Neuropsychological Performance of Low Socio-Economic Status South African Children

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ABSTRACT

The aim of this study, as part of a larger research program, is to investigate the relationship between socio-economic status (SES), years of formal education, and neuropsychological performance in South African children. The sample for the current pilot study consisted of 16 low SES children ranging in age from 7 to 10 years who were in Grades 1-4. They were administered a neuropsychological test battery covering the domains of attention, memory and executive function. I described the performance of these children in relation to international normative standards, and then used analyses of variance to compare the performance of children in different grades. Between-group differences were investigated by means of one-way ANOVAs and proved to be nonsignificant for the most part. Results confirm that, in general and contrary to expectations, the participants performed in the low average to average range relative to international normative standards.

Keywords: Socio-economic status (SES); neuropsychological performance; memory; attention; executive function; children; education.

Socio-economic status (SES) plays a significant role in neuropsychological performance, with several empirical research studies reporting that low SES children score worse than do high SES children on cognitive tasks (Ardila, 1995; Bjorklund & Weiss, 1985; Bowey, 1995; Magnuson and Duncan, 2006; Walker, Petrill, & Plomin, 2005). Defining SES, however, is difficult due to the variety of factors researchers focus on when studying this topic. For instance, Magnuson and Duncan (2006) note that educational, financial and social resources, as well as more macro-level factors such as culture and worldviews, are often grouped under the collective term 'socio-economic status.' They argue, however, that the more proximal factors, particularly family and childrearing environments, are the critical link between a family's SES and a child's wellbeing. The emphasis is therefore on gradients in social and economic resources, rather than cultural underpinnings of categorical social classes. They highlight four key components of parental SES that are particularly relevant for the child's wellbeing: income, education, family structure and neighbourhood conditions. In this paper, I define SES following these parameters.

Internal cognitive processes and observable brain structures naturally play key roles in neuropsychological test performance. Observed SES-related differences in neuropsychological test performance are, therefore, not exclusively associated with external variables such as lack of resources, lack of opportunities or low quality of education. The role of these external variables is, however, significant in accounting for the variance across SES groups. Numerous researchers have investigated the differences between the performances of high and low SES children on various neuropsychological tests, including those assessing cognitive styles and problem-solving skills (Waber, Carlson, Mann, Merola, & Moylan, 1984), phonological sensitivity (Bowey, 1995), classification and recall (Bjorklund & Weiss, 1985), and general academic achievement (Walker, Petrill, & Plomin, 2005). Results from these studies, which are reviewed in more detail below, are consistent in showing that high SES children perform better than low SES children, even when IQ is statistically controlled.

Bowey (1995) found that differences in phonological sensitivity and differences in word-level reading skills were associated with SES: Low SES children performed worse than high SES children. She suggested that this between-group difference may arise because low SES children do not get adequate exposure to the sound patterns and phonological structures of spoken language in their homes.

Studies on the influence of SES on classification and free recall have found that SES does not influence recall as such, but rather that the classification styles children use in sort and recall tasks are influenced by SES. For instance, Jensen and Frederikson (1973) found differences between high and low SES children when they were prompted to organize lists according to taxonomic groups: Low SES children recalled significantly less than did high SES children, a result which indicates that differences in free-recall performance are most apparent when children are predisposed to organize lists (as high SES children are apparently more apt to do). These researchers argue that low SES children are less familiar with the adult-defined taxonomic categories found in middle- and high-SES homes as result of parents' education level.

Likewise, Bjorklund and Weiss (1985) found evidence of SES differences in the relations children use to form categories. They noted that low SES children make the shift from complementary classification (e.g., being aware of the fact that dogs, cats and horses are alike because they all have four legs and a tail) to taxonomic classification (e.g., knowing that dogs, cats and horses are all "animals") later than do children from middle- and high-SES homes. They also point out that if there is no match between the knowledge structures of low SES children and the learning material they are given, greater cognitive effort is required in order to successfully complete tasks. Low SES children therefore often perform worse on neuropsychological and academic tasks purely because their knowledge structures differ from their high SES peers (with highly educated parents) and their "middle-class, college-educated teacher" (1985, p. 127). However, Rosselli and Ardila (2003) argue that children of parents with low levels of education and low SES cannot be assumed to be somehow deprived of knowledge or skills; it is more accurate to assume that they have developed different types of learning than people with higher levels of education.

Waber et al. (1984) similarly found that children employ different cognitive styles in problem-solving situations according to their different SES backgrounds. These researchers conducted tests to examine the efficiency of processing stimuli presented to the right visual field-left hemisphere (RVH-LH) and left visual field-right hemisphere (LVF-RH) of children from high and low SES backgrounds. Results showed marked differences: High SES children showed LH advantage more than did low SES children. The authors argue that these group differences reflect SES-related variation in the nature of information processing in the two hemispheres: High SES children prefer a more analytic approach in problem-solving (associated with the LH), whereas low SES children use more global processes (associated with the RH).

General academic achievement is influenced by all of the abovementioned factors because it is in the school environment where all these skills (problem-solving, recall, classification, etc.) are applied, and also where difficulties with their application are most readily noticeable. Additionally, however, one study (Walker et al., 2005) showed that school characteristics (e.g., class size, presence of free school meals, authorized or unauthorized absences, percent of students classified as ethnic minority, student-teacher ratio, etc.) also have a significant association with academic achievement. The same study showed that when school characteristics were statistically controlled, the correlation of SES with academic achievement showed a modest decrease in comparison to the substantial reduction in correlation when SES was controlled. It can therefore be argued that SES is not exclusively responsible for the difficulties in skills application – SES has a broader influence on a child’s learning environment than school characteristics, as it affects both home and school environments.

School environments, as impacted by SES, in turn impact on the quality and level of education received by the learner. Quality and level of education, in turn, have an important impact on neuropsychological test performance. Shuttleworth-Edwards, Kemp et al. (2004) argue that poor quality of education is associated with lowering of both Verbal and Performance IQ on the Wechsler Adult Intelligence Scale – Third Revision (WAIS-III; Wechsler, 1997). Similar findings were presented by Shuttleworth-Edwards, Donnelly et al. (2004): Quality of education was found to have substantial effects on WAIS-III IQ test performance within the Black southern African population.

Nell (1999) discusses quality of school and education in relation to test-wiseness, and argues that level of education alone is a crude indicator of test-wiseness because it says nothing about those aspects of school quality that are taken for granted in Western settings. Test-wiseness refers to the feelings that participants experience when undertaking a test, i.e., that “you are highly motivated or keyed up, a little nervous, and ready (with not a little trepidation) to meet the challenge. In consequence, when the test session begins, you concentrate intensely, don’t chat to the examiner (even in a one-to-one situation), and take it for granted even without being told that you have to work as fast and accurately as you can” (p.129). The components of test-wiseness that Nell (1999) emphasizes are typically classroom-type skills such as fluent reading, automatised knowledge of the alphabet, good pencil control and familiarity with copying tasks – all acquired through exposure to a formal education system. He further argues that quality of education is partially dependent on physical school quality, i.e., that the necessary resources are accessible to learners.

The major aim of the larger project, of which this is a pilot study, is to investigate the relationship between SES, formal education, and neuropsychological performance in South African children. The specific objectives of this study were to (a) compare, across the domains of memory, attention and executive function, the performance of low SES South African children relative to international normative standards, and (b) investigate whether more years of formal education would be reflected by improved performance of the low SES children on the neuropsychological test battery.

Therefore, my hypotheses are: (1) Low SES South African children will perform poorly (i.e., in the low average range or below) relative to international normative standards, and (2) low SES South African children with more years of formal education will perform better on the neuropsychological test battery than will those with fewer years of formal education.

METHODS

Participants

Participants were 16 English-speaking children between the ages of 7 and 10 years (see Table 1). The sample was drawn from a previously identified low SES school in the Western Cape region. In this case, low SES was determined by the parameters described by Magnusson and Duncan (2006) and Shuttleworth-Edwards, Kemp et al. (2004) in terms of economic and social resources of the surrounding community and within the learner's family. For instance, according to these parameters, schools that previously fell under the South African Department of Education and Training (DET) system are considered low-SES schools.

Participants from Grade 1, 2, 3 and 4 classes were recruited by distributing letters (Appendix A) to parents of children in those classes. Children whose parents who read the letter and who actively consented to their child's participation were included in the study.

Permission for conducting this study was obtained from the Western Cape Department of Education (see Appendix B), and informed consent was obtained from the parents of all participants. Additionally, each participant read (or had read to them) an assent form (Appendix C), which he/she subsequently signed.

Measures

I measured general intellectual functioning as well as neuropsychological performance in three specific domains (memory, attention, and executive function). With regard to neuropsychological performance, the measures used in this study were a combination of subtests from various commonly used standardized batteries designed to measure performance in the abovementioned domains.

General Intellectual Functioning

To measure the general intellectual functioning of the participants, I used the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). There are published research studies using this measure in a South African population. However, Hemp (1989) used the closely related Wechsler Intelligence Scale for Children - Revised (WISC-R; Wechsler, 1974) in a South African TBI study. Studies investigating the relationship between the WASI and the WISC have shown that WASI subtests are statistically significantly correlated with the corresponding WISC subtests; it is therefore suggested that the subtests and IQ scales of the WASI measure constructs similar to those measured by their WISC-III counterparts (Wechsler, 1999).

For the purposes of this study I used Performance IQ (PIQ) as an estimate of general intellectual functioning. In the current context PIQ is likely a better estimate than Verbal IQ (VIQ) or Full Scale IQ (FSIQ) because it does not rely on language abilities. I thus only administered the *Block Design* (BD) and *Matrix Reasoning* (MR) WASI subtests. The BD subtest, which measures perceptual organization, requires the participant to replicate modeled or printed two-dimensional geometric patterns within a specified time limit using two-colour cubes. The MR subtest, which measures nonverbal fluid reasoning, requires the participant to indicate the missing piece from a choice of five possibilities to complete a series of incomplete gridded patterns.

Verbal Memory and Working Memory

Subtests from the Children's Memory Scale (CMS; Cohen, 1997) were used to assess the memory of the participants in the domains of (a) auditory/verbal learning and verbal memory and (b) attention/concentration and working memory. There are no published research studies using this instrument with South African populations.

The *Stories* subtest assessed the ability to recall meaningful and semantic related verbal material. For the immediate recall portion, the participant listened to two stories told by the examiner, and was then required to retell the stories from memory. For the 25-30 minute delayed recall portion, the participant had to retell the two stories and answer factual questions about them.

The *Word Lists* subtest assessed the ability to learn a list of unrelated words over four learning trials. For the immediate recall portion, the participant listened to the initial presentation of the list by the examiner after which he/she has to recall as many words as they can. For the following three trials the participant was reminded only of those words which he/she forgot and asked to recall as many words as they could remember after the reminder. Following these four trials, a distractor word list was presented once after which the participant had to recall as many of the new words as possible. It was then required that the participant recalled the first list once more without a reminder of those words. For the 25-30 minute delayed recall portion the, participant had to recall all the words of the first list that he/she could remember from memory and then to indicate whether a list of words read out loud by the examiner were those that he/she had to remember.

The *Numbers* subtest assessed the ability to repeat random digit sequences of graduated length. In the Forward portion the participant was required to repeat the digits in the same sequence as read out loud by the examiner. In the Backward portion the participant repeated the digits in the reverse order of that read out loud by the examiner.

Visual Memory and Visuoconstructional Abilities

The *Dot Locations* subtest of the CMS was used to measure visual/nonverbal memory. This task assesses the ability to learn spatial location of an array of dots over three learning trials. For the immediate recall portion the participant was presented a picture of the array of dots for 5 seconds after which they had to recall the arrangement on a grid with plastic chips; this was repeated three times. Following this a distractor array was displayed which the participant had to represent and then again recall the first dot array. For the delayed recall portion, the participant was required to recall the initial array displayed earlier.

In addition to the CMS, the Rey-Osterrieth Complex Figure (ROCF; Osterrieth, 1944) was used to assess not only visual-spatial memory but also constructional ability. This test consists of a figure that was copied directly by the participant, and then followed by a trial 3 minutes later which required the participant to draw what he/she can remember from memory. The delayed trial required the participant to recall the figure again 30 minutes later.

Attention

The Test of Everyday Attention for Children (TEA-Ch; Manly, Robertson, Abderson, & Nimmo-Smith, 1999) measured selective attention, sustained attention, and divided attention. It also measured the participants’ ability to switch attention from one activity to another. For the purposes of this study, I used the brief screening version of the TEA-Ch that includes only the first four subtests of the battery. There are no published research studies using this instrument with South African populations.

The *Sky Search* subtest assessed selective and focused attention. In the first part of the task, the participant was required to find as many "target" spaceships as possible on a sheet filled with very similar distractor ships. In the second part of the task, the participant was required to mark, as quickly as possible, all of the "target" spaceships on a page containing only those targets.

The *Score!* subtest assessed sustained attention - testing the participant's ability to self-sustain his/her own attention as this is a simple task with long pauses between sounds. The participant had to keep a count of the number of "scoring" sounds they heard on a soundtrack, as if they were keeping the score on a computer game.

The *Creature Counting* subtest assessed attentional control/switching. The participant was required to repeatedly switch between two relatively simple activities of counting upwards and counting downwards. The participant was required to count aliens in their burrow, with occasional arrows indicating when they had to change the direction in which he/she was counting.

The *Sky Search Dual Task (DT)* subtest assessed sustained-divided attention. The participant was required to combine the first two tasks of finding "target" spaceships (as in *Sky Search*) while keeping a count of scoring sounds heard on a soundtrack (as in *Score!*).

Executive Function

Subtests from the NEPSY-II (Korkman, Kirk & Kemp, 2007) were used to measure performance in this domain. Mulenga, Ahonen, and Aro (2001) used the original NEPSY in a pilot study performed to correlate the performance of Zambian children with that of American children. They found that the NEPSY, with its U.S. norms, is to some degree insensitive to language and cultural factors, making it ideal to use in a South African context. There are no published research studies using either the NEPSY or the NEPSY-II with South African populations.

The *Clocks* subtest primarily assessed planning and organization. In the first part of the task, the participant was required to draw, over several trials, the face of a clock and then add the hands following either instructions from the examiner or the model from a digital clock. In the second part of the task, the participant was required to read, over several trials, the time on clocks either with or without numbers. In the third part of the task, the participant was required to copy two clock drawings.

The *Design Fluency* subtest assessed behavioural productivity. The participant was required to generate unique designs by connecting up to five dots, presented in two arrays: structured (symmetric arrangement of five dots) and random (asymmetric arrangement of five dots). The participant drew as many designs as he/she could on each array within a specific time limit (60 seconds for each array in this case).

The *Inhibition* subtest assessed the ability to inhibit automatic responses in favor of novel responses and the ability to switch between response types. The participant looked at a series of black and white shapes and arrows and named either the shape or the direction or an alternate response, depending on the colour of the shape or arrow.

Procedure

Each participant was individually tested in an allocated room at the school. Testing took place over two sessions of 60-90 minutes each.

At the start of the first session, the participants were given assent forms (Appendix C) to sign if they agreed with the terms of the study. The aims of the study and the testing procedure were verbally explained to participants; it was also reiterated that they could take a break whenever they needed to, that their participation was entirely voluntary, and that they could withdraw from the study at any time. Test administration then began. The order of test administration is shown in Table 2.

I attempted to maintain high motivation in the participants by using star charts. At the completion of every subtest the participant was awarded a gold star; after accumulating a certain number of stars they were given their choice of a variety of small sweets. This reinforcement, and the fact that they could take the star chart home with them at the end of the second session as proof of their work, served as sufficient and adequate motivation to maintain optimal effort.

RESULTS

Data Analysis

All 16 participants completed the full test battery. Their raw scores were converted to age-adjusted scaled scores following conventional procedures. These procedures enabled comparisons between the participants' scores and the published test norms. The primary analyses involved comparing children in the four different grades against one another. In other words, I used a one-way ANOVA, with Grade (1, 2, 3, or 4) being the independent variable and score on neuropsychological test as the dependent variable. In cases where homogeneity of variance was violated, I carried on with the analysis, because ANOVA is relatively robust to this kind of violation. I did not compare performance by the various age groups, or use age as a covariate in the ANOVAs, because (a) participants of different ages were in the same grade, and (b) the dependent variables were all age-adjusted scaled scores. I followed the ANOVA with a priori planned comparisons contrasting the performance of Grade 4 learners with that of Grade 1 (because this is where the biggest effect, if there is one, should lie). Statistical significance decisions were made on the basis of an alpha level of 0.05.

General Intellectual Functioning

Table 3 shows that low SES children, in general, performed in the average range on the BD subtest and in the low average range on the MR subtest. Overall PIQ for the sample was in the low average range. (See Table 4 for qualitative descriptions of WASI performance). The one-way ANOVA and a priori planned comparisons conducted on these data found no significant between-group differences (see Table 5).

Memory

Table 6 shows that low SES children, in general, performed in the average range on the CMS subtests. (See Table 7 for qualitative descriptions of performance on the subtests of this scale.) The one-way ANOVA and a priori planned comparisons conducted on these data found no significant between-group differences (see Table 8).

Table 9 shows that the low SES children, in general, performed in the average range on the 30-minute delayed recall trials of the ROCF, an assessment of visual memory functioning. The one-way ANOVA and a priori planned comparisons conducted on the data from that trial found no significant differences (see Table 10). (Although there was a significant between-group difference for the ROCF Copy trial, $F(3,12) = 4.27$, $p = 0.029$, that portion of the test assesses planning, organization, and visuoconstructional ability, but not visual memory.)

Attention

Table 11 shows that the low SES children, in general, performed in the average range on the subtests of the TEA-Ch. The one-way ANOVA and a priori planned comparisons conducted on these data found that there was only one significant between-group difference: on the *Creature Counting* timing score, omnibus $F(3,12) = 24.42$, $p = 0.00002$ (see Table 12).

Executive function

Table 13 shows that the low SES children, in general, performed at the expected level. A few scores, however, indicated borderline performance on particular *NEPSY-II* subtests (e.g., Inhibition – Switching Combined; see Table 14). The one-way ANOVA and a priori planned comparisons conducted on these data found that there was two significant between-group differences: (a) for the *Clocks* subtest, omnibus $F(3, 12) = 6.39$, $p = 0.008$, and (b) for the *Inhibition Switching* combined score, omnibus $F(3, 12) = 8.26$, $p = 0.003$ (see Table 15).

DISCUSSION

The data from the current study disconfirm both a priori hypotheses. First, the performance of this low SES South African sample was generally, across multiple cognitive domains, in the low average to average range. Second, more years of formal education did not prove to be beneficial in raising performance on the currently administered test battery. These results are surprising given the trends described in the literature in this field.

Individuals from SES, ethnic and cultural backgrounds, and educational status different from that of Western normative samples often perform significantly more poor on neuropsychological tests (Ardila, 1995). According to Skuy, Schutte, Fridjhon, and O’Carroll (2001), issues of cultural difference, sociopolitical disadvantage, cognitive and educational limitations have particular relevance in the South African context. Inadequate norms for the South African sample used in their study, rather than the easily-assumed lower intellectual functioning, are suggested to be the reason for poor performance on the tests on which they have been measured. A subsequent question to these findings is this: To what extent can the standardized norms of tests be trusted to accurately reflect the cognitive abilities of individuals such as these in the current study sample? The fear is that these low SES children might perform so poorly compared to international norms that it might indicate that they might be considered to be impaired in certain domains. Findings by Skuy et al. (2001), Shuttleworth-Edwards, Donnelly et al. (2004), and Shuttleworth-Edwards, Kemp et al. (2004) confirm the need for using norms and approaches which are appropriate to a given population when interpreting and addressing neuropsychological test performance, with specific consideration given to SES and cultural/ethnic group membership and educational status of the population.

Although it is near-impossible to accurately define South African culture as such, there are various reasons why culture cannot be ignored when considering the relationship between socio-economic status and neuropsychological test performance. These reasons include the fact that (a) early recognition of the impact of culture on test performance resulted in the history of psychological testing being alive with attempts to construct measures that are “culture-free” (Anastasi, 1988, as cited in Rosselli & Ardila, 2003, and Cattell, 1940), (b) an explosion of cultural shifts in the form of previously disadvantaged or rural populations making the transition towards Westernization leading to conceptual shifts in the field of psychometric testing (Shuttleworth-Edwards, Kemp, et al., 2004), and (c) culture plays a role in test-taking attitudes and in learnt cognitive abilities (Shuttleworth-Edwards, Donnelly, Reid, & Radloff, 2004). Culture, according to Ardila (1995), dictates what is relevant and what is not in terms of inter-related variables (e.g., language usage, SES, reading ability, home and schooling socialization experiences) and provides models for ways of thinking, acting and feeling, all of which lead to variation in neuropsychological test performance.

Researchers determine the effectiveness of tests and scales developed in specific cultural settings by testing populations from different cultures and backgrounds in order to standardize these tests and scales for use by different groups. The application of neuropsychological tests from one ethnic group to another without appropriate standardization is highly problematic for both diagnostic and placement purposes (Shuttleworth-Edwards, Kemp, et al., 2004). According to Rosselli and Ardila (2003, p.326), it was supposed for some time that the effect of culture can be controlled if verbal items were eliminated and only non-verbal performance items were used. They note, however, that even non-verbal tests may turn out to be as culturally biased as verbal tests because, according to Cohen (1969), the non-verbal tests often require specific strategies and cognitive styles characteristic of middle-class Western cultures. This statement is supported by findings by Waber et al. (1984), in which children from different SES backgrounds employ different cognitive styles in, for example, problem-solving situations.

Possible reasons for these results to differ form the trend of the literature might be: (a) the chosen school was not in actual fact a low SES school, (b) due to volunteer bias, i.e., the possibility that participants were the top academic achievers of their classes, (c) the children who participated are relatively acculturated and the test measures did not take this into account, (d) related to the previous point, these children might be as test-wise as children of their age in the UK and the US (where these tests have been standardized), or most probably, (d) the sample size was not sufficient in accurately measuring the participants' performance on the particular domains measured by the test battery.

Therefore, a critical limitation of the current study was clearly the small sample size. Consequently more children will be assessed in the next phase of this research program in order to establish appropriate and stable normative data for 7 to 10 year old South African children. The addition of a high SES sample will enable comparisons between SES levels, as well as the influence that quality of schooling has on neuropsychological performance. A comparison of the collective performance of all the South African children will be made to determine if the high SES sample will perform in a range even more similar to international standards.

The current study forms part of a larger research program that aims to investigate the relationship between SES, formal education, and neuropsychological performance of South African children. The information gathered from the low SES children will not only be used to establish the normative range of South African children aged 7 to 10 years, but will also be used in another research program that aims to implement and evaluate the effectiveness of a neuropsychological rehabilitation service for children in this age range who have sustained closed traumatic brain injury. Given that the target areas of cognitive remediation for this rehabilitation program are attention, memory and executive function, the current study is critical to future endeavours in this research area.

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Appendix A

Information/Consent Form for Parents of Participants

[DATE]

RE: Research study

Dear Parent(s),

Researchers from the University of Cape Town (UCT) are carrying out a study on children with Traumatic Brain Injury (TBI). The aim of the study is to establish what their neuropsychological performance is after injury, and how they view and understand themselves. We have obtained permission from the governing body of Silverlea Primary School, relevant ethics committees at UCT, and the Western Cape Education Department to conduct this research. We would like to know if you are willing to allow your child to take part in this study.

Here are some more details about the study: We are hoping to recruit approximately 50 children with TBI, 7-10 years of age, for our study. Children who participate in the study will be asked to complete paper-and-pencil tasks that measure self-awareness, meta-cognition, affect and behaviour. Each child will be tested individually, in a classroom, at his/her own pace, under the supervision of his/her tutor. If at any point during the study your child finds any of the measures uncomfortable or feels tired, he/she is free to stop taking part or to take a break. We will also ask you or your child's teacher to fill out some background information questionnaires.

In order to establish the norms against which the TBI children's performance will be measured, a battery of neuropsychological tests will be used to measure the same skills in a similar sample of children, aged 7-10 years, without any form of brain injury, i.e., normal, healthy children. These tests will also measure attention, memory and executive functioning, and they will be performed in the same manner as mentioned above. The effect of socio-economic status (SES) on the children's performance will also be investigated.

It is up to you whether to allow your child to take part in this study. If you do so, you and/or your child are free to stop participation at any time. Whether your child does not take part in the study, or takes part and then chooses to withdraw, it will not affect his/her academic care or schooling. If your child does take part, all information gathered about him/her will be kept confidential.

At the end of the study Silverlea Primary School will receive a copy of the final report which will include feedback about the findings. Ultimately, we hope our research will improve our understanding of TBI and inform future treatment.

If you have any questions about the information in this letter or about the study in general, please do not hesitate to contact either of the researchers:

Fransien Schoeman
Honours Student
Department of Psychology
University of Cape Town
Tel: 0833911269
E-mail: fransien.schoeman@gmail.com

Kevin G. F. Thomas, Ph.D. (Supervisor)
Senior Lecturer
Department of Psychology
University of Cape Town
Tel: (021) 650-4608
E-mail: kevin.thomas@uct.ac.za

Leigh Schrieff
Ph.D. Student
Department of Psychology
University of Cape Town
Tel: 0785592997
E-mail: skylae@gmail.com

If you would allow your child to participate in this study, please complete the attached consent form. Once filled in, please return the consent form to Silverlea Primary School on Wednesday [DATE]. You may keep this information and contact sheet so that you are able to contact the researchers at any time during the study.

Thank you for your time and for considering allowing your child to participate in our study. We appreciate your help!

Sincerely,

Fransien Schoeman
Leigh Schrieff
Kevin Thomas

<u>CONSENT FORM</u>

<u>Title of study</u>: ***Neuropsychological performance low SES children***

<u>Please fill in the following</u>:

<u>Child's full name and date of birth</u>:

____

<u>Class at Silverlea Primary School</u>:

____

- You have been informed about this study's purpose, procedures, possible benefits, and risks, and how 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. You have been told you can ask other questions at any time.
- You voluntarily consent to allow your child to participate in this study. You hereby authorize the collection, use and sharing of your child's performance and other data. By signing this form, you are not waiving any of your legal rights.

_______________________________ __________________________ _____________

Name of Parent/Guardian Signature Date

_______________________________ __________________________ _____________

Name of Researcher/ Signature Date
Person taking consent

PLEASE RETURN THIS COMPLETED FORM TO SILVERLEA PRIMARY SCHOOL
ON [DATE].

Would you like to be notified of future studies carried out by out research group?
_______________ (initial) Yes, I would like to be added to your research participation pool and be notified of research projects in which my child or I might participate in the future.

Method of contact:
Phone number: __________________ E-mail address: ______________________________
Mailing address: ____________________________________
____

Appendix B

Letter Granting Permission to Conduct Research in Schools

Miss Fransien Schoeman
26 Westbrook Court
Haldane Road
RONDEBOSCH
7700

Dear Miss F. Schoeman

RESEARCH PROPOSAL: SOCIO-ECONOMIC STATUS AND THE PERFORMANCE OF A SAMPLE OF SOUTH AFRICAN CHILDREN ON A NEUROPSYCHOLOGICAL BATTERY.

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 **6th August 2007 to 31st August 2007**.
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December 2007).
7. Should you wish to extend the period of your survey, please contact Dr R. Cornelissen 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 following schools: **Silverlea Primary, Belvue Primary and Bokmakierie Primary**.
10. A brief summary of the content, findings and recommendations is provided to the Director: Education Research.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

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

We wish you success in your research.

Kind regards.
Signed: Ronald S. Cornelissen
for: HEAD: EDUCATION

Appendix C

Participant Assent Forms

Assent Form for Child Participant

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

Table 1

Participant Characteristics by Grade

	Grade 1 (n = 5)	Grade 2 (n = 2)	Grade 3 (n =2)	Grade 4 (n =7)
Sex				
Male	0	2	0	4
Female	5	0	2	3
Age				
7 years	5	0	0	0
8 years	0	2	1	0
9 years	0	0	1	2
10 years	0	0	0	5

Table 2

Order of Subtests of Testing Sessions

Session1	Session 2
1. NEPSY – Fingertip Tapping	1. TEA-Ch – Subtests 1-4
2. CMS – Numbers (Forward and Backward)	2. CMS – Stories
3. CMS – Word List	3. CMS – Dot Locations
4. ROCF (Copy and Immediate recall)	4. NEPSY – Clocks
5. WASI – Block Design	5. CMS – Stories (Delayed)
6. CMS – Word List (Delayed)	6. CMS – Dot Locations (Delayed)
7. ROCF (Delayed)	7. NEPSY - Inhibition
8. WASI – Matrix Reasoning	
9. NEPSY – Design Fluency	

Table 3

	Grade 1 (n = 5)	Grade 2 (n = 2)	Grade 3 (n = 2)	Grade 4 (n = 7)	Total Sample (n =16)	Standard Score (*z*)
Block Design (BD)	7.8 (0.8)	7.5 (0.7)	7.5 (2.1)	9.1 (3.2)	8.3 (2.3)	-0.11
Matrix Reasoning (MR)	6.4 (1.1)	6.5 (2.1)	6.0 (1.4)	9.0 (2.7)	7.5 (2.4)	-0.17
PIQ	85.0 (3.7)	84.0 (5.7)	83.0 (8.5)	94.0 (11.7)	88.6 (9.5)	-0.76

Descriptive Statistics for General Intellectual Functioning (WASI)

Note. Means are presented with standard deviations in parentheses. Standard scores were calculated based on the following population norms: for BD and MR: *M* = 10, *SD* = 3; for PIQ: *M* = 100, *SD* = 15.

Table 4

Qualitative Descriptions of WASI Scores

IQ Scores	Subtest Scaled Score	Classification
130 and above	16 – 19	Very Superior
120 – 129	14 – 15	Superior
110 – 119	12 – 13	High Average
90 – 109	8 – 11	Average
80 – 89	6 – 7	Low Average
70 – 79	4 -5	Borderline
69 and below	1 - 3	Extremely Low

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

Table 5

Results of Simple Analysis of Variance of WASI Scores

	Levene's test for homogeneity of variance		Omnibus F test				Tukey's planned comparisons		
	F	p	F	p	df	Effect size (Adj. R^2)	Prediction	p	df
BD	2.44	0.114	0.55	0.682	3,12	-0.108	Grade4 > Grade1	0.775	12
MR	2.46	0.113	1.96	0.174	3,12	0.161	Grade4 > Grade1	0.233	12
PIQ	7.55	0.004	1.53	0.257	3,12	0.096	Grade4 > Grade1	0.364	12

Table 6

Descriptive Statistics for Memory (CMS)

	Grade 1 (n = 5)	Grade 2 (n = 2)	Grade 3 (n = 2)	Grade 4 (n = 7)	Sample (n =16)	Standard Score (*z*)
Dot Locations	11.6 (2.2)	11.0 (2.3)	8.5 (6.4)	11.0 (1.8)	10.9 (2.6)	0.06
Stories IT	9.2 (3.1)	8.0 (1.4)	9.0 (0.0)	11.3 (2.8)	9.9 (2.7)	-0.01
Stories DT	8.8 (3.9)	9.5 (0.7)	10.0 (1.4)	9.7 (3.5)	9.4 (3.1)	-0.04
Word lists L	8.2 (0.4)	9.0 (2.8)	12.0 (1.4)	11.1 (3.6)	10.1 (2.9)	0.01
Word Lists D	8.4 (2.6)	11.0 (4.2)	10.5 (1.4)	12.6 (3.7)	10.8 (3.4)	0.05
Word Lists DR	8.0 (2.3)	7.0 (4.2)	10.0 (1.4)	9.2 (4.6)	8.1 (3.7)	-0.09
Numbers F	10.2 (1.8)	13.0 (1.4)	9.0 (1.4)	11.4 (3.0)	10.9 (2.5)	0.06
Numbers B	9.2 (1.1)	10.0 (0.0)	10.0 (5.6)	11.3 (3.4)	10.0 (3.0)	0.00

Note. Means are presented with standard deviations in parentheses. Standard scores were calculated based on the following population norms: *M* = 10, *SD* = 3. Stories IT = Stories Initial Thematic score; Stories DT = Stories Delayed Thematic score; Word Lists L = Word Lists Learning score; Word Lists D = Word Lists Delayed score; Word Lists DR = Word Lists Delayed Recall score; Numbers F = Numbers Forward; Numbers B = Numbers Backward.

Table 7

Qualitative Descriptions of CMS Scores

Subtest Scaled Scores	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)

Table 8

Results of Simple Analysis of Variance of CMS Subtests

	Levene's test for homogeneity of variance		Omnibus F test				Tukey's planned comparisons		
Subtest	F	p	F	p	df	Effect size (Adj. R^2)	Prediction	p	df
Dot Locations	9.13	0.002	0.64	0.603	3, 12	-0.077	Grade4 > Grade1	0.98	12
Stories Immediate Thematic	6.27	0.008	1.12	0.380	3, 12	0.023	Grade4 > Grade1	0.57	12
Stories Delayed Thematic	1.26	0.333	0.09	0.963	3, 12	-0.222	Grade4 > Grade1	0.97	12
Word Lists Learned	2.44	0.115	1.61	0.239	3, 12	0.109	Grade4 > Grade1	0.29	12
Word Lists Delayed	1.35	0.305	1.60	0.241	3, 12	0.107	Grade4 > Grade1	0.18	12
Word Lists Delayed Recall	3.20	0.062	0.74	0.551	3, 12	-0.056	Grade4 > Grade1	0.94	12
Numbers Forwards	1.70	0.220	1.13	0.377	3, 12	0.025	Grade4 > Grade1	0.83	12
Numbers Backwards	2.73	0.091	1.05	0.408	3, 12	0.009	Grade4 > Grade1	0.33	12

Table 9

Descriptive Statistics for Rey Complex Figure

	Copy	Norm (Copy)	Standard Score (*z*)	Delay	Norm (Delay)	Standard Score (*z*)
Grade 1 (n = 5)	14.8 (9.1)	21.3 (7.7)	-0.43	10.3 (6.7)	13.6 (6.3)	-0.22
Grade 2 (n = 2)	2.8 (9.5)	23.6 (8.0)	0.93	12.8 (9.5)	16.3 (6.8)	-0.17
Grade 3 (n = 2)	27.8 (3.2)	24.5 (6.9)	0.39	16.0 (0.7)	18.7 (6.6)	0.12
Grade 4 (n = 7)	29.1 (5.2)	27.2 (7.6)	0.93	19.1 (8.3)	19.7 (6.7)	-0.15
Sample (n =16)	23.9 (9.1)			15.2 (7.8)		

Note. Raw scores are presented with standard deviations in parentheses. Norms are from *A Compendium of Neuropsychological Tests – Administration, Norms, and Commentary* (Strauss, Sherman & Spreen, 2006).

Table 10

Results of Simple Analysis of Variance of ROCF

	Levene's test for homogeneity of variance		Omnibus F test				Tukey's planned comparisons		
Subtest	F	p	F	p	df	Effect size (Adj. R^2)	Prediction	p	df
ReyC	1.61	0.240	**4.27**	**0.029**	3, 12	0.395	Grade4 > Grade1	0.021	12
ReyD	3.33	0.056	1.40	0.292	3, 12	0.073	Grade4 > Grade 1	0.246	12

Note. ReyC = Copy trial of the ROCF test; ReyD = 30-minute delayed recall trial of the ROCF test. Bold figures indicate findings of statistical significance.

Table 11

Descriptive Statistics for Attention (TEA-Ch)

	Grade 1 (n = 5)	Grade 2 (n = 2)	Grade 3 (n = 2)	Grade 4 (n = 7)	Sample (n =16)	Standard Score (*z*)
1 ID targets	8.8 (4.9)	5.5 (4.9)	9.0 (0.0)	10.1 (3.2)	9.0 (3.8)	-0.07
1 Time/target	3.8 (1.8)	4.5 (3.5)	8.0 (1.4)	7.3 (3.3)	5.9 (3.1)	-0.27
1 Attention score	5.4 (2.6)	5.0 (4.2)	9.0 (1.4)	8.6 (3.6)	7.2 (3.4)	-0.19
2 Score!	9.4 (3.6)	5.5 (0.7)	11.5 (3.5)	11.6 (2.6)	10.1 (3.4)	0.01
3 Creature counting C	8.2 (2.5)	9.0 (1.4)	5.5 (3.5)	9.7 (3.8)	8.6 (3.2)	-0.09
3 Timing score	4.4 (1.7)	7.5 (0.7)	17.5 (2.1)	6.7 (2.1)	7.4 (4.4)	-0.17
4 Sky Search DT	8.0 (4.8)	5.0 (5.7)	3.0 (1.4)	8.0 (1.5)	7.0 (3.6)	-0.2

Note. Means are presented with standard deviations in parentheses. Standard scores were calculated based on the following population norms: *M* = 10, *SD* = 3.

1 ID targets = Subtest 1 Identified targets

1 Time/target = Subtest 1 Time taken per target

3 Creature counting C = Subtest 3 Creature counting correct

Table 12

Results of Simple Analysis of Variance of TEA-Ch Subtests

	Levene's test for homogeneity of variance		Omnibus F test				Tukey's planned comparisons		
Subtest	F	p	F	p	df	Effect size (Adj. R^2)	Prediction	p	df
Identified targets	5.01	0.017	0.74	0.547	3, 12	-0.054	Grade4 > Grade1	0.934	12
Time/target	1.21	0.349	2.04	0.163	3, 12	0.172	Grade4 > Grade1	0.202	12
Attention score	1.15	0.367	1.43	0.281	3, 12	0.079	Grade4 > Grade1	0.382	12
Score	1.89	0.185	2.41	0.118	3, 12	0.220	Grade4 > Grade1	0.610	12
Creature Counting Correct	1.61	0.239	0.92	0.462	3, 12	-0.017	Grade4 > Grade1	0.855	12
Creature Counting time	1.01	0.422	**24.24**	**0.00002**	3, 12	0.823	Grade4 > Grade1	0.201	12
Sky Search DT	2.04	0.162	1.46	0.273	3, 12	0.085	Grade4 > Grade1	1.000	12

Note. Bold figures indicate findings of statistical significance.

Table 13

Descriptive Statistics for Executive Function (NEPSY)

	Grade 1 (n = 5)	Grade 2 (n = 2)	Grade 3 (n = 2)	Grade 4 (n = 7)	Sample (n = 16)	Standard Score (*z*)
Clocks	6.6 (3.4)	6.5 (6.4)	9.5 (4.9)	15.1 (2.9)	10.7 (5.3)	0.05
Design Fluency	6.2 (3.4)	4.5 (2.1)	7.5 (2.1)	7.6 (3.1)	6.7 (3.0)	-0.22
Inhibition NT	9.2 (2.8)	8.0 (0.0)	8.5 (0.7)	9.1 (2.2)	8.9 (2.0)	-0.07
Inhibition NC	9.2 (3.3)	7.5 (3.5)	6.0 (2.8)	9.8 (2.0)	8.9 (2.8)	-0.07
Inhibition IT	9.8 (2.6)	8.0 (1.4)	10.0 (0.0)	8.4 (1.4)	9.0 (1.8)	-0.07
Inhibition IC	7.0 (1.7)	6.5 (2.1)	9.5 (4.9)	9.1 (3.0)	8.2 (2.8)	-0.12
Inhibition ST	7.2 (2.5)	10.0 (1.4)	7.5 (0.7)	9.3 (1.4)	8.5 (2.0)	-0.10
Inhibition SC	6.0 (0.7)	5.5 (0.7)	5.5 (0.7)	9.1 (1.8)	7.3 (2.1)	-0.18
Inhibition TE	6.4 (3.0)	4.0 (1.4)	5.5 (4.9)	9.6 (1.7)	7.4 (3.1)	-0.17

Note. Means are presented with standard deviations in parentheses. Standard scores were calculated based on the following population norms: *M* = 10, *SD* = 3. Inhibition NT = Inhibition Naming Total completion time; Inhibition NC = Inhibition Naming Combined; Inhibition IT = Inhibition Inhibiting Total completion time; Inhibition IC = Inhibition Inhibiting Combined; Inhibition ST = Inhibition Switching Total completion time.

Table 14

Qualitative Descriptions of NEPSY 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).

Table 15

Results of Simple Analysis of Variance of NEPSY Subtests

	Levene's test for homogeneity of variance		Omnibus F test				Tukey's planned comparisons		
Subtest	F	p	F	p	df	Effect size (Adj. R^2)	Prediction	p	df
Clocks Total	1.55	0.251	**6.39**	**0.008**	3, 12	0.519	Grade4 > Grade1	0.009	12
Design Fluency Total	0.34	0.794	0.62	0.618	3, 12	-0.083	Grade4 > Grade1	0.870	12
Inhibition Named Time	1.98	0.170	0.18	0.905	3, 12	-0.195	Grade4 > Grade1	0.999	12
Inhibition Named Combined	1.10	0.386	1.28	0.325	3, 12	0.053	Grade4 > Grade1	0.974	12
Inhibition Time	1.50	0.266	0.94	0.453	3, 12	-0.013	Grade4 > Grade1	0.595	12
Inhibition Combined	2.18	0.142	0.96	0.442	3, 12	-0.008	Grade4 > Grade1	0.575	12
Inhibition Switch Time	0.94	0.449	1.99	0.169	3, 12	0.165	Grade4 > Grade1	0.247	12
Inhibition Switch Combined	6.02	0.009	**8.26**	**0.003**	3, 12	0.592	Grade4 > Grade1	0.009	12
Inhibition Total Errors	3.02	0.072	3.44	0.052	3, 12	0.328	Grade4 > Grade1	0.206	12

Note. Bold figures indicate findings of statistical significance.