusting demands placed on an individual, for example, using recognition tests when recall is a problem (Mateer et al., 1996).

Internally focused interventions either use a compensatory or restorative approach. Compensatory techniques use basic strategies, such as checklists, to complex strategies, such as external memory systems to compensate for the impaired cognitive function (Mateer et al., 1996). Restorative or direct interventions also known as process-specific approaches, aim at restoring basic cognitive processes through the use of repetitive practice. Exercises are designed to target and improve specific cognitive deficits as well as cognitive abilities relying on the impaired function (Mateer et al., 1996; Sohlberg, McLaughlin, Pavese, Hiedrich, & Posner, 2000). The rationale for direct training stems from the work of Luria (see Butler & Copeland, 2002), and is thought to improve cognitive functioning by restoring the underlying neural networks. These methods have primarily been used for attention-training mainly with adults, but also more recently with children.

Attention remediation with adults. A direct intervention for attention remediation with adults is Attention Process Training (APT; Sohlberg & Mateer, 1987) which is based on Sohlberg and Mateer's (1987, 1989) clinical model of attention. Tasks are organised hierarchically, according to attentional domains and task difficulty. The theoretical basis of APT is that consistent activation of attention processes will result in improved cognitive abilities due to neuronal changes (Kerns, Eso, & Thomson, 1999).

Numerous studies have supported the use of direct interventions for attention-training in adults (Cicerone et al., 2005; Rohling, Fraust, Beverly, & Demakis, 2009; Pero, Incoccia, Caracciolo, Zoccolotti, & Formisano, 2006; Sohlberg et al., 2000; Strum, Willmes, Orgass, & Hartje, 1997). Direct attention remediation was found to effect significant improvements in the functional areas of treatment for adult samples in meta-analytic studies (Cicerone et al., 2005; Rohling, Fraust, Beverly, & Demakis, 2009). Support for APT, was found by Solberg et al. (2000), as attentional control and executive functioning improved following APT, compared to a brain injury education and supportive listening program. Another study using a single case design with two patients with severe attentional deficits resulting from a TBI, also supported the use of APT (Pero et al., 2006). Both patients improved on selective attention reaction time tasks and contention scheduling in dual attention tasks.

However, support for direct interventions is not consistent across the literature. Park and Ingles' (2001) meta-analyses found non-significant effects of attention-training in all general cognitive and specific attention measures. Furthermore, where improvement was found, measures were very similar to those used in training. Thus, improvements could be attributed to specific skills learnt through training and not to the restoration of attention functions per se. A number of meta-analyses note that results of attention-training studies need to be interpreted with caution due to a deficiency of high quality experimental designs (Park & Ingles, 2001; Penkman, 2004; Rohling et al., 2009).

Attention remediation with children. Despite the findings above, research regarding attention remediation with children suggests it holds potential and thus, requires further research (Laatsch et al., 2007; Limond & Leeke, 2005; Penkman, 2004). A paediatric attention-training intervention, derived from APT, has been developed as certain APT tasks were not understood by young children (Kerns et al., 1999). It is called *Pay Attention!* (Thomson et al., 2005) and encompasses the clinical model's *sustained*, *selective*, *alternating,* and *divided* attentional components, with colourful and age appropriate tasks for children between 4 and 11 years old.

Kerns et al. (1999) used *Pay Attention!* with children with ADHD. Children who received the intervention showed improvements in both basic and higher components of attention, and showed skill generalisation, in comparison to the control group. Support for attention remediation with children with severe TBI was also reported by Galbiati et al., (2009) as attentional performance and general intellectual functioning normalised after remediation and personal and social skills improved. However, the control group, also with severe TBI, were only seen at pre- and post-test and did not improve as the intervention group did. Similar attentional gains were reported by Butler and Copeland (2002) in an earlier study.

Meta-analyses have also found support for paediatric attention-training (Penkman, 2004; Slomine & Locascio, 2009). However, similar to the adult remediation literature, some meta-analyses reported that effectiveness is still inconclusive due to the lack of rigorous experimental designs (Laatsch et al., 2007; Limond & Leeke, 2005).

Conclusion

Although the neuropsychological function of attention may be somewhat deficient amongst low-SES children, research on the implementation of attention interventions with low-SES children is lacking. This is despite a growing body of literature on the relationship between low-SES and attentional deficits, and its knock-on effects. Therefore, it is pertinent to investigate whether attention remediation can improve attention deficits associated with low-SES children, to prevent higher-order deficits from developing.

Aims and Hypotheses

The aim of this study is to investigate whether the attentional abilities of low-SES children can be improved by implementing the *Pay Attention!* training intervention (Thomson et al., 2005). This will be achieved by assessing whether the children receiving the intervention show greater improvement from pre- to post-test assessment than children receiving an equal amount of play-time with a researcher, and than those receiving neither. *Pay Attention!* has been used with limited success to improve attention among clinical paediatric populations. However, it has not been attempted with non-clinical populations, such as, healthy children from low-SES backgrounds.

Thus, the following hypothesis is tested:

1. Low-SES children receiving the *Pay Attention!* intervention will show greater improvements in their attentional abilities from pre- to post-testing as measured by neuropsychological tests, compared to those who receive an equal amount of play-time with a researcher and compared to those who do not receive either.

As the current study forms part of a larger study, findings will contribute to the larger understanding and development of paediatric attention remediation.

Methods

Design and Setting

A randomized controlled trial using a pretest-posttest design was used. An independent researcher randomly assigned participants to one of three groups, namely: an experimental group, referred to as the intervention group (IG), a play group (PG) and a test-only group (TG). The IG received the intervention. The remaining two groups were both control groups. The PG controlled for the effects of the researchers spending regular, one-on-one time with the IG participants. It is possible that low-SES children do not always have access to one-on-one quality time with relatives or friends. Thus, quality time with researchers could be a rival explanation for changes occurring in IG participants, as this time itself may serve to stimulate or motivate them to perform better on the post-tests. Therefore, PG participants spent an equal amount of time with researchers playing non-attention taxing games.

Participants in the second control group (TG), were only administered the pre- and post-tests, with no intervention or time spent with the researchers in between. The TG controlled for maturation, as participants may go developmental changes in their attentional abilities due to their age and the developmental trajectory of attention. Practice effects were also controlled for by the TG as the pre- and post-testing sessions were approximately 2 months apart. Researchers were blind to group assignment at the pre-test.

The intervention and games took place at the participants' school, while the pre-testing and post-testing was done in a quiet room in the psychology department at the University of Cape Town (UCT).

Participants

The participants were learners at one of two low-SES schools in Cape Town. The schools and participant demographics were determined based on their affiliation with the larger research project that encompasses this study.

The schools' SES is used as a proxy for the participants' SES. The schools are defined as low-SES based on school fees and resources (Van der Berg, 2002; Table 1), thus, it is inferred that the children in the schools are of a similar SES. Parents' SES is also used as a proxy as children do not have the means to establish themselves in their own SES bracket (Hackman &

Farah, 2009). The SES of the participants was confirmed through the use of a demographic questionnaire and asset index given to participants' parents (Appendix A).

Table 1

Demographic Characteristics of Schools

Variables	School 1	School 2
Annual school fees per learner	R 400	R 350
Grade range	Grade R - 7	Grade R - 7
Total learners	406	459
Total teachers	12	16
Pupil-teacher ratio	1:34	1:29
Number of classrooms	11	16
Number of computer rooms	0	1
Number of libraries	0	1

Fifteen children were recruited (*n* = 5 per group). The participants were selected in groups of three, each participant was matched on age, gender and race with two others. In each group of three, each of the participants were randomly assigned to one of the three groups. For instance, a group of 3 mixed-race, female participants between the ages of 7.4 years to 7.10 years were recruited. One participant within this group of three was assigned to the IG, PG or TG.

The specific criteria used to select the participants can be found in a letter to each school, see Appendices B and C. The participants have the following demographic characteristics: from a low-SES background, between the ages of 7.4 years and 12.6 years, are 'coloured', and are taught in English. Ideally, participants in the following age bands were to be recruited: 7.6 - 7.11 years, 8.6 - 8.11 years, 9 - 9.6 years, 10.6 - 10.11 years, and 12 - 12.6 years. Recruited participants were matched on age as closely as possible, however, age bands were adjusted according to sample availability (Table 2).

Exclusion criteria included head injuries which resulted in hospitalisation or loss of consciousness, and any previous diagnoses of learning, psychiatric, neurological or developmental disorders. These were assessed based on parental or teacher reports. These exclusion criteria are necessary as they could possibly influence the participant's performance on the neuropsychological assessment of their attentional abilities as well as their progress in the intervention.

Intervention Group			Play Group			Test-only group		
Age	Gender	Race	Age	Gender	Race	Age	Gender	Race
7.4 -7.10	F	coloured	7.4-7.10	F	coloured	7.4-7.10	F	coloured
8.3-8.10	M	coloured	8.3-8.10	M	coloured	8.3-8.10	M	coloured
9-9.10	M	coloured	9-9.10	M	coloured	9-9.10	M	coloured
10.1-10.4	M	coloured	10.1-10.4	M	coloured	10.1-10.4	M	coloured
12.6-13.11	M	coloured	12.6-13.11	M	coloured	12.6-13.11	M	coloured

Table 2

Selection Criteria for Matched Groups

Note. Age is given in years and months. F' is abbreviated for female and 'M' is abbreviated for male.

Measures

Demographic information.

SES is often measured according to household income, employment and level of education (Hackman & Farah, 2009; Myer, Stein, Grimsrud, Seedat, & Williams, 2008). A 17-item asset index developed for use in South Africa by Myer et al. (2008), uses culturally appropriate measures which evaluate individual and household wealth, thus it has high validity for use in South Africa. This index also has high reliability (Cronbach's $\alpha = 0.92$). Participants' parents completed a questionnaire and asset index following that of Myer et al. (2008), including demographic, SES, and parental education and employment indicators (Appendix A).

Household income. The questionnaire has five categories of annual household income: 1 (R 0), 2 (R 1-R 5001), 3 (R 5001-R 25 000), 4 (R 25 000-R 100 000), and 5 (R 100 001 +).

Parental education. Level of education has seven categories: 1 (0 years/no formal education), 2 (1-6 years/less than primary education), 3 (7 years/primary education), 4 (8-11 years/some secondary education), 5 (12 years/secondary education), 6 (13+ years/tertiary education), and 7 (do not know).

Parental employment. Hollingstead categories were used to determine parental employment. Nine categories are listed: 1 (higher executives, major professionals, owners of large businesses), 2 (business managers of medium sized businesses), 3 (administrative personnel, proprietors of small businesses), 4 (clerical and sales, technicians), 5 (skilled manual including training), 6 (semi-skilled), 7 (unskilled), 8 (homemaker), and 9 (student, disabled, no occupation).

Asset index. Level of SES is determined by the number of household items. Seventeen items may be chosen, for example, a washing machine, at least one car, a retail account or credit card. These are divided into low (1-7), medium (8-14) and high (15-17).

Neuropsychological measures.

General intellectual functioning. General intellectual functioning was measured using the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). Participants' Full Scale IQ (FSIQ) score was assessed by Performance IQ (PIQ) and Verbal IQ (VIQ) scores. Reliability coefficients for these measures range from .92 to .95, showing excellent reliability. PIQ is measured using *Block Design* and *Matrix Reasoning* subtests. VIQ is measured using *Vocabulary* and *Similarities* subtests.

Block Design measures spatial visualization, visual-motor coordination, perceptual organisation and abstract conceptualization. Participants must copy 13 printed or modelled geometric patterns using two-coloured cubes in a specific amount of time.

Matrix Reasoning measures fluid reasoning, including mental manipulation and recognition of associations between abstract symbols. Participants must complete 35 gridded patterns by selecting the missing piece for each grid from five possibilities.

Vocabulary measures language development and word knowledge. *Vocabulary* consists of 42-items. The first four items are pictures for which participants must provide the names. Participants must give a definition for each word presented to them for the rest of the items.

Similarities measures verbal concept formation and categorical reasoning as participants must identify the similarity between pictures or pairs of words, by identifying the picture that best matches those presented or explaining the relationship between word pairs. *Similarities* consists of 26-items.

Only one published study demonstrates the successful use of the WASI in a South African population. However, a replacement for the *Vocabulary* subtest was used (Thornton et al., 2008).

Attention. The brief screening version of the Test of Everyday Attention for Children (TEA-Ch; Manly, Robertson, Anderson, & Nimmo-Smith, 1999) was used to measure selective, sustained, switching, and divided attention. It consists of four subtests: *Sky search*, *Score!*, *Creature counting,* and *Sky search dual task*. Reliability coefficients for the TEA-Ch range from .57 to .87, with high intercorrelations. It also displays excellent validity (Manley et al., 1999). Successful use of the TEA-Ch is reported with English-speaking populations, although studies on its use in South Africa were not found (Bellgrove et al., 2005, Heaton et al., 2002; Manly et al., 2001).

Sky search has two parts and measures focused and selective attention. First participants must mark-off as many target spaceships as quickly as possible from amongst distracters. Second, participants must mark-off as many target spaceships as quickly as possible on a page only containing target ships. By subtracting the second score from the first score, motor slowness is controlled in participants' ability to select target stimuli.

Score! measures sustained attention. Participants have to mentally count scoring sounds on a soundtrack, for which there are variable lengths between the scoring sounds.

Creature counting measures switching and attentional control as participants have to vary their strategy of counting creatures in their burrows by switch between counting forwards and backwards when 'up' and 'down' arrows appear. Participants' accuracy and speed are measured. A minimum accuracy score is required to calculate the results of *Creature counting*. Therefore, the TEA-Ch subtest *Opposite worlds* was used as a supplementary attentional control and switching measure in case minimum accuracy scores were not achieved.

Opposite worlds consists of a string of '1's' and '2's' and has two parts: the Same World where participants must say the numbers as they really are and the Opposite World where participants must call a '1' a '2' and a '2' a '1'. Thus, participants have to vary their response according to the rules of each world.

Sky search dual task measures divided and sustained attention. Participants must simultaneously find the *Sky Search* target spaceships, and mentally count all the *Score!* scoring sounds.

Working Memory. *Numbers* from the Children's Memory Scale (CMS; Cohen, 1997) was used to assess simple attentional capacity and working memory. *Numbers* has two parts: *Numbers forward* and *Numbers backward*. CMS subtest reliability coefficients range from .61 to .93 and content and construct validity ranges from .06 to .96 for all age groups (Cohen, 1997).

As the CMS was standardized and normed in America, there is a lack of literature on its use in South Africa.

For *Numbers forward* participants must repeat random number strings of different lengths in the same order as is read out to them. For *Numbers backward* participants must repeat random number strings of different length in the reverse order as is read out to them.

Inhibition. *Inhibition* from the NEPSY-II (Korkman, Kirk, & Kemp, 2007) was used to measure inhibition. *Inhibition* has three components: *Naming*, *Inhibition,* and *Switching*. This test has excellent content and construct validity as well as reliability with coefficients ranging from .62 to .89.

In the first component, *Naming*, participants must name different black and white shapes, for instance, ‘circles’ or ‘squares’, and give the direction of different black and white arrows, for instance ‘up’ or ‘down’. In the second component, *Inhibition*, participants must inhibit a natural response, for example, saying ‘circle’ for a square and ‘up’ for a down arrow, and vice versa. In the third component, *Switching*, participants must say the correct name of a shape when it is black and the opposite when it is white. The same rule is used for the arrows. This component assesses participants’ ability to switch between naming and inhibiting prepotent responses.

Behavioural measures. Participants’ parents were asked to complete the Behaviour Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) at pre- and post-testing.

BRIEF. Participants’ level of executive functioning was measured using the school-age version of the BRIEF. *T*-scores at or above 65 are considered potentially clinically significant. This measure shows excellent reliability and validity with reliability coeffecients ranging from .76 to .88. Behaviour is assessed on 11 indices. The *Behavioural Regulation Index* (*BRI*) is a scale encompassing *Inhibit, Shift* and *Emotional Control* indices, therefore, measuring behavioural inhibition, set shift and emotional regulation. The *Metacognition Index* (*MI*) encompasses the *Initiate, Working Memory, Plan and organise, Organisation of material* and *Monitor* indices. It assesses goal setting, initiation behaviour and organisation. The *Global Executive Composite* (*GEC*) is a summary measure encompassing all indices.

Procedure

Ethical approval as well as permission to use the schools’ learners and facilities was obtained from the Western Cape Education Department (Appendix D), UCT’s Department of

Psychology Research Ethics Committee, and the schools' principals. The schools were given a list of criteria for the selection of participants as well as a letter explaining the study for the parents of learners who matched the criteria (Appendix B, C and E, respectively). Children were included if their parents provided informed consent (Appendix F). Researchers then contacted the parents of these participants, to introduce and explain the study. However, the number of participants was insufficient. Therefore, more participants were randomly selected from the list of possible learners whose parents were contacted.

All participants were pre-tested using the neuropsychological tests discussed above. This enabled the researchers to establish baseline attentional functioning of participants. Each session lasted approximately 3½ hours. Upon arrival at the testing session, parents were asked to sign a consent form and were compensated for travelling costs. Participants were reminded that participation was voluntary and that they could withdraw from the study at any time, for any reason, without penalty. They were then asked to read and sign an assent form (Appendix G). Participants could take regular breaks and were provided with refreshments. An independent researcher randomly assigned participants to the IG, PG, and TG after pre-testing.

IG procedure. IG participants were seen individually, for approximately 45 minutes twice a week where the *Pay Attention!* intervention was administered to them. IG participants moved from one exercise of attention to the next based on two main criteria: first, number of errors and second, task completion time. If participants decreased their number of errors or improved their completion time on a task, while maintaining the same level of accuracy for three consecutive trials, more difficult task criteria were used in the following session. Sessions commenced with tasks in the first attentional component, i.e. sustained attention. A session did not include tasks from more than two attention components at any time. Participants were rewarded with a sweet after each session.

Pay Attention! intervention measure. As *Pay Attention!* is based on Sohlberg and Mateer's clinical model of attention (1987, 1989), it is divided into four main components; sustained, selective, alternating and divided attention (Thomson et al., 2005). Each of these components is divided into different levels within the intervention.

The first component is sustained attention which, at its first level, uses the sustained visual attention tasks of *Card Sort* and *House Search*. *Card Sort* requires participants to use various criteria to sort cards into piles. *House Search* requires participants to mark various house stimuli as targets. The second level of visual sustained attention uses *Card Flip* for which participants press a buzzer in response to target stimuli. The third level is auditory sustained attention where participants must press a buzzer in response to hearing target stimuli. Difficulty of tasks increases as the complexity of response criteria increases as well as the speed at which the participant should respond.

The second component is selective attention which, at its first level, uses *Card Sort* and *House Search*, with auditory and visual distracters respectively. The second level uses *Card Flip* with auditory distracters and uses auditory selective attention tasks.

The third component is alternating attention which, at its first level, uses *Card Sort*. The second level, consists of *House Search* and an auditory alternating attention task. Participants have to switch between two response criteria in all tasks.

The fourth component is divided attention which has one level with two main tasks. The first is the simultaneous completion of two visual tasks while the second is the simultaneous completion of an auditory/visual task.

PG and TG procedure. For the PG, volunteers were recruited take play sessions. Volunteers were UCT psychology undergraduate students who were awarded research points for their participation as part of the psychology department's Student Research Participation Programme (SRPP). Volunteers spent the same amount of time playing with the PG participants as the researchers spent implementing the intervention with the IG participants. The games played aimed to tap physical abilities as opposed to cognitive abilities, such as attention. This controlled stimulating the PG's attention which could cause confounding factors to arise. Therefore, games such as hop-scotch, jump rope, and hula-hooping were played. Neither researchers nor volunteers spent any time with TG participants during this 10-week period.

After 10-weeks all participants underwent post-testing. The same neuropsychological tests administered at pre-testing were re-administered, with the exception of the WASI subtests as the general intellectual functioning of participants is not expected to change. IG participants were compensated R300 for their participation. All participants were again compensated R50 for travelling expenses. These results will be made available to participants' parents, teachers and principals of participating schools.

Data Analysis

In neuropsychological assessment it is important to analyze individual change pre-testing to post-testing and to assess whether this change is statistically significant or not (Parsons, Notebaert, Shields, & Guskiewicz, 2009). In order to determine whether the intervention contributes to statistically significant changes observed in individual participants the *Reliable Change Index* (*RCI;* Jacobson & Truax, 1991) was used. The individual RCI scores of participants were analyzed within their age bands across the different groups to detect any significant changes, using a reliable change generator, developed by Devilly (2004). This clinical tool is based on the original Jacobson and Truax (1991) RCI model and generates three levels of change at different confidence intervals: the 68.26%, 95% and the 99% confidence intervals. The data input into the program includes pre- and post-test scores, the subtest's test-retest reliability coefficient and the standard deviation of the normative sample for that subtest. An RCI score of above 1.96 is considered a significant difference between pre- and post-test scores. These criteria equate to a 95% confidence interval.

The RCI is based on the following formula:

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

where s is the standard deviation and rxx is the test-retest reliability coefficient. The standard error of difference (*SEd*) gives the change from the time of pre-test to the time of post-test, using the test-retest reliability coefficient. This measure indicates whether these scores have changed more than fluctuations on tests of imprecise measurement (Jacobson & Traux, 1991).

Results

Sample

The parent questionnaire and asset index was used to identify demographic information and level of SES of all participants (Appendix A). Participants in the IG were matched as closely as possible to their controls on age, gender and race. All participants were 'coloured' and able to converse in English.

Age. Ages of participants at the time of pre-testing are presented in Table 3. Their ages ranged from 7.4 years to 13.11 years (M = 9.59, SD = 1.88). Within each age band participants were matched on age as closely as possible. The age bands of all participants were: 7.4- 7.10 years, 8.3- 8.10 years, 9- 9.10 years, 10.1- 10.4 years, and 12.6- 13.11 years.

Gender. The ratio of females to males was 3 to 12. Participants were matched on gender; therefore all females were in the first age band (7.4- 7.10 years) while all the other age bands had male participants (Table 3).

Table 3

Matched Age and Gender for Participants in each Group

Intervention Group		Play Group		Test-only Group	
Age	Gender	Age	Gender	Age	Gender
7.10	F	7.6	F	7.4	F
8.10	M	8.7	M	8.3	M
9.5	M	9.0	M	9.10	M
10.1	M	10.2	M	10.4	M
12.6	M	12.7	M	13.11	M

Note. Age is given in years and months. 'F' is abbreviated for female and 'M' is abbreviated for male.

Asset index. The asset index is used to indicate the level of SES. Table 4 shows the number of household items participants have in working order in their homes. Some responses were consistent across all participants, for instance, all indicated that they do not make use of domestic services in their homes. Overall the number of assets in our sample ranged from 9- 16. Eight participants had assets in the high category (15-17), six in the medium category (8-14) and none in the low (1-7) category.

Household income. Annual household income is an important determinant of SES level. Twelve of the fifteen participants indicated a household income in categories 2, (R1- R5 001), 3 (R5 001- R25 000), and 4 (R25 000- R 100 000). One participant indicated a household income in category 1 (R0), and two participants indicated a household income in category 5 (R100 000+; Table 4).

Parental education. The most frequent level of education for both fathers and mothers was category 4 (8-11 years/some secondary education). This was followed by category 5 (12 years/secondary education) for fathers and mothers as well (Table 4).

Parental employment. Most fathers indicated employment in category 4 (clerical and sales, technicians), followed by category 5 (skilled manual having had training). Most mothers indicated category 8 (homemakers), followed by category 6 (semi-skilled; Table 4).

Table 4

Demographic Information of Participants as per the Parent Questionnaire and Asset Index

Variable	Age Bands				
	7.4- 7.10 years	8.3- 8.10 years	9- 9.10 years	10.1- 10.4 years	12.6- 13.11 years
Sex (male: female)	0:3	3:0	3:0	3:0	3:0
Number of assets (IG:PG:TG)	16:16:13	14:15:16	12:16:16	14:15:11	15:9:CNC
Annual household income (IG:PG:TG)	3:4:5	4:3:4	2:4:1	3:4:2	4:3:5
Father's education (IG:PG:TG)	5:4:6	6:5:4	5:3:4	5:4:CNC	4:4:6
Mother's education (IG:PG:TG)	4:5:4	5:6:5	4:4:4	4:4:4	2:4:5
Father's employment (IG:PG:TG)	2:4:2	4:4:5	4:7:5	5:7:CNC	CNC:8:1
Mother's employment (IG:PG:TG)	8:5:8	4:2:8	6:7:7	6:4:1	6:8:8

Note. Annual household income, parental employment, and parental education are represented as categorized in the parent questionnaire and asset index. CNC is abbreviated for 'could not calculate' due to missing data.

Neuropsychological Measures

General intellectual functioning.

WASI.

VIQ. Both the 7.4- 7.10 year and 8.3- 8.10 year age bands scored within the ‘average’ range according to the qualitative descriptions of WASI IQ scores (Appendix H; Table 5). However, the PG participant in the 8.3- 8.10 year age band is an outlier as he scored in the higher bound of ‘average’ while the other participants scored within the ‘low average’ range.

The 9- 9.10 year and 12.6- 13.11 year age bands scored within the ‘borderline’ range (Table 5). However, the 12.6- 13.11 year IG participant scored within the upper bound of ‘low average’. The 10.1- 10.4 year age band scored within the ‘low average’ range (Table 5). An outlier, the PG participant, may be elevating the mean of this age band as his score was ‘average’ while the other participants’ scores were in the ‘borderline’ range.

PIQ. Apart from the 9- 9.10 year age band scoring within the ‘borderline’ range, all age bands scored within the ‘low average’ range (Table 5). Although within the 7.4- 7.10 year and 8.3- 8.10 year age bands both the PG participants scored within the ‘borderline’ range. The 10.1- 10.4 year age band has considerable score variability as the PG participant scored within the ‘average’ range, the IG within ‘low average’, and the TG within ‘borderline’.

FSIQ. The 7.4- 7.10 year age band scored within the ‘average’ range. However, the 8.3- 8.10 year, 10.1- 10.4 year, and the 12.6- 13.11 year age bands all fell within ‘low average’, and the 9- 9.10 year age band fell within ‘borderline’ (Table 5). An outlier, in the 10.1- 10.4 year age band, is elevating the mean to ‘low average’ as the PG participant scored within the ‘average’ range while the other participants scored within the ‘borderline’ range. A similar case for the the 12.6- 13.11 year IG participant is found.

Table 5

Age band and Overall Means and Standard Deviations for General Intellectual Functioning

Scale	Age bands (*n* = 3 per group)					Overall (*N* = 15)
	7.4- 7.10 year	8.3- 8.10 year	9- 9.10 year	10.1- 10.4 year	12.6-13.11 year	
VIQ	109 (3.61)	93.67 (12.42)	75.33 (2.08)	86.67 (15.04)	79 (9.17)	88.73 (14.89)
Description	Average	Average	Borderline	Low average	Borderline	Low average
PIQ	82 (3.61)	80.67 (3.51)	77.67 (7.37)	85.33 (7.09)	87.67 (4.04)	88.67 (5.84)
Description	Low average	Low average	Borderline	Low average	Low average	Low average
FSIQ	94.67 (4.73)	85.33 (5.13)	74 (3.61)	84.67 (12.42)	81 (7)	83.93 (9.28)
Description	Average	Low average	Borderline	Low average	Low average	Low average

Note. The means are presented with standard deviations in parentheses. Description of scores is according to the qualitative WASI IQ descriptions (Appendix H).

Attention, working memory, and inhibition.

Following are two sections describing the changes seen for the groups and age bands from pre- to pot-test. The first section only refers to group changes as seen descriptively which are not necessarily significant, while in the second section only the individual significant improvements will be discussed with regards to the age bands.

Descriptive statistics. The descriptive statistics for each score from the subtests of the NEPSY-II, CMS, and TEA-Ch used to assess participants at the pre- and post-tests are presented in Table 6. However, the *Creature counting* subtest measuring attentional control/switching is not included as most participants did not achieve the minimum accuracy score. Thus, *Opposite worlds,* an alternative measure of attentional control/switching, is included.

Sustained attention. In the measure of sustained attention, *Score!*, the PG's scores decreased in performance from pre- to post-test while both the IG and TG's scores showed improvements from pre- to post-test.

Selective attention. All groups' scores improved from pre- to post-test for both the selective attention subtests.

Attentional control/switching. In the attentional control/switching measure, *Opposite worlds,* the IG's scores decreased from pre- to post-test while the PG and TG's scores improved.

Sustained/divided attention. The sustained/divided attention subtest, *Sky search: dual task,* saw the IG's scores decreasing from the pre- to post-test. However, an improvement was found for the PG and TG's scores.

Inhibition. All the groups showed an increase in performance for all the inhibition subtests from pre- to post-test.

Working memory. In the first subtest of working memory, *Numbers: forward,* the IG's scores stayed the same while the PG and TG's scores decreased. The IG and PG's scores improved on the second subtest *Numbers: backward,* however, the TG's scores decreased.

Table 6

Group and Overall Means and Standard Deviations for each Subtest score at Pre-test and Post-test

Cognitive Function	Specific Subtest Score	Groups (*n* = 5 per group)						Overall (*N* = 15)	
		Intervention Group		Play Group		Test-only Group			
		Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Sustained attention	Score!	7.2 (1.29)	9.6 (2.61)	11.4 (1.82)	7.8 (3.03)	6.2 (3.49)	8.8 (2.59)	8.27 (3.31)	8.73 (2.66)
Selective attention	Sky search: time per target	6 (3.24)	10.2 (2.28)	5.8 (3.27)	6.8 (3.42)	5.2 (2.49)	10 (1.58)	5.67 (2.82)	9 (2.85)
	Sky search: attention score	6.8 (2.59)	11.4 (2.88)	7 (4.21)	7.2 (3.96)	5.8 (2.77)	11 (2.35)	6.53 (3.04)	9.87 (3.5)
Attentional control/ Switching	Opposite worlds	6.6 (4.04)	6.2 (2.39)	2.4 (2.59)	6.4 (3.85)	5.2 (3.11)	7.2 (3.63)	5.33 (3.22)	6.6 (3.14)
Sustained/ Divided Attention	Sky search: dual task	8.6 (2.61)	6.6 (2.07)	5.4 (2.88)	8 (2.12)	6.8 (1.92)	7.8 (1.64)	6.93 (2.69)	7.47 (1.92)
Inhibition	Inhibition: completion time	9.2 (2.86)	11.6 (3.05)	7.6 (3.05)	10 (2.83)	6.75 (3.1)[a]	8.75 (1.89)[a]	7.93 (2.89)[b]	10.21 (2.75)[b]
	Inhibition: combined scaled score	8.2 (1.64)	12 (1.87)	6.6 (4.72)	10.8 (2.77)	7.2 (5.07)[a]	8 (3.74)[a]	7 (3.31)[b]	10.5 (3.18)[b]
	Switching: completion time	10 (2.45)	11.6 (1.95)	9.2 (2.28)	9.6 (1.82)	7.4 (2.51)	9.8 (1.3)	8.87 (2.50)	10.33 (1.8)
	Switching: combined scaled score	8 (2.35)	10.8 (1.3)	10.2 (2.49)	11.6 (2.07)	6 (2.55)	8 (2.45)	8.07 (2.89)	10.13 (2.45)
	Inhibition: total errors	6.8 (2.68)	11 (1.22)	7.8 (4.76)	11.4 (3.65)	5.6 (4.22)	5.8 (4.09)	6.73 (3.81)	9.4 (4)
Working Memory	Numbers: forward	8.6 (1.52)	8.6 (1.52)	8 (2.74)	7.4 (2.51)	7.6 (3.29)	6.6 (3.21)	8.07 (2.46)	7.53 (2.47)
	Numbers: backward	9.8 (4.32)	10.6 (3.78)	6 (2.92)	7.2 (3.35)	9.8 (3.63)	7.6 (1.95)	8.53 (3.87)	8.47 (3.29)

Note. The means are presented with standard deviations in parentheses.

[a] *n* = 4 due to missing data. [b] *n* = 14 due to missing data.

RCI results. The results from the RCI analyses of individual change on subtest scores between pre- and post-tests, are presented within the matched age bands. Initially statistically significant improvements from the RCI analyses are presented for each individual in the each age band. The 95% confidence interval was used to indicate significant change, in other words, scores from pre- to post-test needed to improve by at least 1.96 standard deviations in order to demonstrate significant improvement. Following this, subtest improvements only seen in the IG and not in the other two groups are presented. This improvement is determined by significant change only found for the IG participant in the age band and not for their matched PG or TG participant. RCI analyses on the *Score!* subtest from the TEA-Ch could not be conducted as the test-retest reliability coefficient has not been published.

7. 4- 7.10 year age band. The IG participant showed significant statistical change in *Sky search: time per target*, *Inhibition: completion time, Inhibition: combined scaled score,* and *Switching: combined scaled score.* Similarly, significant change was also seen for the PG participant in *Sky search: dual task* and *Inhibition: combined scaled score*. The only significant change for the TG participant was for *Sky search: dual task* (Table 7). Therefore, improvements limited to the IG, were found for *Sky Search: time per target, Inhibition: completion time,* and *Switching: combined scaled score.*

Table 7

Change in the 7.4- 7.10 year Age band from Pre- to Post-test for each Subtest score

Cognitive Function	Specific Subtest	IG Participant	PG Participant	TG Participant
Selective attention	Sky search: time per target	ΔΔ	Δ	-
	Sky search: attention score	-	Δ	-
Attentional control/ Switching	Opposite worlds	-	-	Δ
Sustained/ Divided attention	Sky search: dual task	-	ΔΔΔ	ΔΔΔ
Inhibition	Inhibition: completion time	ΔΔ	-	Δ
	Inhibition: combined scaled score	ΔΔΔ	ΔΔΔ	-
	Switching: completion time	Δ	-	Δ
	Switching: combined scaled score	ΔΔΔ	Δ	Δ
	Inhibition: total errors	Δ	Δ	-
Working Memory	Numbers: forward	Δ	-	-
	Numbers: backward	-	-	-

Note. Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

8. 3- 8.10 year age band. The IG participant showed significant change in *Sky search: time per target* and *Sky search: attention score*. While the PG participant had no significant change in any of the subtests, the TG participant showed the same significant change as the IG participant (Table 8). Therefore, no improvements were found solely for this IG participant.

Table 8

Change in the 8.3- 8.10 year Age band from Pre- to Post-test for each Subtest score

Cognitive Function	Specific Subtest	IG Participant	PG Participant	TG Participant
Selective attention	Sky search: time per target	ΔΔΔ	-	ΔΔΔ
	Sky search: attention score	ΔΔ	-	ΔΔΔ
Attentional control/ Switching	Opposite worlds	-	-	Δ
Sustained/ Divided attention	Sky search: dual task	-	-	-
Inhibition	Inhibition: completion time	Δ	-	-
	Inhibition: combined scaled score	Δ	-	-
	Switching: completion time	-	-	Δ
	Switching: combined scaled score	-	Δ	Δ
	Inhibition: total errors	Δ	-	-
Working Memory	Numbers: forward	-	-	-
	Numbers: backward	Δ	-	-

Note. Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

9- 9.10 year age band. The IG participant showed significant change for *Sky search: time per target, Sky search: attention score,* and *Numbers: backward*. The PG participant significantly improved in *Sky search: dual task*, *Inhibition: combined scaled score, Switching: combined scaled score,* and *Inhibition: total errors.* Significant change was found for *Sky search: time per target* and *Sky search: attention score* for the TG participant (Table 9). Therefore, improvement limited to the IG participant was only found for *Numbers: backward.*

Table 9

Change in the 9- 9.10 year Age band from Pre- to Post-test for each Subtest score

Cognitive Function	Specific Subtest	IG Participant	PG Participant	TG Participant
Selective attention	Sky search: time per target	ΔΔΔ	-	ΔΔΔ
	Sky search: attention score	ΔΔΔ	-	ΔΔΔ
Attentional control/ Switching	Opposite worlds	-	Δ	-
Sustained/ Divided attention	Sky search: dual task	-	ΔΔΔ	Δ
Inhibition	Inhibition: completion time	-	Δ	CNC[a]
	Inhibition: combined scaled score	-	ΔΔΔ	CNC[a]
	Switching: completion time	-	-	Δ
	Switching: combined scaled score	Δ	ΔΔΔ	Δ
	Inhibition: total errors	-	ΔΔΔ	-
Working Memory	Numbers: forward	-	-	-
	Numbers: backward	ΔΔΔ	-	-

Note. Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

[a]CNC is abbreviated for 'could not calculate' due to missing data.

10.1- 10.4 year age band. The IG participant significantly improved in *Sky search: time per target, Sky search: attention score*, and *Switching: combined scale score*. The PG participant significantly improved in *Opposite worlds*. The TG participant showed significant improvement for *Sky search: time per target, Sky search: attention score*, *Opposite worlds,* and *Inhibition: combined scaled score* (Table 10). Therefore, improvement exclusive to the IG participant was for *Switching: combined scale score*.

Table 10

Change in the 10.1- 10.4 year Age band from Pre- to Post-test for each Subtest score

Cognitive Function	Specific Subtest	IG Participant	PG Participant	TG Participant
Selective attention	Sky search: time per target	ΔΔ	-	ΔΔΔ
	Sky search: attention score	ΔΔΔ	-	ΔΔΔ
Attentional control/ Switching	Opposite worlds	-	ΔΔΔ	ΔΔ
Sustained/ Divided attention	Sky search: dual task	-	Δ	-
Inhibition	Inhibition: completion time	-	-	Δ
	Inhibition: combined scaled score	-	-	ΔΔΔ
	Switching: completion time	-	-	Δ
	Switching: combined scaled score	ΔΔ	-	Δ
	Inhibition: total errors	Δ	-	-
Working Memory	Numbers: forward	-	-	-
	Numbers: backward	-	Δ	-

Note. Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

12.6- 13.11 year age band. Significant improvements for the IG participant were for *Inhibition: combined scaled score, Switching: combined scaled score*, and *Inhibition: total errors*. The PG participant significantly improved in *Opposite worlds, Inhibition: completion time,* and *Inhibition: combined scaled score*. The TG participant significantly improved in *Sky search: time per target* and *Sky search: attention score* (Table 11). Therefore, the only exclusive improvement for the IG participant was found for *Inhibition: total errors*.

Table 11

Change in the 12.6- 13.11 year Age band from Pre- to Post-test for each Subtest score

Cognitive Function	Specific Subtest	IG Participant	PG Participant	TG Participant
Selective attention	Sky search: time per target	Δ	-	ΔΔ
	Sky search: attention score	Δ	-	ΔΔ
Attentional control/ Switching	Opposite worlds	Δ	ΔΔ	-
Sustained/ Divided attention	Sky search: dual task	-	-	-
Inhibition	Inhibition: completion time	-	ΔΔ	-
	Inhibition: combined scaled score	ΔΔΔ	ΔΔΔ	-
	Switching: completion time	Δ	-	-
	Switching: combined scaled score	ΔΔΔ	-	-
	Inhibition: total errors	ΔΔ	-	-
Working Memory	Numbers: forward	Δ	-	-
	Numbers: backward	-	Δ	-

Note. Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

Overall the IG participants had 15 significant improvements. These were found for: *Sky search: time per target, Sky search: attention score, Inhibition: completion time, Inhibition: combined scaled score, Switching: combined scaled score, Inhibition: total errors,* and *Numbers: backward*. However, the PG had 10 significant improvements. These were for: *Opposite worlds*, *Sky search: dual task*; *Inhibition: completion time, Inhibition: combined scaled score, Switching: combined scaled score*, and *Inhibition: total errors*. Similarly, the TG had 11 significant improvements which were for: *Sky search: time per* *target, Sky search: attention score*, *Opposite worlds, Sky search: dual task*; *Inhibition: combined scaled score.*

Therefore, within each age band there were limited, exclusive IG improvement from pre- to post-test. The IG participant in the 7.4- 7.10 year age band had improvements for *Sky Search: time per target, Inhibition: completion time,* and *Switching: combined scaled score*. No improvements limited to the IG participant were found in the 8.3- 8.10 year age band, however, the 9- 9.10 year IG participant had one for *Numbers: backward.* The 10.1- 10.4 year IG participant showed improvement for *Switching: combined scale score* while the 12.6- 13.11 year IG participant had two for *Switching: combined scaled score,* and *Inhibition: total errors*.

Behavioural Measures.

The BRIEF includes eleven indexes that characterize executive functioning. Descriptive change for each group and index are presented below (Table 12).

Descriptive statistics.

Inhibit. An improvement from pre- to post-test was found for the PG and IG's scores while the TG's decreased.

Shift. An improvement on this index is seen for the TG's scores while the IG's stayed approximately the same and the PG's scores decreased.

Emotional control. IG's scores decreased on this index, the PG's increased and the TG's remained approximately the same.

Initiate. All groups show a decrease on this index.

Working memory. The PG's scores had a slight increase while all other groups' scores decreased on this index.

Plan/organize. All groups' scores decreased on this index.

Organization of materials. The IG and TG's scores slightly increased while the PG's decreased.

Monitor. The IG's scores increased from pre- to post-test while the PG and TG's scores decreased.

Behavioural regulation (BRI). The IG and TG's scores are fairly constant, whereas the PG's increased.

Metacognition (MI). All groups' scores decreased on this index.

Global executive composite (GEC). The IG's scores increased whereas the PG and TG's scored decreased.

Table 12

Descriptive statistics for Pre-test and Post-test T-scores on the BRIEF Parent Form

Variable	Group (*n* = 5 per group)						Overall (*N* = 15)[a]	
	Intervention Group		Play Group		Test-only Group[a]			
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Inhibit	55.2 (13.7)	54.6 (12.4)	52.6 (11.1)	53.8 (13.9)	48.5 (9.7)	46.3 (13.5)	52.4 (11.2)	51.9 (18.1)
Shift	52.8 (12.9)	52.6 (11.3)	49.2 (10.2)	48.4 (11.2)	45.8 (10.8)	49 (11.4)	49.5 (10.9)	50 (10.6)
Emotional control	58.4 (12.2)	57.8 (14.7)	45.8 (10.7)	47.4 (9.3)	52.8 (7.2)	52.8 (6.7)	52.3 (11.1)	52.6 (11.2)
Initiate	52 (9.3)	50 (13.7)	52.6 (12.1)	47.6 (7.8)	50.5 (60.7)	45.3 (9.4)	51.8 (11.6)	47.8 (10)
Working memory	50.4 (11.1)	48.2 (8.1)	50 (11.1)	50.2 (10.6)	50.8 (19.1)	45.8 (13.1)	50.4 (12.6)	48.2 (9.8)
Plan/organize	49.2 (10.2)	48.2 (11.3)	47.4 (12)	45.4 (8.7)	51.3 (11.3)	49 (9.1)	49.1 (10.4)	47.4(9.2)
Organization of materials	50.2 (10.3)	51 (10.6)	48.8(11.4)	47.6 (8.3)	39.8 (7.3)	40 (9.1)	46.7 (10.3)	46.6 (9.8)
Monitor	49.8 (12.1)	50.8 (10.6)	47 (13.8)	46.4 (11.7)	49.5 (18.1)	46.5 (13.2)	48.7 (13.4)	48 (11)
BRI[b]	56.8 (14.9)	56.4 (14.5)	49.4 (8.7)	50.2 (8.6)	49.5 (9.5)	49.5 (10.9)	52.1 (11.2)	52.2 (11.2)
MI[c]	55 (10.4)	49.6 (12.2)	49 (12.2)	47.6 (11.3)	55 (22.1)	44.5 (11.8)	52.9 (14.1)	47.4 (11.1)
GEC[d]	52.8 (13.9)	56 (11.1)	49 (11.3)	48.6 (11.3)	48.8 (14.2)	46.3 (12)	50.3 (12.2)	50.6 (11.3)

Note. The means are presented with standard deviations in parentheses.

[a]The means and standard deviations were calculated using *N* = 14 due to missing data. [b]BRI: Behavioural Regulation Index is the sum of Inhibit, Shift and Emotional Control. [c]MI: Metacognition Index is the sum of Initiate, Working Memory, Plan/Organize, Organization of Materials and Monitor. [d]GEC: Global Executive Composite is the sum of BRI and MI.

RCI results.

The results from the RCI analyses of individual change between pre- and post-test on the BRIEF indices are presented within the matched age bands. The inconsistency scale was used to detect inconsistent responses on the pre- and post-test parent forms. This forms part of the BRIEF scoring protocol.

7.4- 7.10 year age band. Only the TG participant had a significant increase in shift, plan/organize and *MI* (Table 13).

Table 13

Change in the 7.4- 7.10 year Age band from Pre- to Post-test for the BRIEF indices

BRIEF Index	IG participant	PG participant	TG participant
Inhibit	-	-	-
Shift	-	-	ΔΔΔ
Emotional control	-	Δ	-
Initiate	-	Δ	-
Working memory	-	-	Δ
Plan/Organize	-	-	ΔΔΔ
Organization of materials	-	-	Δ
Monitor	-	-	Δ
BRI	-	-	-
MI	-	-	ΔΔ
GEC	-	-	Δ

Note: Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

8.3- 8.10 year age band. None of these participants showed a significant increase on the indices, although the TG participant's results are 'questionable' on the inconsistency scale (Table 14).

Table 14

Change in the 8.3 year- 8.10 year Age band from Pre- to Post-test for the BRIEF indices

BRIEF Index	IG participant	PG participant	TG participant
Inhibit	-	-	-
Shift	-	Δ	-
Emotional control	-	-	Δ
Initiate	-	-	-
Working memory	-	-	-
Plan/Organize	-	-	-
Organization of materials	-	-	-
Monitor	Δ	-	-
BRI	-	-	Δ
MI	Δ	-	-
GEC	-	-	-

Note: Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

9- 9.10 year age band. No participants showed any significant improvements from pre-test to post-test on any of the indices (Table 15).

Table 15

Change in the 9- 9.10 year Age band from Pre- to Post-test for the BRIEF indices

BRIEF Index	IG participant	PG participant	TG participant
Inhibit	-	-	-
Shift	-	-	-
Emotional control	-	-	-
Initiate	-	-	-
Working memory	-	-	-
Plan/Organize	-	-	-
Organization of materials	-	-	-
Monitor	-	-	-
BRI	-	-	-
MI	-	-	-
GEC	-	-	-

Note: Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

10.1- 10.4 year age band. None of the participants show any significant improvements. Although the PG participant showed no significant change, his results are 'questionable' on the inconsistency scale (Table 16).

Table 16

Change in the 10.1- 10.4 year Age band from Pre- to Post-test for the BRIEF indices

BRIEF Index	IG participant	PG participant	TG participant
Inhibit	-	-	-
Shift	-	-	-
Emotional control	-	-	-
Initiate	-	-	-
Working memory	-	-	-
Plan/Organize	-	-	-
Organization of materials	-	-	-
Monitor	-	Δ	-
BRI	-	-	-
MI	-	-	-
GEC	-	-	-

Note: Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.

12.6- 13.11 year age band. Only the IG participant had a significant increase, found on *GEC*. Although the PG participant showed no significant change, his results are 'questionable' on the inconsistency scale. Results for the TG participant could not be calculated due to missing data (Table 17).

Table 17

Change in the 12.6- 13.11 year Age band from Pre- to Post-test for the BRIEF indices

BRIEF Index	IG participant	PG participant	TG participant[a]
Inhibit	-	-	CNC
Shift	-	-	CNC
Emotional control	-	-	CNC
Initiate	-	-	CNC
Working memory	-	-	CNC
Plan/Organize	-	-	CNC
Organization of materials	-	-	CNC
Monitor	-	Δ	CNC
BRI	-	-	CNC
MI	-	-	CNC
GEC	ΔΔΔ	-	CNC

Note: Δ change at the 68.26% confidence interval, ΔΔ change at the 95% confidence interval, ΔΔΔ change at the 99% confidence interval.
[a] CNC is abbreviated for 'could not calculate' due to missing data.

Discussion

The current study's aim was to investigate whether the attentional abilities of children from low-SES backgrounds could be improved by implementing the attention-training intervention, *Pay Attention!* Fifteen children were randomly assigned to one of three groups; the IG, PG, or TG. Neuropsychological measures were used to establish baseline attentional functioning and a parental behavioural measure was used to determine participants' behavioural functioning. Both were administered at pre- and post-test. It was hypothesised that low-SES children receiving the *Pay Attention!* intervention (IG) would show greater improvements in their attentional abilities from pre- to post-test compared to those who spent an equal amount of play-time with a researcher (PG) and compared to those who did not receive either (TG).

Sample Variation

Participants were matched as best as possible within each age band on race, language, SES, and age. However, as the schools were used as a proxy for participants' SES, variation was found in the sample for annual household income and the asset index. For example, in the 7.4-7.10 year age band household income for the TG participant was R 100 001+ while the other two participants were between R 5001-R 100 000. A similar pattern was seen in the 12.6- 13.11 age band. Another outlier was found in the 9- 9.10 year age band as household income for the TG participant was R 0 while for the PG participant it was R 25 000-R

100 000 and for the IG participant, R 1-R 5000. Although participants seemed fairly matched on the asset index, 8 were in the high and 6 in the medium categories, the index may not have captured the asset variation between the groups accurately. Possible ceiling effects may have occurred in the high annual household income outliers leading to an under representation of their assets. Thus, within the age bands and across the groups participants were not perfectly matched, leading to comparisons between participants where some were of higher-SES than others. Therefore, even though we controlled for quality time spent with researchers (PG) and practice effects (TG), SES was not as stringently controlled. Therefore, the variation in SES may be a confounding reason or mediator for change seen in the sample.

Although *Pay Attention!* was designed for children up to 11 years of age, this study included children in the 12 year old age band due to its affiliation with a larger research project. Although most participants were matched within at least 10 months, a 13.11 year old participant (TG) was included in the 12.6- 13.11 year age band due to the incorrect birth date given at pre-test. This is problematic due to the developmental trajectory of attention as executive attentional abilities have been found to develop during this age group (Klenberg et al., 2001; Vakil et al., 2009). Thus this participant was not the ideal comparison to those in his age band.

Multiple studies have found correlations between poor cognitive performance and low-SES children (Desert et al., 2009; Hackman & Farah, 2009; Mezzacappa, 2004; Sarsour et al., 2011; Turkheimer et al., 2003). The current study supported these findings as most participants scored at or below ‘low average’ in the attention subtests, according to the TEA-Ch qualitative score descriptions (Appendix I). A similar trend is seen for the working memory subtest, *Numbers: backward,* and the inhibition subtests, where many participants scored ‘borderline’ and below, according to the qualitative descriptions of CMS and NEPSY-II scores, respectively (Appendix J and K). As none of these tests were normed in South Africa, these findings should be interpreted with caution.

Similarly, 66.67% of all participants had a WASI FSIQ of below ‘average’. However, all the 7.4- 7.10 year participants as well as the TG participants from the 8.3- 8.10 year and 10.1- 10.4 year age bands, all scored within the ‘average’ to ‘high average’ range for VIQ and FSIQ. Thus, the general intellectual functioning of our sample also had a degree of variability. This may have affected the speed at which participants with a higher FSIQ adjusted to task demands in the pre- and post-tests. Moreover, general intellectual functioning could possibly mediate the effectiveness of *Pay Attention!* It is acknowledged that the WASI has not been standardised for use in South Africa, thus results are interpreted cautiously.

However, the WASI subtests correlate highly with the Wechsler Intelligence Scale for Children-Revised (WISC-R) which was successfully used in a study of South African children with TBI (Hemp, 1989).

Significant Improvements

Fifteen significant improvements for the IG were found for the following subtests: *Sky search: time per target, Sky search: attention score, Inhibition: completion time, Inhibition: combined scaled score, Switching: combined scaled score, Inhibition: total errors*, and *Numbers: backward.* These were not all improvements that were exclusive to the IG participants as particular control participants showed significant improvements on some of the same subtests. Various explanations may account for control participants' significant improvements such as, exceptionally poor performance at pre-test. Very poor pre-test scores were found in the TG participant in the 9- 9.10 year age band, as he scored 'extremely low' on *Sky search: time per target* and *Sky search: attention score*. This participant was also an outlier on SES (annual household income of R 0). Similarly the PG participant in the 12.6- 13.11 year age band, scored 'well below expected level' on *Inhibition: combined scale score.* Both these participants showed improved performance to 'average' and 'at expected level' at post-test, respectively. Both also had two of the three lowest FSIQ scores of the sample. Similar large qualitative and quantitative improvements were found for the TG participants of the 8.3- 8.10 year and the 10.1- 10.4 year age bands also leading to significant changes at the time of post-test. Therefore, these participants may be masking the true improvements in the IG of their age bands as their particularly poor performance at pre-test, perhaps due to test anxiety, lead to significant improvements at post-test. Thus, their improvements may be an example of regression to the mean. Although it is possible that these participants did show a true change, this is questionable as the majority of the other participants showed performance in qualitative categories above these participants at pre-test.

The significant improvements found in the PG and TG groups may also, however, be due to what the groups were designed to control for; practice effects and quality time. PG participants' showed most improvement on inhibition subtests, thus improvements on these subtests may be accounted for by one-on-one time spent with participants. The most change in the TG participants was found for the attention subtests. Therefore, change in these subtests may be due to practice effects, which is interesting as parallel versions of these subtests were used. It is important to note, however, that these effects were not found for all age bands.

Therefore, within most age bands limited improvements that were exclusive to at least one IG participant, were seen from pre-test to post-test in the following subtests: *Sky search: time per target, Inhibition: completion time, Switching: combined scaled score*. *Numbers: backward,* and *Inhibition: total errors*. These measures assess selective attention, inhibition and working memory. None of the IG participants' showing these changes performed particularly poorly at pre-test on these tasks. Therefore, improvements cannot be attributed to regression to the mean. However, the current study's results need to be interpreted with caution as only a few exclusive significant changes were seen in the IG as significant changes were also seen in the control groups. This leaves room for question and further investigation.

Only one IG participant showed significant improvement on the BRIEF, this participant was in the 12.6-13.11 year age band and showed significant improvement on the *GEC* index. He showed no significant changes on any of the other indices, this may be due to his *T*-scores at the time of pre- and post-testing being generally similar. This participant scored in the 'low average' for FSIQ and was not an outlier with regards to the asset index and annual household income. Thus, overall support for the generalisation of attention-training to behaviour was not found.

The IG was only trained on sustained and selective attention yet there seems to be significant change on some higher-order attentional measures, for example, the 9- 9.10 year participant for *Numbers: backward* assessing working memory. These results are in accordance with direct intervention theory that restoring basic attentional components leads to improvements in higher-order abilities relying on these (Mateer et al., 1996). Similar results were found by Kerns et al. (1999) as children with ADHD receiving *Pay Attention!* had greater improvements on basic and higher components of attention, compared to a control group. That study along with Butler and Copeland's (2002), did not find significant support for the generalisability of attention-training, which is in line with the lack of behavioural findings in the current study.

The IG participant in the 7.4- 7.10 year age band showed the most significant improvements. This may be a function of her age as the intervention is designed for younger children. The effectiveness of the intervention may also have been aided by the rapid developmental change occurring in this age band (Klimkeit et al., 2004, Vakil et al., 2009), although, only two to three months past during the course of the intervention. She may, however, also have been more receptive to attention-training as she had one of the highest FSIQ scores.

Our findings demonstrate, albeit tenuously, that *Pay Attention!* may have the potential to improve attentional abilities in low-SES paediatric populations. The intervention was most effective with the youngest participant; although, general intellectual functioning may have mediated this relationship. The current study also shows limited support for the generalisation of basic attention-training to higher attentional tasks. However, these results are somewhat inconclusive due to the variation in the sample.

Limitations and Directions for Future Research

During the implementation of this study, a number of limitations emerged. Internal validity was compromised by not using a blind component at post-testing. An independent researcher was used for the random assignment of participants to groups after pre-testing, but at the time of post-testing, researchers were aware of each participant's group. However, the IG participants were not tested by the same researcher who administered the intervention nor by the same researcher that administered the pre-test. However, control participants were tested by the same researchers and it is recognised that this may be a limitation that may have contributed to these participants feeling more at ease at the post-assessment sessions. This may also have contributed to improvements in some of the scores seen in these groups.

Possible fatigue effects may also have affected participants' performance at pre-test as testing lasted approximately 3 hours, whereas test duration was shorter during post-testing due to the exclusion of the WASI. However, participants were given as many breaks as necessary and were provided with refreshments at both pre- and post-testing.

The variability of the sample was a limitation as IG participants could not be perfectly matched with their controls due to a limited number of participants fitting the selection criteria. However, due to time constraints and limited resources researchers had to continue with the sample as it was. In addition, analysis of variance could not be computed due to lack of statistical power because of the small sample size. Thus, significant differences at pre-test and any significant group effects could not be detected.

Every intervention session was allocated 45 minutes but as it was implemented on a healthy sample of children from low-SES backgrounds less time was needed to complete each session, thus some sessions lasted approximately 25 to 30 minutes. This may have affected the intensity of attention-training. However, the number of tasks was determined by the larger study. Moreover, because the intervention was only implemented over 10-weeks and participants were only trained on sustained and selective attention tasks, had the intervention run over a longer period of time, a greater change in participants' attention may have been detected. Thus longer, more intense training sessions may be necessary to affect change in this populations' attentional ability. However, it is important to note that there is pressure to implement interventions over a shorter period of time due to costs (Butler & Copeland, 2002). Thus, although the intervention was relatively short, some significant change was still seen.

As this study was the first of its kind, there was little support in terms of infrastructure. Moreover, as it was carried out at low SES schools, limited facilities were at the researcher's disposal. Despite these constraints, the current study demonstrated that attention-training interventions can be conducted successfully in schools in this context.

As the current study lacks a longitudinal component possible lag-effects of the attention-training may not be detected as well as the degree of maintenance of attentional changes (Butler & Copeland, 2002; Slomine & Locascio, 2009). Therefore, future research should include longitudinal assessments to determine if there are significant lag-effects after attention-training as well as whether significant changes are maintained over time.

Due to the lack of support systems, PG participants had sessions with different volunteers, whereas IG participants consistently interacted with one researcher. Thus, future research should keep conditions between the IG and PG more constant, for instance, PG participants being assigned one particular volunteer for the duration of the study as the IG participants are. Furthermore, both IG and PG participants should be rewarded at the end of each session.

Despite these limitations, however, an intervention over a 10-week period was implemented successfully with children from a predominantly low-SES environment. This pilot trial of the intervention and the experience and contextual knowledge gained in the process can only serve to improve future efforts.

Practical Implications

As some significant improvements were found in the IG, this study shows that *Pay Attention!* holds potential to improve the attentional abilities of children from low-SES backgrounds. Therefore upon further supporting evidence, *Pay Attention!* could be implemented in low-SES South African schools to improve low-SES children's attentional abilities. This could facilitate an improvement in academic work as well. However, the current study did not assess whether generalisation to academic work occurred for the IG participants, an area open for future research. The current study adds to a larger body of research on attention remediation services in South Africa as it is the first study to implement attention-training in a non-clinical paediatric population.

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Appendix A: Parent Questionnaire and Asset Index

PARENT QUESTIONNAIRE AND ASSET INDEX

GENERAL INFORMATION

Full name (Parent):	
Telephone:	Work: ( ) Home: ( ) Cell:
How would you describe your ethnicity / race?	1. Black 2. Coloured 3. White 4. Asian 5. Other(specify):
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, unspedified labour, porter, unemployed)	7.	7.	7.
8. Homemaker	8.	8.	8.
9. Student, disabled, no occupation	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 center (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.

Appendix B: Letter to School 1

Dear Miss October,

Thank you for being willing to host our research at your school again this year. The letter to parents and the consent form that explains the study is attached. The ages of the children that I need to participate in this study are:

3 coloured, English speaking male children aged 9 years – 9 years 6 months

3 coloured, Eng/Afr speaking male children aged 8 years 6 months to 8 years 11 months

The children who had head injuries who we tested before were from poor socio-economic circumstances, so it would be best if we could also match these children on those criteria too please.

If you could please give the invitation letter and consent form to a few learners matching these criteria, that would be great!

Thanks so much for your help.

Kind regards,

Leigh Schrieff

Lecturer

ACSENT Lab, Dep. of Psychology

University of Cape Town

South Africa

Tel: 078 559 2997

Email: leigh.schrieff@uct.ac.za

Appendix C: Letter to School 2

Dear Miss Francis,

Thank you for being willing to host our research at your school again this year. The letter to parents and the consent form that explains the study is attached. The ages of the children that I need to participate in this study are:

3 coloured, English speaking female children aged 7 years 6 months – 7years 11 months
3 coloured, English speaking male children aged 10 years 6 months to 10 years 11 months
3 coloured, English speaking male children aged 12 years to 12 years 06 months

The children who had head injuries who we tested before were from low socio-economic circumstances, so it would be best if we could also match these children on those criteria too please.

If you could please give the invitation letter and consent form to a few learners matching these criteria, that would be great!

Thanks so much for your help.

Kind regards,

Leigh Schrieff
Lecturer
ACSENT Lab, Dep. of Psychology
University of Cape Town
South Africa
Tel: 078 559 2997
Email: leigh.schrieff@uct.ac.za

Appendix D: Western Cape Education Departmental Ethical Approval

Navrae
Enquiries **Dr A.T Wyngaard**
IMibuzo

Telefoon
Telephone **021 467 9272**
IFoni

Faks
Fax
IFeksi

Verwysing
Reference **20090428-0002**
ISalathiso

-Kaap Onderwysdepartement

ı Cape Education Department

ɪe leMfundo leNtshona Koloni

Miss Leigh Schrieff
Department of Psychology
University of Cape Town
Private Bag
Rondebosch
7700

Dear Miss Leigh Schrieff

RESEARCH PROPOSAL: THE IMPLEMENTATION AND EVALUATION OF A COGNITIVE REHABILITATION SERVICE FOR CHILDREN FOLLOWING TRAUMATIC BRAIN INJURY

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 **1 April 2011 till 30 September 2011**
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: Audrey T Wyngaard
for: **HEAD: EDUCATION**

Appendix E: Letter to Parents

30 March 2011

Dear parent / guardian,

My name is Leigh Schrieff and I am a lecturer at the University of Cape Town's Psychology Department. My students and I would like to invite your child to participate in a research study. The main purpose of this research is to investigate the effectiveness of a neuropsychological rehabilitation service for children who have experienced a head injury. This research was undertaken because of a **need of such services in South Africa**. We have already collected some of the information needed for this study with children who have had a head injury in the past. For this part of the study, however, **we need to collect information from healthy children who have not had a head injury before.**

If you allow your child to participate in this research, two sets of neuropsychological tests (for example, tests of memory and attention) will be carried out with your child, one at the beginning of the study, and one three months later. You, as the parent/caregiver, will also be asked to complete two forms so that the investigator can know more about your child's performance. The test performances will then be compared with other information that has been collected in the study. **The study will not cost you anything** and you will be compensated for any travelling expenses and for your participation.

We may also invite your child to participate in an intervention program, but we will contact you with further details about this, should we invite your child to participate in that part of the study. The form attached, gives you more details about this study. If you would like your child to participate in this study, please sign and return that form. **Please also provide your contact details so that we can get in touch with you.**

Thank you for taking the time to read this letter.

Regards,

Leigh Schrieff
Lecturer
ACSENT Lab, Dep. of Psychology
University of Cape Town
South Africa
Tel: 078 559 2997

Email: leigh.schrieff@uct.ac.za

Appendix F: Parental Consent Form

UNIVERSITY OF CAPE TOWN

DEPARTMENT OF PSYCHOLOGY

Informed Consent to for you and your child to participate in research and authorization for collection, use, and disclosure of 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 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)**

____

2. **Title of Research Study**

   The implementation and evaluation of a neuropsychological rehabilitation service following paediatric traumatic brain injury

3. **Principal Investigator and Telephone Number(s)**

   Leigh Schrieff, PhD candidate

   Department of Psychology, office 4.30

   University of Cape Town

   Contact number: 078 5592997

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 a neuropsychological rehabilitation service for children who have experienced a traumatic brain injury. This research was undertaken because of a need of such services in South Africa.

6. **What will be done if you take part in this research study?**
   Two sets of neuropsychological tests will be carried out with your child, one at the beginning of the study, and one three months later. You, as the parent/caregiver, will also be asked to complete two short forms so that the investigator can know more about your child's performance. The test performances will then be compared with other information that is collected in the study. We may also invite your child to participate in an intervention program, but we will contact you with further details about this, should we invite your child to participate in that part of the study.
7. **If you choose to participate in this study, how long will you be expected to participate in the research?**
   On two occasions you will be required to bring your child to Red Cross War Memorial Children's Hospital for testing. Each visit should last for approximately 2 hours.
8. **How many people are expected to participate in the research?**
   15
9. **What are the possible discomforts and risks for you or your child?**
   There are no known risks associated with participation in this study.
   One possible area of discomfort that you or your child may experience is that you may get tired during the testing and interview periods. You will be allowed to take breaks whenever you want to. We will also serve refreshments halfway through the assessments.
   If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigator listed on the front page of this form.

10a. What are the possible benefits to your child?

Your child may or may not personally benefit from participating in this study.
By you and your child partaking in the neuropsychological assessment, this will provide you with a deeper understanding of the functioning of your child.

10b. What are the possible benefits to others?

The information collected from these neuropsychological assessments will serve as important information that can be compared with children who have sustained traumatic brain injuries.
Additionally, this research will allow us to gather information about how healthy children perform on the administered tests. This research can then be applied to people who have

experienced a traumatic brain injury.

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

Participating in this study will not cost you anything.

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

You will be compensated for travelling costs to and from Red Cross Hospital for both testing sessions.

13a. 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.

13b. If you withdraw, can information about you and your child still be used and/or collected?

Information already collected may be used.

14. 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.

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

This information gathered from you will be demographic information and records of your responses, or your child's performance on the neuropsychological tests. 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 your 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.

16. 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 Investigator and others attached to this research project may benefit if the results of this study are presented at scientific meetings or in scientific journals. This study is being undertaken for the Principal Investigator's doctoral degree.

17. **This study has been approved by the Research Ethics Committee of the Department of Psychology at the University of Cape Town and the Western Cape Education Department.**
18. **Signatures**

As a representative of this study, I have explained to the participant's (child's) parent/guardian 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 (your signature) Date

Authorization for ________________________________ (your child's name) to participate in the study.

Relationship to child participating in the study: mother / father / legal guardian

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If you do consent to your child participating in this research, could you please provide us with your contact details so that we can contact you to tell you more about this study.

Method of contact:

Phone number: __________________________

E-mail address: ____________________________

Mailing address: ___________________________________

____

____

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

_______________ (initial) 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.

Appendix G: Assent Form for Participants

Name of Participant ("Study Subject")

____

I am going to be required to complete some tests. The person who is going to administer the tests has told me that I can stop if I am feeling tired and need to take a break, that I may end my participation at any stage during the test period, and that nobody else will be told my answers to the questions in the tests.

____ _________________

Signature of Child Date

____ _________________

Signature of Researcher Date

Appendix H: Qualitative Descriptions of WASI IQ Scores

Table 18

Qualitative Descriptions of WASI Scores

IQ Scores	Classification
130 and above	Very Superior
120 – 129	Superior
110 – 119	High Average
90 – 109	Average
80 – 89	Low Average
70 – 79	Borderline
69 and below	Extremely Low

Note. Taken from Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999).

Appendix I: Qualitative Descriptions of Tea-Ch Scores

Table 19

Qualitative Descriptions used for TEA-Ch Scores

Scaled Score	Classification
16 - 19	Very superior
14 - 15	Superior
12 - 13	High average
8 -11	Average
6 - 7	Low average
4 - 5	Borderline
1 - 3	Extremely low

Note. Taken from Red Cross Paediatric Neuropsychology Clinic.

Appendix J: Qualitative Descriptions of CMS Scores

Table 20

Qualitative Descriptions of CMS Scores

Scaled Score	Classification
16 and above	Very superior
14 - 15	Superior
12 - 13	High average
8 -11	Average
6 - 7	Low average
4 - 5	Borderline
3 and below	Impaired

Note. Taken from Children's Memory Scale (Cohen, 1997).

Appendix K: Qualitative Descriptions of NEPSY-II Scores

Table 21

Qualitative Descriptions of NEPSY-II Scaled Scores

Scaled Score	Classification
13 – 19	Above Expected Level
8 – 12	At Expected Level
6 – 7	Borderline
4 – 5	Below Expected Level
1 – 3	Well Below Expected Level

Note. Taken from NEPSY-II (Korkman, Kirk, & Kemp, 2007).