INTELLECTUAL, COGNITIVE AND ACADEMIC OUTCOMES OF VERY LOW BIRTH WEIGHT ADOLESCENTS LIVING IN DISADVANTAGED COMMUNITIES

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Thesis presented in partial fulfilment of the requirements for the degree

MEdPsych

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at the

University of Stellenbosch

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December 2004

DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously, in its entirety or in part, submitted it at any university for a degree.

Signature

_____ 25/11/04

Date

ABSTRACT

Since the introduction of neonatal intensive care, infants that are extremely premature and of very low birth weight (VLBW) are now surviving. There is concern as to whether many of them have developmental problems. A study of the relevant literature revealed that VLBW children tend to score lower than their peers on IQ tests, reading accuracy, reading comprehension, spelling and maths. Studies on developmental outcome in VLBW infants have all been conducted in developed countries. The situation in developing countries has therefore not been investigated.

The purpose of this study was to investigate the intellectual, cognitive and academic outcomes of 18 English- and Afrikaans-speaking adolescents (between 12 and 14 years) who weighed less than 1250g at birth and were living in disadvantaged communities in Cape Town. Their performance was compared with controls matched for age, sex and socio-economic status. The relationships between intellectual ability, cognitive controls and academic achievement were also investigated. Intellectual ability was assessed by means of the Senior South African Intelligence Scales-Revised (SSAIS-R), and the Cognitive Control Battery (CCB) developed by Santostefano was used to assess cognitive functioning. The academic achievement tests included the Neale Analysis of Reading Ability (and the Afrikaans version, the Afrikaanse Prosaleestoets), the ICE Spelling test (and the Afrikaans version, the IPV Speltoets) and the Schonell 5 Mathematics test.

Results showed that no significant differences were found between the index and control groups on IQ scores, cognitive control measures or academic achievement. These findings suggest that the low socio-economic status of all the adolescents had a levelling effect on their performance. There were some positive correlations between intellectual ability, cognitive controls and academic achievement. It was recommended that a programme of Cognitive Control Therapy which was developed by Santostefano, be implemented by educators in classrooms to improve cognitive control functioning and academic performance.

OPSOMMING

Sedert die aanvang van intensiewe sorg vir pasgebore babas, het erg premature babas met 'n baie lae geboortegewig, begin oorleef. Kommer het egter ontstaan dat sulke kinders moontlik 'n toename in ontwikkelingsprobleme kan ondervind. 'n Studie van die relevante literatuur het bevestig dat kinders met 'n lae geboortegewig geneig is om laer tellings in IK toetse, lees akkuraatheidstoetse, leesbegripstoetse, spel en wiskunde toetse te kry, vergeleke met kinders van dieselfde ouderdomsgroep. Die opvolgstudies op babas met lae geboortgewig het in ontwikkelde lande plaasgevind. Die situasie in ontwikkelende lande is nog nie ondersoek nie.

Die doel van hierdie studie was om die intellektuele, kognitiewe en akademiese vordering van 18 Engels- en Afrikaanssprekende lae geboortegewig adolessente (tussen 12 en 14 jaar) wat as 1250g by geboorte geweeg het en in minder bevoorregte gemeenskappe in Kaapstad gewoon het, te bestudeer. Deelnemers se resultate is met 'n kontrolegroep, gepas ten opsigte van ouderdom, geslag en sosio-ekonomiese status, vergelyk. Intellektuele vaardighede is deur middel van die Senior Suid-Afrikaanse Individuele Skaal – Hersien (SSAIS-R) gemeet, en die Cognitive Control Battery (CCB), wat deur Santostefano ontwikkel is, is gebruik om kognitiewe funksionering te bepaal. Die akademiese vaardigheidstoetse het uit die Neale Analysis of Reading Ability, die ICE Spelling Test (en die Afrikaanse weergawe, die IPV Speltoets) en die Schonell 5 Mathematics test, bestaan.

Die resultate van die studie het geen beduidende verskille tussen die studie en kontrolegroep met betrekking tot IK, kognitiewe kontrole of akademiese vordering getoon nie. Hierdie bevindinge het aangedui dat die lae sosio-ekonomiese vlakke van die adolessente in hierdie studie 'n gelykmakende effek op hulle prestasies gehad het. Daar was positiewe korrelasies tussen intellektuele vaardighede, kognitiewe kontroles en akademiese prestasie. Dit word voorgestel dat 'n Cognitive Control Therapy program, deur Santostefano ontwikkel, deur onderwysers in die klaskamer gebruik word om die kognitiewe kontrole funksionering en akademiese vordering van kinders te bevorder.

ACKNOWLEDGEMENTS

I would like to express my thanks and appreciation to:

Professor Petra Engelbrecht for her constructive supervision and enthusiasm for the topic.

Professor Chris Molteno for his support and guidance during the study and his consistent encouragement.

Dr Clare Thompson for inviting me to participate in the study and for her assistance during the assessment process.

Mrs Connie Philips for her warm relationship with the adolescents and their families that ensured that they arrived for their appointments.

The adolescents and their families for their willingness to participate in this research project.

My family and friends for their support.

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ACTUALITY, PROBLEM STATEMENT AND OBJECTIVES

1.1   INTRODUCTION

"Taken as a group, very low birth weight children have been found to have lower IQs, to be more likely to perform poorly at school, and to show signs of emotional disturbance, as compared with controls... [however], little research (and few longitudinal studies) have been conducted in developing countries, where the majority of low birth weight babies are born and where there is a multitude of concurrent adverse influences that are likely to compound the effects of low birth weight... (Richter & Griesel, 1994:68-70).

The improved survival of premature and low birth weight infants has been attributed to advances in neonatal care, particularly the use of assisted ventilation in infants developing breathing problems as a result of immature lungs (Bregman, 1998:675). Low birth weight (LBW) is referred to as 2500g or below and very low birth weight (VLBW) is considered to be 1500g or below (Richter & Griesel, 1994:67). Increase in survival of infants who would previously have died, raises the question of whether there is a concomitant increase of children with neurodevelopmental disabilities. Other questions are also surfacing, such as the edge of viability (Hack & Fanaroff, 2000:89), and the allocation of health care resources in the presence of increasingly limited health budgets (Cooper, 1999:1160), particularly in a country such as South Africa. The proportion of VLBW infants ranges from 13% to 43% in poor communities in many developing countries. A study of VLBW infants in Soweto reported that 73% were small for gestational age (Richter & Griesel, 1994:68). Given the high incidence of VLBW children in many South African communities, research is necessary to gain a greater understanding of VLBW status in a developing country.

There are a limited number of studies of the intellectual performance in adolescents who were VLBW because the survival rates of such infants were very low before the 1980s. Saigal (2000:109) reviewed six studies conducted in the United States, Canada and Australia. Most of these studies found that the VLBW children had lower scores than controls. The mean age at assessment ranged between 9 and 14. Taylor, Hack, Klein et al. (1998:387) reported a difference of 21 points in IQ between extremely low birth weight adolescents who were <750g and controls. The studies, however, were not consistent in the categorisation of low birth weight and different groups were studied. Furthermore, Saigal (2000:109) commented that some of the studies reported the IQ of all VLBW survivors, whereas others reported only on those in mainstream education, or those who did not have neuro-sensory impairments. Saigal also commented that different cognitive assessments were used in the studies. A number of studies have also assessed the academic achievement outcomes of VLBW children. Many studies reported that VLBW children performed worse than their peers on reading accuracy, reading comprehension, spelling and mathematics (Rickards, Ryan & Kitchen, 1988:19; Saigal, Szatmari, Rosenbaum, Campbell, & King, 1991:751; & Botting, Powls, Cooke & Marlow,1988:652).

International research also indicates that socio-economic status has consistently been shown to correlate with outcome in the VLBW infant (Ornstein et al., 1991 in Thompson, 2000:55-56). Cooper, Saloojee, Bolton and Mokhachane (1999:1179) have described a considerable improvement in the survival of VLBW infants over the past five decades at Baragwanath Hospital. They also showed that only 6% of surviving infants had VLBW. Thompson, Buccimazza, Webster, Malan, & Molteno (1993:961) reported a similar incidence of cerebral palsy among VLBW survivors at Groote Schuur Hospital. This rate is consistent with a meta-analysis reported by Escobar Escobar, Littenberg, and Petitti (1991:204). The improved survival rate of VLBW infants from disadvantaged communities may be attributed to the large proportion of small for gestational age infants, who are more mature at lower birth weights (Thompson et. al., 1993:961).

Cooper (1999:1160) estimates that if there are 2.5% VLBW infants surviving in South Africa, 25 000 infants would require care on an annual basis. He divides these infants into 3 categories:

1. those born in the private sector who usually have access to appropriate neonatal care;

2. those born in the public sector institutes where intensive care facilities exist; and

3. those born outside the areas mentioned above where no intensive care facilities exist.

Cooper claims that only 20% are born in the private sector and one-fourth to one-third in the public sector have access to intensive care.

Intensive care facilities are expensive to establish and to run. They will have to compete with all other aspects of health care in a country facing severe budgetary constraints in all provinces. Health planners and administrators will need all available information regarding VLBW infants, not only survival rates and incidences of major disabilities, but also the potential for cognitive development and scholastic achievement, if they are to make informed budgetary decisions.

Most of the studies of VLBW children have been conducted in Western countries. The focus of these studies has been on intellectual and academic functioning. Research has not considered cognitive processing in VLBW adolescents. Cognitive theory proposes that the improvement of cognitive processes could result in the improvement of academic functioning, whereas intellectual functioning is considered to be largely fixed (Haywood, Tzuriel & Vaught, 2002:43). There are vast implications for learners if interventions which aim to enhance cognitive processes result in improved scholastic functioning.

Dr Clare Thompson and Professor Chris Molteno initiated a follow-up study of infants who weighed less than 1250g and were born at or referred to Groote Schuur Hospital from July 1988 over a 12-month period. It was decided to use this birth weight category for a number of reasons. This birth weight cut-

off would represent a cohort at great risk, and would yield a cohort size that could be studied within available resources. Marlow, D'Sousa and Chiswick (1987 in Thompson, 2000:13) had recently published a follow-up study in the United Kingdom using this birth weight category and concluded that infants weighing less than 1250g were at highest risk and should receive the closest follow-up.

At 6 years of age the children were matched for sex and social class with children who were normal birth weight infants. All the children were assessed on the Griffiths Scales (Thompson, 2000:viii) and a battery of occupational therapy assessments (Coetzer, 1995:5). The results of the Griffiths Scales indicated that the VLBW children scored significantly lower than their matched controls. The average developmental quotient (DQ) for the VLBW children was 92 (SD 8). and 99 (SD 8) for their matched controls. The VLBW children achieved lower scores than the controls on all six scales (Thompson, 2000:50). The VLBW children scored significantly lower on all developmental levels. It was also found that visual perception, visual-motor integration, fine motor skill and gross motor skill were all significantly poorer in the VLBW children. A follow-up study was planned to assess the intellectual ability and academic achievement of the index and control children when they reached adolescence. Dr Thompson and Professor Molteno asked the researcher to assess the participants. The researcher planned a study which included the assessment of cognitive functioning as this had not been investigated in VLBW children.

Investigation of the intellectual, cognitive and academic outcomes in South African VLBW adolescents is necessary to establish whether international findings can be applied to the local population. The importance of investigating the academic achievement of VLBW adolescents was highlighted by recent surveys of the literacy and numeracy levels of learners in the Western Cape that indicated that academic achievement was very poor (Grade 6 pupils performing at Grade 3 level – study, 2004:1,5). Are VLBW adolescents performing poorer than their peers on academic assessments? This question must be investigated. The political, social and economic

context of South Africa and the recent changes in educational policy and practice, may well contribute to a unique living environment for VLBW adolescents which could lead to findings that differ from international research results.

1.2   STATEMENT OF THE PROBLEM

This study was part of the long-term follow-up of VLBW infants. A study of the intellectual and academic functioning of VLBW adolescents has not been undertaken in South Africa or any other developing country. It was felt that should such assessment data become available for South Africa, it could be compared to similar data obtained in Western countries. This would indicate the generalisability of the research results to the South African context. It is important to look particularly at VLBW adolescents living in disadvantaged communities in developing countries. It is also important to use controls who were matched for sex and socio-economic status to investigate whether the performance of the VLBW adolescents differs from their peers. Furthermore, the cognitive functioning of VLBW adolescents has not yet been investigated in any studies. The Cognitive Control Battery (CCB) could be used to provide information about whether certain cognitive control principles are underdeveloped in VLBW adolescents living in disadvantaged communities. If the results indicate that there are cognitive controls which are underdeveloped, then a programme of Cognitive Control Therapy (CCT) could be devised to address these areas and be implemented by educators. The assessment of the control group would provide information about whether these adolescents could also benefit from such an intervention. Santostefano (1988:120), the developer of the CCB, has shown that Cognitive Control Therapy has resulted in improved scholastic results.

1.3   STATEMENT OF OBJECTIVES

The objective of this study will be to answer the following questions:

1.3.1 Is there a difference in the intellectual ability, as assessed on the Senior South African Intelligence Scales-Revised (SSAIS-R), between VLBW adolescents and their matched controls?

1.3.2 Is there a difference in the cognitive functioning, as assessed on the Cognitive Control Battery (CCB), between VLBW adolescents and their matched controls?

1.3.3 Is there a difference in academic achievement in the areas of reading, spelling and mathematics, between VLBW adolescents and their matched controls?

1.3.4 Is there a relationship between cognitive controls and intellectual ability?

1.3.5 Is there a relationship between cognitive controls and academic achievement in the areas of reading, spelling and mathematics?

1.3.6 Is there a relationship between intellectual ability and academic achievement in the areas of reading, spelling and mathematics?

1.4 HYPOTHESES

The following hypotheses were postulated:

1.4.1 VLBW adolescents will achieve lower scores on the Senior South African Intelligence Scales-Revised (SSAIS-R) in comparison to their matched controls.

1.4.2 VLBW adolescents will display lower levels of cognitive functioning, as assessed on the Cognitive Control Battery (CCB), in comparison to their matched controls.

1.4.3 VLBW adolescents will achieve poorer academic results in reading, spelling and mathematics, in comparison to their matched controls.

1.4.4 It will be shown that cognitive controls and intellectual ability, as assessed on the SSAIS-R, measure different aspects of cognitive-intellectual functioning. Cognitive controls define processes which are basic to and underlie intellectual test performance.

1.4.5 It will be shown that cognitive controls are correlated with academic achievement in the areas of reading, spelling and mathematics.

1.4.6 It will be shown that there is an association between intellectual ability, as measured on the SSAIS-R, and academic achievement in the areas of reading, spelling and mathematics.

1.5   DEFINITION OF CONCEPTS

1.5.1 Very Low Birth Weight Status

New born infants are categorised in terms of birth weight. Low birth weight (LBW) infants are those that weigh less than 2500g at birth. Very low birth weight (VLBW) infants weigh 1500g or below at birth, and extremely low birth weight (ELBW) infants are those that have birth weights of less than 1000g (Thompson, 2000:13). These categories represent increasing risks for developmental outcome. Low birth weight may be attributed to either prematurity, dysmaturity or a combination of both. Premature babies are born before 37 weeks gestation. Dysmature babies are small for their respective gestational ages. They are also referred to as small-for-gestational-age (SGA) babies and they are considered to have been malnourished in utero. Prematurity and dysmaturity lead to increased neonatal and developmental problems. More SGA babies are born in poor communities. Richter and Griesel (1994:68) commented that low birth weight has a greater impact on

development in these circumstances. There appear to be some indications that SGA babies may be more seriously impaired than preterm babies, and these impairments may extend into adolescence.

In developed countries the incidence of low birth weight infants is lower than in developing countries. In the United States the prevalence of LBW was reported to be 6,8% of all births according to Raju (1986 in Thompson, 2000:13), whereas in the Western Cape area of South Africa the LBW rate was estimated to be 14,7% (Louw, Kahn, Woods, Power & Thompson, 1995 in Thompson, 2000:13). There is no published data about VLBW rates in South Africa as a whole. According to unpublished statistics from the neonatal department at Groote Schuur Hospital, the rate in the city of Cape Town is about 5% (Thompson, 2000:13).

In a study conducted in Soweto, it was found that the low birth weight infants had suffered intrauterine growth retardation and that the main causes were multiple pregnancies, poor socio-economic conditions and maternal undernutrition. Maternal undernutrition is one of the main causes of fetal undernutrition and consequently, of low birth weight. Research has found that if a mother is undernourished then it is highly probable that her unborn child will also be undernourished (Richter and Griesel, 1994:68-69).

A number of other factors affect the pregnancy and birth conditions of women in poor communities. Maternal undernutrition and low birth weight are also associated with lack of adequate prenatal care, a poor reproductive history, age (above 40 years or below 17 years), short stature (less than 140 cm), a history of chronic infectious disease, a short inter-pregnancy interval (less than 6 months), and pregnancy complications (including oedema, high blood pressure and urine positive for protein). These risk factors for low birth weight are related to income or socio-economic status (Richter & Griesel, 1994:68-69). North American research has shown that low birth weight is also associated with smoking, being single, receiving no prenatal care and being black. These factors are also related to socio-economic status. Lack of antenatal care is strongly associated with low birth weight in South Africa.

Lack of antenatal care and low birth weight appear to be the result of social and economic deprivation. Women from low socio-economic backgrounds report high levels of stressful life events, which have been found to increase the risk of pregnancy complications and preterm delivery. A direct link has not been found between measured life stress and low birth weight (Richter & Griesel, 1994:68-69).

1.5.2 Intellectual and cognitive functioning

The Pocket Oxford Dictionary (1984) describes intelligence as "intellect, understanding, quickness of understanding". The term stems from the Latin words *intellegentia*, which means understanding and knowledge, and *ingenium*, which refers to one's natural disposition or ability (Eysenck, 1998:11-16). There is evidence which supports the existence of a largely genetic and stable human quality referred to as 'intelligence' (Lomofsky & Skuy, 2001;188). Many theorists have proposed definitions of intelligence. Van den Berg (1996:161) identified a number of themes regarding the nature of intelligence. He found that intelligence is regarded as an ability to adapt to new situations in life; an ability to learn; an ability to deal with abstract symbols and relationships; and an ability to solve diverse and novel problems. Lomofsky and Skuy (2001:188) proposed that intellectual functioning and cognitive functioning should be linked "to highlight the fact that theorists currently believe there is both a genetic and a learned dimension" to the capacity to think, reason and learn. Reuven Feuerstein has provided a great deal of documentation regarding the modifiability of cognitive functioning (Feuerstein & Feuerstein, 1991:13).

Haywood, Tzurial and Vaught (1992:43) described intelligence as being largely genetic and modest modifiability is possible with great effort. Assessment of intelligence is based on achievement and the products of past learning (Kaufman, 1994:6). Haywood et al. explained that all individuals, regardless of their intellectual ability, need to acquire certain cognitive processes which must be taught or learnt and there is high modifiability with

teaching. Cognitive processes are generalised across content domains. Assessment of cognitive processes is dynamic and there is a focus on the process of learning in teaching situations.

According to Haywood and Switzky (1992 in Lomofsky & Skuy, 2001:189), intelligence and cognitive processes are different, yet complementary, constructs. This balanced approach

> "is a refreshing alternative to both the exclusive emphasis on the genetic determinism of intelligence by Arthur Jensen (1998) and his colleagues and the equally single-minded espousal of the propensity for cognitive modifiability by Feuerstein and his collaborators. The former leads to pessimism and fatalism, as well as a passive acceptance of individuals and societies as they are. It does not provide an impetus for human endeavour and change. Conversely, the extreme emphasis placed by Feuerstein and his colleagues on the 'active modification' of the individual results in non-accepting, unrealistic, and sometimes threatening, demands on teachers and learners alike" (Lomofsky & Skuy, 2001:189).

Lomofsky & Skuy (2001:190) have described this balanced perspective as the 'active acceptance' approach. It acknowledges the endowment of any given individual, and it also appreciates that the modifiability of relevant cognitive processes can result in the optimal development and competent use of an individual's endowment. Intellectual and cognitive functioning is believed to have both an intrinsic and an extrinsic dimension.

The balanced 'active acceptance' approach regarding intelligence and cognitive functioning will be used for the purposes of this study.

1.5.3 Academic Achievement

The Pocket Oxford Dictionary describes academic as "scholarly, to do with learning". Santostefano (1988:166) used the term 'academic achievement' to refer to performance on achievement tests which assessed reading accuracy and comprehension, spelling and mathematics. The term academic achievement will be used in the present study to refer to the assessment of reading accuracy, reading comprehension, spelling and mathematics.

1.5.4 Adolescence

Adolescence refers to the ages of approximately 12/13 to 22 or 25 years, with the distinction between early adolescence (12-15 years), middle adolescence (15-18 years) and late adolescence (18-22/25 years). Ackermann (2001:104) commented that this is an over-simplistic definition of adolescence. A purely physiological approach states that adolescence begins at puberty. This approach does not take into account the fact that emotional and social maturity do not necessarily coincide with physiological maturity. According to the cognitive approach, the adolescent phase is characterised by abstract-logical reasoning, complex problem-solving strategies and meta-cognition. Cognitive development, however, is a gradual process and some individuals may never reach this level of thinking. The sociological approach proposes that puberty characterises the onset of adolescence, and maturity into adulthood is determined by society. This varies from culture to culture. It is problematic that two different criteria are used to define adolescence, namely a physiological and a societal criterion. The transitional approach describes adolescence as a phase of transition. Not enough significance is attributed to the developmental and psychological aspects of adolescence.

Ackermann (2001:104-106) supported the psychological approach, which describes adolescence as a critical process in which individuals explore their identities and move from relative dependence towards relative independence. This approach acknowledges how important the adolescent phase is in terms

of further development and psychological well-being. Accelerated body growth and sexual maturation have a variety of effects on emotional and social development.

According to Piaget's (1981:69) model of cognitive development, formal operations may be attained during adolescence. Formal operations are characterised by more abstract thinking. Cognitive operations are often based on hypothetical possibilities and abstract-logical reasoning may become a more dominant mode of thinking. A more advanced level of thinking becomes possible and propositions (logical deductions made from hypothetical statements) are used in problem-solving (Louw, Van Ede & Louw, 1998:412). Proportional reasoning (an example may be using one mathematical relationship to discover another) and combinatorial reasoning (the ability to systematically consider an number of possible solutions to problems) are also characteristic of the adolescent phase (Ackermann, 2001:107).

A recent article in Time magazine (Park, 2004:47-48) described the latest research of adolescent brain functioning using functional Magnetic Resonance Imaging (fMRI). Dr Giedd analysed 1800 children and teenagers. He asked them to complete tests of intelligence and cognitive functioning while he conducted brain imaging. It was found that the prefrontal cortex is the last part of the brain to develop and it is responsible for executive functions e.g., planning, setting priorities, organising thoughts, suppressing impulses, and weighing the consequences of one's actions. The prefrontal cortex continues to develop during the adolescent phase. Typical adolescent behaviour (e.g. emotional outbursts and reckless behaviour) appears to be the result of a surge of hormones and "a paucity of the cognitive controls needed for mature behaviour" (Park, 2004:48). Brain imaging specialists have found that most brain development appears to follow a set course with alterations reflecting genetic predispositions. More subtle changes in grey matter are the result of experience and environment. "The brain, more than any other organ, is where experience becomes flesh" (Park, 2004:48).

It is also important to consider Vygotsky's (1978:86) views of cognitive development. Vygotsky described the zone of proximal development which refers to the level of development directly above an individual's current level. Individuals are not yet able to perform tasks within the zone of proximal development on their own. They need mediation from adults and/or peers to develop the necessary skill or competency. Cooperative learning opportunities enable learners to problem-solve about ideas in each others' zone of proximal development. The educator acts as a mediator using scaffolding to provide encouragement, clues and examples to assist learners in arriving at solutions (Ackermann, 2001:107). This type of learning requires a highly competent educator with excellent group management skills and a well-developed curriculum.

Cognitive development is influenced by other aspects of development in both direct and indirect ways. It depends on social, emotional and physical development (which includes neurological, sensory, motor and perceptual functioning). Cognitive development is also affected by an individual's motivation level, self-esteem, experiences of success or failure, future perspectives and eco-systemic factors (Gouws, Kruger & Burger, 2000:143-144). According to Nielsen (1996:416), family income is the best indicator of how well an adolescent will do in school and how much education s/he will complete. Nielsen explained that lower family income is linked to increased stress in the home. It has also been found that many educators believe that learners from impoverished backgrounds are incapable of performing academically (Winfield, 1995:113). These educators claim that intelligence is fixed and that there are racial/ethnic group differences. These perceptions are often communicated to learners in direct and indirect ways and affect their sense of competency and their ability to realise their potential.

Cognitive development impacts on other areas of development. For example, higher levels of cognitive reasoning may cause conflict in the child-adolescent relationship as the adolescent starts to challenge their parents' ideas and decisions. The development of hypothetical thinking may result in adolescents questioning values and social systems. Adolescents also explore

their self-concept at this stage becoming more self-conscious, and possibly more self-critical and idealistic. Identity formation is generally accepted as the central developmental task during adolescence. Erikson described this process as the identity crisis, the fifth stage in his eight-stage model of psycho-social development. It refers to the process of exploration and the consideration of alternatives. Gulotta (1995 in Ackermann 2001:110) describes this as a dynamic process of testing, selecting and integrating self-images and personal ideologies. It is important to consider all these variables in cognitive development.

During adolescence, the major systems involved are the family, the school, the peer group, and the broader community (David, Lazarus & Lolwana, 2002:55). These systems may have an enormous impact on developmental and learning processes. Family disruption and parenting styles have direct effects on the development of adolescents. Adolescents whose parents have an authoritative style in which love, warmth and sensitivity is demonstrated, tend to show higher levels of self-esteem and moral standards, and better academic results than adolescents who experience other styles e.g. authoritarian and permissive styles. Ackermann (2001:112-114) described adolescents who come from families characterised by rejection, detachment, father absence and permissive parenting styles as often being diffused. Foreclosed adolescents tend to come from families which are enmeshed and where authoritarian parenting styles are evident. Adolescents in *moratorium* often come from families in which autonomy and individual self-expression is valued. Adolescents who grow up in families where there is an effective balance between bonding and separation, are said to reach identity achievement status.

1.5.5 Disadvantaged Communities

In relation to disadvantage, Campbell (2003:45) refers to a large international literature that recognises a combination of two forms of social disadvantage: material social exclusion which is related to poverty, and symbolic social exclusion which is as a result of lack of respect and recognition. In addition to

the direct effects of socio-economic deprivation, members of marginalized groups often lack material or symbolic resources to deal with stressful situations. People who lack power to shape their life course in significant ways are less likely to believe that they can take control of their circumstances.

The discussion above has highlighted some of the complexities involved in attempting to understand the intellectual and cognitive functioning of adolescents living in disadvantaged communities.

The concepts of intellectual and cognitive functioning, adolescence and disadvantaged communities have been defined for the purposes of this study. The research design will now be discussed.

1.6   RESEARCH DESIGN

1.6.1 Introduction

A research design lays out the plan for how the research will be undertaken. It also clarifies what the research problem is. The logical rationale of the research is also discussed in an attempt to make sure that the data addresses the research question (Mouton, 2001:55-56).

The research design for this study is directed by the objectives stated in 1.3. It fits into the postpositivist paradigm of research as described in Chapter 3 and is quantitative in nature. The present research project is a correlation study as the aim is to identify whether there is a relationship between cognitive controls and intellectual and scholastic functioning. It is a relationship study which explores the relationships between measures of the different variables obtained from a few individuals at approximately the same time to gain an understanding of factors that contribute to a more complex characteristic (Mertens, 1998:92).

1.6.2 Methodology

Data collection methods consisted of a literature review as well as the collection of the data. The results of the intellectual, cognitive and academic assessments provided the data. The purpose was to compare the performance of the VLBW adolescents with their matched controls.

1.6.2.1   Literature review

At the outset of a research project, it is advisable to conduct an in-depth literature review. It is important to consider how other research projects in the field have been conducted and the results of these studies. A good literature review should include as many aspects of the research topic as possible. All theories and studies should be evaluated in a fair manner. The review should include current sources. The structure of the review should be clear and logical (Mouton, 2001:90-91).

The literature review in this study will be conducted in order to
- review the international research findings of the behavioural and cognitive outcomes of VLBW children.
- explore the theories of intelligence and cognitive functioning;
- consider the assessment of intelligence and cognitive processes, as well as the relationship between intelligence and cognition; and
- explore the environmental influences on child development, with particular consideration of disadvantage communities in South Africa.

1.6.2.2   Population and sample

The population of this study is 12 to 14 year old VLBW coloured adolescents living in disadvantaged communities in the Greater Cape Town area. (The term 'coloured' will be used in this study, although the researcher is aware that some members of this population group refer to themselves as 'people of colour'). These adolescents weighed 1250g or less at birth and were born at or referred to Groote Schuur Hospital from July 1988 over a 12 month period. The children were matched with controls at age 6 for sex and socio-economic status. Xhosa-speaking children and those with Fetal Alcohol Syndrome were excluded from the original group. A research assistant contacted the families of the VLBW children who had been assessed at age 6. This group will be referred to as the index group as they were identified as being very low birth weight infants, whereas the control group were of normal birth weight. The study design aimed to assess all the children in the cohort. However, time limitations allowed for only 18 of the cohort and their controls to be assessed. It was decided to include subjects on the basis of proximity and affordability of transport to Groote Schuur Hospital where testing was to be done. The sample did not differ from the cohort in terms of birth weight, gestational age and socio-economic status. This will be discussed further in Chapter 3.

1.6.2.3   Instruments

The intellectual functioning of South African school-aged children is assessed by means of the Senior South African Intelligence Scale – Revised (SSAIS-R). This instrument was developed in 1964 by the Human Sciences Research Council and was revised in 1991, at which time updated norms were established. A cognitive assessment instrument was sought which could be used in conjunction with the SSAIS-R. An instrument was needed which could be administered in a relatively short period of time and which could be easily translated into Afrikaans, the language spoken by some of the participants. An assessment instrument which was accompanied by an

effective intervention programme was also a pre-requisite. The Cognitive Control Battery (CCB) was developed by Sebastiano Santostefano in 1988. The subtests are non-verbal and the assessment takes thirty minutes to administer. The results of this assessment identify any cognitive control principles which are under-developed. An intervention programme called Cognitive Control Therapy (CCT) was created by Santostefano to develop any areas of weakness. This intervention can be implemented by psychologists or educators (Santostefano, 1985:33). The instructions of the CCB are easily translated into Afrikaans. The CCB has been used to assess children and adolescents from various cultural backgrounds in South Africa (Engelbrecht, 1996:204). The Neale Analysis of Reading Ability was developed in 1966 by Neale in Great Britain. This reading assessment was translated into Afrikaans by Bower and Hartman in 2002. The Schonell 5 Mathematics test was developed in Great Britain and South African norms were established in 1973 (SAALED Newsletter, 1973). The assessment consists of one hundred sums which assess basic mathematical operations. The instruction to complete as many sums as possible in the given time period, was easily translated into Afrikaans. The ICE Spelling assessment was translated into Afrikaans (IPV Speltoets) and norms were provided for the English and Afrikaans versions.

1.6.2.4   Procedure

The research assistant contacted the families of the index participants and their matched controls. The research assistant made appointments for the assessments which were conducted at Groote Schuur Hospital during the school holidays. Two participants were assessed during the course of a morning. The researcher assessed one participant while the other participant had breaks. The researcher conducted the assessments mentioned in 1.6.2.3, scored them and entered the results so they could be analysed by means of the SPSS programme (SPSS, 1991).

1.6.2.5   Data analysis

Descriptive statistics were obtained by means of the SPSS (1991) statistical programme in order to summarise the data. The means for the total sample on intellectual functioning, cognitive functioning and academic achievement were provided. The performance of the index group and the control group was then compared on intelligence, cognitive functioning and academic achievement.   Correlations were calculated to establish whether there were associations between cognitive functioning and intelligence, then cognitive functioning and academic achievement, and finally, intelligence and academic achievement.

1.7   PROGRAMME OF STUDY

Chapter 2 consists of a review of the research on the intellectual and behavioural outcomes of VLBW children. This section is followed by an overview of the literature concerning the controversies surrounding intelligence and cognitive functioning, and the relationship between them. The assessment of intelligence and cognitive functioning is discussed. The context of the adolescent living in a disadvantaged area of Cape Town is described and the impact this has on cognitive development is explored.

In **Chapter 3** a brief discussion of the nature of research and relevant terminology is followed by a description of the method of research used in this study. The findings are presented and discussed.

Chapter 4 consists of conclusions based on the findings of this study, their implications, any limitations of the study that were identified, and recommendations for further research.

Chapter 2

LITERATURE REVIEW

2.1   INTRODUCTION

In this chapter, international research findings regarding the cognitive and behavioural outcomes of VLBW children will be reviewed. An exploration of the concepts of intelligence and cognition will follow. The assessment of intelligence and cognitive processes, as well as the relationship between intelligence and cognition, will then be discussed. Further discussion will then focus on environmental influences on child development, with particular consideration of adolescents currently living in disadvantaged communities in South Africa. A summary of the literature concludes the chapter.

2.2   COGNITIVE AND BEHAVIOURAL OUTCOMES OF VLBW CHILDREN

Very low birth weight infants tend to display deficits in basic reflexes, muscle tone, spontaneous movement and visual orientation in early infancy (Richter and Griesel, 1994:70). The differences detected between VLBW infants & those of normal birth weight tend to disappear in infants who grow up in highly supportive care-giving environments. The development of VLBW infants is believed to be influenced by the following: the history, personal characteristics and social context of the caregivers; the constitution and temperament of the child; and the nature and extent of medical complications. A study by Bradley, Caldwell, Rock, Casey & Nelson (1987:301) found that the most efficient predictor of the cognitive development of LBW children at 18 months was a measure of characteristics of the child's home experience, which includes the stimulation offered to the child and the organisation of the home. LBW babies are also believed to be more sensitive to environmental insufficiencies and consequently, more vulnerable to negative environmental experiences.

LBW babies have also been found to be more apathetic, under-demanding and unresponsive to environmental stimulation. As a consequence of their often erratic movements and unstable behaviour, caregivers find it difficult to establish mutually satisfying interactions. This may result in less than optimal care for the infant which may compound the effects of prenatal undernutrition. Richter and Griesel (1994:71) comment: "Thus, a general conclusion about biological risk, including LBW, is that effects can be ameliorated by a supportive and stimulating caregiving environment or exacerbated by a deprived and stressed environment".

The discussion of the consequences of low birth weight will be followed by a review of international studies of the cognitive and behavioural outcomes of VLBW children. Three relevant meta-analyses have been reported in the medical literature:

1. Aylward, Pfeiffer, Wright and Verhust (1989:515) carried out a meta-analysis of 80 studies published in the previous decade that explored the outcome of low-birth weight infants. The combined average intelligence/developmental quotient (IQ/DQ) was 97.7 (SD 6.19) and for the control subjects it was 103.78 (SD 8.16). This difference was statistically significant, but was considered not to be clinically significant.

2. Escobar, Littenberg and Petitti (1991:204) looked at published studies with data about morbidity among surviving VLBW infants. A total of 111 outcome studies were published between 1960 and 1991. Follow up ranged from 6 months to 14 years. The median incidence of cerebral palsy was 7.7% and for all disability 25%.

3. Bhutta, Cleves. Casey, Cradock and Anand (2002:728) included case-control studies reporting cognitive and/or behavioural data on children born with birth weight less than 1500g, who were evaluated after 5 years of age. They reviewed 227 studies and selected 15 with cognitive data and 16 with behavioural data. Their conclusion based

on the 1556 cases and 1720 controls was that preterm infants were at risk for reduced cognitive test scores and they also showed an increased incidence of ADHD and other behaviours.

There are four reports of studies on infants with birth weights less than 1500g who were followed up until 12 years or older.

Table 1.   Adolescent follow-up studies of VLBW infants and their matched controls

Author/Country	Year of Birth	Birth Weight	Mean Age	Mean IQ (SD)
Levy-Shiff et al. (Israel)	NA NA	<1500g >2500g	13 13	105.1 (10.5) 114.4 (9.8)
Botting, et. al. (UK)	1980-1983 1980-1983	<1500g >2500g	12 12	89.7 (17.2) 97.8 (17.4)
Saigal et. al. (Canada)	1977-1982 1977-1982	500-1000g 3395g	14 14	89 (19) 102 (13)
Rickards et. al. (Australia)	1980-1982 1980-1982	<1500g 3417g	14 14	96.2 (15.5) 105 (13.5)

Rickards, Ryan and Kitchen (1988:19) reported that the VLBW children did better on the two Performance subtests (Picture Arrangement and Block Design) than on any of the Verbal subtests (particularly Vocabulary). However, Botting, Powls, Cooke and Marlow (1998:658) found that the differences in Full-scale IQ scores in the VLBW cohort compared to controls was accounted for by the poorer Performance IQ, with a mean deficit of 10 points compared with only 4.5 IQ points on the Verbal IQ.

Rickards et al. (1988:19) reported that 24% of the VLBW children in their study had not achieved the criterion for reading accuracy and 48% had not reached criterion for reading comprehension on the Neale Analysis of

Reading Ability. Saigal, Szatmari, Rosenbaum, Campbell and King (1991:751) found their extremely low birth-weight (ELBW) cohort (less than 1000g) had significantly poorer performance on all three WRAT-R subtests. The mean WRAT-R scores in reading and spelling were in the borderline range of 1 SD below the mean, but the ELBW cohort was particularly poor in arithmetic. Botting et al. (1998:652) reported that the VLBW children in the mainstream educational setting performed less well than their peers on all areas of educational skills. After adjusting for IQ differences, reading comprehension scores and basic mathematical scores remained poorer for the VLBW cohort.

One can conclude that despite substantial improvements in survival rates of VLBW infants, poor outcomes among survivors are common. Disabilities are more frequently encountered in survivors and lower IQ scores and behaviour problems, particularly ADHD, are found. The differences in IQ between VLBW and control subjects persist into adolescence. Of note, however, is the fact that all studies published have been conducted in developed countries. The level of care, particularly neonatal intensive care, is routine in such countries, whereas in developing countries neither the care nor the resources to mount rigorous follow-up studies are available.

The outcomes of VLBW children have been discussed. The discussion will now focus on the ways in which intelligence is defined and understood.

2.3   INTELLIGENCE

One of the aims of the present study is to investigate whether VLBW adolescents have lower Intelligence Quotients (IQs) than their controls. This necessitates a review of past and present ideas regarding the concept of intelligence.

2.3.1 Historical Perspective

The term intelligence comes from the Latin words *intellegentia*, which refers to the English words understanding and knowledge, and *ingenium*, which refers to one's natural disposition or ability. The Romans and the Chinese used terms which were similar to general ideas about intelligence today. Confucius regarded intelligence as having a "top brain" and a quick mind (Eysenck, 1998:11-16). The notion of intelligence has been reformulated over the past 2,500 years. During the nineteenth century, Francis Galton and Wilhelm Wundt began to investigate whether all knowledge is obtained by means of the senses. Researchers at that time studied reaction time, sensorial perception, mechanical memory and motor skills (van den Berg, 1996: 158).

At the turn of the twentieth century, Binet set out to develop a test, which could provide a more objective assessment of children's abilities than the subjective perceptions of teachers. He had been asked by French authorities to develop tests which would identify children in need of special education. According to Anderson (2001:288), Binet's genius was to realise that the universally acknowledged increase in intelligence during child development provided the basis of a measurement scale. Binet argued that intelligence referred to the ability to comprehend, judge and reason well (Truch, 1993:13). He conceptualised intelligence as mental age and this set the format for the majority of intelligence tests, notably the Stanford-Binet and the Wechsler tests. The content of items on the Stanford-Binet Scale was different for different age groups of testees, which presented theoretical problems. David Wechsler tried to resolve this issue in the intelligence test he developed and revised. He used the deviation IQ scale that guaranteed that IQ had the same standard deviation at each age level (van den Berg, 1996:160).

2.3.2 Theories of Intelligence

Since the development of intelligence testing, various types of theories of intelligence have emerged. Psychometric theories of intelligence are well

known. Spearman developed a theory of general ability in which he proposed that general intelligence (g) reflected a hypothetical mental power or energy that was part of all intellectual operations (Anderson, 2001:290). Truch (1993:13) noticed similarities between this form of mental energy and electricity. He claimed that both are found in the real world and they can both be measured, stored, used in different ways, and transformed. A kind of "wiring" helps both forms to operate and they are subject to fluctuations at any time. Truch believed that intelligence is the orderly, purposeful flow of this energy and it is governed by an individual's "will" and his/her decision-making abilities, which are referred to as executive functions in the information-processing model. According to Truch, intelligent behaviour is the "channelling of this energy for a purposeful act. The act itself may promote the welfare of the person and/or a social group" (1993:13). He pointed out that this may result in working towards a worthy cause, such as research, or in life-destroying acts, such as the creation of deadly weapons. Truch highlighted the fact that intelligent behaviour can be used for good or evil.

Thurstone (1938:3) advocated that abilities are multiple in nature. He identified seven primary mental abilities which included verbal comprehension, general reasoning, word fluency, memory, number, spatial, and perceptual speed abilities (Foxcroft, 2001:180). Guilford developed the structure-of-intellect model that is based on three dimensions. The products dimension relates to the way stimuli are organised. The operations dimension refers to intellectual processes which include cognition, memory and evaluation, and the content dimension relates to the nature of the stimuli (Kaufman, 1994:52). This model proposes that there are at least 120 unique human abilities which can be taught.

Piaget's (1981:4-5) theories of thinking fall into the category of epistemological theories. He identified the processes of assimilation and accommodation in incorporating and integrating information. Sternberg (1997:146) felt that Piaget focused more on competence than performance. Computational theories emphasise performance and the importance of understanding the information processing involved in thinking. Biological

theories have strived to demonstrate the link between information processing and biological functioning. Anthropological theories emphasise the perspective that the concept of intelligence is a cultural product and they ignore the biological findings. Theories that embrace a systems approach integrate the most useful approaches identified from the previously mentioned theories.

Howard Gardner proposed the theory of Multiple Intelligences in his book *Frames of Mind* (1993:1). His theory proposes that all humans have seven distinct and universal capacities or intelligences. These intelligences are innate and universal and are shaped by the cultures they appear in. The intelligences Gardner identified are: linguistic, logical-mathematical, spatial, musical, bodily-kinaesthetic, interpersonal and intrapersonal intelligence (Walters, 1992:2). He has subsequently included more intelligences in his model. Walters argued that Western culture places too much emphasis on the linguistic and logical-mathematical intelligences and educational practice should focus on developing all these capacities. Eysenck (1998:112) questioned whether the seven intelligences proposed by Gardner are separate and independent. He argued that verbal ability, mathematico-logical ability and spatial ability are quite highly correlated. Eysenck could not find any scientific basis for emotional intelligence. He wrote, "Creativity in real life combines IQ and personality, motivation and special abilities in a fascinating combination that transcends the undefined 'practical intelligence' and 'emotional intelligence' of the Gardners and the Golemans" (1998:112).

Sternberg's Triarchic Theory (1997:343) also represents a system approach to abilities. This theory emphasises the importance of three aspects of abilities: namely, analytical, creative and practical. Sternberg explained that there are different types of processes which are implicated in intellectual activities. Metacomponents are higher-order executive processes which are involved in planning, monitoring and evaluating problem-solving. Performance components are lower-order processes in which the problem-solving strategies are implemented. These strategies need to be learnt and knowledge-acquisition components make this possible. This process involves

attending to relevant information and comparing new information with previously acquired information. The Triarchic Theory recognises that all individuals have strengths and weaknesses and it refutes the traditional notion of g.

Horn and Cattell's Fluid-Crystallised Theory (1982:623) is an additional theory of intelligence. Crystallised intelligence resembles the skills assessed by verbal subtests on intelligence tests and refers to problem-solving ability and factual learning which is the result of formal schooling and acculturation. Fluid intelligence refers to the ability to solve novel problems and is not influenced by schooling or acculturation. Non-verbal subtests appear to measure this ability. Kaufman (1994:50) noted that although associations between these two constructs and the verbal and non-verbal subtests of intelligence tests have been made, this has been complicated by the fact that Horn has extended his theory to include eight abilities which measure intelligence. This theory has shaped the development of recent tests which will be discussed later in this chapter, eg. Kaufman Assessment Battery for Children (K-ABC).

2.3.3 Intelligence and socio-economic status

The Fluid-Crystallised Theory has implications for the discussion of the influence of socio-economic status on intellectual performance. The definition of fluid intelligence assumes that problem-solving is not affected by formal schooling or acculturation (Kaufman, 1994:50). Sternberg (2001:28) has shown that people from different cultures sometimes interpret and solve problems in ways which lead them to score poorly on IQ tests. Jensen (1985 in Utley, Haywood & Masters, 1992:451) found that the average IQ of minority children was 85, which was one standard deviation below the average for children from middle-class backgrounds. A study was conducted in a coloured working-class community in Cape Town during the late 1990s by Peterson and Carolissen (2000:104-105). Forty-seven children (ages 4-6 years) who attended two preschools were assessed on the Junior South African Intelligence Scales (JSAIS). It was found that the cognitive abilities of

65% of the children were below average, with 24% in the cognitively handicapped range. School clinics and other agencies corroborated the findings with their assessments. The authors were very concerned about the low cognitive results of the children. Only 61% of their parents had completed Grade 8.

Kaufman (1994:183) described studies which found that the WISC-III Full Scale IQ score was directly proportional to the amount of parental education. He commented that the trend suggests that a child's background experiences can influence his/her verbal and non-verbal skills. He has found that on the WISC-III, children from low socio-economic backgrounds tend to perform slightly poorer on the verbal scale in comparison to the performance scale. These children may have had limited opportunities for cultural enrichment and acculturation and they may lack the knowledge base to solve problems requiring crystallised reasoning. Kaufman (1994:183) suggested that higher performance versus verbal scores for culturally disadvantaged children

> "...may suggest true intellectual ability despite inadequate learning experiences. The poor school achievement that often accompanies cultural deprivation is, almost by definition, consistent with the low verbal IQ".

Kaufman (1994:6) commented that IQ tests are a kind of achievement test and a measure of prior learning. Learning occurs in a culture and so it is culture loaded. This explains why IQ scores are good predictors of conventional school achievement. Das, Naglieri and Kirby (1994:199) made the following contribution to this argument:

> "Lacking a theory, traditional IQ testing relied upon correlation for its justification; because the test scores correlated with, for instance, school success, they were good measures of the cognitive processes underlying school success. Yet race and home background are also good correlates of achievement in many societies but no one seriously believes they are good measures of cognitive processes (if they are

correlates, then we seek to discover *why* so that education can minimise negative effects of the correlations)"

The issues of socio-economic status and race have fuelled the debate surrounding intelligence.

2.3.4 Current Debates

Psychologists cannot agree on an exact definition of intelligence, although a number of themes emerge regarding the nature of intelligence. Intelligence is regarded as an ability to adapt to new situations in life; an ability to learn; an ability to deal with abstract symbols and relationships; and an ability to solve diverse and novel problems (van den Berg, 1996:161). Eysenck (1998:8) referred to a survey regarding the intelligence controversy, which included 600 experts in the fields of intelligence testing, educational psychology, developmental psychology, behavioural genetics, sociology, education, cognitive science, counselling psychology and occupational psychology. Most of them agreed on the importance of abstract thinking and reasoning, problem-solving ability and the capacity to acquire knowledge. According to van den Berg (1996:161), "intelligence may be regarded as a hypothetical property that people possess to some degree according to their ability to solve diverse problems of differing complexity and novelty". The difficulty lies in attempting to measure complexity and novelty objectively.

The field of intelligence testing has resulted in the emergence of theories of different types of intelligence. Foxcroft (2001:178) distinguishes between different types of intelligence, namely, biological intelligence, social (or practical) intelligence and psychometric intelligence. Biological intelligence refers to objective measurements of the physical structure and functioning of the brain. Social or contextual intelligence demands that intelligent behaviour must be defined in the context in which it occurs. Foxcroft (2001:178) also regards this form of intelligence as practical intelligence, which Sternberg,

Grigorenko and Bundy define as "the ability to adapt to, shape, and select real-world environments" (2001:25). These authors report that research suggests that this type of intelligence is factorially distinct from the kind of academic intelligence measured by conventional intelligence tests. In some studies conducted in non-Western countries, practical intelligence skills were actually negatively correlated with academic intellectual skills. Greater investigation is required to establish whether these practical skills make more of a difference to adaptation in everyday functioning and economic productivity than academic skills.

Foxcroft (2001:178) identified a third type of intelligence, namely psychometric intelligence, which refers to levels of functioning on psychologically defined constructs as measured by standardized psychological tests. From this perspective, intelligence is "what intelligence tests measure" with the assumption that it takes a certain type of intelligence to do well on the items of the test. Truch (1993) has conceptualised intelligence in a similar fashion. He found the following distinctions useful when he explains the results of IQ score to parents and teachers. He refers to them as Intelligence A, Intelligence B and Intelligence C. Intelligence A refers to innate genetic potential. Intelligence B refers to the interaction between Intelligence A and the environment, which is affected by "culture, home environment, birth weight, birth trauma, malnutrition, and a host of other factors" (1993:23). Intelligence C is the score on an individual test of intelligence. Truch claimed that Intelligence C is used to infer Intelligence B.

There is currently a great deal of discussion and research regarding how intelligence should be conceptualised and measured. A major issue in the intelligence debate is the importance of the speed of processing. Kaufman (1994:195) conducted a study which found that children who solved the Picture Arrangement, Block Design and Object Assembly subtests on the WISC-III quickly also performed better on other similar problems than those who worked slower. He suggested that an individual's speed of processing on non-verbal subtests appears to be an intellectual attribute. Conversely, children who have learning difficulties may be penalised by the speed factor

on intelligence tests. Kaufman discussed the range of variables which affect speed: namely, visual-motor coordination problems, reflective cognitive tempo, perfectionist tendencies, language disorders, learning disabilities, dyslexia, ADHD etc. He admitted that speed of processing is a complex, multifaceted variable. The literature on intelligence seems to emphasise the importance of speed of processing and this may reflect Western cultural values. It is accepted that individuals have different learning styles and accuracy in solving problems should be emphasised. Impulsive, hurried thinking styles often result in inaccuracy.

Technical reports on the development of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) indicate that the Full Scale IQ is no longer the sum of verbal and performance composites (Williams, Weixx & Rolfhus, 2003:2). It now includes greater contributions from working memory and processing speed. Working memory is described as the ability to hold information in mind temporarily, to perform an operation or manipulation with the information, and to produce a correct result. Research has shown that working memory is an essential component of fluid reasoning and other higher order cognitive processes, and is closely related to achievement and learning. Three of the performance subtests which emphasised speeded performance and motor skill have been removed. Speed of information processing was found to be dynamically related to mental capacity, reading performance and reasoning. A supplemental subtest called Cancellation has been included which measures visual selective attention and processing speed. The testee is required to scan arrangements of pictures and target those which are inappropriate. The revisions and additions included in the WISC-IV illustrate the trends evident in the contemporary research of cognitive functioning.

Models for understanding intelligence are constantly being reformulated. Anderson (2001:293) addressed the issue of whether inhibitory processes are implicated in intelligence. These processes refer to the ability to attend to relevant information and inhibit irrelevant information. Anderson suggests that the processes involve executive functioning and the ability to attend to

relevant information is part of the developmental process. A recent model of mental processing proposed that processing consists of the following dimensions: speed of processing, control of processing (the ability to focus on relevant information) and working memory (the processes enabling an individual to hold information in an active state while integrating it with other information until the current problem is solved) (Demetriou, Christou, Spanoudis and Platsidou, 2002:6). There appears to be a growing interest in the ways in which individuals process information.

The information-processing model applies to the learning process in general and it consists of four components. The first phase is the input phase whereby an individual obtains information from the sense organs. In the integration phase, an individual interprets and processes the information. This information is then stored during the storage phase and it is expressed via language or muscle activity during the output phase. Kaufman (1994:10) pointed out that the integrative and processing components are evaluated by intelligence tests, whereas more attention needs to be paid to the input and output processes involved when individuals perform tasks.

The following discussion highlights developments in the fields of information processing and cognition.

2.4   COGNITION

2.4.1 Historical Perspective

Santostefano described the approach to investigating cognition before 1940 as "formal" in the sense that researchers tried to explain cognition as determined by physical properties to stimuli. This was typical of the behaviourist tradition. After 1940, researchers applied "functional" approaches which focused on how individuals used cognitive behaviours to adapt to changing environments. At this time, the "organismic model" of human behaviour emerged in the behavioural sciences and there was a shift towards

perceiving individuals as "inherently and spontaneously active – approaching, avoiding, selecting, modifying, and giving meaning to stimuli" in adaptation and learning (Santostefano, 1986:6). Studies conducted within this model become known as the "New Look" in perception. George Klein developed the idea of cognitive controls which was one of the New Look approaches. American psychologists were influenced by Piaget and Freud during the 1950s and they became interested in how cognition, affect and personality were interrelated (Santostefano, 1986:ix). A significant revolution has occurred in the field of psychology since the 1960s and there has been a move away from the behaviourist tradition towards the cognitive tradition.

2.4.2 Current Definitions of Cognition

The term cognition is used in the literature in a wide variety of ways. According to Cilliers (1998:23), cognition literally means 'meaning" and it involves all the mental processes whereby an individual becomes aware of his/her environment, gains knowledge and organises and applies knowledge. Haywood, Tzuriel & Vaught (1992:43) indicated that cognitive processes must be taught and learnt. Cognitive processes consist of a mix of native ability, work habits, attitudes, motives and strategies (Lomofsky & Skuy, 2001:189). According to Ashman and Conway (1997:41), cognition "involves taking in, storing, retrieving, transforming, and manipulating information that is obtained through the senses. It also involves perception, awareness, judgement, the understanding of emotions and memory and learning".

Santostefano defined cognition as "any process by which an individual becomes aware of, obtains knowledge of, and takes action with regard to, some piece of information, be it an object, a person, a fantasy, a memory, a thought, or a feeling. Some of the mental functions which are involved are attending, perceiving, recognising, comparing, conceiving, judging, reasoning, and remembering" (1986:5).

2.4.3 Important Cognitive Theorists

2.4.3.1 Sebastiano Santostefano

Santostefano was influenced by the New Look in perception and the work of George Klein. Klein and his followers discovered that adults consistently use specific cognitive-ego strategies to approach, avoid, compare and cluster information (Santostefano, 1985:12). Adults use these strategies to control information and to adapt to their current situation. Santostefano was interested in whether these strategies were also used by children to approach, select, avoid and process information. He conducted studies and found that children do employ these strategies. Each cognitive control defines a developmental range of cognitive behaviours and they form a developmental hierarchy. Santostefano defined cognitive controls as:

> "having the status of intervening variables that define principles by which motor behaviour, perception, memory, and other aspects of cognition are organised as an individual co-ordinates him/herself with environmental demands" (1988:7).

Santostefano identified five separate dimensions of cognitive controls that are available to an individual at birth. Each of the controls change as the child matures. The five cognitive controls usually become fully developed in children by the age of three. The process of each cognitive control remains consistent throughout an individual's lifetime, although the organisation of each control changes. These cognitive controls operate simultaneously and they create a pattern of the strategies in which an individual processes information in both learning and social contexts. Santostefano claimed that the way cognitive controls operate correlated with age, although they were relatively independent of IQ and gender (Santostefano & Moncata, 1989:43).

The cognitive controls can be described in the following way:

1. Body ego-tempo regulation

   This control refers to the way a person uses images or symbols to represent and regulate the body. Young children use the same tempo whether they are moving fast or slow because they have not yet learnt to regulate their body motility. As children mature they are able to distinguish between different body tempos and regulate their tempo appropriately (Santostefano, 1988:7).

2. Focal attention

   This cognitive control refers to the way a person scans a field of information. Young children scan slowly and they survey narrow sections of information. As they get older they employ more active scanning and they survey larger areas of fields of information (Santostefano, 1988:7).

3. Field articulation

   This control process involves the way an individual manages information which contains aspects which are both relevant and irrelevant to a particular task. Young children attend to both relevant and irrelevant information in the same manner. As they mature, children learn to withhold attention from irrelevant information and to focus their attention on what is relevant (Santostefano, 1988:7).

4. Levelling-sharpening

   This control mechanism refers to the way a person constructs images of information that change or stay the same over time and then compares these with present perceptions. Young children construct global images of past information and consequently they do not detect changes when confronted with slightly different images. As they develop, children start of construct sharper, more differentiated images. This strategy helps them to perceive differences between past and present information (Santostefano, 1988:7).

5. Equivalence range

This control refers to the way an individual groups and categorises information in terms of a concept or belief. Words, thoughts and beliefs form part of this control. Young children use limited, concrete categories, whereas older children construct broader categories that are based on more abstract concepts (Santostefano, 1988:7).

The developmental hierarchy of cognitive controls is based on the principle of directiveness of behaviour which states that "development proceeds from a state of relative globalness and lack of integration to a state of increasing differentiation, articulation and integration" (Santostefano, 1988:7). Each cognitive control in the developmental hierarchy encompasses an increasingly differentiated level of developmental organisation. The developmental hierarchy is summarised in Figure 1. This graphic representation illustrates the levels within each control from global and diffuse cognitive functioning to more differentiated cognitive functioning. Within the focal attention control there is development towards more active scanning, characterised by broad visual sweeps and directed at broader sections of a field of information. Progression has occurred within the field articulation control when individuals are able to withhold their attention from irrelevant information and attend to relevant information. Differentiation within the levelling-sharpening control is evident when more detailed and stable images are constructed that are increasingly articulated from present perceptions.

Santostefano (1988:8) stated: "...When functioning adequately, the process of a control is viewed as relying upon, subsuming and integrating the processes of other controls lower in the hierarchy". He explained that field articulation functions efficiently when there is modulated motility and attention on relevant information. The levelling-sharpening control operates efficiently when the principles of focal attention and field articulation are developed, and the organisation of relevant and irrelevant information is held in a stable, differentiated image that can be compared to perceptions of present
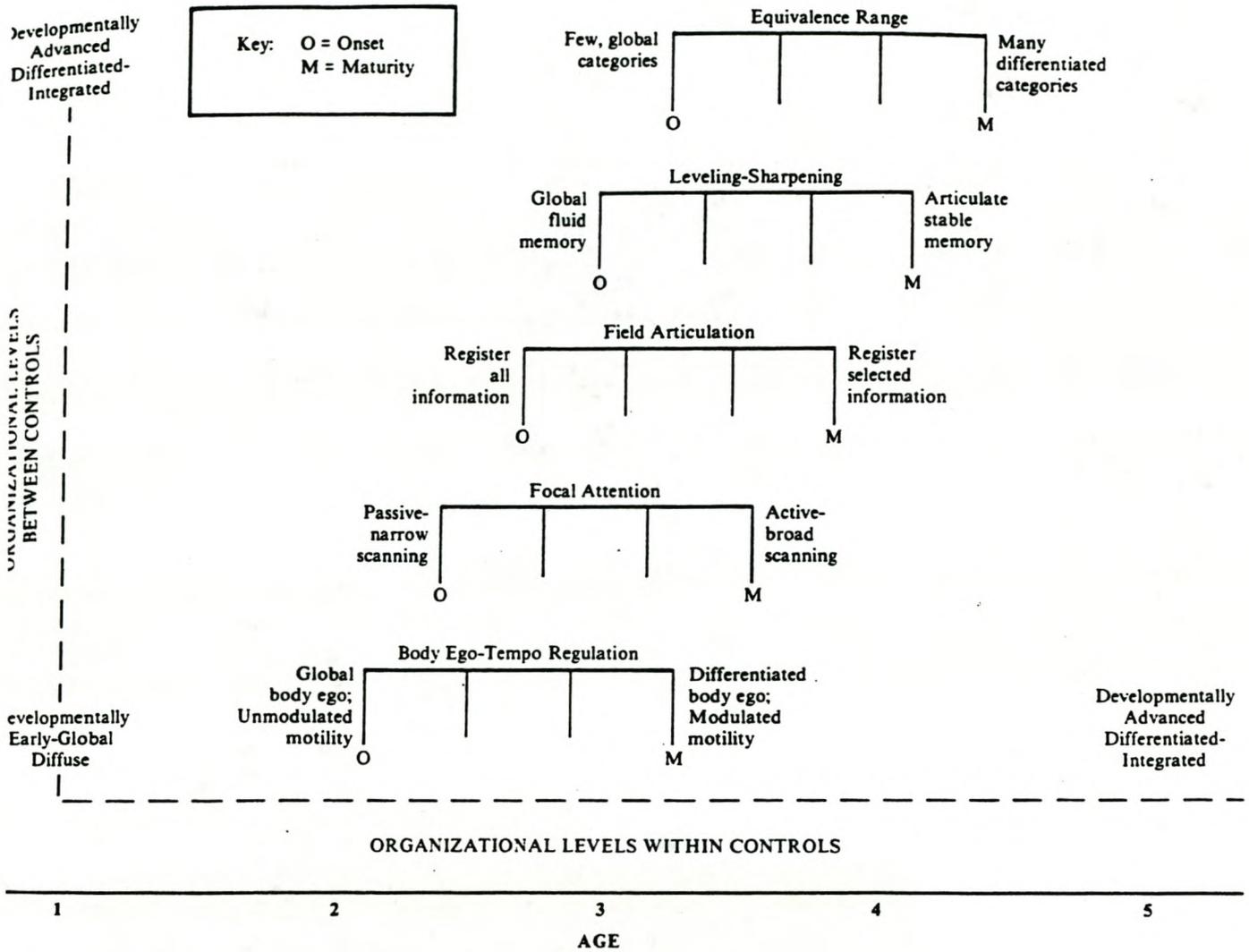
Fig. 1   Santostefano's Developmental Model of Cognitive Controls
(Santostefano, 1988:9)

information.   These concepts form the theoretical framework of Cognitive
Control Therapy (Santostefano, 1984:78).

The relationship between cognition and affect will now be explored. An individual's cognitive functioning is influenced by his/her affective state, and visa versa. Cognitive and affective functioning must be kept in balance. Cognitive controls are used to maintain this balance. This cognitive-affective coordination involves a balance between inner forces, such as feelings, memories and fantasies, and the external environment. According to Santostefano (1988:12), there are three phases in the development of cognitive-affective coordination.

- In children under the age of five years, cognitive controls are oriented toward their inner world of fantasy. They usually experience information in the environment in very personal and highly imaginative ways.
- In children between the ages of five and nine years, cognitive controls become more oriented towards information in the external environment.
- From age nine to adolescence, cognitive controls are oriented towards both internal and external environments. The controls become more flexible and mobile.

The successful development of cognitive-affective coordination is associated with normal personality development. A cognitive-affective imbalance results in what Santostefano refers to as psychopathology. In this case the cognitive control level of an individual may not be appropriate, or a cognitive control may not be flexible enough for a specific situation. Dysfunctional cognitive controls are the result of mismatches between a person's cognitive functioning and his/her environment. This may occur when an individual is suddenly exposed to an unusual environment for an extended period of time. An individual may also be exposed to such an environment during a critical period when his/her cognitive style and problem-solving approach are vulnerable (Santostefano, 1988:13). Santostefano, Estevez & Santostefano (2001:37) investigated life stressors and cognitive styles in children. They reported that children who were exposed to arguments and threatening

gestures among adults made more errors when they tried to focus their attention while being distracted by stimuli concerning nurture.

In abnormal development cognitive controls may be immature in individuals as a result of mismatches between cognition and stimulation until age three and the cognitive controls continue to be mismatched with the demands of his/her context. The individual may experience stress, anxiety or aggressive tendencies (Santostefano, 1985:33). Calicchia, Moncata & Santostefano (1993:731-740) assessed a sample of violent and non-violent juvenile inpatients. The results indicated that the violent inpatients had differences in attention and memory when compared with non-violent inpatients, especially when they were processing aggressive stimuli. The authors postulated that dangerous juveniles produce fewer errors when the stimulus is aggressive and therefore, they may not experience the anxiety and fear commonly associated with violence. The use of cognitive assessment in forensic evaluations could have significant implications in predicting which juveniles might repeat violent acts. This area requires further research.

The relationship between cognition and affect has been discussed. It is important to compare the model of cognitive controls and Piaget's theory of cognitive development. Piaget's model of cognitive development has been very influential in the field of cognitive development in the United States. Piaget's theory (1981:14) was based on a series of stages which describe the processes which individuals use to obtain information from infancy to adolescence. The theory centres on the concept of a schema which is conceptualised as "a pattern of overt actions, perceptions of mental images, and words that are applied in different situations" (Santostefano, 1988:18). He described sensorimotor schema which involve physical and mental actions, and cognitive schema which refer to mental actions. Piaget believed that cognitive schemas originate from sensorimotor schemas. He pointed out that schemas change in structure and function as the individual progresses through four stages (Santostefano, 1988:18).

There are some similarities between Piaget's model and the model of cognitive controls. Piaget and Santostefano both agreed that cognitive activity is adaptation and cognitive actions originate from physical actions. Both theorists also believed that cognitive structures assimilate existing information while also accommodating to new and different information. There are, however, a number of differences between the models. Piaget's theory does not take individual differences in information processing into account. Cognitive control theory emphasises individual differences in the functioning of each cognitive control principle. Santostefano's model proposes that cognitive controls work simultaneously to manage cognitive tasks at all stages of development, whereas schemas in Piaget's model only operate at one stage or in one task. Cognitive control theory includes the process of gathering information from the external world and from the internal world of fantasies, and the way emotions are regulated as this occurs. The cognitive control model also highlights the manner in which individuals temporarily modify the way they obtain information as the environment and internal pressures change (Santostefano, 1988:19-20).

Santostefano conducted independent factor analytic studies using cognitive controls. He investigated the relationships between cognitive controls and intelligence, academic achievement and socio-economic status.

2.4.3.1.1   Cognitive Controls and Intelligence

When Santostefano investigated the construct validity of the CCB, he included IQ as assessed by the WISC. The results of these studies suggested that intellectual ability does not underlie the cognitive control processes measured by the CCB . He conducted a study of 84 children who were admitted to an inpatient psychiatric facility as a result of severe emotional problems. Their ages ranged from 6 years to 17 years. They were assessed by means of the WISC and the CCB. Their total WISC IQs ranged from 61 to 125 and the mean IQ was 97.9. The relationship between IQ and CCB performance was investigated by means of two separate factor analyses. In the first analysis

the CCB scores were factor analysed with the WISC Full Scale IQ and in the second analysis the same CCB scores were factor analysed with the 11 WISC subscale scores to determine whether the specific response processes of the subtests were indicative of a fundamental cognitive process. Santostefano found that the Full Scale IQ did not define a basic cognitive principle when factor analysed with CCB scores, and IQ did not modify the cognitive constructs defined by the CCB (1988:163).

Santostefano conducted another study of 96 children attending kindergarten, Grade 1 and Grade 2 in a school that served a low socio-economic status section of a city. They were assessed by means of the WISC and the CCB. Their IQs ranged from 64 to 121 with a mean of 94.8. When the results of the WISC and the CCB were correlated, only one correlation was significant and it was from a subtest of the CCB which is not included in the CCB manual, namely the Circles Test of Focal Attention. It was found that children who scanned broadly when judging the sizes of pairs of circles tended to have higher total IQs. In another study of 24 boys with reading disabilities and a control group, Santostefano (1988:166) did not find any significant correlations between intelligence as assessed by the IPAT Test of G (Institute of Personality and Ability Testing) and the Circles Test of Focal Attention, the FDT, and the LSHT. Santostefano mentioned a study by Zarembo (1967 in Santostefano, 1988:166) who did not find any significant correlations between the Circles Test of Focal Attention, FDT, LSHT and the WISC in a study of 44 children in Grades 3 and 4. Santostefano concluded the following:

"These studies strongly suggest that the CCB and the WISC measure different aspects of cognitive-intellectual functioning. The studies also suggest that cognitive controls define mechanisms that are basic to and underlie intellectual test performance. Further, the field articulation principle (ignoring irrelevant information) is implicated in the Digit Span and Coding subtests, the levelling-sharpening principle in all Verbal Subtests as well as Block Design and Picture Completion, and the equivalence range principle (categorising and conceptualising information) in the Object Assembly and Picture Arrangement

Subtests. These observations are, of course, still tentative and require further study" (Santostefano, 1988:166).

2.4.3.1.2   Cognitive controls and academic achievement

Santostefano also investigated whether the CCB and academic achievement tests measure different or similar cognitive processes. He assessed 43 children in Grade 1 by means of the CCB and the California Test of Mental Maturity which evaluates numerical computation, number problems, reasoning by inferences, verbal comprehension, immediate recall of spoken words, and delayed recall of the content of stories which were read by the examiner. None of the CTMM scores had a significant role in defining the factors. This finding suggested that cognitive control processes were basic to the academic skills assessed by the CTMM. The subtest scores of the CTMM were analysed and it was found that broad, active scanning (SST) and ignoring irrelevant information (FDT) were involved in achieving high scores on the number problems subtest of the CTMM. On this subtest the testee was read a problem and was then required to scan a row of pictures and mark the correct answer. Santostefano called for further research to explore the relationship between the two cognitive control principles, scanning and selective attending, and mathematical problem solving. Levelling-sharpening (constructing differentiated images) was found to be involved in the CTMM subtest of delayed recall in which the testee heard a story and was then required to answer questions about the story (Santostefano, 1988:167).

Santostefano (1988:168) explored the relationship between cognitive controls and academic achievement further in a study of 114 children in Grade 3 and again in Grade 4 using the Iowa Test of Basic Skills (ITBS). This test assesses vocabulary, reading comprehension, language skills (spelling, capitalisation, punctuation, usage) and mathematics (concepts and problem solving). He found that field articulation control (FDT) was implicated in answering the items on this test which required the testee to select correct answers from a row of options. Santostefano also discussed a study by

Garrity (1972 in Santostefano, 1988:168) of 120 children in Grade 5 who were assessed on the Stanford Achievement Test which evaluates reading, mathematics, science and social studies. The findings suggested that scanning strategies, selective attention and constructing memory images formed part of basic underlying functions in many different academic achievement tests. Developmentally immature cognitive functioning was associated with low scores in all academic tasks of this test.

2.4.3.1.3   Cognitive controls and socio-economic status

Santostefano described a study by Zarembo (1967 in Santostefano, 1988:170) which investigated the relationship between CCB and socio-economic status (SES). The sample was a group of 44 children in Grades 3 and 4 whose IQs ranged from 75 to 135 with an average of 116. SES was evaluated by means of the North-Hatt Scale, which was based on public attitudes of occupations. The children were required to do the Circles Test of Focal Attention, the FDT and the LSHT. Only one aspect of field articulation (errors in naming colours) related to SES. Santostefano pointed out that errors in naming colours appeared to be related to the regulation of affects and to the expression of impulses and affects in action. He proposed that the group of low-SES children in this study could be described as acting out impulses and affects, and as struggling to relieve tension in socially acceptable ways. Santostefano was interested in the relationship between field articulation, the regulation of affects, and SES.

In another study (Garrity, 1972 in Santostefano, 1988:170) 120 white and black Grade 5 boys were assessed. There were equal numbers of both while and black boys from low-SES and high-SES groups. This was established by means of the Hamburger Revised Occupational Scale for Rating Socio-economic Status. The boys were assessed on an intelligence test and all fell within the average range. When the results of the high-SES group were compared with the results from the low-SES group, it became evident that the latter group displayed developmentally lower levels of functioning on all the

CCB subtests. They tended to use narrower scanning and they attended to both relevant and irrelevant information. This group also tended to construct global, fluid images of information and to compare these inefficiently with present perceptions. Another aspect of this study was the use of the Deutsch's Deprivation Index Scale (1968) which evaluated housing dilapidation, the number of children in the family, the extent of dinner conversation at home, the number of cultural experiences the child anticipated for the following weekend, and whether the child had attended kindergarten. The only significant correlation with this index was the LSHT Ratio score. Children who used levelling (the construction of global, fluid images of information) were also found to receive little social stimulation. Santostefano raised the issue of whether social stimulation is a unique contributing factor in the development of the levelling-sharpening controls. He also highlighted the fact that the levelling-sharpening principle plays a dominant role in the cognitive functioning of older children. He wondered whether social deprivation would correlate with body tempo and focal attention in younger children (Santostefano, 1988:170-171).

Santostefano called for more research to be conducted to explore the relationship between cognitive controls and intelligence. He also encouraged researchers to investigate the relationship of cognitive controls and academic achievement, and socio-economic status. The current study aims to investigate these relationships.

The intervention programme for inadequate cognitive control functioning will now be discussed.

2.4.3.2.4   Cognitive Control Therapy

Santostefano (1985:33) developed Cognitive Control Therapy during the 1960s. This method is a cognitively oriented, psychodynamic method of psychotherapy which was designed to help children and adolescents whose cognitive difficulties were affecting their scholastic progress and who were not

benefiting from traditional play therapy and verbal psychotherapy. Santostefano realised that these children struggled in these areas as they both require learning, and these children did not appear to have the necessary cognitive structures to know how to learn. He also developed the Cognitive Control Battery which was designed to measure three non-verbal cognitive functions which are important in learning and adaptation, namely scanning, attending selectively and comparing images of past information with present perceptions. Therapists used the Cognitive Control Battery to assess children before and after the intervention of Cognitive Control Therapy. The therapy was found to be useful in a number of studies during the 1980s and the 1990s (Santostefano, 1985; Cotugno, 1987; Santostefano, 1988; Engelbrecht & du Preez, 1992). Children and adolescents from various cultural backgrounds in South Africa have been assessed by means of the Cognitive Control Battery and many have successfully completed Cognitive Control Therapy (Engelbrecht, 1996:204). This usefulness of this instrument and the therapy in the South African context supports the notion that they are not culturally biased. Engelbrecht (1994:249) recommended that the therapy by used in conjunction with classroom activities to increase opportunities for transfer of skills to academic tasks.

2.4.3.2.5   Recent Research on Cognitive Functioning

Santostefano developed the notion of cognitive controls in the 1960s. Recent investigation of executive function using functional Magnetic Resonance Imaging (fMRI) distinguished between cognitive control and conflict monitoring. Cognitive control was described as a resource-limited system that guides voluntary, complex actions. Such actions include solving difficult tasks, overcoming habitual responses and correcting errors. Conflict monitoring provides ongoing feedback indicating whether control is being allocated effectively. It is typically activated in tasks that require focused attention, for example the California Stroop test (MacDonald, Cohen, Stenger & Carter, 2000:1835). Zelazo, Muller, Frye and Marcovitch (2003:vii) developed the Cognitive Complexity and Control (CCC) Theory which refers

to how "the development of executive function can be understood in terms of age-related increases in the maximum complexity of the rules children can formulate and use when solving problems". These researchers have built on the principles of cognitive control theory.

The assessment of cognition has been explored in a variety of ways. While Santostefano was developing the Cognitive Control Battery and Cognitive Control Therapy, other theorists were also developing batteries to assess cognition. These assessment devices will now be discussed.

2.4.3.2   Reuven Feuerstein

In the mid 1960s interactive methods of assessment were developed. At this time an Israeli psychologist called Reuven Feuerstein set out to develop assessment techniques which would be suitable for gauging the learning potential of immigrants from diverse cultures. He worked with disadvantaged adolescent emigrants to Israel during the 1950s and 1960s (Feuerstein & Feuerstein, 1991:5; Frisby & Braden, 1992:283). He decided to develop assessment methods which would accommodate immigrants from diverse cultures. His work has focused on the assessment of learning potential rather than the assessment of their often impoverished prior experiences (Ashman & Conway, 1997:110). Feuerstein developed the Learning Potential Assessment Device (LPAD) which was based on two major concepts, namely Structural Cognitive Modifiabiliy and Mediated Learning Experience. Structural Cognitive Modifiability refers to Feuerstein's belief that "people have the capacity to modify their cognitive functions and adapt to changing demands regardless of their learning problems, age and the severity of their cognitive deficit" (Ashman & Conway, 1997:111). Mediated Learning Experience (MLE) refers to the way "an adult assists in the enculturation of a child by mediating to modify the frequency, order, intensity and context of stimuli so the child can learn most effectively" (1997:111). Sewell and Price (1991:298) analysed child-rearing practices from the framework of Mediated Learning Experience (MLE). They discussed a study of mother-infant

interaction in low and middle-class socio-economic backgrounds by Farran and Ramey (1980 in Sewell & Price, 1991:298). There wasn't a social-class difference in the levels of interaction between mothers with their 6-month-old infants who did not differ in intellectual performance. However, levels of interaction differed between 6 and 20 months. Middle-class mothers increased interaction with subsequently higher levels of cognitive performance of their children, whereas low socio-economic mothers decreased interaction with their children. These authors concluded that the interactive process associated with cognitive development is of great significance.

Feuerstein's approach consists of assessment and instruction. The Learning Potential Assessment Device (LPAD) employs the teach-test-teach assessment approach. This enables the assessor to establish what an individual's specific cognitive deficiencies are. These deficiencies could occur during the following phases:

- the input phase (when relevant information is gathered);
- the elaboration phase (when information is manipulated to produce the required result); or
- the output phase (when the desired result is reported) (du Preez, 1991:42).

Feuerstein's remediation programme is called Instrumental Enrichment (IE) and it is intended to improve cognitive functioning in children and adolescents at upper elementary, middle and secondary levels. It consists of thirteen different types of exercises that are repeated in cycles. It is recommended that the programme be done two to three hours a week over a two- to three-year period (Sternberg, 1984:41).

The Learning Potential Assessment Device (LPAD) has disadvantages that are particularly relevant in the South African context. It requires extensive training in order to become familiar with the materials and the nature of the intervention phase of the assessment. The administration of the LPAD is very

time-consuming because the examiner requires many extensive interactions to sufficiently analyse the testee's difficulties. A small body of research has found the LPAD to be effective but critics of this assessment device do not find it to be a viable alternative to individual IQ tests. The remediation programme Instrumental Enrichment requires extensive teacher training which has to be provided by an official training authority (Sternberg. 1984:42). There are limited funds in the South African education budget for this type of training. Furthermore, Sternberg points out that the Instrumental Enrichment programme would be unlikely to fit into an existing curriculum and he questions the transferability of the skills to academic and real-world situations.

Two theorists who have built on the work of Santostefano & Feuerstein are J.P Das and Jack A. Naglieri. They are at the forefront of a movement to develop tests that measure ability as a multidimensional concept (Kroesbergen, Van Luit & Naglieri, 1993 in SAALED News, 2004:6).

2.4.3.3   J.P. Das and J. A. Naglieri

Theories of intelligence testing developed separately from the cognitive approach. Das, Naglieri and Kirby (1994:3) suggested that attempts to define intelligence during the period 1920-1960 were unsuccessful because there was a lack of consensus and a useful definition of intelligence could not be found. These authors called for an approach to intelligence testing which is based on cognitive theory. They highlighted two fundamental issues in intellectual assessment: the purpose of assessment, and the nature of what is being measured. Das, Naglieri and Kirby proposed that the first purpose of intellectual assessment is scientific curiosity. It is "a method of determining and mapping the diversity of human mental competencies" (1994:6). The second purpose of intellectual assessment is prediction. The intention is to "measure a set of intellectual characteristics at a point in time to predict how individuals will perform on other measures or at other points in time or to predict the environmental conditions under which they will perform best"

(1994:6). The two purposes relate to the theoretical basis and application of intellectual assessment.

The application of intellectual assessment needs to be evaluated. The development of intelligence testing was greatly influenced by the need to select small numbers of people for placements. Learners with special needs were categorised and placed in special schools or institutions according to their intelligence scores. There is a strong movement in education at present to try to meet the needs of all learners within mainstream schools. In this context, assessment should be used to provide educators with guidelines as to how individual learners work optimally (Das, Naglieri & Kirby, 1994:6).

If one of the purposes of intellectual assessment is prediction, then the extent to which mental characteristics are predictable must be explored. A major assumption in intellectual assessment has been that assessment and prediction require fixed mental abilities. Das, Naglieri and Kirby (1994:6) challenged this assumption and argued that although a certain amount of stability is important for meaningful measurement, assessment does not need to focus on fixed abilities. They pointed out that normal cognitive development is a process of change, although the process is not necessarily chaotic. These authors criticised traditional intelligence tests for placing too much emphasis on the more stable aspects of cognition. They believed that these tests may have neglected aspects of cognition that can be developed. Das et. al. also highlighted the fact that prediction also has its limits and prediction is not the same as understanding or explanation. "Traditional tests of intelligence are made up of items and subtests that have been selected because they correlate with other measures, not because they are derived from theoretical notions of what is being measured" (Das et. al. 1994:8). Das et. al. argued that explanation and understanding, rather than blind prediction, are the real aims of scientific enquiry.

In addition to reviewing the purposes of assessment, it is essential to consider the nature of what is being measured. Traditional intelligence tests have focussed on ability. An ability is "a trait or characteristic of a person, with

respect to some mental task, that has attained a stable level of performance" (Das, Naglieri & Kirby, 1994:8). Abilities are generally considered to be like capacities in the sense that they can be measured. Most of the abilities determined by traditional intelligence tests have correlated with a group of tasks and have not been based on theory. The cognitive approach to intelligence highlights that:

> "capacities interact with processes that are dynamic and controllable, and that the processes themselves may be subject to capacity limitations. The existence of a capacity may be less important than the way in which that capacity is employed" (Das, Naglieri & Kirby, 1994:9).

Strategies are extremely important in being able to access one's ability and these are the processes to address when trying to develop performance. The cognitive approach highlights the importance of all the aspects of the information-processing model. Traditional intelligence tests only considered some of these aspects.

The theoretical argument proposed by Das and Naglieri led them to develop an assessment device called the Cognitive Assessment System (CAS). This is a norm-referenced measure of intelligence based on the PASS theory of cognitive processing. PASS consists of four cognitive components: Planning, Attention, Simultaneous and Successive processes. The PASS theory is based on the neuropsychological work of Luria. His model consisted of three functional units: the first unit is responsible for arousal and attention, the second unit is responsible for coding simultaneous and spontaneous information, and the third unit is responsible for mental activity (namely planning, execution and checking) (Das, Naglieri & Kirby, 1994:12). The CAS can be used with children aged 5-17 and there are thirteen subtests which assess the four processes identified by the PASS theory. Research has indicated that the CAS has been shown to be a valuable diagnostic tool and useful in planning interventions. CAS scores have been found to be strongly related to achievement. Researchers are currently investigating how the CAS can be used to assess individuals with specific learning difficulties

(Kroesbergen, Van Luit & Naglieri, 1993:9). The CAS is a full assessment battery and it takes a substantial amount of time to administer.

2.4.3.4   Kaufman

Kaufman developed an assessment device which was also based on Luria's neurological theory but from a different perspective. Kaufman based the Kaufman-ABC (K-ABC) on cerebral specialisation theory with a focus on sequential and simultaneous information-processing. The entire battery has its roots in the broad fluid-crystallised dichotomy (Kaufman: 1996:174). There are fifteen subtests which assess two coding processes (sequential and simultaneous) and achievement. The battery is based on North-American norms and some of the achievement subtests have a strong American bias. According to Ashman and Conway (1997:101), the K-ABC has received extensive critique and criticism.

The assessment of intellectual and cognitive functioning has been discussed. The next section focuses on the relationship between intelligence and cognitive processes.

2.4.3.5   THE LINK BETWEEN COGNITION AND INTELLIGENCE

This literature review has highlighted the controversies and complications of defining and understanding intelligence and cognition. IQ studies in the early 1990s in South Africa explored many of these issues with particular attention to the relevance of IQ testing in a multicultural society. Shuttleworth-Jordan (1996 in Foxcroft, 2001:185) observed signs of a narrowing gap in the results of different cultural groups in South Africa in association with a reduction in socio-cultural differences. Foxcroft (2001:185) concluded that

"This indicates quite clearly that differences in test results of various cultural groups can often be attributed to the general level of acculturation of a group, compared to the norm group for which the measures are constructed and against whose results comparisons are made".

Green (1996:135) agreed and commented that the thinking power of children is affected by the types of developmental opportunities provided by families and communities.

Theorists have developed a greater understanding of intelligence and some have attempted to research whether there is a link between intelligence and cognition, since theories of cognitive functioning suggest the possibility for intervention. Traditional IQ testing was challenged by the developing belief regarding the modifiability of intelligence. Advocates of this theory believed that the development of information-processing skills could result in changes in scores on standardised tests of intelligence. As discussed previously in this chapter, Feuerstein maintained that people have the capacity to modify their cognitive functions and adapt, regardless of their prior experiences and circumstances (Feuerstein & Feuerstein, 1991:13; Ashman & Conway, 1997:110). He understood intelligence as the capacity of the individual to use previous experience in his/her adaptation to new situations. He believed that culture is transmitted through Mediated Learning Experiences (Skuy, 1996:186). Carl Haywood developed Feuerstein's theories and he compared intelligence and cognitive processes in the following table:

Table 2   **A comparison of intelligence and cognitive processes (from Ashman & Conway, 1997:94).**

Intelligence is

1.   largely genetic (i.e. inherited)

2.   related to a range of aptitudes (e.g. verbal, spatial, numerical)

3.   largely fixed (or modifiable with considerable effort)

4.   linked to the ability to learn culturally based knowledge

5.   evaluated using measures that assess past learning (e.g. school achievement)

Cognitive processes are

1.   taught and learnt (i.e. through learning and problem-solving experience)

2.   influenced by some fundamental competence, but also by learning and problem-solving habits, motivation, attitudes, and strategies

3.   easily modified through effective instruction

4.   generalisable across domains of knowledge

5.   evaluated using measures that elaborate learning and problem-solving procedures, often in applied settings

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This approach to intelligence and cognitive processes opened up the possibility of a child's cognitive potential and the importance of remedial or enrichment programmes to develop that potential. It also placed more emphasis on educators, schools and education authorities to become more accountable for education outcomes. Since the 1980s a view of psycho-educational assessment has developed which is described as a transactional view. According to Haywood, Tzuriel and Vaught:

"individual differences in intellectual development and expression are seen to be products of genetic endowment engaged in a series of 'transactions' with environmental circumstances, and with a person-characteristic trajectory of development. There are 'self-righting tendencies' to return to the genetically determined trajectory" (1992:44-45).

These authors described how unfavourable environments may block an individual's intelligence or not allow its application in learning and problem-solving (Haywood, Tzuriel & Vaught: 1992:46).

The transactional perspective is based on a set of assumptions about intelligence, the nature of cognition, the importance of motivation and other affective variables which are involved in learning and problem-solving. Haywood summarised these assumptions in the following manner (Ashman & Conway, 1997:95-96):

- Intelligence refers to various aspects of behaviour and individuals present with differences in strengths and weaknesses.
- Generally speaking, intelligence is largely determined by many factors which are primarily genetic or environmental.
- Cognitive development is a biological process although individual differences cannot be explained by 'innate ability'.
- Successful human functioning involves a wide range of thinking, perceiving, learning and problem-solving skills. The way in which individuals acquire these skills depends on their motivation and attitude to learning and problem-solving.
- All individuals have the potential for further intellectual development.

- Intelligence is modifiable to a limited extent. Cognitive processes, on the other hand, can be developed and this can result in substantial changes in performance.

A study was conducted by Sanz de Acedo Lizarraga, Ugarte, Iriarte and Sanz de Acedo Baquedano (2003:59) which investigated the effects of a cognitive intervention on intelligence, self-regulation and academic achievement. These authors considered "intelligence to be multifaceted, using modifiable and flexible cognitive processes of inductive reasoning and problem solving" (2003:60). They hypothesised that self-regulation plays an important role in the modifiability of these processes. A programme was designed called "Portfolio" which was based on The Instrumental Enrichment Program developed by Feuerstein, The Philosophy for Children Program devised by Lipman and Project Intelligence (Hernstein, Nickerson, Sanchez & Swets in Sanz de Acedo Lizarraga, Ugarte, Iriarte and Sanz de Acedo Baquedano, 2003:61). Twenty 13 year-olds underwent this programme in Spain over a 2-year period. When compared with the control group, it was shown that these students improved their intellectual capacity, cognitive flexibility, use of self-regulation skills, and academic achievement. This study supports the description of the relationship between intelligence and cognition presented above.

Metacognitive studies contribute to the investigation of the relationship between intelligence and cognition. A recent study by Veenman, Wilhelm and Beishuizen (2004:105) showed that metacognitive skilfulness (general skills for managing problem-solving and learning situations) increases from childhood to early adulthood. The increase in metacognitive skilfulness is not exclusively determined by intellectual development. IQ appears to mediate metacognition but does not explain it. Metacognitive development is associated with maturing cognitive capacity. Stimulation from both home and school enhances this metacognitive development. The relationship between intelligence and cognition is highly complex and far more research is needed to understand these dynamic mental processes.

Investigation of intellectual and cognitive processes in South African adolescents living in disadvantaged communities requires an analysis of their socio-economic context.

2.5 THE SOCIO-ECONOMIC CONTEXT

Child development is influenced by biological factors through the genotype and environmental factors which regulate human behaviour. Sameroff and Fiese (1990:119) have theorised about the concept of the *environtype* which is similar to the *genotype*, and consists of cultural, familial and parental characteristics that regulate the child's experiences and opportunities and his/her development. Bronfenbrenner (1979:3) described the progressive, mutual accommodation between the active, growing individual and the changing elements of the environment in which s/he lives. The *microsystem* refers to the immediate setting of a child in an environment with particular features, activities and roles (e.g. the home or the school). The *mesosystem* consists of the relationships between the major settings at a specific point in the individual's development (e.g. between the home and school). The *exosystem* is an extension of the mesosystem and it includes settings that the child may or may not be part of, but which affects areas in which the child does participate (e.g. the world of work and neighbourhoods). Finally the *macrosystem* refers to the institutional patterns of culture, including the economic, social and political systems expressed in the microsystems, mesosystems and exosystems. Children's learning occurs in all of these systems (Dawes & Donald, 2000:3).

From a developmental perspective, McCall (1981:1) postulated a conceptual scheme of childhood development in which early development in the first 18-24 months is highly canalised and follows species-specific paths. After this period, canalisation slowly begins to weaken and individual differences in experience and genetics in heritance have greater effect. According to this scheme, genetic and environmental factors have minor correlations with

development during the first two years and then both have decreasing correlations thereafter.

Scarr (1992:6) developed a path model for child development. Normal development requires a genotype within the species-normal range, as well as a species-normal environment. Within this there is a unique genotype composed of alleles in loci that have normal variants in the population, and the developing person also has an individual environment. The unique genotype and environment give rise to an enduring phenotype that manifests in both contextual and situational behaviours. Scarr sets the model within the school context in the following example. The enduring phenotype represents intelligence, the contextual behaviour might represent the school behaviour and a situational behaviour could be a maths test. School behaviour would be influenced, in addition to the effects of intelligence, by factors such as achievement, motivation and performance on the maths test by, for example, test anxiety.

Ecocultural theory also considers the socio-cultural environment of the child and family and is based on cross-cultural literature (Weisner, 1984 in Bernheimer, Gallimore & Weisner, 1990:221). Each family, according to this theory, is adapting to a 'niche', which implies an evolution through time and adaptation to the constraints imposed by, for example, the subsistence base, the climate, and the political climate of the region. A family's 'niche' is also a product of social construction through which the members organise, understand and give meaning to their everyday lives. A 'niche' is construed as a person's and family's cultural as well as material place. This also has an influence on child development. In South Africa, child development occurs within various socio-cultural environments, many of them reflecting situations of adversity. Dawes and Donald (1994:17) point out that the notion of adversity is necessarily framed with reference to a value statement on life circumstances and the desirability or otherwise of a certain developmental outcome. Nevertheless, an environment includes the physical elements (such as housing, sanitation and cultural artefacts), social features (including language use, values and conventional social practices), as well as dominant

and subsidiary ideologies. These all impact on school performance. Dawes and Donald make a plea for the construction of models that explain, at a psychological level, how the various environmental elements interact and contribute to the child's developmental trajectory.

Bradley, Caldwell, Rock, Casey and Nelson (1989:301) have shown that families within a given SES group may differ widely as to the type of stimulation provided to their children in the home environment. In South Africa, Richter and Grieve (1991, in Richter & Griesel, 1994:80) demonstrated in poor township families that the caregiver's (usually the mother's) active structuring of her infant's experiences through the way she patterned her interactions with her child was most important for the child's cognitive development. These authors claim that the maternal emotional state is critical in the developmental outcome of malnourished children. The maternal mental state, in particular depression, has been shown to have long-term adverse effects on child development. Maternal depression is particularly prevalent in disadvantaged communities (Cooper, Tomlinson, Swartz, Woolger, Murray & Molteno, 1999:554).

If genetic influences on development are predetermined, the only way to enhance a child's development is to enrich the environment, particularly if this is felt to be lacking. This notion led to a number of initiatives in compensatory education of which the Project Head Start in the United States was the best known. Unfortunately, the positive effects of Head Start were initially found to be disappointing. Jensen (1969:1) therefore concluded that compensatory education had been tried but had failed. Later reports were more encouraging. Recent reviews have shown that early intervention does work (Ramey, Bryant & Suarez, 1985:47). These reviews included first-generation intervention projects from the late 1950s and early 1960s, as well as second-generation projects such as the Milwaukee Project and the Carolina Abecedarian Project and a third-generation project, the Carolina Approach to Responsive Education (Project CARE). Ramey, et al., (1990:47) concluded that early education can reduce grade retention and special class placement, but not permanent changes in IQ. They also claim that more educationally

intense programmes produce longer-lasting changes and that structured intervention programmes lead to better cognitive outcomes. Based on the conceptualisation of a cumulative transactional model of development, the prospect of enhancing poor developmental progress due to environmental deficits is improving.

The discussion will now focus on the particular context of adolescents living in South Africa in 2002. An analysis of all the contextual factors of the participants of the current study is necessary.

2.6 THE ADOLESCENT IN SOUTH AFRICA IN 2002

Bronfenbrenner's (1979:3) ecosystemic approach is useful in analysing the role of the South African context in the lives of adolescents.

2.6.1 The Social and Political Context

The Apartheid era was characterised by legislation which ensured the prosperity of the white minority in all aspects of life. This legislation had an enormous effect on the social welfare and education opportunities for the inhabitants of the country. The majority of South Africans were living in desperate conditions during the Apartheid era (Oakes, 1988:375-381). Many communities were seriously affected by poverty, violence, poor health services, discrimination and inferior education and these conditions persist. Education policies were devised to separate cultural groups and the quality of education provided was determined along racial lines (National Department of Education South Africa, 2000:8).

It is important to look at the latest census results to gain an insight into the demographics and quality of life for many citizens in present-day South Africa. Census 1996 was the first national census since the country's first democratic elections in 1994, and Census 2001 provided updated statistics (Statistics South Africa, 2003). South Africa had a population of approximately 44.8

million people in 2001. Eight-five percent of households had access to clean water, 50% of families had a flush toilet and 70% used electricity for lighting. The unemployment rate was almost 42%. The number of people living in the Western Cape increased by 14% from 1996 to 4.5 million people. This has had serious implications for the provision of education, health services and sanitation. A total of 8.2% of the population speaks English at home. The percentage of people speaking mainly Afrikaans at home dropped from 14.4% in 1996 to 13.3% in 2001. Nearly 80% of coloured people spoke Afrikaans at home and approximately 19% spoke English (SA still a very unequal society, 1993:1). It was found that one in three South Africans aged 20 or older had not completed primary school or had no schooling at all. Sixteen percent of the population had had some primary schooling in 2001, 6.4% had completed primary school, 30.8% had some secondary school and 20.4% had matriculated. In general, children were going to school at an earlier age in 2001 than in 1996 (Education is reaching more people, results show, 2003:6). These statistics provide an indication of quality of life for many South Africans. Although a democratic government has governed the country since 1994 the living conditions have not improved for many people.

Quality of life and socio-economic development can be determined by the infant mortality rate (IMR) (Biersteker & Robinson, 2000:29). The World Health Report of 1998 (World Health Organisation, 1998:220-228) included basic indicators from a number of countries. The data for South Africa is compared with a few other countries in the Table 3.

Table 3.   Basic indicators presented in the World Health Report 1998

	Infant Mortality Rate (per 1000)	Under-5 mortality rate (per 1000)	Deliveries in health facilities (percentage)	Fertility rate	Adult literacy rate (percentage)	Gross National Product (GNP) US $
South Africa	48	68	79	3.8	81.8	3160
United States	7	9	99	2.0	97	26 980
United Kingdom	6	7	99	1.7	-	18 700
Kenya	66	101	44	5.4	54.4	280

The vast difference in the Infant Mortality Rate (IMR) in South Africa compared with the United States and the United Kingdom illustrates the large disparity in quality of life in these countries. The infant and under-5 mortality rate of children under 5 was the lowest in the Western Cape when compared with other provinces, according to the South African Demographic and Health Survey in 1998 (Child Health Unit, 1999:24). In general, South Africa fared far worse on most indicators presented in Table 3 than the United States and the United Kingdom but not as poorly as Kenya. The indicators for 2002 were published in the World Health Report 2004. Information from this report is presented in Table 4.

Table 4.   Basic indicators presented in the World Health Report 2004

	Total population (000)	Fertility rate	Life expectancy
South Africa	44 759	2.6	50.7
United States	291 038	2.1	77.3
United Kingdom	59 068	1.6	78.2
Kenya	31 540	4.1	50.9

The fertility rate has decreased in South Africa and life expectancy in South Africa and Kenya is lower than in the Western countries as a result of AIDS. According to The State of the World's Children report 2004 (UNICEF, 2003:111-113), the infant mortality rate in South Africa was 52 in 2002. This rate was higher than in 1997 as a result of AIDS. The extent of the AIDS epidemic will be discussed later in this chapter.

The 12 - 14 year-olds of 2002 were born towards the end of the Apartheid era and they were raised during the years following the inception of the new democratic dispensation in South Africa in 1994. They were affected by the cultural practices which developed during the apartheid era. These cultural practices were evident in the realms of education, social welfare and social attitudes. Poverty and crime are two extremely significant aspects of the South African context and both have an enormous effect on the development of young people (Biersteker & Robinson, 2000:26).

2.6.2   The Economic Context

The South African economic climate is characterised by poverty, unemployment, slow economic growth and an unequal distribution of wealth. It was estimated in 2000 that 60% of South African children live in poverty. The level of education influences poverty. When parents have less than secondary and post-secondary education, their chances of being poor are increased (Biersteker & Robinson, 2000:27). Peterson and Carolissen (2000:105) conducted research during the late 1990s in a coloured working-class community in Cape Town. Many of the participants in the current study live in this community or in similar communities. There were high levels of unemployment, gangsterism, community and domestic violence and few social services in this area. A survey was conducted of parents of preschool children who were the focus of the study. It was found that 38% of the parents had completed Grade 7 or less, 25% had finished Grade 8, 16% had finished Grade 10 and 8% matriculated. Thirty-three percent of the parents were unemployed and 62% of the women were single parents. They reported

that the following stressors negatively affected their ability to be effective caregivers: domestic violence, unemployment, financial problems, alcoholism and exhaustion due to long hours at work. This group of parents could be seen to be representative of the majority of parents living in this community.

2.6.3 Health

The HIV/AIDS epidemic is rapidly spreading across Southern Africa where the five countries with the highest HIV prevalence rates in the world are located. South Africa has the more cases of HIV/AIDS than any other country, with an estimated 4.7 million people living with HIV. A recent household survey by Connolly, Colvin, Shisana & Stoker (2004:776) revealed that the HIV prevalence in the general population was estimated to be 11.4% (12.8% in females and 9.5% in males). Black people had the highest prevalence (12.9%), compared with white people (6.2%), coloured people (6.1%) and Indian people (1.6%). Informal settlements in urban areas had the highest HIV prevalence rate (21.6%). A recent article in the Cape Times (Smetherham, 2004:3) stated that the most worrying trend in the Western Cape is the leap in teenage infections. The HIV/AIDS epidemic is affecting all spheres of South African life.

Many South Africans do not have enough food to eat and this has a devastating effect on the development of children. Richter and Griesel (1994:66) emphasised the impact that malnutrition has on social and emotional development. They pointed out how malnutrition affects caregivers and all the members of a family ie. how the ecosystem of the child is involved. Maternal undernutrition is one the main causes of foetal undernutrition and therefore low birth weight. It was estimated that nearly a quarter of children under six years in South Africa were stunted as a result of long-term nutritional deficiencies in 1995 (Richter, Griesel, & Rose, 2000:74).

2.6.4 Education

The group of participants in this study started formal schooling during the period 1995 - 1997 when the Department of Education embarked on an initiative to revolutionise the curriculum that was inherited from the previous dispensation. The new approach was called Outcomes-Based Education (OBE) and there was to be a greater focus on skills development rather than on product and results-based learning (Green, 2001:11). There was insufficient in-service training for educators, many of whom had never received formalised teacher training. Learners in Grade 1 and Grade 8 were introduced to the new curriculum in 1995 and these learners continued with this curriculum as they progressed through the grades. Most of the participants of the current study have only been exposed to OBE during their scholastic careers.

There was much criticism of OBE and curriculum developers were forced to acknowledge that the instruction to educators on how to teach and assess learners was far too complicated. Many revisions have been made to the curriculum since it's implementation. Educators "feel overwhelmed, frustrated and helpless, their perception being that decisions have been imposed upon them without their being consulted and made a part of the decision-making process" (Swart & Pettipher, 2001:40). South African educators are struggling to implement OBE as they lack training, support and resources and class sizes are very large, which is not conducive to group-based work, an important aspect of Outcomes-Based Education. De Jong (2000:154) described South African schools as being adverse environments. He observed that many schools are characterised by low staff morale, poor resources and facilities, mismanagement and social problems for example, gangsterism, substantial abuse and disillusioned learners.

The Western Cape Education Department undertook to conduct literacy and numeracy assessments of Grade 3,6 and 8 learners which were started in October 2002. These tests were based on selected learning outcomes of the South African curriculum. They assessed learning and the grade level of

learners' knowledge and skills. The Grade 3 and 6 tests were developed by South African university and non-government organisation experts in assessment and curriculum development. The Grade 8 tests were developed by the University of New South Wales and they have been used in thirteen other countries. These tests assessed reading, writing, addition and subtraction, space and shape. The Grade 8 tests will be conducted every year and each school will receive a report of the competencies of their specific learners. Underachieving schools will be monitored and given assistance. The results of the Grade 3 and 6 tests have been released and the Grade 8 results will be available in October 2004 (Tests home in on school weaknesses, 2004:19).

The Grade 3 tests were used to assess 52 000 learners from 1 400 schools. The learners scored a mean of 39% for reading and writing, and 30% for numeracy (Grade 3 students score 'F' for failure in national literacy survey, 2003:4). Diagnostic tests were also conducted with 35 000 Grade 6 pupils at more than 1000 primary schools. The results indicated that 63.3% of learners failed both the numeracy and literacy tests at the Grade 6 level. Only a small percentage (15%) passed the numeracy test which included basic fractions, multiplication and division. Learners were required to do a 600-word comprehension and to write a ten-sentence report on the literacy test. Only 35% passed this test. The results were analysed and it was found that the highest results were achieved by learners at former Model C schools, while the lowest results were achieved by learners at previously disadvantaged schools. There were marginal differences between the boys and girls in the numeracy test, but the girls performed better in the literacy test (Grade 6 pupils performing at Grade 3 level – study, 2004:1,5). The results discussed above highlight the number of learners who are not achieving learning outcomes for a host of different reasons. Donald (1993:139) conceptualised special educational need in South Africa as being intrinsically generated (disability based), extrinsically generated (system based) and reciprocally generated. He commented that the extent of special educational need in this country is far greater than in developed countries. A study was conducted last year regarding the extent of learning difficulties in approximately 800

Grade 3 learners living in various demographic areas in Pretoria. Their parents completed surveys which indicated that just over 51% of their children experienced problems in Grades 1 and 2. Most of the prevalent problem areas were related to task completion, focus and attention (Kokot, 2004).

2.7   SUMMARY

This literature review has described international research findings of the cognitive and behavioural outcomes of VLBW children. These children tend to perform worse than their peers on intelligence tests and in scholastic assessments. These studies were conducted in developed countries. The concepts of intelligence and cognition were explored. The discussion highlighted the complexities involved in attempting to define intelligence and cognition, and the difficulties inherent in trying to use a single assessment tool to assess mental ability. It is generally accepted that intelligence is largely genetic, is related to a range of aptitudes and is linked to the ability to learn culturally based knowledge. Cognitive processes, on the other hand, are taught and learnt through learning and problem-solving experience, and they are easily modifiable through effective instruction. The assessment of cognitive controls, therefore, provides scope for enhancing intellectual ability where necessary, and facilitating the improvement of academic skills. A comprehensive profile of mental ability was found to be useful when both intelligence and cognition were assessed. The purpose of assessment was also discussed and the value of assessment procedures that guide intervention was emphasised. Cognitive assessments and intervention programmes were evaluated and considered for use in the South African context. The context of the participants in the study was described from an ecosystemic perspective. The South African context plays a significant role in this research project because of the impoverished conditions in which many of the participants live.

Chapter 3

RESEARCH DESIGN, METHODOLOGY, RESULTS AND DISCUSSION

3.1   INTRODUCTION

This chapter focuses on the research design, methodology and an in-depth discussion of the results.

It is important to consider what the term research encompasses. Mertens (1998:2) describes research in the following way:

> "...it is the process of systematic inquiry that is designed to collect, analyse, interpret, and use data to understand, describe, predict, or control an educational or psychological phenomenon or to empower individuals in such contexts. The exact nature of the definition of research is influenced by the researcher's theoretical framework..."

3.2   RESEARCH PARADIGM AND DESIGN

The paradigm in which the researcher works influences the way s/he perceives the nature of research. The present study will be conducted in the postpositivist paradigm. Theorists debate about what postpositivist research encompasses. Some theorists claim that postpositivist research refers to all the types of research which have originated since the move away from strictly positivist inquiry. This could include the interpretive/constructivist paradigm and the emancipatory paradigm. In clarifying the postpositivist position it is necessary to consider the assumptions of positivist research. Positivists believe that it is possible to study phenomena in the social realm in an

objective, value free way, as one would study phenomena in the natural realm. The postpositivists claim that a reality does exist although,

> "...it can only be known imperfectly because of the researcher's human limitations (critical realism). Therefore, researchers can discover "reality" within a certain realm of probability. They cannot "prove" a theory, but they can make a strong case by eliminating alternative explanations"
> (Reischardt & Rallis, 1994 in Mertens, 1998:8-9).

According to Creswell (2003:7), postpositivist research reflects a deterministic philosophy in the sense that causes probably determine outcomes. Postpositivist researchers usually conduct experiments which investigate causes that influence outcomes. Postpositivist research attempts to reduce ideas into a set of measurable ideas to test.

Correlation analysis was used in the present study. Correlation refers to a direct mathematical link between variables measured on ordinal or interval/ratio scales (Black, 1999:627; Miller & Brewer, 2003:53). It can be said that if one variable increases, so does the other. Black (1999:620) cautioned that "correlation studies should make no pretence about identifying causality". Mertens (1998:92) explained that this type of relationship study explores the relationship between measures of the different variables obtained from a few individuals at approximately the same time to gain an understanding of factors that contribute to a more complex characteristic.

3.3   METHODOLOGY

This investigation was undertaken to examine whether VLBW adolescents living in a non-Western country had lower intelligence quotients (IQs) and scholastic difficulties when compared with adolescents who were normal birth weight and living in the same area. For this purpose, the intellectual, cognitive and academic performance of 12 to 14 year old adolescents living in

the greater Cape Town area had to be assessed. Many of the adolescents who participated in this study live in impoverished neighbourhoods and are affected by the factors described in Chapter 2. Consideration of these factors made it difficult to select assessment tools that would be appropriate for the sample. The research project was designed to assess intelligence in an attempt to compare the results with research conducted in developed countries regarding the cognitive outcomes of children and adolescents who were low birth weight infants. The Senior South African Intelligence Scales-Revised (SSAIS-R) was found to be most appropriate to assess intelligence as it is based on the Wechsler Intellectual Scales for Children (WISC) and it has been designed for assessing the South African population. It is available in both English and Afrikaans. This intelligence test will be discussed later in this chapter.

A number of cognitive assessments were reviewed in Chapter 2. Many of these assessment devices provide useful information regarding cognitive functioning. The researcher had to consider the practicalities of assessing the cognitive abilities of the sample in addition to assessing their intelligence and scholastic abilities. The advantages and disadvantages of all cognitive assessments which have been reviewed were discussed in Chapter 2. The Cognitive Control Battery (CCB) provides a useful profile of cognitive functioning and an intervention programme (Cognitive Control Therapy) which Santostefano developed to address weak aspects of cognitive functioning. This intervention programme can be implemented by educators in the classroom which makes it a possibility in the South African context (Engelbrecht, 1994:249). As the CCB is an entirely nonverbal assessment the researcher was able to translate the instructions into Afrikaans. The CCB will be discussed in greater detail later in this chapter.

The selection of academic assessments which could be appropriate for South African learners was problematic. Most South African academic assessment tools are out-dated and norms have not been established on a representative sample of the population. The norms for foreign academic tests are also not appropriate when assessing South African learners. The researcher decided

to select academic assessments which focused on particular skills and to compare the results within the sample. The norms of the tests were not used. A reading assessment was necessary to assess the reading skills of both English and Afrikaans-speaking participants. The Neale Analysis of Reading Ability (Neale, 1966:1) is a British assessment tool which has been translated into Afrikaans (Bower & Hartman, 2002:1). The Neale Analysis of Reading Ability was selected in order to assess both accuracy and comprehension skills. The Senior South African Intelligence Scales-Revised (SSAIS-R) has an Arithmetic subtest which assesses the ability to solve word-based problems. An assessment was sought which simply tested computational skills under a time pressure. The Schonell 5 Mathematics test consists of one hundred sums which assess addition, subtraction, multiplication and division. The ICE Spelling test was selected to assess spelling skills as there is an Afrikaans version called the IPV Speltoets. This spelling test is used by educational psychologists and learning support teachers in schools in the Western Cape and Gauteng. The assessments will be discussed more fully later in this chapter.

3.3.1 Subjects

The cohort comprised of adolescents who were low birth weight infants (less than 1250g) born at or referred to Groote Schuur Hospital from July 1988 over a 12 month period. This hospital formed part of the Peninsula Maternal and Neonatal Service (PMNS) which catered for the less affluent section of the population. Of the 235 liveborn infants, 143 survived to discharge.

One hundred and six infants were assessed at one year of age and were evaluated with the Griffiths Scales of Mental Development and a battery of occupational therapy assessments (Coetzer, 1995: iv). Ninety-six of these survivors were assessed at two years of age. Seventy of these survivors were assessed at six years of age with normal birth weight controls matched for age, sex and socio-economic status. Five index children with Cerebral Palsy were not assessed with controls. Children who had Foetal Alcohol

Syndrome were not included in this sample. The children in the control group were selected from the community. A research assistant visited the index family and evaluated the suitability of available controls in the index household or nearing neighbouring household. If these children were not suitable, then children in local pre-schools or child-care were selected. It was important that the controls had birth weights >2500g, normal Apgar scores and uncomplicated perinatal course with early discharge home. In cases where more than one control was available, then the child nearest in age to the index child was chosen (Thompson, 2000:vi, 37). At that stage children with congenital abnormalities and major disability were excluded from the assessment. All children were assessed on the Griffiths Scales (Thompson, 2000:viii) and a battery of occupational therapy assessments (Coetzer, 1995:5).

The present study was planned to investigate the relationship between cognitive control and intellectual and scholastic functioning in the learners in both the index and control groups when they were in their adolescence. The overall study was to include assessment of developmental outcome of the entire cohort. The focus of the current study was to investigate cognitive control functioning in addition to intellectual functioning and academic achievement. The selection of the sample was based on the participants' proximity to Groote Schuur Hospital and their access to transport services. This was necessitated by funding and resource constraints. The participants for the study were therefore obtained by nonprobability sampling which is described by Babbie (2004:182) as any technique in which samples are selected in some way not suggested by probability theory. This is acceptable if it is proven that there is no obvious bias and that key characteristics of the sample do not differ from the cohort.

In the present sample there was no difference in birth weight (average birth weight of the sample: 1030.26g; average birth weight of the cohort: 1052.25g) or gestational age (average gestational age of the sample: 33.2 weeks; average gestational age of cohort: 33.005 weeks). The socio-economic status of the sample did not differ from the cohort. The social class of the

sample was established by using data collected when the VLBW adolescents were in their infancy. Social class was classified according to the occupational grading of the breadwinner (Molteno, Hollingshead & Moodie, 1980:729). This classification was based on the British Registrar General's classification of five classes: I – professional and managerial; II – small business; III – artisan/skilled labourer; IV – semi-skilled labourer; and V – unskilled labourer or unemployed. In the study by Molteno et al. of a large birth cohort of coloured families in Cape Town, most of the families were in classes III, IV or V. Where a particular breadwinner was classified as I or II, most of the relatives came from class III. The classification therefore grouped I, II and III together as group 1, IV as group 2, and V as group 3. In the present study, the controls were matched for social class. Of the pairs, 6 were group 1, 3 were group 2 and 9 were group 3.

The present study involved 36 English- and Afrikaans-speaking adolescents from the cohort. Eighteen of the adolescents were low birth weight infants and eighteen were normal birth weight infants. Xhosa-speaking adolescents who were seen at 6 years were excluded because the author was unable to assess them in their mother tongue. The sample consisted of coloured adolescents from the greater Cape Town area. There were 19 females and 17 males. Twenty-one of participants were English-speaking and fifteen were Afrikaans-speaking. They attended Grades 6, 7 and 8 at schools in the Greater Cape Town area. The adolescents had a mean age of 13.2 years (standard deviation (SD) = 0.5, range 12 – 14 years).

3.3.2   Research Instruments

3.3.2.1   The Senior South African Intelligence Scales-Revised (SSAIS-R)

The SSAIS-R (HSRC, 1991) has been standardised for Afrikaans- and English-speaking South African children from 7 years 0 months to 16 years and 11 months. Intelligence is understood in the manual of the SSAIS-R as

"a composite of related mental abilities that in combination represent a general intelligence factor" (HSRC Manual Part I, 1991:3). At the outset of the manual it is stated that wherever the word intelligence is used, "developed academic potential is implied". A sample of 2 000 learners was taken for each of the education departments that taught learners with English or Afrikaans as a mother-tongue language, namely, the House of Assembly, the House of Representatives and the House of Delegates. This was done between 1986-1988. Three additional tests were included to improve the diagnostic value of the SSAIS which was developed in 1964. These included Memory for Digits, Coding and Picture Arrangement. The reliability of the Picture Arrangement Test was found to be unacceptably low and was not included in the SSAIS-R although the other two subtests were included.

Only non-environmentally disadvantaged learners were included in the sample for the calculation of the norms (HSRC Manual Part III:1). The socio-economic status of learners who may be environmentally disadvantaged is assessed by means of the Socio-economic Deprivation Questionnaire (SED Questionnaire). This questionnaire requires information regarding the parents; formal qualifications, the family's economic prosperity, and the educational opportunities at home (HSRC Manual Part I, 1992:14). If a learner is found to be environmentally disadvantaged, then the norms for environmentally disadvantaged learners are used. These norms are provided as it is believed that learners who are environmentally disadvantaged may have inadequate knowledge of and inadequate familiarity with the cultural content of the items of the SSAIS-R and this may negatively influence their performance on this intelligence scale (HSRC Manual Part III:1). In the present study the Socio-economic Deprivation Questionnaire (SED Questionnaire) was not used to assess the socio-economic status of the participants as the aim of the study was to compare the performance of the participants as a group using a single set of norms.

Content, predictive and construct validity have been well argued and established (Owen & Taljard, 1996:180).

The SSAIS-R provides a Verbal Scaled score, a Non-Verbal Scaled score and a Full Scaled score. There are eleven subtests.

The Verbal Scale consists of the following subtests:

- The Vocabulary subtest indicates an individual's language development and language usage. Long-term memory and concept formation form part of these abilities.
- The Comprehension subtest provides a measure of an individual's degree of comprehension of a variety of social situations which require knowledge of conventional standards of behaviour.
- The Similarities subtest assesses logical and abstract reasoning, verbal concept formation and long-term memory. The individual is required to classify items and distinguish between essential and non-essential information.
- The Number Problems subtest provides a measure of numerical reasoning which includes logical reasoning and abstract thought. Mental alertness and concentration are necessary for the meaningful manipulation of numbers.
- The Story Memory subtest assesses short-term auditory memory.

The Non-Verbal Scale consists of the following subtests:

- The Pattern Completion subtest assesses logical thinking; more specifically, accurate visual perception, concrete reasoning and concept formation.
- The Block Designs subtest assesses perceptual organisation, spatial visualisation and orientation, and abstract conceptualisation. Concentration and visual-motor co-ordination are essential for success on this subtest.
- The Missing Parts subtest assesses knowledge and comprehension of familiar situations, the ability to distinguish between essential and non-

essential information and the ability to view the whole in relation to its parts.

- The Form Board subtest assesses visual perception, visual organisation, visual concept formation and the ability to understand the underlying relations between objects.

There are two additional subtests:

- The Memory for Digits subtest assesses auditory short-term memory for numbers. The second part of the subtest requires the testee to recall digits backwards. The testee has to store the information for a longer period of time and transform the information using mental control.
- The Coding subtest assesses visual-associative learning ability, psychomotor speed, visual-motor integration and co-ordination (HSRC Part I, 1991:5-11).

3.3.2.2 The Cognitive Control Battery (CCB)

Santostefano started investigating cognitive controls in 1959 and his research resulted in the development of the Cognitive Control Battery (CCB) which was completed in 1988. He developed five test procedures of which three have been formally standardised and are included in the CCB. Stratified age norms are not available for the remaining two tests (Santostefano, 1988:21).

Description of the Cognitive Control Battery:

The Record Booklet for the CCB is presented in Addendum A to give an indication of how test is scored.

3.3.2.2.1 The Scattered Scanning Test (SST): this test provides a measure of focal attention (scanning style). The following aspects of scanning style are measured:

Motor Tempo Test (MT): this is a preliminary procedure to measure the child's usual motor tempo in marking shapes. It takes individual fine motor speed and coordination into account. The child has to mark in succession eighteen geometric shapes in two rows. The time the child takes to complete the task is noted (See Record Booklet in Addendum A) (Santostefano, 1988:34).

The Scattered Scanning Test (SST) Form 2 is used by children older than 9 years of age. This test contains 200 geometric shapes randomly arranged, including 40 circles and 40 crosses. The child is given 30 seconds to mark only the circles and crosses as quickly as possible. (See Record Booklet in Addendum A) (Santostefano, 1988:34). The following measures are obtained:

- Number Correct Shapes Marked (NC): the number of circles and crosses marked in 30 seconds.
- Ratio I (R1): a measure of the vigour of scanning (passive vs. active). Higher Ratio I scores show more active scanning while lower Ratio 1 scores show more passive scanning.
- Total Distance (TD): this score is obtained by drawing a line from the centre of the first shape marked and the second, and then adding up the distances between each successive shape marked.
- Ratio II (R2): the measure of the breadth of scanning (narrow vs. broad). Higher Ratio 2 scores indicate broader scanning whereas lower Ratio II scores reveal more narrow scanning.
- Mean Distance (MD): this is the average distance of a single visual sweep. This score is considered to be one aspect of focal attention and is independent of vigour or breadth of scanning.

The Fruit Distraction Test (FDT): this test consists of four cards and the child is required to name the colours or objects depending on the instruction given. Practice cards are used to train the child before three of the cards.

- Card 1 consists of 50 rectangular bars with the colours red, green, yellow, or blue and arranged in 5 rows with 10 bars in each row. The colours of the bars were assigned randomly. The Practice Strip contains all the colours.
- Card 2 contains 50 drawings of red apples, yellow bananas, blue grapes and green heads of lettuce. The fruit and vegetables are set out like the colours on Card 1. A Practice Strip is used beforehand.
- Card 3 also has apples, bananas, grapes and heads of lettuce displayed in the same way as Card 2. Line drawing of other objects are on one side of each fruit in a random fashion. These objects include food-related objects such as a cake, an ice-cream cone, a bottle of milk, a spoon and a glass. There are also objects which are not food related such as a chair, car, airplane, shoe, telephone or a clock. The instructions for this card make it clear that these objects are irrelevant to the task of naming the fruits. A Practice Strip is not provided for this card.
- Card 4 also has the same arrangement of fruit as Card 2 and Card 3 although the colours of the fruit are incorrect. The card has the same four colours which were used in Card 1 (namely red, green, yellow and blue). The child is asked to name the colours which the fruit should be. A Practice Strip is used before Card 4 (Santostefano, 1988:34).

The following measures are obtained from the Fruit Distraction Test:

1.   Card 2 Time (T2): the time taken to name the colours of the fruit.

2.   Card 2 Errors (E2): the total number of naming errors on Card 2 regardless of whether they were corrected or not.

External distractibility: the following measures indicate the extent of external distractibility since Card 3 has irrelevant objects which may affect the child's ability to name the colours correctly. The time taken to complete the task and the number of errors on Card 3 are compared with the child's performance on Card 2 where s/he simply had to name the colours of the fruit.

3.   Card 3 – Card 2 Time (Card 3-2 Time): the total time to name colours on Card 3 minus the total time to name colours on Card 3.

4.   Card 3 – Card 3 Errors (Card 3-2 Errors): the total number of naming errors on Card 3 minus the total number of naming errors on Card 2.

Internal distractibility: the following measures indicate the extent of internal distractibility since the colours of the fruit on Card 4 are incorrect. The child's performance on Card 4 is compared with his/her performance on Card 2 where the colours of the fruit were correct.

5.   Card 4 – Card 2 Time (Card 4-2 Time): the total time to name colours on Card 4 minus the total time to name colours on Card 2.

6.   Card 4 – Card 3 Errors (Card 4-2 Errors): the total number of naming errors which Card 4 minus the total number of naming errors on Card 2 (Santostefano, 1988:55).

Levelling-Sharpening House Test (LSHT): this test consists of a series of 60 pictures of a house displayed in succession. The child looks at each picture for approximately 5 seconds and reports on whether something in the picture changes or looks different. The following measures are obtained:

- First Stop score (STOP): this is the number of the card on which the first correct change is perceived.
- Number of Correct Changes (CHANGE): this score is the total number of changes perceived.
- Levelling-Sharpening Ratio (RATIO): this ratio takes into account correct changes which were not perceived by the child, correct changes which were noticed by the child and how soon these changes were detected after the change was introduced.

The interpretation of these scores reveals valuable information. Early detection of the first correct change (i.e. lower STOP scores) and the detection of many correct changes indicates the construction of stable, differentiated images of ongoing information and the differentiation of these images from present perceptions. The detection of many correct changes and smaller lags in noticing these changes result in a smaller Levelling-Sharpening Ratio, which is referred to as cognitive sharpening (Santostefano, 1988:75).

On the other hand, a profile may indicate that the first correct change is noticed later in the test and fewer correct changes are detected. This profile suggests that the child constructed global, undifferentiated images of ongoing information which is fused with present perceptions. This is referred to as cognitive levelling (Santostefano, 1988:75).

Standardisation Procedures:

The CCB was standardised on a sample of 1103 children ranging from the ages of 4 years to 12 years. An effort was made to assess children from various ethnic groups, a range of socio-economic levels and different geographic locations. The tests were standardised on a sample of well-adjusted learners from various public school systems in the United States to ensure that the norms would be useful in

assessing adaptive functioning in addition to identifying psychological and learning difficulties. The norms for the Fruit Distraction Test and the Levelling-Sharpening House Test were stratified into four age levels: 4-5, 6-7, 8-9. and 10-12. A restricted distribution in older children was evident on the Scattered Scanning Test and consequently norms were only stratified for the first three age levels on this test so norms are only available for children up to 9 years 11 months (Santostefano, 1988:31-32).

Psychometric Properties:

Santostefano conducted a number of studies which investigated the consistency and stability of CCB scores. He found moderate-to-high levels of correlation (although indirect) between alternate forms of the three subtests of the CCB which indicated that the forms measured common underlying dimensions. A reasonable degree of stability was found with the CCB over a 5-year period with latency-age children. This degree of stability was also evident when he administered the Levelling-Sharpening House Test under stressful and non-stressful conditions over more brief periods (Santostefano, 1988:130).

Santostefano used factor analytic studies to investigate the construct validity of the CCB. These studies offered strong initial evidence that children's cognitive functioning can be reduced to a few basic principles which satisfy the operational definitions of cognitive controls (Santostefano, 1988:141).

3.2.2.3 Neale Analysis of Reading Ability

The Neale Analysis of Reading Ability is a British reading assessment which provides levels for reading accuracy, reading rate and reading comprehension. It is applicable for children aged 6-13 years and the Afrikaans version was used for Afrikaans-speaking participants (Bower &

Hartman, 2002:1). Children are asked to read paragraphs which become increasingly difficult. For the purposes of this study the participants were only asked to read the paragraphs on levels 1-4 on both the English and Afrikaans versions. The Afrikaans texts are presented in Addendum B. The accompanying pictures were not presented to the participants. They were asked questions about each paragraph and they were not permitted to consult the text.

The Neale Analysis of Reading Ability was carefully constructed and appropriate passages were selected based on tests with 192 children. Over 2000 British children were used to establish the norms. The test proved to have high reliability and validity (Neale, 1966:10).

The number of correct words read by each participant was recorded and converted into a percentage of words read correctly. The Accuracy level is usually worked out according to how many errors were made on each passage. Using the correct number of words read per paragraph provides a better indication of how much of the paragraphs were read accurately than a simple record of errors. The number of correct responses to 28 comprehension questions was also entered. The norms were not used as they are not applicable to the South African population.

3.2.2.4   The Schonell 5 Mathematics test

This mathematics test consists of one hundred sums which require participants to do addition, subtraction, multiplication and division (see Addendum C). The participants were instructed to work across the rows of sums and to try to complete as many sums as possible in 5 minutes. This assessment has British norms and South African norms were published in the SAALED Newsletter in 1973 (See Addendum D). The researcher was not able to locate the reference for this test. The norms were not used and the results of the index and control groups were compared.

3.2.2.4   The ICE Spelling test and the IPV Speltoets

The ICE Spelling list consists of 100 words which are read aloud to the testee until he/she has spelt seven consecutive words incorrectly (see Addendum E). The IPV Speltoets is the Afrikaans version (see Addendum F).   The researcher could not locate the references for these tests.   In order to combine the results from the English and the Afrikaans versions, the researcher converted the raw scores into norms.   These norms were then coded 1-18 on the data spreadsheets.   The results for the index and control groups were compared.

3.3.3 Research Procedure

As briefly mentioned in Chapter 1, the procedure was initiated when the research assistant contacted the families of the index adolescents to establish whether they would be available for an assessment.   These families then contacted the adolescent who was matched with their child. If the families were unable to contact the adolescent who was the control, they were asked to find an adolescent who was the same sex and social class as their child. The participants and their parents gave verbal consent to be assessed.   The participants were all given the same instructions for all the assessments and the instructions for the Cognitive Control Battery were translated into Afrikaans when necessary. The participants were given feedback at the end of the assessment regarding their performance on the scholastic tests and recommendations were made where necessary.   The participants and their parents were reimbursed for their travel expenses and they were provided with lunch.

3.4   RESULTS

As discussed in 1.6.2.5, the data was analysed by means of the SPSS statistical programme (1991).

3.4.1 Descriptive statistics

Table 5(a).   The descriptive statistics of the SSAIS-R

	N	Minimum	Maximum	Mean	Std. Deviation
IQ	36	51.00	106.00	76.56	13.26
VERBAL	36	50.00	99.00	73.50	13.37
NON-VERBAL	36	50.00	119.00	86.25	14.64
VOC	36	0.00	9.00	5.44	2.22
COMP	36	1.00	12.00	6.33	3.00
SIM	36	3.00	11.00	6.69	2.16
NUM	36	2.00	11.00	6.17	2.52
S/M	36	1.00	13.00	5.28	3.08
MfD	36	2.00	16.00	6.69	3.28
P/C	36	3.00	11.00	7.61	2.17
B/D	36	0.00	19.00	8.80	4.08
M/P	36	2.00	16.00	6.69	3.28
F/B	36	3.00	17.00	8.22	3.16
CODE	36	3.00	16.00	7.72	2.68

Notes: Voc=Vocabulary, Comp=Comprehension, Sim=Similarities, Num=Number Problems, S/M=Story Memory, MfD=Memory for Digits, P/C=Pattern Completion, B/D=Block Designs, M/P=Missing Parts, F/B=Form Board, CODE= Coding.

The results in Table 5(a) indicate that the average IQ (76.6) for the total sample fell within the borderline range (range 71-80). The average verbal score (73.5) for the total sample also fell within the borderline range and the average non-verbal score (86.3) fell within the low average range.

Table 5(b). The descriptive statistics of the CCB

	N	Minimum	Maximum	Mean	Std. Deviation
SST					
Motor Tempo	36	26.00	65.00	45.97	8.84
Shapes Marked	36	26.00	72.00	59.28	9.63
Ratio I	36	45.00	74.00	63.39	9.27
Total Distance	36	25.00	75.00	63.47	11.80
Ratio II	36	46.00	75.00	59.64	9.38
Mean Distance	36	25.00	62.00	43.28	8.78
FDT					
Card 2 Time	36	29.00	70.00	50.03	9.77
Card 2 Errors	36	34.00	53.00	41.08	5.93
Card 3- 2 Time	36	25.00	66.00	47.22	9.70
Card 3-2 Errors	36	24.00	71.00	48.11	14.33
Card 4-2 Time	36	27.00	64.00	46.53	9.06
Card 4-2 Errors	36	22.00	63.00	47.92	12.83
LSHT					
First Stop Score	36	26.00	68.00	44.97	8.97
Correct Changes	36	28.00	57.00	39.22	6.62
Ratio	36	30.00	54.00	41.20	7.07

NOTES: SST=Scattered Scanning Test, FDT=Fruit Distraction Test, LSHT=Levelling-Sharpening House Test, Shapes Marked=Number of Correct Shapes Marked, Correct Changes=Number of Correct Changes, Ratio=Levelling-Sharpening Ratio.

Scores on the CCB are converted to T-scores which are interpreted in terms of six levels: T-scores of 35 or lower suggest severe dysfunction; T-scores between 36 and 40 suggest moderately severe dysfunction; and T-scores between 41 and 45 suggest borderline dysfunction. Santostefano pointed out

that a proportion of children whose performance was initially classified as "borderline" may be classified as "normal" if retested within the same time span since no test is perfectly reliable. He also pointed out that children whose performance was classified as "normal" might be found to fall within the "borderline" range if retested. T-scores between 46 and 55 indicate age-adequate functioning; T-scores between 56 and 65 indicate functioning which is above average. Santostefano referred to the performance of children whose T-scores are 65 and above as indicative of hypermature dysfunction as these skills may be found to be maladaptive in certain situations eg. scanning which is too active or excessively extensive (Santostefano, 1988:46).

T-scores are not available for SST raw scores produced by children older than 9 years, 11 months. If the T-scores were lower than 40 they would indicate that the child's scanning ability was significantly below would be expected of his/her age (Santostefano, 1988:44). The participants in the current study performed satisfactorily on this test which would be expected since their ages range from 12-14 years. The average results on Motor Tempo (T score=46) and Mean Distance (T score=43), however, were very poor considering the ceiling for the norms on this test. A profile of the average results of the CCB subtests is presented in Addendum G.

On the Levelling-Sharpening House Test (LSHT) the First Stop Score (T-score=45) fell within the borderline dysfunction range. The number of correct changes (T-score=39) fell within the moderately severe dysfunction range and the average levelling-sharpening ratio (T-score=41) fell within the borderline dysfunction range. These average T-scores suggest that many of the participants displayed cognitive functioning which was characterised by the construction of global, undifferentiated images of ongoing information fused with present perceptions (cognitive levelling).

On the Fruit Distraction Test (FDT), the T-score for the average number of errors in naming the colours of the fruit on Card 2 (T-score=41) fell within the borderline dysfunction range, whereas the average time taken to complete the card fell within the normal range (T-score=50). On the Scattered Scanning

Test (SST), the average mean distance fell within the borderline dysfunction range (MD T-score=43).

It must be noted that the means on the subtests of the CCB do not reflect the actual profile scores of participants and there were large discrepancies between the profiles of individual participants. Analysis of individual profiles was beyond the scope of the current study.

Table 5(c). The descriptive statistics of the academic achievement assessments

	N	Minimum	Maximum	Mean	Std. Deviation
NEALE Comprehension	36	.00	26.00	12.83	5.21
NEALE Reading Accuracy	36	0.00	99.00	86.01	17.73
SPELLING	36	1.00	18.00	7.44	4.35
MATHS	36	8.00	70.00	29.17	13.85

Table 5(c) indicates that the participants answered on average 12 of the 28 comprehension questions correctly on the Neale comprehension test. Although the norms for the Neale Analysis of Reading Ability and the Afrikaanse Prosalesstoets were not used in the present study, they provided useful qualitative information. On the Neale comprehension test the participants performed on average in the 6 – 8 year 10 month range, and on the Afrikaanse Prosaleestoets at an 8 year 5 month level. The participants were able to read on average 86% of the texts correctly although it must be remembered that the texts were graded in difficulty. The means for the Neale comprehension and reading accuracy tests and the spelling tests were affected by a participant who was not able to read or write. The results of the spelling assessments revealed that the average spelling ability of the participants was at a Grade 4 Semester 1 level (see Addendum E and Addendum F). The participants were in Grades 6-8. The results of the maths assessment revealed that the average arithmetic age of the

participants was 10:0 years (see Addendum D). The average age of the sample was 13.2 years.

3.4.2 Comparison of Intellectual Ability between the Index and Control Groups

Table 6 (a). Comparison of Intellectual Ability between the Index and Control Groups on the SSAIS-R

	VLBW	CONTROLS	t	df	Significance
IQ	76.4	76.6	-.050	17	NS
VERBAL	74.4	72.5	.420	17	NS
NON-VERBAL	85.1	87.3	-.439	17	NS
VOC	5.44	5.44	-.375	17	NS
COMP	6.00	6.67	-.864	17	NS
SIM	6.95	6.44	.825	17	NS
NUM	6.28	6.06	.287	17	NS
S/M	6.06	4.50	1.833	17	NS
MfD	7.50	5.89	1.451	17	NS
P/C	8.78	7.11	-.519	17	NS
B/D	7.44	7.78	-1.652	17	NS
M/P	7.67	9.94	1.610	17	NS
F/B	7.61	7.83	.439	17	NS
CODE	8.22	8.22	-.266	17	NS

Notes: VLBW=Very Low Birth Weight Group; CONTROLS=Control group. Voc=Vocabulary, Comp=Comprehension, Sim=Similarities, Num=Number Problems, S/M=Story Memory, MfD=Memory for Digits, P/C=Pattern Completion, B/D=Block Designs, M/P=Missing Parts, F/B=Form Board, CODE= Coding.

As indicated in the table above, no significant differences were found.

3.4.3 Comparison of Cognitive Control Functioning between the Index and Control Groups

Table 6(b).   Comparison of Cognitive Control Functioning between the Index and Control Groups on the CCB

	VLBW	CONTROLS	t	df	Significance
SST					
Motor Tempo	45.4	46.6	-.391	17	NS
Shapes Marked	58.72	59.8	-.249	17	NS
Ratio I	63.6	63.2	.169	17	NS
Total Distance	62.9	64.0	-.233	17	NS
Ratio II	60.5	58.8	.453	17	NS
Mean Distance	42.2	44.4	-.744	17	NS
FDT					
Card 2 Time	48.7	51.4	1.210	17	NS
Card 2 Errors	40.0	42.2	-1.153	17	NS
Card 3- 2 Time	47.8	46.6	.337	17	NS
Card 3-2 Errors	48.8	47.4	.234	17	NS
Card 4-2 Time	44.6	48.4	-1.22	17	NS
Card 4-2 Errors	51.1	55.9	-.417	17	NS
LSHT					
First Stop Score	46.2	43.8	.671	17	NS
Correct Changes	40.9	37.6	1.467	17	NS
Ratio	88.4	86.0	1.158	17	NS

NOTES: VLBW=Very Low Birth Weight Group, CONTROLS=Control Group, SST=Scattered Scanning Test, FDT=Fruit Distraction Test, LSHT=Levelling-Sharpening House Test, Shapes Marked=Number of Correct Shapes Marked, Correct Changes=Number of Correct Changes, Ratio=Levelling-Sharpening Ratio.

No significant differences were found between the index and control groups.

3.4.4 Comparison of Academic Achievement between the Index and Control Groups

Table 6(c). Comparison of Academic Achievement between the Index and Control Groups

	VLBW	CONTROLS	t	df	Significance
NEALE Comprehension	13.8	11.7	1.225	17	NS
NEALE Reading Accuracy	88.4	86	.423	17	NS
SPELLING	7.2..	7.7	.052	17	NS
MATHS	26.7	31.6	-1.061	34	NS

Notes: VLBW=Very Low Birth Weight Group; CONTROLS=Control group.

Tables 6(a), (b) and (c) indicate that there were no significant differences between the index group and the control group regarding intelligence, cognitive controls and scholastic performance.

3.4.5 The Correlations between Cognitive Control Functioning and Intellectual Ability

In Table 7(a), the correlations between the SSAIS-R and the CCB are shown. On the Scattered Scanning Test (SST) the following correlations were significant. Motor Tempo was associated with the Verbal score ($r = 0.348$, $P < 0.01$) and strongly associated with Comprehension ($r = 0.501$, $P < 0.01$) and Similarities ($r = 0.363$, $P < 0.05$). The Number of Correct Shapes Marked correlated with Story Memory ($r = 0.346$, $P < 0.05$) and Form Boards ($r = 0.408$, $P < 0.05$). Ratio 1 was negatively correlated with Comprehension ($r = -0.408$, $P < 0.05$). The Total Distance covered on the Scattered Scanning Test was strongly associated with Form Boards ($r = 0.523$, $P < 0.01$) and Coding ($r = 0.390$, $P < 0.05$). There was a negative correlation between Ratio II and Vocabulary ($r = -0.331$, $P < 0.05$) and (Comprehension ($r = -0.410$, $P < 0.05$).

Table 7(a).   Correlation among CCB and SSAIS-R

	IQ	Verb	Non-Verb	Voc	Comp	Sim	Num	S/M	MfD	P/C	B/D	M/P	F/B	CODE
SST														
Motor Tempo	.226	.348*	-.052	.270	.501**	.363**	.219	.206	.167	-.031	-.197	-.168	.182	.054
Shapes Marked	.282	.232	.189	.139	.130	.108	.160	.346*	-.069	-.044	.137	.094	.408*	.303
Ratio I	-.034	-.224	.223	-.252	-.408*	-.261	-.099	-.072	-.178	.064	.317	.139	.107	.141
Total Distance	.302	.200	.253	-.010	.150	.225	.202	.246	.081	-.038	.099	.169	.523**	.390*
Ratio II	-.027	-.219	.232	-.331*	-.410*	-.234	-.084	-.035	-.093	.014	.306	.183	.151	.204
Mean Distance	.316	.201	.310	-.015	.148	.251	.297	.084	.229	.046	.159	.412*	.226	.335*
FDT														
Card 2 Time	.001	.091	-.055	-.023	.236	.302	.112	-.270	.407*	.005	-.162	.200	-.297	.449**
Card 2 Errors	.288	.215	.258	.203	-.013	.012	.258	.194	.229	.037	.267	.266	.142	.315
Card 3-2 Time	.106	.014	.158	-.184	.029	.165	.050	.008	.043	.216	-.109	.150	.124	.327
Card 3-2 Errors	.094	.148	.045	.003	.242	.092	.071	.023	.070	.140	-.092	.248	-.294	.040
Card 4-2 Time	.383*	.047	.619**	-.084	-.069	-.035	.160	.192	.047	.168	.293	.519**	.658**	.081
Card 4-2 Errors	.333*	.165	.409*	-.059	.038	.000	.224	.271	.036	.344*	.181	.280	.274	-.247
LSHT														
First Stop Score	.285	.183	.269	.071	.138	.204	.138	.209	.208	.386*	.221	.140	.026	-.049
Correct Changes	.229	.138	.382*	-.017	.013	.055	.107	.309	.206	.494**	.319	.131	.232	-.084
Ratio	.334*	.198	.357*	-.037	.065	.124	.181	.414*	.275	.345*	.262	.195	.264	-.084

Notes: Verb=Verbal, Non-Verb=Non-Verbal, Voc=Vocabulary, Comp=Comprehension, Sim=Similarities, Num=Number Problems, S/M=Story Memory, MfD=Memory for Digits, P/C=Pattern Completion, B/D=Block Designs, M/P=Missing Parts, F/B=Form Board, CODE= Coding.

SST=Scattered Scanning Test, FDT=Fruit Distraction Test, LSHT=Levelling-Sharpening House Test, Shapes Marked=Number of Correct Shapes Marked, Correct Changes=Number of Correct Changes, Ratio=Levelling-Sharpening Ratio.

An association was found between Mean Distance and Missing Parts (r = 0.412, P < 0.05) and Coding (r = 0.335, P < 0.05).

In summary, there was an association between motor tempo and verbal ability. Both verbal and non-verbal subtests were associated with focal attention. Motor speed and co-ordination were associated with verbal ability, Comprehension and Similarities. Vigour of scanning was associated with Story Memory and Form Boards. Active scanning was negatively associated with Comprehension which may require more passive scanning. The breadth of scanning (Total Distance) correlated with Form Boards and Coding. The breadth of scanning (Ratio II) was negatively associated with Vocabulary and Comprehension. The Mean Distance, which is an aspect of focal attention, was associated with Missing Parts and Coding.

On the Fruit Distraction Test (FDT), the following correlations were significant. Card 2 Time was associated with Memory for Digits (r = 0.407, P < 0.05) and strongly associated with Coding (r = 0.450, P < 0.01). There were strong positive correlations with Card 4 – 2 Time and Full Scale IQ (r = 0.383, P < 0.01) and the Non-verbal score (r = 0.619, P < 0.01). There were also strong correlations between Missing Parts (r = 0.519, P < 0.01) and Form Boards (r = 0.658, P < 0.01). There was an association between Card 4 – 2 Errors and Full Scale IQ (r = 0.333, P < 0.01) and Non-verbal ability (r = 0.409, P < 0.01).

In summary, there were some correlations between measures of field articulation and verbal and non-verbal abilities. There was an association between a greater amount of time spent on a task and Memory for Digits and Coding. There was a negative association between external distractibility and Form Boards. The less time taken on Card 4 compared with Card 2 was associated with higher scores for IQ, non-verbal ability, Missing Parts and Form Boards. The fewer errors made on Card 4 compared with Card 2 were associated with IQ, verbal ability and Pattern Completion. These two measures (Card 4 – 2 Time and Card 4 – 2 Errors) are an indication of internal distractibility.

On the Levelling-Sharpening House Test (LSHT) there was an association with the First Stop Score and Pattern Completion (r = 0.386, P < 0.05). A correlation was found between the Number of Correct Changes and Non-verbal ability (r = 0.382, P < 0.05) and Block Designs (r = 0.313, P < 0.05) and a strong correlation was found with Pattern Completion (r = 0.494, P < 0.01). The levelling-sharpening Ratio was associated with Full Scale IQ (r = 0.334, P < 0.05) and Non-verbal ability (r = 0.357, P < 0.05). It was also associated with Story Memory (r = 0.414, P < 0.05) and Pattern Completion (r = 0.345, P < 0.05).

In summary, Pattern Completion was associated with all aspects of levelling-sharpening (the construction of global, undifferentiated images of ongoing information fused with present perceptions). The levelling-sharpening ratio (i.e. the greater number of correct changes perceived and smaller lags in perceiving them) correlated with IQ, Non-verbal ability and Story Memory. The Number of Correct Changes (which represents the construction of stable, differentiated images) was associated with Non-verbal ability.

3.4.6 The Correlations between Cognitive Control Functioning and Academic Achievement

In Table 7(b), the correlations between the scholastic tests and the CCB are shown. There was a strong positive association between reading accuracy and Card 2 Time (r = 0.510, P < 0.01). There was also an association with Card 3 – 2 Errors (r = 0.384, P < 0.05). There were no correlations with reading comprehension. There was a strong correlation between spelling and Card 2 Time (T2) (r = 0.466, P < 0.01) and Card 3 – 2 Errors (r = 0.441, P < 0.01). There was an association with Maths and Number of Correct Shapes Marked (r = 0.301, P < 0.05) & Total Distance (r = 0.338, P < 0.05). There was

Table 7(b).   Correlation among CCB and Academic Achievment Results

	MT	NC	R1	TD	R2	MD	T2	E2	C3T	C3E	C4T	C4E	STOP	CHANGE	RATIO
Neale Reading Accuracy	-.062	.004	.041	-.091	.030	.024	.510**	.096	.266	.384*	-.282	-.210	-.126	.127	-.027
Neale Comprehension	.157	.050	-.216	.002	-.156	.150	.090	.119	-.043	.062	.097	.231	.138	.161	.298
Spelling	.09	-.119	-.153	-.159	-.250	.025	.466**	.086	.069	.441*	-.193	-.165	.152	-.013	-.098
Maths	.295	.301*	-.053	.338*	-.042	.192	.423*	.568**	.227	.015	.196	-.215	-.095	.097	.107

Notes: MT=Motor Tempo, NC=Number of Correct Shapes Marked, R1=Ratio 1, TD=Total Distance, R2=Ratio 2, MD=Mean Distance, T2=Card Time 2, E2=Card 2 Errors, C3T=Card 3 Time-Card 2 Time, C3E=Card 3 Errors-Card 2 Errors, C4T=Card 4 Time-Card 2 Time, C4E=Card 4 Errors-Card 2 Errors, STOP= First Stop Score, CHANGE=Number of Correct Changes, RATIO=Levelling-Sharpening Ratio.

Table 7(c).   Correlation among SSAIS-R and Academic Achievement Results

	IQ	Verb	Non-Verb	Voc	Comp	Sim	Num	S/M	MfD	P/C	B/D	M/P	F/B	CODE
Neale Reading Accuracy	-.042	.137	-.210.	.160	.262	.244	-.079	-.085	.367*	.119	-.253	-.004	-.572**	.368*
Neale Comprehension	.522**	.578**	.265	.488**	.482**	.348*	.435**	.522**	.515**	.192	.027	.388*	.058	-.062
Spelling	.271	.416*	.013	.399*	.511**	.541**	.295	-.031	.488**	.293	-.139	.211	-.416*	.333*
Maths	.282	.367*	.051	.267	.306	.368*	.330*	.236	.406*	.042	-.105	.136	.043	.466**

Notes: Verb=Verbal, Non-Verb=Non-Verbal, Voc=Vocabulary, Comp=Comprehension, Sim=Similarities, Num=Number Problems, S/M=Story Memory, MfD=Memory for Digits, P/C=Pattern Completion, B/D=Block Designs, M/P=Missing Parts, F/B=Form Board, CODE= Coding.

also an association with Card 2 Time (r = 0.423, P < 0.05) and a strong association was found with Card 2 Errors (r = 0.568, P < 0.01).

In summary, a correlation was evident with reading accuracy and speed of working and external distractibility. An association was also found with spelling and speed of working and external distractibility. There was a correlation with Maths and breadth of scanning, working speed and accuracy of working. Reading comprehension was not related to the CCB.

3.4.7 The Correlations between Intellectual Ability and Academic Achievement

Table 7(c) represents the correlation among the SSAIS-R and the academic achievement results. There was an association between Neale Reading Accuracy and the Memory for Digits subtest (r = 0.367, P < 0.05) and Coding (r = 0.368, P < 0.05). There was a strong negative association with the Form Boards subtest (r = -0.572, P < 0.01).

There was a strong positive correlation between Neale Reading Comprehension and IQ (r = 0.522, P < 0.01). There was also a strong positive correlation between Neale Reading Comprehension and the Verbal score (r = 0.578, P < 0.01). There were positive correlations between the Neale Reading Comprehension and all the verbal subtests. There was a strong positive correlation between the Neale Reading Comprehension and the Comprehension subtest (r = 0.482, P < 0.01). This would seem to imply that understanding the items on the Comprehension subtest relate to being able to comprehend the questions of the Neale Reading Comprehension. There was also a strong negative correlation between Neale Reading Comprehension and Story Memory (r = 0.522, P < 0.01). This follows the expected pattern as both the Neale Reading Comprehension and the Story Memory subtest involve immediate auditory recall. There were also strong positive associations between Neale Reading Comprehension and the Number subtest (r = 0.435, P < 0.01) and the Memory for Digits subtest (r =

0.515, $\underline{P}$ < 0.01). There was a correlation with Similarities ($\underline{r}$ = 0.348, $\underline{P}$ < 0.05). On the non-verbal scale there was an association with Missing Parts ($\underline{r}$ = 0.388, $\underline{P}$ < 0.05).

A positive association was found between Spelling and Verbal IQ ($\underline{r}$ = 0.416, $\underline{P}$ < 0.05). There was a correlation between Spelling and Vocabulary ($\underline{r}$ = 0.399, $\underline{P}$ < 0.05), Comprehension ($\underline{r}$ = 0.511, $\underline{P}$ < 0.05), Similarities ($\underline{r}$ = 0.541, $\underline{P}$ < 0.05), Memory for Digits ($\underline{r}$ = 0.488, $\underline{P}$ < 0.05) and Coding ($\underline{r}$ = 0.333, $\underline{P}$ < 0.05). There was a negative correlation with Form Boards ($\underline{r}$ = -0.416, $\underline{P}$ < 0.05).

An association was evident between Maths and the Verbal score (r = 0.367, P < 0.05). There was a strong positive correlation between Maths and Coding (r = 0.466, P < 0.01). Associations were also evident with Similarities ($\underline{r}$ = 0.368, $\underline{P}$ < 0.05), Number ($\underline{r}$ = 0.330, $\underline{P}$ < 0.05) and Memory for Digits ($\underline{r}$ = 0.406, $\underline{P}$ < 0.05).

In summary, it was predictable that a strong association was found between reading comprehension and verbal ability (including many of the verbal subtests), and to a lesser extent between spelling and verbal subtests. Reading accuracy was associated with immediate auditory recall (Memory for Digits). Maths was correlated with verbal ability and predictably with Number skills, Similarities and short-term memory (Memory for Digits), as well as with Coding. A strong negative association was found between Form Boards and reading accuracy and spelling.

3.4.8 Overview of results

There were no significant differences between the index group and the control group in terms of intelligence, cognitive controls or scholastic tests. The average IQ scores on the SSAIS-R were in the borderline range. The average verbal scaled scores were in the borderline range and average non-verbal scaled scores were in the low average range. The average levelling-

sharpening ability as measured on the CCB of the total sample was found to be poor. There were correlations between the CCB and the SSAIS-R. There was an association between some aspects of field articulation (CCB) and academic skills. There were predictable associations between academic skills and certain aspects of the SSAIS-R.

3.5   DISCUSSION

The SSAIS-R and the CCB were used to assess intellectual ability and cognitive control functioning respectively, in adolescents who were low birth weight and their matched controls. Academic achievement was also assessed. The relationships between intellectual ability, cognitive control functioning and academic achievement were also explored.

The **first objective** of the study was to compare intellectual ability in VLBW adolescents with their matched controls. No significant differences were found. This finding contradicts the results discussed of studies conducted in developed countries where VLBW children tended to score significantly lower on intelligence scales when compared with their matched controls (Botting, Powls, Cooke, & Marlow, 1988: 652; Rickards, Ryan, & Kitchen, 1988:19; Saigal, Szatmari, Rosenbaum, Campbell, & King, 1991:751; Levy-Shiff, Mogilner, Lerman, & Krikler, 1994:63). Although the sample of the current study is relatively small, it was found to be representative of the larger group of infants who were born with low birth weight during the period 1988-1989. This finding may suggest that the effects of growing up in a low socio-economic status area may put all the adolescents at a disadvantage regarding their cognitive development. According to the literature (Rickards, Ryan & Kitchen 1988:19; Levy-Shiff, Mogilner, Lerman, & Krikler, 1994:63; Botting, Powls, Cooke & Marlow 1998:658; Saigal, 2000:107), VLBW adolescents are at a disadvantage in terms of having lower IQs and poorer academic results. The finding of this study suggests that the low socio-economic status of all the adolescents had a levelling effect on their

performance on the intelligence scale and the academic tests. The fact that some of the adolescents were low birth weight did not appear to be a significant factor in this analysis.

This finding is not consistent with the results of the follow-up study of the sample at age 6 (Thompson, 2000:viii). The index children achieved significantly lower DQs on the Griffiths assessment compared with the control children and they achieved lower scores on all six scales. The average DQs for the index and control children fell within the normal range. The finding of the current study suggests that the environment has had a great influence on the intellectual ability of the children in the sample between the ages of 6 and 12. The disabling effects of living in a disadvantaged environment and receiving a poor level of education are evident (Kaufman, 1994:183). A proposed conceptual scheme of childhood development was discussed in Chapter 2 in which early development in the first 2 years is highly canalised and follows species-specific paths (McCall, 1981:1). After this period canalisation starts to weaken as individual differences in experience and genetics in heritance have greater effect. This process is supported by the finding of the current study in which environmental influences have played an ever-increasing role in the development of participants from the age of 6 to 12 years.

The average Full Scale IQ score for the sample was below the average scores of the South African population. This finding is consistent with the research conducted by Jensen (in Utley, Haywood & Masters, 1992:451) which found that the average IQ of minority children was below the average for children from middle-class backgrounds. Peterson and Carolissen (2000:104) conducted a study of preschoolers living in a coloured working class community in Cape Town. They found that the cognitive abilities of 65% of the children were below average. According to these authors, school clinics and agencies corroborated the results with their assessments. In the

present study, the participants on average obtained lower verbal scores than non-verbal scores. This finding is consistent with research based on the intellectual performance of children from low socio-economic backgrounds (Kaufman, 1994:185). Kaufman argued that this may be the result of few opportunities for cultural enrichment or acculturation.

The **second objective** of the study was to investigate whether there was a difference between the cognitive control functioning in the index and control groups. No significant differences were found. It may be hypothesised that the discussion above regarding the impact of disadvantaged circumstances may also explain why no differences were found. Further investigation is necessary to explore this. No other studies have explored cognitive controls in VLBW children.

The **third objective** was to compare the academic achievement results of the index and the control groups. No significant differences were found in their results in the reading, spelling and maths assessments. This finding is not consistent with international studies which report that VLBW children tend to achieve lower scores in reading, spelling and mathematics (Rickards, Ryan, & Kitchen, 1988:19; Saigal, Szatmari, Rosenbaum, Campbell & King, 1991:751; Botting, Powls, Cooke, & Marlow, 1998:658). The finding in the current study suggests that the effects of low socio-economic status and poor education put all learners at a disadvantage. The norms for the assessments were not used although they provide valuable qualitative information. The average spelling level of the participants in this sample who were in Grades 6-8, was approximately at a Grade 3 Semester 2/Grade 4 Semester 1 level on the ICE Spelling/IPV Speltoets assessments. The average comprehension level on the Neale Analysis of Reading Ability was in the 6 – 8 year 10 month range. The average age level of the four basic mathematical processes as assessed on the Schonell 5 Mathematics test was found to be 10 years according to the South African standardised norms,

and 9 years 5 months according to the British standardised norms (SAALED Newsletter, 1973:29-31). The average chronological age for the sample was 13 years 2 months. These findings are consistent with the results reported in recent surveys of the literacy and numeracy levels of learners in the Western Cape. More than half of the Grade 6 learners failed the literacy and numeracy assessments and only 30-40% of Grade 3 learners passed literacy and numeracy tests as discussed in Chapter 2.

The **fourth objective** was to compare the correlations between cognitive control functioning and intellectual ability. The results will be compared with a study conducted by Santostefano with 84 children who were 6-17 years and who were admitted to an inpatient psychiatric facility (1988:164). They were assessed by means of the CCB and the WISC. Santostefano found that there was a positive correlation between Full Scale IQ on the WISC and field articulation (the time taken to ignore incorrect colours) and the levelling-sharpening ratio. This was also found in the current study in which the SSAIS-R was used. Santostefano did not include verbal and non-verbal IQ in his analysis. In the current study, non-verbal IQ was associated with the performance time of ignoring correct colours (field articulation) and an aspect of levelling-sharpening (namely, detecting subsequent changes soon after they were introduced). Verbal IQ was positively associated with motor tempo.

In the current study, performance on the Pattern Completion subtest (which measures logical accurate visual perception, concrete reasoning and concept formation) was strongly associated with all three aspects of levelling-sharpening and ignoring incorrect colours. The ability to complete patterns using logical reasoning involves the construction of stable, differentiated images of ongoing information and the ability to differentiate these images from present perceptions. This subtest is not used in the WISC. This subtest appears to provide valuable information regarding levelling-sharpening ability.

The **fifth objective** was to compare correlations between cognitive control functioning and academic achievement. There was a strong positive correlation between aspects of field articulation (specifically, the performance time of naming colours and ignoring irrelevant information while making fewer naming errors) and reading accuracy and spelling. This performance time of naming colours and making fewer naming errors was also associated with maths calculations. Santostefano also found that the performance time of naming colours correlated with reading comprehension, vocabulary, language (including spelling) and maths (concepts and problem-solving) in the Iowa Test of Basic Skills (Santostefano, 1988: 168). These results suggest that field articulation is especially implicated in academic skills, which supports Santostefano's findings. An aspect of focal attention (namely, the total distance covered) was also associated with maths calculations in the current study. It is interesting to note that correlations were not found between reading comprehension and measures on the CCB despite the fact that a correlation was found in the study conducted by Santostefano which was mentioned earlier.

The **sixth objective** was to investigate the relationship between intellectual ability and academic achievement. There were strong positive correlations between reading comprehension and IQ, verbal IQ, non-verbal IQ, all of the verbal subtests and the Missing Parts subtest. This would suggest that good scores on reading comprehension were related to higher IQ scores. As mentioned earlier, reading comprehension was not correlated with the CCB.

Verbal IQ correlated positively with reading comprehension, spelling and maths. Many of the verbal subtests were also positively associated with spelling and mathematical calculations. This is consistent with the fact that reading comprehension, spelling and mathematical calculations all require verbal ability.

Short-term auditory recall (the Memory for Digits subtest) was associated with reading accuracy, reading comprehension, spelling and mathematical

calculations. All of these academic tasks require memory skills. It was mentioned previously in this discussion that Memory for Digits was associated with the performance time of naming colours (field articulation). Coding (which measures visual-associative learning ability) was also associated with reading accuracy, spelling and mathematical calculations, and the performance of naming colours (an aspect of field articulation) on the CCB. The implementation of a Cognitive Control Therapy programme which includes field articulation could result in improved performance on academic tasks.

A review of the profile of the average results of the participants extends this discussion although the average results do not allow for an in-depth analysis of individual profiles (see Addundum G). On the whole, the cognitive control principles of focal attention and field articulation fell within the average range. On the Scattered Scanning Test, the participants displayed relatively slow motor tempo and narrow visual sweeps (Mean Distance). On the Fruit Distraction Test, the participants on average were not able to name colours accurately, although other measures of field articulation fell within the normal range. The profile of average results revealed that the cognitive controls of the sample were global and diffuse, particularly field articulation and levelling-sharpening. The developmental hierarchy discussed in Chapter 2 highlighted how cognitive differentiation occurs as each cognitive control develops simultaneously. Each cognitive control integrates the processes of the other controls lower in the hierarchy (Santostefano, 1988:8). Generally speaking, the profile of average results indicates that aspects of each of the cognitive controls are diffuse resulting in inadequate cognitive functioning.

It is interesting to note that field articulation ability was generally satisfactory. The participants performed poorly on the academic tasks although the statistical analysis revealed that performance on these tasks correlated with aspects of field articulation which was generally satisfactory. These findings could suggest that the average field articulation ability of the participants was

satisfactory, and perhaps the poor quality of the education they have received could have contributed to their poor academic achievement results.

The levelling-sharpening principle was found to be below average in all aspects. It is interesting to note that in a study by Zarembo (1967 in Santostefano, 1988:170) which explored the effect of socio-economic status on performance on the CCB, it was found that greater errors in naming colours was related to low socio-economic status. Another study described in Chapter 2 (Garrity, 1972 in Santostefano, 1988:170) reported that lower LSHT Ratio scores were related to low socio-economic status. It was concluded that children who used levelling (the construction of global, fluid images of information) were also found to receive little social stimulation. These two findings were evident in the present study. These findings provide additional support for the argument that the participants in the present study have experienced a developmental lag in the differentiation process of the developmental hierarchy discussed previously. Additional research is needed to investigate this further.

The intellectual, cognitive and academic outcomes of the adolescents in the present study indicate that an intervention is necessary which helps them improve their scholastic results in order to improve their opportunities in the future.

The argument presented in the literature review (Ashman & Conway, 1997:94) proposed that since intellectual ability is considered to be largely fixed, interventions should target the development of cognitive processes in an effort to improve individuals' performance in a range of skills. The findings of the current study indicate that although the average focal attention ability of the sample was satisfactory, motor tempo was quite slow and there was a tendency towards narrow visual sweeps. The cognitive control principle of

field articulation was found to be associated with reading accuracy, spelling and maths. The participants need to develop their skills in these areas. The profile of the adolescents' average performance revealed that levelling-sharpening ability was below average. The information gathered from this assessment of cognitive functioning highlights the necessity of implementing a Cognitive Control Therapy programme that includes a few introductory sessions on focal attention and all the activities which develop field articulation and levelling-sharpening. It is hoped that the development of the cognitive control principles of field articulation and levelling-sharpening will result in improvements in academic skills.

The results of this study have shown that in this sample the effects of being low birth weight were overshadowed by the adolescents' low socio-economic status and differences in cognitive functioning were not found with their matched controls. Aspects of field articulation and levelling-sharpening were found to be below average in the total sample, which suggests that this is indicative of adolescents from low socio-economic backgrounds. The proposed intervention of a Cognitive Control Therapy programme, specifically tailored to address field articulation and levelling-sharpening, could be implemented by teachers in schools in the greater Cape Town area. It is hypothesised that this intervention could have benefits for many learners who experience academic difficulties.

Chapter 4

CONCLUSIONS, IMPLICATIONS, LIMITATIONS AND RECOMMENDATIONS

4.1 INTRODUCTION

This chapter includes brief comments regarding the conclusions drawn from the research. These conclusions will have certain implications for the assessment of South African VLBW adolescents. Possible limitations of the study will be discussed, and recommendations concerning further research in this field will be mentioned.

As stated in **Chapter 1**, the objectives of this study were to examine whether there was a difference in the intellectual ability, cognitive functioning and academic performance of VLBW adolescents when compared with their controls. The study also examined whether there were relationships between cognitive controls, intellectual ability and academic achievement. In **Chapter 2** a literature review was undertaken to discuss the international research findings regarding the cognitive and behavioural outcomes of VLBW children. The concepts of intelligence and cognition were also explored, as well as the relationship between them. The influence of disadvantageous circumstances on development was described with particular reference to South Africa. **Chapter 3** focused on the research methodology, the research process, the results and a discussion of the results.

4.2 LIMITATIONS OF THIS STUDY

Before conclusions can be reached, certain limitations of the study must be considered.

4.2.1 Sample

The selection of the sample was not random, but it was based on the participants' proximity to Groote Schuur Hospital and their access to transport services.   However, the sample did not differ from the cohort in terms of birth weight, gestational age and social class.   The sample of this study is not representative of all VLBW adolescents in South Africa, as it was comprised of coloured adolescents living in disadvantaged communities in Cape Town.

4.2.2 Instruments

The author could not find the reference for the ICE Spelling test and the IPV Speltoets, despite a thorough search and consultation with many practitioners and academics in the Western Cape as well as in Gauteng.   The validity of the results of the spelling assessments could have been enhanced if information regarding the source and norms could have been located.   The adolescents who spoke English were assessed by means of the English spelling test and the Afrikaans adolescents were assessed on the Afrikaans test.   The results were combined. The two spelling tests were useful in comparing the spelling abilities of both English and Afrikaans adolescents.

The cultural validity of the Cognitive Control Battery must also be considered. The instrument is useful for different cultural groups as it is not language-based.   The Levelling-Sharpening House Test requires the testee to look at pictures of a house displayed in succession and identify whether something changes or looks different. Some of the adolescents live in poor areas where they may not have been exposed to the Western aspects of a scene of a house depicted in the pictures eg. the weather vane and the cobbled path. Furthermore, children from impoverished environments have most likely received little stimulation and not had practice in spotting the difference in pictures.   The validity of the norms would then be questioned.   These concerns about the cultural validity of the CCB must be noted, although the

instrument appears to be a useful instrument for different cultural groups on the whole.

The cultural validity of the SSAIS-R also requires consideration. The SSAIS-R provides norms for environmentally disadvantaged children based on the Socio-economic Deprivation Questionnaire. The researcher decided not to use these norms as the total sample needed to be assessed on a single set of norms.

4.2.3 Method

The quantitative approach used in this study can lack depth and an insider perspective which could lead to surface level analyses. The data could possibly be sample and context specific. The author was not able to obtain qualitative data during the assessment process. This was due to the labour-intensive nature of the assessment process. Time was limited and the author had to assess two adolescents during the course of a morning. The battery of assessments was extensive and the quantitative assessment data was the primary focus of the study. Perhaps more in-depth research of a smaller sample would enable researchers to include both quantitative and qualitative data.

4.3 CONCLUSIONS

Hypothesis 1: VLBW adolescents will achieve lower scores on the Senior South African Intelligence Scales-Revised (SSAIS-R) in comparison to their matched controls.

The VLBW adolescents did not achieve lower IQ scores than their controls and no significant difference was found. There were also no significant differences on any of the subtests of the SSAIS-R. International research findings indicated that VLBW children tend to perform worse on IQ tests than

their controls, although the current study did not support this trend in the sample from a disadvantaged community.

Hypothesis 2:   The VLBW adolescents will display lower levels of cognitive functioning, as assessed on the Cognitive Control Battery (CCB), in comparison to their matched controls.

There was no significant difference between in cognitive functioning between the index and control groups.

Hypothesis 3:   VLBW adolescents will achieve poorer academic results in reading, spelling and mathematics, in comparison to their matched controls.

No differences were found between the academic results of the VLBW adolescents and their controls. Results from international studies indicate that VLBW children tend to perform worse. Recent literacy and numeracy tests in the Western Cape have highlighted the poor academic skills of learners.

Hypothesis 4:   It will be shown that cognitive controls and intellectual ability, as assessed on the SSAIS-R, measure different aspects of cognitive-intellectual functioning. Cognitive controls define processes which are basic to and underlie intellectual test performance.

A positive correlation was found between Full Scale IQ on the SSAIS-R and the field articulation (the time taken to ignore incorrect colours) and the levelling-sharpening ratio on the CCB. This correlation was also found in Santostefano's (1988:164) study of children in a psychiatric facility. He concluded that the Full Scale IQ score does not define a basic cognitive principle when factor analysed with CCB scores and IQ does not modify the cognitive constructs defined by CCB measures. The current study supports this finding. The Pattern Completion subtest of the SSAIS-R was strongly

associated with all three aspects of levelling-sharpening and ignoring incorrect colours. This subtest was found to be useful in evaluating levelling-sharpening ability.

Hypothesis 5: It will be shown that cognitive controls are correlated with academic achievement in the areas of reading, spelling and mathematics.

Aspects of field articulation were positively associated with reading accuracy and spelling. The performance time of naming colours and making fewer naming errors were also associated with maths calculations. Field articulation was found to be implicated in academic skills. Santostefano (1988:168) found similar results and concluded that since the correlations were relatively small, measures of cognitive control and academic skills do not relate to the same cognitive construct.

Hypothesis 6: It will be shown that there is an association between intellectual ability, as measured on the SSAIS-R, and academic achievement in the areas of reading, spelling and mathematics.

Reading comprehension was positively correlated with Full Scale IQ, verbal IQ, non-verbal IQ, all the verbal subtests and the Missing Parts subtest. Positive correlations were also found between many of the verbal subtests and spelling and mathematical calculations. Memory for Digits was associated with all the academic results. Coding was also associated with reading accuracy, spelling and mathematical calculations. Short-term auditory recall and visual-associative learning ability are important in academic tasks.

Hypotheses 1,2 and 3 as stated in Chapter 1 do not appear to be supported by the findings of this study. Hypothesis 4 was supported by this study. Hypotheses 5 and 6 were partially supported by the results of this study.

4.4   RECOMMENDATIONS

In light of this study, the following recommendations are made with regard to further research of VLBW adolescents living in disadvantaged communities:

4.4.1 Further Research

4.4.1.1   Assessment of the cohort would enhance the reliability of the findings. VLBW children from other language groups should also be included.

4.4.1.2   More detailed evaluation of socio-economic background would reveal risk factors associated with poor cognitive development.

4.4.1.3   The Socio-economic Questionnaire could be used to establish whether the norms for environmentally disadvantaged should be used in particular cases.

4.4.1.4   Additional research could also include qualitative data obtained during the assessment process on the SSAIS-R, CCB and the Neale. This information could be useful in analysing whether the index and control groups differ in their approach to cognitive tasks.

4.4.1.5   Further research could incorporate a South African spelling assessment with norms for both English and Afrikaans learners.

4.4.1.6   A research project should be undertaken which includes the intellectual and cognitive assessment of VLBW adolescents, an intervention of Cognitive Control Therapy for those participants who require it, and then re-assessment of their intellectual and cognitive functioning and their scholastic performance in the classroom.

4.4.1.7 The CCB could also be used with other children at risk in South Africa. A project is currently underway to investigate the cognitive functioning of such children living in disadvantaged communities in the Western Cape (Perold, 2004, personal communication).

4.4.2 Interventions

4.4.2.1 The results of the present study suggest that many of the participants had difficulties with aspects of field articulation and levelling-sharpening. An intervention programme should be designed which incorporates a few focal attention tasks, some field articulation tasks and the levelling-sharpening activities. Teachers could be trained in this programme and it could be incorporated in the curriculum. A pilot project should be undertaken in a few classes in a school. This intervention could be aimed at children in the intermediate phase at primary school to enhance their academic skills. The Education Department could include this programme in the national curriculum.

4.4.2.2 Eco-systemic interventions could be devised which attempt to educate parents in disadvantaged communities about the importance of stimulating their children at an early age to develop their cognitive abilities. The upliftment of these communities on all levels would improve the circumstances of children living there and hopefully their performance at school would improve.

4.4.2.3 Psychologists could be trained to use the CCB in identifying poor cognitive control functioning and be able to implement Cognitive Control Therapy. The CCB is also useful in identifying whether children are internally and/or externally distractible which is important in investigating attention disorders.

4.5   FINAL WORD

During the research process, the researcher became increasingly aware of the complexity of investigating intellectual and cognitive functioning.   The impact of growing up in a disadvantaged community was a significant factor in the present study and it affected all the participants regardless of whether they were VLBW status or not.   More attention needs to be paid to investigating interventions which can enhance the development of these children at risk.   Education can play a crucial role in this process.   The present study has indicated that many of the participants were candidates for Cognitive Control Therapy.   This is a unique intervention which can be implemented by educators in classrooms.   Researchers have found that learners have benefited from Cognitive Control Therapy. Further investigation is required to explore how this intervention can be implemented to benefit as many learners as possible while remaining effective and efficient.

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ADDENDUM A

COGNITIVE CONTROL BATTERY
Record Booklet

Sebastiano Santostefano, Ph.D.

Published by

WPS WESTERN PSYCHOLOGICAL SERVICES
Publishers and Distributors
12031 Wilshire Boulevard
Los Angeles, California 90025-1251

Child's Name _____ Date Tested _____ _____ _____
(Year / Month / Day)

School _____ Grade _____ Sex _____ Date of Birth _____ _____ _____
(Year / Month / Day)

Parent's Name _____ Age _____ _____ _____
(Years / Months / Days)

Referred by _____ Examiner _____

Reason for Referral _____

Language spoken at home (if other than standard English) _____

Rapport ☐ Good ☐ Variable ☐ Poor General Observations _____

CCB PROFILE

Scattered Scanning Test						Fruit Distraction Test						Leveling-Sharpening House Test		
Motor Tempo	Number Correct Shapes Marked	Ratio I	Total Distance	Ratio II	Mean Distance	Card 2		Card 3-Card 2		Card 4-Card 2		First Stop Score	Number Correct Changes	Ratio Score
						Time	Errors	Time	Errors	Time	Errors			
___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___	___	___	___	___	___
___	___	___	___	___	___	___	___	___	___	___	___	___	___	___

Percentile
99
98
93
84
69
50
31
16
7
2
1

Percentile

Scattered Scanning Test (SST)

Scoring Summary

Raw Score

tor Tempo (Regular)
seconds   MT _____

mber Correct Shapes Marked   NC _____

al Number of Shapes Marked
(correct and incorrect)   TS _____

al Distance
centimeters   TD _____

Raw Score

Mean Distance [TD ÷ (TS - 1)]
in centimeters   MD _____

Ratio I [MT x NC x .01]   R1 _____

Ratio II [MT x TD x .01]   R2 _____

Qualitative Observations

(Check all that apply)

Motor Tempo Test
- ◯ Draws continuous line through several shapes
- ◯ Scribbles on shapes
- ◯ Marks shapes with circle or X
- ◯ Skips around

Length of training required:
- ◯ Long   ◯ Average   ◯ Brief

SST Training
- ◯ Marks shapes with circle or X
- ◯ No response

Length of training required
- ◯ Long   ◯ Average   ◯ Brief

SST Performance
- ◯ Random
- ◯ Orderly
- ◯ Shifting Series
- ◯ Periphery
- ◯ Initially successful then scribbles or stops
- ◯ Somatic complaints (e.g., dizzy, sleepy)
- ◯ Regresses during second, more complex, task
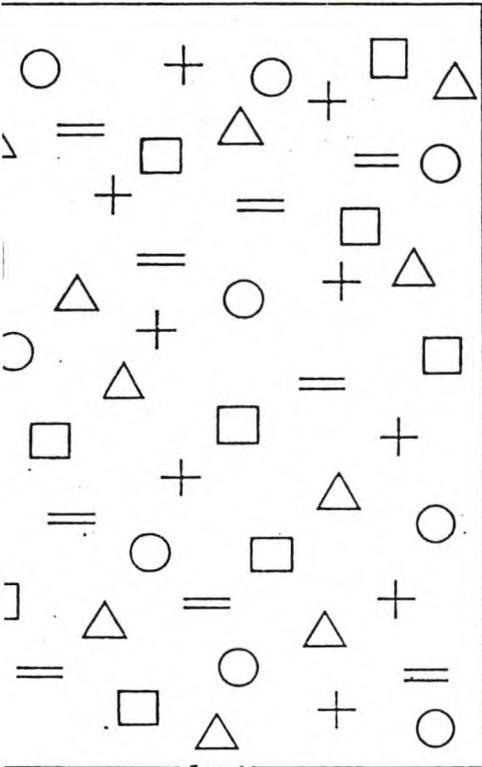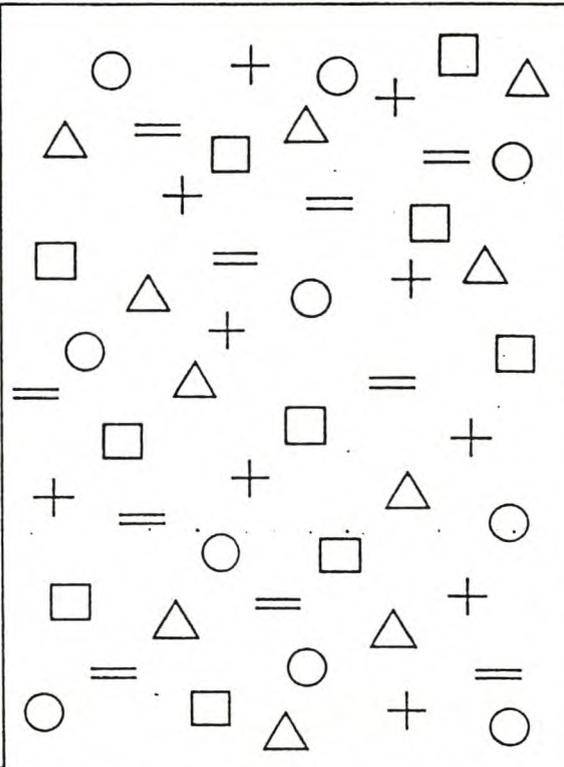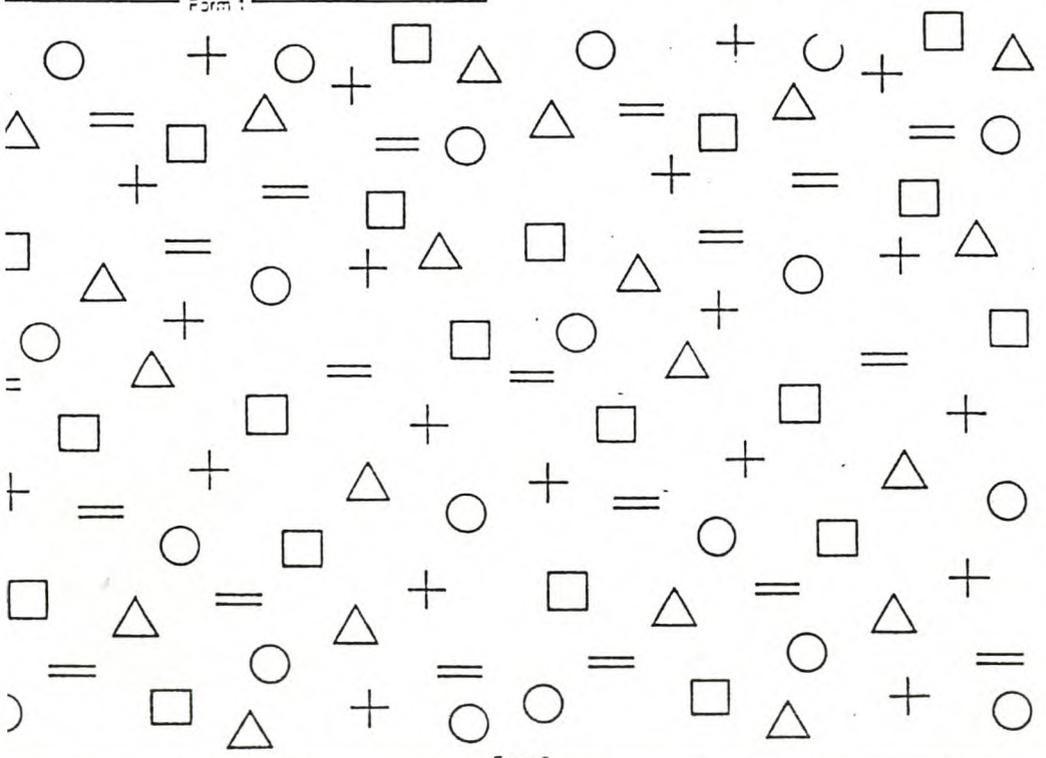
Extra Scores

Number Incorrect
Shapes Marked _____

Motor Tempo (Fast)
in seconds _____

Motor Tempo (Slow)
in seconds _____

Form(s) Administered

(Check all that apply)

- ◯ Form 1 Squares
- ◯ Form 1 Circles & Crosses
- ◯ Form 2 Circles & Crosses

Form 1

Form 2

is form is for recording the *sequence* of the child's markings. Do not use to calculate distance scores

Fruit Distraction Test (FDT)

ELLOW	GREEN	BLUE	BLUE	RED
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

ELLOW	YELLOW	BLUE	GREEN	GREEN
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

RED	GREEN	YELLOW	RED	BLUE
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

LLOW	YELLOW	RED	GREEN	GREEN
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

LLOW	RED	BLUE	YELLOW	GREEN
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

RED	GREEN	YELLOW	BLUE	GREEN
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

LUE	RED	YELLOW	GREEN	BLUE
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

RED	RED	GREEN	BLUE	GREEN
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

RED	YELLOW	RED	BLUE	RED
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

LUE	BLUE	YELLOW	BLUE	RED
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	

Scoring Summary

DISTRACTIBILITY SCORE SUMMARY

Raw Score

	Raw Score
Card 2 Time	
Card 2 Errors	
Card 3 - Card 2 Time	
Card 3 - Card 2 Errors	
Card 4 - Card 2 Time	
Card 4 - Card 2 Errors	

Length of training required:

Card 1	O Long	O Average	O Short
Card 2	O Long	O Average	O Short
Card 3	O Special Prompting Required		
Card 4	O Long	O Average	O Short

Qualitative Observations

(Check all that apply)

	Card 1	2	3	4
Skipped	☐	☐	☐	☐
Lost Place	☐	☐	☐	☐
Step Back	☐	☐	☐	☐
Introductory Verbalizations	☐	☐	☐	☐
Voice Change (Shouting)	☐	☐	☐	☐
Rhythm Change	☐	☐	☐	☐
Head Thrust	☐	☐	☐	☐
Finger Pointing	☐	☐	☐	☐
Attention External	☐	☐	☐	☐
TOTAL				

Card 3 Recalls
(Circle all that apply)

Correct Recalls   Raw Score

Food-Related

Non-Food-Related

TOTAL ____
CUTOFF SCORE ____

Incorrect Recalls

Food-Related ____

Non-Food-Related ____

TOTAL ____
CUTOFF SCORE ____

			Total	Corrected
Errors				
ds) Card 1		Card 1		
Card 2		Card 2		
Card 3		Card 3		
Card 4		Card 4		

Leveling-Sharpening House Test (LSHT)

Scoring Summary | Qualitative Observations

Correct Change Scores

First Stop _____

...er Correct Changes _____

Ratio Score _____

Additional Scores

? _____
X _____
Y _____

Vague Score Total _____

Miscellaneous Change Scores

P _____
? _____
X _____
Y _____

TOTAL _____

Incorrect Change Scores

	A		B
Aa	_____	Ba	_____
Ac	_____	Bo	_____
Am	_____		
Ao	_____		
As	_____		
TOTAL	_____	TOTAL	_____
CUTOFF SCORE	_____	CUTOFF SCORE	_____

Qualitative Observations

(Check all that apply)

○ Aggressive
○ Distractible
○ Glances
○ Grabs Cards
○ Restless
○ Somatic
○ Tuned Out

...INING

Card 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____

Length of training required:
○ Long ○ Average ○ Short

...TING

...ng	Change Introduced	Card Number	Response	Cards Remaining	Change Introduced	Card Number	Response
		1	_____	30	Three Pickets of Fence (Pic)	31	_____
		2	_____			32	_____
		3	_____			33	_____
Doorknob (DK)		4	_____	27	Panes of Oval Window (Ov-p)	34	_____
		5	_____			35	_____
		6	_____			36	_____
Horizontal Fence Board (FB)		7	_____	24	Smoke from Chimney (Sm)	37	_____
		8	_____			38	_____
		9	_____			39	_____
Rays of Sun (RY)		10	_____	21	Oval Window (Ov-all)	40	_____
		11	_____			41	_____
		12	_____			42	_____
Ground Line to Right of Fence (Gr-R)		13	_____	18	Diagonal Roof Line (Rf)	43	_____
		14	_____			44	_____
		15	_____			45	_____
Top of Weather Vane (W-tp)		16	_____	15	Remainder of Weather Vane (W-all)	46	_____
		17	_____			47	_____
		18	_____			48	_____
Ground Line to Left of Evergreen (Gr-L)		19	_____	12	Vertical Windowpanes of Front and Side Windows (Vp-2)	49	_____
		20	_____			50	_____
		21	_____			51	_____
Directions on Weather Vane (W-dir)		22	_____	9	Flagstones in Walk (Stone)	52	_____
		23	_____			53	_____
		24	_____			54	_____
Horizontal Pane of Side Window (Hp-side)		25	_____	6	Evergreen Tree (Tree)	55	_____
		26	_____			56	_____
		27	_____			57	_____
Horizontal Pane of Front Window (Hp-Front)		28	_____	3	Remainder of Walk (Walk)	58	_____
		29	_____			59	_____
		30	_____			60	_____

...mber of Stop

...eported

...mber Change ...eared

...om First ...ance to Stop

ADDENDUM B

'n Geel vink land in my tuin.

Ek voer haar met mielies.

Sy bou haar nes in my boom.

Nou kyk ek na haar kuikens.

Flip en Ansie speel by die rotse.

Skielik hoor hulle 'n harde plas.

'n Visser-man het in die see geval.

Hy kan nie swem nie,

want hy is beseer.

Die kinders probeer trek hom uit,

maar hy is te swaar.

Ansie hou die man se kop bo die water

en Flip gaan soek hulp.

Die leeus tree vir die laaste keer op.

Gert staan eenkant en wag om op te ruim.

Die donderweer maak die leeus rusteloos.

Skielik struikel Sarel, die leeutemmer.

Sy sweep val. Die jongste leeu wil op hom

afspring. Gou-gou spring Gert tot in die hok,

gryp die sweep en laat dit klap.

Sy ratse aksie gee vir Sarel kans om die orde

te herstel.

Na hierdie avontuur weet Gert hy sal nooit

weer wonder wat hy eendag wil word nie!

Dit is middernag. 'n Grillerige gehuil loei deur die verlate huis. Die meisies hou dadelik op om rond te snuffel.

"Spoke!", fluister een van die twee.
"Ag bog!", antwoord haar maat, maar nogtans beweeg sy voetjie vir voetjie in die rigting van die geheimsinnige geluid.

Die meisies skraap moed bymekaar en nuuskierig benader hulle die ou kombuis. Met ingehoue asems swaai hulle die deur oop. Dadelik verander hul vrees in jammerte, want in die ligstrale van hul flitse lê 'n uitgeputte plaashond. 'n Vlaag wind het veroorsaak dat hy 'n gevangene in die kombuis geword het waar hy na rotte gejag het.

ADDENDUM C

SCHONELL 5
(5 Minute)

a	b	c	d	e
3 + 8 =	12 - 5 =	7 x 6 =	3 + 9 =	42 ÷ 7 =
27 ÷ 3 =	5 x 0 =	12 - 7 =	11 - 4 =	15 - 7 =
9 + 3 =	36 ÷ 9 =	7 x 9 =	7 + 6 =	8 + 9 =
9 + 4 =	12 - 3 =	1 x 0 =	4 x 6 =	13 - 6 =
0 ÷ 5 =	48 ÷ 8 =	64 ÷ 8 =	9 x 6 =	8 x 7 =
14 - 8 =	4 + 7 =	5 + 6 =	5 ÷ 5 =	3 x 0 =
6 + 7 =	8 x 0 =	63 ÷ 9 =	18 - 9 =	7 x 7 =
4 + 9 =	0 ÷ 8 =	63 ÷ 7 =	6 x 9 =	11 - 6 =
15 - 8 =	0 x 2 =	9 x 3 =	8 x 5 =	4 ÷ 4 =
54 ÷ 9 =	5 + 7 =	8 + 6 =	9 + 5 =	7 + 8 =
11 - 3 =	13 - 8 =	6 x 0 =	14 - 6 =	7 + 7 =
36 ÷ 4 =	15 - 9 =	13 - 5 =	6 x 7 =	7 x 8 =
0 x 1 =	6 + 9 =	17 - 8 =	15 - 6 =	0 ÷ 7 =
54 ÷ 6 =	4 x 9 =	0 x 5 =	13 - 4 =	16 - 9 =
11 x 7 =	84 ÷ 12 =	88 ÷ 11 =	12 x 6 =	10 x 12 =
12 x 4 =	11 x 11 =	96 ÷ 12 =	11 x 12 =	121 ÷ 11 =
60 ÷ 12 =	12 x 7 =	108 ÷ 12 =	12 x 8 =	120 ÷ 12 =
72 ÷ 12 =	11 x 10 =	11 x 8 =	132 ÷ 12 =	12 x 11 =
11 x 9 =	77 ÷ 11 =	144 ÷ 12 =	12 x 12 =	110 ÷ 11 =
48 ÷ 12 =	12 x 5 =	99 ÷ 11 =	132 ÷ 11 =	12 x 9 =

ADDENDUM D

TABLE OF ARITHMETIC AGES: ORIGINAL BRITISH STANDARDIZATION VERSUS NEW CAPE PENINSULA STANDARDIZATION

Score	British Standardized Sample Arithmetic Age		South African Standardized Sample Arithmetic Age	
	Yrs.	Mths.	Yrs.	Mths.
4	7	0	9	0
6	7	2	9	0
7	7	4	9	1
8	7	6	9	2
9	7	8	9	3
10	7	9	9	4
11	7	11	9	4
12	8	0	9	5
13	8	2	9	6
14	8	3	9	6
15	8	5	9	7
16	8	6	9	7
17	8	7	9	6
18	8	8	9	8
19	8	8	9	8
20	8	9	9	9
21	8	10	9	9
22	8	11	9	9
23	9	0	9	10
24	9	2	9	11
25	9	2	9	11
26	9	3	9	11
27	9	3	9	11
28	9	4	10	0
29	9	5	10	0
30	9	6	10	0
31	9	7	10	1

Score	British Standardized Sample Arithmetic Age		South African Standardized Sample Arithmetic Age	
	Yrs.	Mths.	Yrs.	Mths.
32	9	8	10	1
33	9	9	10	2
34	9	10	10	2
35	9	11	10	3
36	10	0	10	3
37	10	1	10	3
38	10	2	10	4
39	10	3	10	4
40	10	4	10	5
41	10	5	10	5
42	10	6	10	6
43	10	7	10	6
44	10	8	10	6
45	10	9	10	7
46	10	9	10	7
47	10	10	10	7
48	10	11	10	8
49	11	0	10	8
50	11	1	10	9
51	11	2	10	9
52	11	3	10	9
53	11	3	10	9
54	11	4	10	10
55	11	5	10	10
56	11	6	10	11
57	11	7	10	11
58	11	8	11	0

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Score	British Standardized Sample		South African Standardized Sample	
	Arithmetic Age		Arithmetic Age	
	Yrs.	Mths.	Yrs.	Mths.
59	11	9	11	0
60	11	10	11	0
61	11	11	11	1
62	12	0	11	1
63	12	1	11	2
64	12	2	11	2
65	12	3	11	3
66	12	4	11	3
67	12	5	11	3
68	12	6	11	4
69	12	8	11	5
70	12	9	11	5
71	12	11	11	6
72	13	0	11	7
73	13	2	11	7
74	13	3	11	8
75	13	5	11	9
76	13	6	11	9
77	13	8	11	10
78	13	11	11	11
79	14	1	12	0
80	14	4	12	1
81	14	6	12	2
82	14	9	12	4
83	15	0	12	5

ADDENDUM E

ICE - Spelling list

1 look	26 sound	51 example	76 parachute
2 bed	27 finish	52 article	77 luggage
3 top	28 smile	53 complaint	78 frequently
4 hat	29 children	54 entrance	79 contribution
5 fox	30 again	55 sleeve	80 scholar
6 box	31 corner	56 concert	81 experience
7 frog	32 wedding	57 guide	82 messenger
8 sit	33 shower	58 method	83 vertical
9 old	34 torch	59 graceful	84 original
10 ship	35 delay	60 require	85 audience
11 duck	36 skirt	61 drought	86 chaos
12 trust	37 music	62 transfer	87 quotient
13 time	38 telephone	63 yawn	88 innocent
14 wing	39 fence	64 favour	89 similarity
15 girl	40 value	65 manager	90 renewal
16 help	41 thought	66 pattern	91 vicinity
17 fly	42 laugh	67 gallery	92 tolerance
18 open	43 warning	68 region	93 leisure
19 sixteen	44 title	69 ache	94 committed
20 bunch	45 velvet	70 chocolate	95 fictitious
21 stove	46 ninety	71 impossible	96 adequate
22 bone	47 energy	72 cyclist	97 coincidence
23 puppy	48 growth	73 caution	98 pursuit
24 number	49 creature	74 autumn	99 pneumonia
25 brother	50 harbour	75 continent	silhouette

ORMS:

1-7 Gr 1:1st semester	45 - 49 Gr 4:1st semester	73 - 74 Gr 7:1st semester	87 Gr 10:1st semester
8-16 Gr 1:2nd semester	50 -56 Gr 4:2nd semester	75 -78 Gr 7:2nd semester	88 Gr 10:2nd semester
17 - 23 Gr 2:1st semester	57 -59 Gr 5:1st semester	79 - 80 Gr 8:1st semester	89 Gr 11:1st semester
24 - 32 Gr 2:2nd semester	60 -63 Gr 5:2nd semester	81 - 82 Gr 8:2nd semester	90 Gr 11:2nd semester
33 - 37 Gr 3:1st semester	64 - 67 Gr 6:1st semester	83 - 84 Gr 9:1st semester	91 Gr 12
38 - 44 Gr 3:2nd semester	68 - 72 Gr 6:2nd semester	84 - 86 Gr 9:2nd semester	

ISTRUCTIONS

oday we are going to write a number of words. Listen carefully and write each word next
its number. The first words are easier than those that follow. Do your best and try to get
many correct as you can"

ch word has to be pronounced seperately. The enunciation should be quiet distinct,
thout any dislocation of the syllables. Each word may be repeated <u>once only,</u> but is not
be illustrated in a sentence or phrase. The tester begins with the first word and reads
ch word in succession. There is no time limit. The class tempo is more important than
in of the individual pupil. Pupils should be discourage from making repeated changes
excessively slow writing by speeding up the rate at which the words are read.

e test may be discontinued when seven word are consecutively spelt incorrectly.

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ADDENDUM F

IPV - Volle speltoets

1 ek	26 eier	51 rekening	76 diagnose
2 kos	27 lemoen	52 student	77 onverbiddelik
3 mooi	28 lastig	53 spreeu	78 flenter
4 nag	29 maker	54 nadelig	79 bolmakiesie
5 krom	30 bekruip	55 energie	80 komitee
6 doek	31 iemand	56 voedsel	81 rapport
7 slaap	32 bedagsaam	57 gelukkig	82 teologie
8 lig	33 meeste	58 alarm	83 vandalisme
9 niks	34 deftig	59 stukkend	84 tradisioneel
10 spat	35 taamlik	60 redakteur	85 saamflans
11 knoop	36 woelig	61 nêrens	86 plakkaat
12 streel	37 sluier	62 telling	87 ongeërg
13 stroop	38 patroon	63 ivoor	88 kandidaat
14 tuin	39 wetenskap	64 tarentaal	89 roetine
15 hoekom	40 vreemd	65 weduwee	90 effektief
16 baie	41 oggend	66 sedig	91 doeane
17 lank	42 asseblief	67 gretig	92 objektief
18 kameel	43 verskyn	68 surplus	93 venynig
19 getal	44 meervoud	69 eintlik	94 ultimatum
20 dink	45 standerd	70 biblioteek	95 kriterium
21 skil	46 koejawel	71 sukkelaar	96 ruïneer
22 taai	47 wakker	72 kaskenades	97 ressorteer
23 druk	48 alleen	73 verflou	98 ordonnansie
24 vrugte	49 haastig	74 kwaliteit	99 milieu
25 reus	50 kilometer	75 desperaat	vermicelli

NORMS:

- 7 Gr 1:1e semester	53 - 57 Gr 4:1e semester	75 - 76 Gr 7:1e semester	85 Gr 10:1e semester
- 20 Gr 1:2e semester	58 - 62 Gr 4:2e semester	77 - 78 Gr 7:2e semester	86 Gr 10:2e semester
1 - 29 Gr 2:1e semester	63 - 65 Gr 5:1e semester	79 - 80 Gr 8:1e semester	87 Gr 11:1e semester
0 - 38 Gr 2:2e semester	66 - 68 Gr 5:2e semester	81 - 82 Gr 8:2e semester	88 Gr 11:2e semester
9 - 45 Gr 3:1e semester	69 - 71 Gr 6:1e semester	83 Gr 9:1e semester	89 Gr 12
6 - 52 Gr 3:2e semester	72 - 74 Gr 6:2e semester	84 Gr 9:2e semester	

INSTRUKSIES

andag gaan ons 'n aantal woorde skryf. Luister goed en skryf elke woord langs sy nom
ie eerste woorde is makliker as die wat daarop volg. Doen net julle bes en probeer om
oveel woorde as moontlik reg te skryf.

ie woord word een-vir-een gelees, en die uitspraak moet korrek en duidelik wees, sond
at die woorde in lettergrepe opgebreek word. Elke woord mag slegs een keer herhaal
ord, maar mag nie in 'n sin of sinsnede geïllustreer word nie. Daar is geen tydsbeperki
ie. Leerders kan ontmoedig word om herhaaldelik veranderinge aan te bring of te stadi
e skryf deur die tempo waarteen die woorde gelees word, te versnel.

taak na 7 opeenvolgende foute

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ADDENDUM G

A List of Abbreviations and Codes for the Data

ses		Socio-economic status
1	=	Professional & managerial; small business; artisan/skilled labourer
2	=	Semi-skilled labourer
3	=	Unskilled labourer/unemployed
gender		
1	=	Male
2	=	Female
vlbw		Very Low Birth Weight
1	=	Very Low Birth Weight adolescents
2	=	Normal Birth Weight adolescents
language		
1	=	English
2	=	Afrikaans
iq		Full Scale IQ
verbal		Verbal IQ
perf		Performance IQ
neale		Neale comprehension results
maths		Schonell 5 Maths results
spelnorm		Norms for the spelling tests
spelling		ICE & IPV results
vocab		Vocabulary
compr		Comprehension
simil		Similarities
number		Number
storymem		Story Memory
pattern		Pattern Completion
digitmem		Memory for Digits
coding		Coding
fboards		Form Boards
mt		Motor Tempo
nc		Number of Correct Shapes Marked
ri		Ratio 1
td		Total Distance
r2		Ratio 2
md		Mean Distance
t2		Card Time 2
e2		Card 2 Errors
c3t		Card 3 Time
c3e		Card 3 Errors
c4t		Card 4 Time
c4e		Card 4 Errors
stop		First Stop Score
change		Number of Correct Changes
ratio		Levelling-Sharpening Ratio
reading		Neale Reading Accuracy (%)

age	ses	gender	vlbw	language	iq	verbal
13.06	3.00	1.00	1.00	1.00	84.00	80.00
14.02	3.00	1.00	2.00	1.00	80.00	66.00
13.04	1.00	1.00	1.00	1.00	84.00	85.00
12.09	1.00	1.00	2.00	1.00	89.00	95.00
13.10	2.00	1.00	1.00	2.00	83.00	77.00
13.06	2.00	1.00	2.00	2.00	83.00	65.00
13.06	1.00	2.00	1.00	2.00	51.00	50.00
12.10	1.00	2.00	2.00	2.00	60.00	56.00
13.01	2.00	2.00	1.00	1.00	82.00	89.00
13.11	2.00	2.00	2.00	2.00	67.00	69.00
13.06	3.00	2.00	1.00	2.00	69.00	63.00
13.08	3.00	2.00	2.00	2.00	75.00	61.00
13.08	1.00	2.00	1.00	1.00	69.00	68.00
13.09	1.00	2.00	2.00	1.00	64.00	70.00
13.03	3.00	2.00	1.00	1.00	70.00	76.00
13.01	3.00	2.00	2.00	1.00	67.00	62.00
13.05	3.00	1.00	1.00	1.00	82.00	95.00
13.01	3.00	1.00	2.00	1.00	78.00	73.00
13.07	2.00	2.00	1.00	1.00	102.00	86.00
13.10	2.00	2.00	2.00	1.00	51.00	62.00
13.06	3.00	1.00	1.00	2.00	74.00	68.00
13.10	3.00	1.00	2.00	2.00	70.00	68.00
13.08	3.00	1.00	1.00	1.00	94.00	90.00
14.00	3.00	1.00	2.00	1.00	77.00	65.00
13.10	1.00	2.00	1.00	1.00	71.00	73.00
12.07	1.00	2.00	2.00	1.00	106.00	99.00
14.02	1.00	1.00	1.00	2.00	95.00	93.00
14.04	1.00	1.00	2.00	1.00	94.00	89.00
13.05	3.00	1.00	1.00	2.00	63.00	61.00
13.08	3.00	2.00	2.00	2.00	86.00	77.00

perf	neale	maths	spelnorm	spelling	vocab	compr
92.00	12.00	19.00	6.00	43.00	9.00	3.00
102.00	15.00	64.00	7.00	45.00	5.00	4.00
87.00	20.00	37.00	11.00	66.00	8.00	6.00
85.00	14.00	39.00	4.00	26.00	8.00	7.00
94.00	14.00	38.00	7.00	57.00	7.00	6.00
108.00	.00	26.00	1.00	1.00	4.00	3.00
71.00	8.00	8.00	3.00	27.00	1.00	1.00
74.00	12.00	19.00	4.00	32.00	5.00	2.00
78.00	13.00	37.00	15.00	79.00	7.00	7.00
72.00	4.00	70.00	8.00	58.00	4.00	6.00
83.00	12.00	13.00	6.00	51.00	5.00	2.00
99.00	14.00	16.00	9.00	65.00	3.00	6.00
78.00	12.00	31.00	5.00	43.00	4.00	6.00
65.00	8.00	21.00	12.00	69.00	6.00	9.00
69.00	10.00	31.00	11.00	65.00	6.00	10.00
81.00	7.00	23.00	11.00	64.00	4.00	5.00
71.00	24.00	39.00	14.00	75.00	7.00	12.00
89.00	12.00	45.00	5.00	37.00	5.00	7.00
119.00	17.00	22.00	14.00	78.00	7.00	11.00
50.00	11.00	32.00	9.00	65.00	6.00	7.00
89.00	13.00	24.00	7.00	53.00	7.00	4.00
80.00	12.00	17.00	9.00	64.00	7.00	5.00
100.00	16.00	17.00	2.00	14.00	5.00	9.00
97.00	16.00	19.00	7.00	46.00	4.00	8.00
74.00	11.00	41.00	2.00	16.00	6.00	7.00
113.00	15.00	46.00	17.00	83.00	8.00	10.00
99.00	26.00	28.00	3.00	25.00	9.00	9.00
102.00	19.00	35.00	4.00	25.00	4.00	11.00
74.00	10.00	9.00	3.00	24.00	2.00	4.00
99.00	9.00	23.00	6.00	52.00	8.00	7.00

similar	number	storymem	pattern	blocks	missing	digitmem
6.00	9.00	8.00	11.00	10.00	8.00	4.00
3.00	7.00	6.00	11.00	10.00	13.00	10.00
6.00	8.00	10.00	7.00	10.00	8.00	8.00
6.00	8.00	10.00	7.00	10.00	8.00	9.00
5.00	7.00	8.00	9.00	8.00	10.00	6.00
5.00	7.00	5.00	8.00	11.00	10.00	3.00
4.00	2.00	2.00	8.00	7.00	4.00	7.00
5.00	3.00	3.00	3.00	6.00	7.00	5.00
10.00	10.00	7.00	9.00	6.00	5.00	10.00
10.00	6.00	1.00	5.00	4.00	8.00	7.00
7.00	2.00	7.00	8.00	8.00	7.00	7.00
4.00	5.00	3.00	6.00	6.00	19.00	5.00
8.00	3.00	5.00	8.00	8.00	6.00	5.00
8.00	4.00	1.00	7.00	6.00	4.00	4.00
8.00	4.00	4.00	9.00	6.00	.00	6.00
5.00	4.00	4.00	8.00	7.00	8.00	4.00
10.00	9.00	11.00	6.00	6.00	9.00	9.00
8.00	3.00	7.00	6.00	10.00	7.00	2.00
9.00	10.00	2.00	20.00	8.00	14.00	16.00
6.00	2.00	1.00	3.00	3.00	2.00	7.00
6.00	6.00	3.00	8.00	11.00	7.00	9.00
5.00	5.00	4.00	5.00	8.00	8.00	5.00
8.00	7.00	13.00	8.00	8.00	12.00	2.00
5.00	5.00	2.00	7.00	11.00	12.00	5.00
5.00	7.00	7.00	7.00	4.00	6.00	10.00
11.00	10.00	9.00	13.00	10.00	17.00	12.00
9.00	8.00	9.00	10.00	7.00	10.00	11.00
9.00	11.00	6.00	5.00	9.00	16.00	8.00
6.00	6.00	3.00	6.00	7.00	6.00	4.00
5.00	7.00	6.00	11.00	8.00	10.00	4.00

coding	fboards	mt	nc	ri	td	r2
6.00	6.00	38.00	49.00	64.00	41.00	56.00
5.00	7.00	39.00	66.00	74.00	61.00	67.00
8.00	7.00	47.00	55.00	57.00	55.00	52.00
9.00	8.00	41.00	70.00	74.00	75.00	74.00
11.00	9.00	40.00	72.00	74.00	75.00	74.00
3.00	16.00	51.00	60.00	62.00	71.00	56.00
4.00	4.00	26.00	27.00	70.00	25.00	67.00
11.00	9.00	33.00	72.00	74.00	75.00	74.00
11.00	7.00	51.00	72.00	74.00	75.00	59.00
17.00	7.00	43.00	58.00	72.00	71.00	66.00
5.00	7.00	54.00	64.00	57.00	73.00	52.00
8.00	8.00	39.00	56.00	74.00	58.00	64.00
10.00	5.00	48.00	72.00	74.00	75.00	64.00
6.00	3.00	50.00	53.00	52.00	58.00	52.00
6.00	7.00	50.00	49.00	53.00	49.00	47.00
10.00	6.00	51.00	58.00	57.00	64.00	54.00
6.00	6.00	54.00	58.00	51.00	58.00	47.00
9.00	10.00	58.00	72.00	62.00	75.00	56.00
9.00	10.00	47.00	56.00	62.00	64.00	57.00
6.00	3.00	51.00	53.00	51.00	52.00	47.00
8.00	7.00	35.00	56.00	74.00	64.00	74.00
6.00	7.00	48.00	57.00	63.00	59.00	54.00
5.00	12.00	35.00	66.00	74.00	69.00	74.00
4.00	8.00	47.00	59.00	67.00	65.00	59.00
9.00	8.00	65.00	60.00	45.00	75.00	46.00
12.00	8.00	43.00	52.00	59.00	65.00	64.00
7.00	12.00	60.00	64.00	51.00	67.00	47.00
8.00	11.00	60.00	58.00	48.00	75.00	54.00
11.00	6.00	35.00	59.00	74.00	67.00	75.00
6.00	10.00	48.00	70.00	70.00	64.00	57.00

md	t2	e2	c3t	c3e	c4t	c4e
37.00	40.00	39.00	45.00	46.00	28.00	61.00
32.00	59.00	53.00	54.00	57.00	60.00	50.00
44.00	37.00	47.00	45.00	57.00	41.00	50.00
56.00	55.00	53.00	42.00	46.00	44.00	39.00
44.00	51.00	53.00	62.00	46.00	54.00	32.00
44.00	31.00	39.00	39.00	26.00	64.00	50.00
25.00	51.00	35.00	49.00	62.00	31.00	50.00
42.00	47.00	39.00	52.00	24.00	47.00	22.00
32.00	51.00	43.00	50.00	40.00	47.00	39.00
48.00	59.00	53.00	66.00	40.00	47.00	22.00
42.00	43.00	36.00	40.00	33.00	50.00	58.00
44.00	51.00	39.00	62.00	67.00	60.00	58.00
42.00	47.00	39.00	50.00	46.00	48.00	45.00
53.00	55.00	36.00	50.00	67.00	27.00	32.00
27.00	47.00	35.00	50.00	62.00	37.00	58.00
44.00	43.00	35.00	57.00	71.00	48.00	22.00
44.00	59.00	36.00	45.00	57.00	39.00	39.00
44.00	55.00	43.00	49.00	33.00	60.00	58.00
48.00	55.00	39.00	56.00	46.00	50.00	55.00
30.00	55.00	35.00	44.00	40.00	32.00	22.00
50.00	59.00	37.00	40.00	40.00	44.00	39.00
37.00	51.00	53.00	27.00	46.00	50.00	55.00
39.00	29.00	37.00	54.00	57.00	47.00	58.00
42.00	40.00	47.00	32.00	26.00	39.00	32.00
48.00	43.00	36.00	25.00	33.00	39.00	58.00
62.00	55.00	47.00	57.00	52.00	56.00	50.00
39.00	40.00	43.00	52.00	40.00	60.00	58.00
62.00	64.00	39.00	50.00	62.00	52.00	58.00
44.00	37.00	39.00	57.00	33.00	52.00	50.00
32.00	47.00	36.00	49.00	67.00	50.00	62.00

	stop	change	ratio	reading
1	48.00	39.00	35.00	72.00
2	48.00	52.00	54.00	90.00
3	50.00	35.00	39.00	98.00
4	41.00	39.00	41.00	94.00
5	33.00	35.00	37.00	96.00
6	50.00	32.00	37.00	.00
7	50.00	43.00	44.00	87.00
8	32.00	35.00	35.00	82.00
9	40.00	43.00	44.00	95.00
10	31.00	32.00	33.00	96.00
11	50.00	43.00	49.00	91.00
12	46.00	32.00	37.00	97.00
13	48.00	35.00	37.00	95.00
14	48.00	35.00	39.00	96.00
15	50.00	32.00	32.00	94.00
16	50.00	43.00	39.00	93.00
17	41.00	43.00	44.00	96.00
	48.00	57.00	52.00	88.00
	50.00	52.00	46.00	98.00
	33.00	28.00	30.00	98.00
	43.00	39.00	41.00	92.00
	46.00	35.00	39.00	64.00
	48.00	47.00	52.00	64.00
	50.00	39.00	44.00	91.00
	46.00	43.00	49.00	75.00
	68.00	43.00	54.00	99.00
	50.00	43.00	49.00	87.00
	33.00	32.00	35.00	75.00
	64.00	43.00	52.00	73.00
	31.00	43.00	33.00	93.00

1-6

	age	ses	gender	vlbw	language	iq	verbal
1	14.01	1.00	2.00	1.00	1.00	70.00	70.00
2	13.11	1.00	2.00	2.00	1.00	92.00	96.00
3	14.00	2.00	2.00	1.00	2.00	60.00	50.00
4	13.03	2.00	2.00	2.00	2.00	80.00	72.00
5	14.00	3.00	1.00	1.00	1.00	73.00	61.00
6	13.07	3.00	1.00	2.00	2.00	61.00	61.00

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	perf	neale	maths	spelnorm	spelling	vocab	compr
1	76.00	6.00	34.00	8.00	54.00	3.00	7.00
2	90.00	18.00	35.00	18.00	85.00	9.00	12.00
3	90.00	7.00	15.00	7.00	54.00	.00	1.00
4	95.00	13.00	25.00	4.00	31.00	3.00	7.00
5	89.00	19.00	38.00	6.00	41.00	5.00	3.00
6	71.00	13.00	14.00	3.00	25.00	5.00	4.00

perf	neale	maths	spelnorm	spelling	vocab	compr

	similar	number	storymem	pattern	blocks	missing	digitmem
1	7.00	7.00	4.00	7.00	6.00	7.00	6.00
2	11.00	9.00	5.00	8.00	6.00	16.00	10.00
3	4.00	3.00	1.00	7.00	10.00	9.00	3.00
4	6.00	8.00	5.00	9.00	9.00	8.00	4.00
5	7.00	5.00	5.00	10.00	4.00	10.00	12.00
6	4.00	5.00	3.00	6.00	6.00	6.00	2.00

	coding	fboards	mt	nc	ri	td	r2
1	15.00	7.00	58.00	72.00	57.00	75.00	54.00
2	14.00	4.00	45.00	54.00	60.00	51.00	52.00
3	7.00	8.00	31.00	55.00	73.00	59.00	74.00
4	8.00	11.00	48.00	66.00	68.00	74.00	61.00
5	10.00	9.00	43.00	54.00	62.00	67.00	66.00
6	6.00	5.00	43.00	43.00	51.00	39.00	47.00

	md	t2	e2	c3t	c3e	c4t	c4e
1	44.00	64.00	43.00	49.00	57.00	39.00	50.00
2	39.00	70.00	39.00	27.00	71.00	41.00	61.00
3	50.00	64.00	39.00	42.00	71.00	47.00	58.00
4	44.00	51.00	39.00	47.00	26.00	48.00	50.00
5	60.00	60.00	43.00	50.00	52.00	50.00	61.00
6	44.00	37.00	34.00	35.00	33.00	47.00	63.00

	stop	change	ratio	reading
1	44.00	39.00	39.00	89.00
2	48.00	32.00	33.00	98.00
3	26.00	43.00	35.00	96.00
4	52.00	39.00	49.00	79.00
5	50.00	39.00	44.00	90.00
6	33.00	28.00	31.00	77.00

ADDENDUM H

COGNITIVE CONTROL BATTERY
Record Booklet

Sebastiano Santostefano, Ph.D.

Published by

WPS WESTERN PSYCHOLOGICAL SERVICES
Publishers and Distributors
12031 Wilshire Boulevard
Los Angeles, California 90025-1251

Child's Name __PROFILE OF AVERAGE RESULTS__ Date Tested _____ Year / Month / Day

School _____ Grade _____ Sex _____ Date of Birth _____ Year / Month / Day

Parent's Name _____ Age _____ Years / Months / Days

Referred by _____ Examiner _____

Reason for Referral _____

Language spoken at home (if other than standard English) _____

Rapport ☐ Good , ☐ Variable ☐ Poor   General Observations _____

CCB PROFILE

Scattered Scanning Test						Fruit Distraction Test						Leveling-Sharpening House Test		
Motor Tempo	Number Correct Shapes Marked	Ratio I	Total Distance	Ratio II	Mean Distance	Card 2		Card 3-Card 2		Card 4-Card 2		First Stop Score	Number Correct Changes	Ratio Score
						Time	Errors	Time	Errors	Time	Errors			
46	59	63	63	60	43	50	41	47	48	47	53	45	39	41

Percentile: 99, 96, 93, 84, 69, 50, 31, 16, 7, 2, 1