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Jugdav, Sasha

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Psychology

School of Human and Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503

Fax: 011 717 4559

Master's Research Report

The Preschool 'Moment' - Tracking the Relationships between Early Childhood Development, Socioeconomic Status and Demographic Indicators among Pre-schoolers in Soweto.

By

Sasha Jugdav

864026

Supervised by Dr. Sahba Besharati and Dr. Catherine Draper

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Johannesburg.

Declaration

I, Sasha Jugdav, declare that this research report is my own, unaided work. It is submitted for the degree of Master of Arts in Social and Psychological Research by Coursework and Research Report at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other university.

Sign: _____

Date: _____

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Abstract

Insight into early childhood development across various socio-economic contexts has yielded valuable and informative results on the relationship between development and environment. Though previous studies have contributed immensely to supporting the positive relationship between socio-economic status and development, studies coming from low-income and non-Western contexts are challenging this well-established relationship. This is the cornerstone on which the presented study is based.

Objective: The primary aim of this study was to investigate the relationship between socioeconomic status, demographic indicators and early childhood development (ECD) components amongst preschool children from Soweto, a low-income setting in South Africa. The secondary aim was to compare the performance of South African preschool children with performance of preschool children from Australia and America on the same ECD measures.

Methods: Thirty-six preschool children aged three to five years old were assessed on three measures of ECD encompassing cognitive, motor and socio-emotional skills. These measures were the Early Years Toolbox for executive function (cognitive skills), Ages and Stages Questionnaire 3rd edition for fine and gross motor skills and the Pediatric Evaluation of Emotions, Relationships and Socialisation for emotion recognition and emotion perception (socio-emotional skills). Socioeconomic status was considered in terms of access to services, amenities (e.g. flushing toilets and running water) and resources (e.g. computers, televisions, cell phones). Demographic variables included age and sex. Relationships between these variables were analysed by means of correlations and linear regressions. Comparisons between study and norm data were established by means of independent samples t-tests and descriptive statistics.

Results: Contrary to the majority of literature, preschool children from Soweto performed better than normative scores from an Australian sample on two executive function tasks and on fine motor skills compared to American norms. The Sowetan sample, however, performed worse than their normative counterparts on socio-emotional skills. Better socioeconomic status was found to be related to fewer errors on emotion perception, however it was also related to worse performance on visuo-spatial memory. There were no significant sex differences on task performance and minimal differences in performance between older and younger children.

Conclusion: These findings show that the relationship between socioeconomic status and ECD may differ across different contexts which merits further investigation. Results also indicate that the Sowetan sample show better than expected performance on impulse control, visuo-spatial working memory and fine motor skills considering the economically challenged contexts from which they come. Future research investigating these trends in similar contexts is encouraged.

Keywords: early childhood development; socioeconomic status; executive function; preschool; Soweto

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Chapter One: Introduction and Literature Review

The developmental changes in the early years of childhood form part of an exciting and dynamic chapter of the human lifespan. Early childhood development (ECD), understood as the cognitive, physical and emotional health presented by children in the first five years of life, has become a particularly important area of inquiry in the last two decades (Irwin, Siddiqi, & Hertzman, 2009). The United Nations, for example, have set improved educational outcomes and better quality education as their fourth Sustainable Development Goal that forms part of their 2030 agenda (UN News Centre, 2015). The United Nations have considered various indicators to assess improved educational outcomes, including looking at educational access and development of children under five years old to adulthood. Furthermore, the South African government has communicated their interest in and commitment to ECD by proposing compulsory education in the preschool years before formal schooling (Ramaphosa, 2019). The 'preschool', years are understood as the ages between three and five and are regarded as a critical period of life (Levendosky, Huth-Bocks, Shapiro, & Semel, 2003). This is largely due to research consistently finding predictive relationships between the living and learning environments in the early years and performance outcomes later on in life (Barnett & Belfield, 2006; Blair, Zelazo, & Greenberg, 2005; Shonkoff et al., 2012). These performance outcomes include cognitive and emotional development and school outcomes such as mathematics, literacy and language abilities (Kiernan & Huerta, 2008; Walker, Greenwood, Hart, & Carta, 1994).

These critical early years are framed by research on long-term academic performance in school, the socioeconomic climate and the demographics of development (Becker, Miao, Duncan, & McClelland, 2014; Burger, 2010; Pagani & Fitzpatrick, 2014). Research has used this information to investigate the ramifications of disadvantageous socioeconomic circumstances on

development (Becker et al., 2014; Burger, 2010; Pagani & Fitzpatrick, 2014). This has been done by assessing the impact that socioeconomic status (SES) and demographic characteristics have on development and performance (Hackman et al., 2015; Raver, McCoy, et al., 2013; Walker et al., 2011). In studies interested in childhood development, SES has been conceptualised as comprising of social class and position, parental income, education and occupation (Conger, Conger, & Martin, 2010) as well as household income and access to services (e.g. running water), resources (e.g. computers) and amenities (e.g. flushing toilets; Hackman, Farah, & Meaney, 2011). Demographics have been studied as the combination of geographic location of living, age, sex and gender (Hackman et al., 2015; Raver, McCoy, et al., 2013; Walker et al., 2011) as well as race and ethnicity (Rodriguez et al., 2016) and weight status (Hendy & Williams, 2012).

Studies on the relationship between SES, demographics and ECD (see Burger 2010, Hackman et al., 2015 and Raver et al. 2013), have been invaluable in illustrating the context and nature of development in the early years and have drawn attention to the challenges of cultivating better developmental outcomes in various contexts. However, some aspects of the developmental picture have been omitted and are still unclear. These include the fragmented conceptualisation of ECD and ambiguity of the relationship between SES, demographic indicators and ECD components. In the review of literature that follows, these issues and discussions are addressed.

1.1 Early Childhood Development

The first five years of life are crucial as children are primarily engaged in the first experiences of learning, socialisation and rapid physical development. Studies have understood

ECD as integrating cognitive, socio-emotional processes and the development of motor skills that arise during the first five years of life. These skills include development of a child's dexterity, co-ordination and mobility, mental skills and social and communicative skills (Irwin et al., 2009). These intersect with one another and are influenced by a number of contextual, socioeconomic and home factors such as housing density, parental education and household income (Rhoades, Greenberg, Lanza, & Blair, 2006), as well as child nutrition, infectious diseases and environmental pathogens (Walker et al., 2007).

Although the literature on ECD is extensive, studies on ECD have tended to focus tightly on one or two of the above mentioned components (cognitive, socio-emotional, motor) rarely incorporating all three as an integrated model of ECD (Burger, 2010; Blair & Raver, 2012; Gershoff et al., 2007; Phillips & Shonkoff, 2000). For example, in a review of factors influencing child development, Blair and Raver (2012) focussed on studies investigating child development that only included cognitive skills and self-regulation, and not motor or socio-emotional skills. Similarly, in studying the impact of material setbacks on child development, Gershoff et al. (2007) investigated cognitive and socio-emotional skills among American preschool children however not motor skills. In comparison, Hamadani et al. (2010) investigated the relationship between exposure to arsenic and cognitive, language and motor skills among one-year-old children in Bangladesh, however not including socio-emotional skills. Lastly, in a study investigating socio-economic and maternal factors in child development of Turkish children by Comuk-Balci et al. (2016), motor skills of children from birth to seven years were considered, however they did not assess cognitive or socio-emotional skills. These studies have added value by honing in on individual components of ECD and have contributed to understanding each of these components in detail. In addition, these studies clearly illustrate that cognitive, socio-

emotional and motor skills have been consistently used to frame ECD individually. However, they also draw attention to the fact that these factors have rarely been investigated in an integrated manner. Furthermore, as this review will show, research has consistently shown these components to be interrelated, with a strong consistent relationship with executive function. Best and Miller (2010) understand executive function as a cognitive function that is widely responsible for goal-oriented and reflexive behaviour. It is also understood to be comprised of inter-related cognitive abilities that are considered to be 'higher order' (Anderson & Reidy, 2012; Carlson, 2005). These abilities include inhibition, regulation of impulses, attention and cognitive flexibility, working memory and problem-solving (Anderson & Reidy, 2012; Anderson, 2002).

1.2 Theoretical Framework and a Three-Component Model

Numerous models of executive function exist and carve out the nature of these higher order functions by focussing on different areas. Some of these models include Anderson's (2002) four-component model including cognitive flexibility, goal-setting, attentional control and information processing; Baddeley and Della Salla's (1996) model of working memory and a central executive system; Miller and Cohen's (2001) focus on the functions of the prefrontal cortex; and Lezak's (1993) four-factor framework including self-motivated behaviour, planning and ability to think ahead, meaningful action and 'performance effectiveness' in the context of head injury and executive 'dysfunction'. One such model that stands out however is that of Miyake and colleagues' (2000) three-factor model of executive function. Miyake and colleagues' (2000) framework of executive function includes inhibition, working memory and attentional shifting as three core components. Similar to Anderson's (2002) conceptualisation of executive function, Miyake and colleagues (2000) understand these components to be separable

and standalone components however they are interrelated and operate in an integrated process (Anderson 2002; Miyake et al., 2000). Inhibition, also referred to as impulse/inhibitory control, refers to the ability to restrain one's responses and behaviour (Diamond, 2013). Diamond (2013) describes working memory as the ability to retain and process information in mind for short periods of time while the ability to flexibly switch between stimuli and adjust one's behaviour accordingly is referred to as attentional shifting (Diamond, 2013). This model was initially based on a young adult population and later extended to preschool children in a series of studies (Hughes, 1998; Miyake et al., 2000; Welsh, Pennington, & Grossier, 1991). A recent key study by Howard and Melhuish (2017) presented a measure, called the Early Years Toolbox (EYT), which further extends Miyake and colleagues' (2000) framework of executive function to include preschool-aged children. The EYT collected data from Australian children between two and five years old and was developed to assess various components of executive function (visuo-spatial and phonological working memory, attentional shifting and inhibition) as well as the ability to self-regulate, language skills and social development in the early childhood years (Howard & Melhuish, 2017).

The three executive function components of the EYT directly correspond to Miyake and colleagues' components (Howard & Melhuish, 2017). Howard and Melhuish (2017) indicated in their study that the performance of executive function components were generally higher with older children between ages two and four, however these improvements plateaued between ages four and five. From these contributions, the framework provided by Miyake et al. (2000) and the research on the EYT measure indicate two important things. Firstly, that the three core components of executive function can be observed and measured in the early childhood years, confirming the applicability of the model to this age period. Secondly, it confirms that these

components of executive function are highly active, flexible and rapidly developing in the early years (Best & Miller, 2010; Howard & Melhuish, 2017; Miyake et al., 2000). The study presented in this thesis was based on this framework. This three-factor model was chosen due to its holistic and accessible understanding of executive function, which in turn made assessment of executive function in the preschool years accessible (Anderson & Reidy, 2012).

1.3 Integration of ECD Components

Based on this theoretical framework, it is worth noting studies that bring the components of ECD and executive function together. Few studies have incorporated cognitive development, motor development and socio-emotional cognition as a holistic understanding of ECD. This is despite the vast amount of literature that consistently draws links between all three of these components. For example, a recent review article showed that motor development has an impact on social cognition and general social skills in the preschool years (Leonard & Hill, 2014). Specifically, the review presented a study on four-year-old Australian children and reported that poor motor skills were correlated to poor emotion comprehension studies (Piek, Bradbury, Elsley, & Tate, 2008). In another example, a longitudinal study on Norwegian children in grades one and four and reported that children with better motor proficiency displayed better social standing amongst their peers (Ommundsen, Gundersen, & Mjaavatn, 2010). Lastly, the review described a study on five-year-old children from Israel reported that motor skills in the early years can even predict prosocial behaviour (Bart, Hajami, & Bar-Haim, 2007).

Furthermore, both motor development and socio-emotional cognition have been linked to executive function. For example, a study by Grissmer and colleagues (2010) on American preschool children report fine and gross motor skills to be linked to response inhibition and

attention (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010). A recent South African study investigated the link between motor development and executive function (Cook et al., 2019) using a sample of preschool children in both rural and urban areas in South Africa. Cook and colleagues (2019) showed that South African preschool children with more locomotor skills and less moderate and vigorous physical activity showed better performance on working memory. Executive function has also been related to aspects of socio-emotional cognition such as facial emotion recognition. In a study by Rosenqvist and colleagues (2014) on Finnish preschool children, it was reported that emotion recognition abilities improve with age as assessed by the NEPSY-II and Affect Recognition measures. Furthermore, they also report that a range of other neurocognitive functions, including executive functions, are significant predictors of emotion recognition ability (Rosenqvsit, Lahti-Nuuttila, Laasonen & Korkman, 2014). Other studies on this relationship have been done in the context of schizophrenia and from adult samples (Henry, Phillips, Crawford, Letswaart, & Summers, 2006; Hoaken, Allaby, & Earle, 2007; Tang et al., 2015). Specifically, a study comparing adult schizophrenic patients to controls, has shown that better emotion recognition was correlated with better scores on the Wisconsin Card Sorting Task, a measure of cognitive flexibility (Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000). In another study that investigated adult emotion recognition, Hoaken and colleagues (2007) showed that scores on executive function measures were significantly correlated with ability to interpret facial affect. This, however, was done in the context of violent and non-violent criminal offenders compared to a control group (Hoaken et al., 2007). Considering all of these studies, ECD components are undoubtedly related and provide support for the study of ECD as three integrated components.

1.4 SES, Demographics and ECD

The cognitive, socio-emotional and motor skills described above, exist and develop in a contextual environment. Studies have pursued a more in-depth understanding of ECD in the socioeconomic and demographic climate of the individual. The developmental environment is one of the key puzzle pieces that inform the entire lifespan (Burger, 2010). Research at the beginning of the 2000s showed a marked interest in the possible relationships between ECD, executive function, demographic indicators and SES. Studies have focused on defining what executive functions are and what they and consist of (mostly adopting Miyake and colleagues' (2000) three-factor model) and they have looked at the relationship between demographic factors, SES and executive function (Anderson, 2002; Blair & Raver, 2012; Carlson, 2005; Hackman et al., 2015; Walker et al., 2011). The demographic characteristics and socioeconomic indicators that have been used to define SES in the literature have been previously described above (see page 2). For the purposes of the present study, SES was considered as access to resources in the home such as flushing toilets, running tap water and computers (Kagura et al., 2016). Demographics that were focussed on were age in years and months and sex.

1.4.1 Cognitive development.

Studies on the relationship between age and ECD have generally asserted that ECD skills improve as children get older (Anderson, 2002; Kromholz, 2006). Garon and colleagues (2008) reported that executive function components show critical development from three years old onwards. Impulse control has been found to increase significantly between three and five years old, but in a study done by Carlson (2005) on children between one and six years old from White middle-class backgrounds, specific improvements are seen between younger three-year-olds and older three-year-olds indicating vast improvement in the third year (Carlson, 2005; Garon, Bryson, & Smith, 2008). Switch accuracy shows main improvements between four years and six

years old with the largest increases in ability reported between three years and four years old (Garon et al., 2008). Carlson (2005) established that the ability to switch to a new rule is significantly higher after four years old. Working memory abilities are reported to show various developmental patterns between three and five years old (Garon et al., 2008). Specifically, retention and manipulation abilities, which are components of working memory, have not been widely shown before the age of three years old. Studies such as those by Luciana (2003) on preschool American children and Rasmussen and Bisanz (2005) on preschool Canadian children have identified that retention and manipulation abilities continue to improve over the preschool period and throughout childhood (Garon et al., 2008; Luciana, 2003; Rasmussen & Bisanz, 2005). These developmental progressions of cognitive development must be viewed in light of relevant context. A recent review by Fry, Langley and Shelton (2017) reports that, compared to non-disadvantaged young people, cognitive performance among young people between the ages of 15 and 24 years old who had been exposed to poverty and homelessness was impeded. An area of cognitive ability that was impacted negatively across studies was working memory (Fry et al., 2017).

Findings on sex and gender and ECD also seem to be mixed. On measures of cognitive development, a study on American children reported that boys show better performance on working memory and spatial reasoning (Krikorian & Bartok, 2003). In contrast a more recent study also on three-year-old American children reported that there were no significant differences in executive function performance between boys and girls (Wiebe et al., 2011). Furthermore, a study found no significant gender differences between five- to six-year-old American girls and boys on self-regulation, vocabulary, literacy, mathematics and general knowledge (Matthews, Ponitz, & Morrison, 2009).

A limitation of these studies (e.g. Matthews et al. 2009; Wiebe et al., 2011 and Krikorian and Bartok, 1998) is that 'gender' is heavily emphasised which is a social demographic indicator and is considered a term used to describe one's psychological attributes and behaviour (Muehlenhard & Peterson, 2011). 'Sex' being a biological indicator has not been considered as a variable as much as 'gender'. A key implication of using gender instead of sex in research with young children is that an assumption is being made about the children's psychological attributes and behaviour. This then also attributes a social demographic 'label', placing the young participants into pre-determined categories which they may or may not understand. This has implied that children have already internalised gendered standards and have incorporated these into their behaviour, without having supported this assumption with other studies. Similarly, some scholars may argue the same points in response to the use of sex categories (Muehlenhard & Peterson, 2011). The use of sex categories may be argued as an assumption of one's biological attributes without having adequately investigated chromosomal, hormonal and genital markers in order to classify within sex categories (Muehlenhard & Peterson, 2011). Due to these debates, conflict over the use of sex and gender categories can be understood as choosing the lesser of two 'evils'. The study presented in this thesis has used sex categories, and not gender categories, because the understanding of gender has evolved to be incredibly subjective and the belonging to one gender category or another is a personal choice. However, sex categories still have some biological basis to them which are measurable. Furthermore, the use of sex categories does not make an assumption of psychological attribute or behaviour roles, which is particularly important when conducting research with young participants.

A large amount of literature has reported that children from a lower SES show worse outcomes on impulse control (Lipina, Martelli, Vuelta, & Colombo, 2005; Sarsour et al., 2011),

working memory (Engel, Dos Santos, & Gathercole, 2008; Sarsour et al., 2011), attention (Mezzacappa, 2004) and cognitive flexibility (Lipina et al., 2005; Sarsour et al., 2011). Specifically, in a study assessing a sample of American children around the age of five years old, impulse control ability was shown to be lower on children coming from low- to medium-SES backgrounds (Noble, Norman & Farah, 2005). Another key study by Blair and Raver (2013) on American four-year-old children reported that financial strain and poor housing quality were predictive of working memory, attention and inhibitory control. Children with longer exposure to financial difficulties and poor household conditions performed significantly worse on these executive function measures than children with shorter exposure (Blair & Raver, 2013). In a sample of children around nine years old from various socioeconomic backgrounds, Sarsour and colleagues (2011) reported that family SES was the greatest predictor of impulse control and cognitive flexibility. Another study by Engel et al. (2008) on Brazilian children aged six to seven years old, reported that children from higher SES backgrounds showed better outcomes on working memory. A third study by Mezzacappa (2004) confirms the trend of previous studies by reporting that socially advantaged American children of diverse racial categories from ages four to seven years old show better attention accuracy.

1.4.2 Motor development.

Recent studies on sex and gender differences of motor development are sparse. However, of the recent literature, more studies assert that boys perform better on motor development outcomes than girls (Barnett, Beurden, Morgan, Brooks, & Beard, 2010; Goodway, Robinson, & Crowe, 2010; Morley, Till, Ogilvie, & Turner, 2015; Valentini et al., 2016). For example, in a study done by Goodway et al. (2010) on disadvantaged Hispanic and African American children and Valentini and colleagues (2016) on Brazilian children, it was shown that boys perform better

on fundamental motor skills. In addition, Morley et al. (2015) found that boys perform better on gross motor skills (Morley et al., 2015). In a study assessing the motor proficiencies of children aged four to seven years old from the UK, girls were shown to perform better on fine-motor skills (Morley et al., 2015) and other studies have found mixed differences (Anderson & Reidy, 2012; Kromholz, 2006). These mixed differences must be considered in light of the use of various measurement tools and criteria as well as differing cultural and socialisation practises across contexts.

Studies have also consistently found that higher SES is associated with better motor proficiency (Comuk-Balci, Bayoglu, Tekindal, Kerem-Gunel, & Anlar, 2016; Dutta Chowdhury, Wrotniak, & Ghosh, 2010). A study done by Comuk-Balci et al. (2016) reported that in a sample of 2038 children from Turkey between birth and six years old, higher SES was correlated with better fine motor skills, specifically among younger age groups. Similarly, another study by Dutta Chowdhury et al. (2010), on children aged five to 12 years old from a rural and impoverished area in India, illustrates that better nutrition and higher SES were significant predictors on gross motor abilities such as running, upper limb co-ordination and strength. Motor development has been shown to improve with age, with more of an improvement between five and six years old based samples of American children (Butterfield, Lehnhard, & Coladarci, 2002) and children from Finland (Iivonen, Saakslahti, & Nissinen, 2011).

1.4.3 Socio-emotional development.

According to Beauchamp and Anderson (2010) socio-emotional skills include a variety of social skills such as social information processing (e.g. ability to recognise and match facial expressions), theory of mind, moral reasoning and judgements and evaluations of social risk. In terms of recognising and matching facial expressions (also termed ‘emotion recognition’ and

'emotion perception'; Beauchamp & Anderson, 2010), studies have shown that women display better performance on the ability to perceive emotions (Hampson, van Anders, & Mullin, 2006; Hoffmann, Kessler, Eppel, Rukavina, & Traue, 2010; Montagne, Kessels, Frigerio, Haan, & Perrett, 2005). Specifically, a study by Hampson et al. (2006) on students from Canada reported that adult women show faster speeds in processing facial expressions, presented on a computer, compared to men. Hoffman et al. (2010) confirm similar results by reporting that women showed better accuracy on emotion perception. This was done in an experimental setting where adult men and women from Germany were shown two sets of images – highly expressive faces and less expressive faces. Both men and women showed high accuracy on highly expressive faces however women showed better accuracy on more subtle facial expressions (Hoffmann et al., 2010). A study by Montagne et al. (2005) further confirms Hoffman and colleagues' (2010) findings with a similar experimental study. Montagne et al. (2005) tested female and male students from the Netherlands on their accuracy to detect facial expression from video clips of expressive faces. Female students showed better accuracy compared to male students (Montagne et al., 2005).

Few studies document that higher SES is associated with better emotion perception ability (Edwards, Manstead, & Macdonald, 1984; Elfenbein & Ambady, 2002). Emotion perception is understood as the ability to gauge emotion from facial expressions (Beauchamp & Anderson, 2010). Edwards et al. (1984) reported a positive correlation between emotion perception and 'sociometric' status among children from England aged eight to 11 years old. This particular study operationalised sociometric status by evaluating the profession of the participants' fathers or those in a paternal role to the participant (Edwards et al., 1984) which has been significantly altered by other studies since 1984. Emotion perception has been shown to

improve with age with most significant improvements between three and five years old (Boyatzis, Chazan, & Ting, 1993; Denham & Couchoud, 1990). In a more recent study, Raver, Blair and Garrett-Peters (2015) reported that longer time spent exposed to poverty, measured by chronic exposure to income poverty and difficult living situations in the home (such as a chaotic living environment), was a significant contributor to four-year-olds' ability to recognise and regulate negative emotions. The sample consisted of mostly African American children which excludes the experiences of American children from other ethnic groups (Raver, Blair, & Garrett-Peters, 2015).

1.5 Challenge to the SES narrative

The literature discussed above on SES and the various ECD components has generally asserted a positive relationship. Specifically, a majority of studies from high-income countries consistently show that better socioeconomic circumstances are associated with better outcomes on ECD components (see Lipina et al., 2005; Mezzacappa, 2004; Raver et al., 2015). These studies have contributed to the prevailing trend of higher SES being related to better ECD skills, nevertheless research has challenged the way this relationship is understood. For example, a recent study on British children aged four to five years old has shown that SES has no significant effect on working memory (Alloway, Alloway, & Wootan, 2014). A meta-analysis on the SES-ECD relationship concluded that SES is only influential as a moderator variable (Letourneau, Duffet-leger, Levac, Watson, & Young-morris, 2011). Increasing literature from low- and middle-income contexts is also changing this prevailing understanding. For example, a recent study on motor development and executive function has shown that children from rural parts of South Africa perform better on executive function tasks compared to their counterparts from Australia, classified as a high income country (Cook et al., 2019). Other examples challenging

the prevailing understanding of a positive relationship between SES and ECD come from studies emphasising cultural and societal differences and potential differences in the cognitive development of children in different countries (e.g. Chow, Henderson, & Barnett, 2001; Victora, Victora, & Barros, 1990, see below). These cultural and societal variations can be understood as factors that bolster development, or, 'resilience' (Dass-Brailsford, 2005; Gonen et al., 2019; van Heerden, Hsiao, Matafwali, Louw, & Richter, 2017; Venetsanou & Kambas, 2009).

Particularly, in a study done on South African children aged between two months and five years old, van Heerdan and colleagues (2017) reported that South African and Zambian children performed better than children from America, Norway, Korea and Spain on assessments of communication, fine motor and gross motor skills. Tomaz and colleagues (2019) also report high gross motor proficiency among South African children aged three to six years old across different income levels. Considering samples in other parts of the world, a study by Victora et al. (1991) comparing the motor development of Brazilian children to British children found that Brazilian children showed better motor proficiencies. This was attributed to the living environment of Brazilian children where spontaneous activity and play is emphasised contrary to British societal culture (Victora et al., 1990). Similarly, a study comparing children from Hong Kong and American children showed that children from Hong Kong showed greater fine motor skills, reading and writing skills compared to American children (Chow et al., 2001). The culture of children from Hong Kong is significantly different as children from Hong Kong are taught to use chopsticks from as early as three years old and preschool education is compulsory from three years old (Chow et al., 2001). These studies are important examples that emphasise the role of cultural and societal effects on development and draw attention to differences in development comparing low- and high-income countries.

Another drawback of the mainstream literature is that studies have considered socioeconomic indicators and demographic information quite broadly. In depth research in *household* indicators (e.g. services, resources and amenities inside the home) have not adequately been accounted for (Black et al., 2017; Walker et al., 2011) with studies heavily emphasising parental income and education in isolation (Conger et al., 2010; Hackman & Farah, 2009; Rhoades, Greenberg, Lanza, & Blair, 2011; Sirin, 2005a; Walker, Greenwood, Hart, & Carta, 1994). In studies that have considered socioeconomic and demographic factors, the broader environmental influencers that have been considered include disease (Lorntz et al., 2006; Patrick et al., 2005; Walker et al., 2007) violent living conditions (Thabet, Karim, & Vostanis, 2006) and environmental pollution (Hamadani et al., 2010; Jedrychowski et al., 2009). Though informative and valuable, especially those conducted in low- and middle-income countries, there is one key limitation. There is a substantial focus on environmental and socioeconomic indicators from a 'top-down' perspective – the focus on these factors have been exceptionally valuable in illustrating the relationship between environmental factors and development, however study into factors that are closer to the individual (i.e. in the household; access to resources and services like running tap water, flushing toilets and computers) have not been considered in as much detail.

1.6 Rationale and Study Aims

The review of literature above has contributed three key pieces of knowledge. Firstly, studies on ECD have indicated that early development comprises of motor, cognitive and socio-emotional components in integration and that there is value in studying these components together when assessing ECD. Secondly, these components tend to be related to one another through the lens of executive function, particularly the inhibition component. The three-factor

model of understanding executive function has not only shown to be useful in understanding ECD components but has also been shown to be appropriate for the preschool ages. Lastly, the literature reports a mixed understanding of the relationship between ECD and socioeconomic status and demographic factors. The majority of studies reviewed above have advocated for a positive correlation between SES and ECD, however studies coming from non-Western and low- to middle-income contexts have challenged this correlation. Therefore, in order to determine whether the positive correlation holds for a South African sample, further investigation into the relationship between SES and ECD was the basis for the study presented in this thesis.

The main aim of this study was to investigate the relationship between the three components of ECD (motor, cognitive, socioemotional), SES and demographic indicators of preschool aged children from a low-income context in South Africa. Within this aim, this study aimed to investigate if a positive correlation exists between SES, demographic indicators and performance on ECD components. A secondary aim was also to compare the performance of this study's sample to the performance of American and Australian samples (provided by normative data from the measurement tools used in this study). The research questions that guided this study were as follows: (1) what relationship exists between SES, demographic factors and ECD components? (2) Do preschool children from the low-income setting of Soweto perform better than, worse than, or at par with children from high-income contexts? It was hypothesised that a higher SES (evidenced by access to more resources, services and amenities) is related to better performance and outcomes on ECD measures.

Chapter Two: Methods

The methods that were undertaken to conduct this study are outlined in this chapter. The study design and a brief discussion of the context of the study will be given followed by a discussion of the sample and sampling technique, the measurement tools employed, the procedure that was followed to collect the data, ethical considerations and how the statistical analyses were conducted.

2.1 Study Design

This study operated as a pilot study for a larger ongoing longitudinal study called the 'Surveillance Study of Movement Behaviours in Young Children' (SUNRISE). As the primary aim of this study was to investigate the relationship between socioeconomic indicators and ECD outcomes in a low-income setting (i.e. a relationship between two variables at one specific point in time), this study followed a quantitative methodology and was cross-sectional and correlational. It was also exploratory in nature as: (1) ECD has rarely been studied as three integrated components and; (2) this study contributed to emerging literature from low-income settings that investigate whether or not the well-established positive relationship between SES and ECD is maintained in the context of a Sowetan sample (Wagner, 2012). In this way, this study can also be considered descriptive as it assessed the SES and ECD relationship in a low-income setting in greater depth (Wagner, 2012). In the context of regression analysis, the socioeconomic and demographic variables were treated as independent variables and the ECD outcome variables were treated as dependent variables in order to establish how SES, age, sex and performance on ECD measures were correlated.

2.2 Context of Research

SOCIO-ECONOMIC STATUS AND DEVELOPMENT

The study took place in the township[1] area of Soweto in the south-west of Johannesburg, South Africa. Within Soweto, participants were sourced from four preschools in three areas in Soweto – Diepkloof, Orlando and Meadowlands. Diepkloof and Orlando are two areas in fairly close proximity to each other whereas Meadowlands is further south of Soweto. Soweto is part of the Johannesburg city that is semi-urban with residents living at different points of the poverty and wealth spectrum (Mbembe, Dlamini, & Khunou, 2005; The Human Sciences Research Council, 2014). In 2013, Soweto residents accounted for 26.18% of the total population of Johannesburg and had the highest percentage of community services outputs and transport outputs than any other region in Johannesburg (The Human Sciences Research Council, 2014). Despite these large outputs, over 20% of the Sowetan population are living below the national poverty line (Statistics South Africa, 2011; Statistics South Africa 2018). In 2011, 79.26% of Soweto's population identified themselves as black African, 10.43% as White, 5.34% as Coloured and 4.97% as Indian (Statistics South Africa, 2011). In 2011 just over 20% of people living in Soweto were classified as living in poverty (The Human Sciences Research Council, 2014). Furthermore, Soweto also had the highest amount of functional illiteracy than any other region in Johannesburg (The Human Sciences Research Council, 2014). In 2008, households in Soweto reported an average of four to five people living in each household (Mears, 2012).

As mentioned earlier, this study was not a stand-alone study operating as a pilot study for a larger ongoing longitudinal study called the 'Surveillance Study of Movement Behaviours in Young Children' (SUNRISE). The SUNRISE study aims to investigate whether four-year-old children from low, middle and high income countries are meeting the World Health

[1] An informal term, a 'township' is understood to be an underdeveloped living settlement that was allocated to non-White South Africans during the Apartheid era (Pernegger & Godehart, 2007).

Organisation's guidelines for physical activity and movement in the early years of life. In doing this, SUNRISE is also interested in determining whether this is linked to sex, age, socioeconomic status and urban or rural settlements. The study presented was a pilot study for SUNRISE as the same executive function and motor development measures were used. Data was collected by a research team consisting of three key members which were two main researchers who were responsible for the administration of measures, data collection and analysis and one local fieldworker. Prior to data collection, the three ECD outcome measures were tested on preschool children from the east Johannesburg area to determine any administration issues and general fit of the measures to children in the preschool age range. Overall it was observed that the measures required more informal translations and that the socio-emotional cognition measure took the longest to administer. More details on this process can be found in Appendix A.

2.3 Sample and Sampling Technique

The sampling technique used to source participants was non-random as the study specifically required four-year-old children (or as close to four as possible) from Soweto. Areas and preschools in Soweto were accessed based on convenience, specifically considering: (1) the spatial proximity to one another in Soweto; (2) and schools who had been involved in previous research studies, and therefore were easy to access and were more open to participation. Preschools were contacted by the co-supervisor for the project and a local fieldworker of the study. Recruitment of the schools and participants was largely based on having an effective gatekeeper (this study's gatekeeper was the local fieldworker) who could explain, in various indigenous languages, what the study entailed and how the preschools can be a part of the process. It was imperative that parents clearly understood what participation would entail and that their informed consent was necessary.

Fifty-eight eligible participants from four preschools in Soweto were identified for this study. Register lists of the children (with their dates of birth) were provided to the research team by the preschools in order to identify eligible children. Participants were identified as eligible if they turned four years old between January and August 2018, or if they turned five years old between August and December 2018. However, three-year-olds close to the four-year-old mark were also included where possible. Recruitment of the children began with recruiting their parents/guardians who were approached in two ways. Firstly, parents were contacted telephonically by the research assistant. Their child's age and eligibility was confirmed before they were invited to participate. Secondly, parents/guardians were invited to a parents' meeting held at the preschools, where the study was explained, and they were invited to participate in the study.

Information sheets explaining the study and consent forms for children to participate in the study were either signed at the parents' meeting or left with the preschool teachers to distribute to parents who were not able to attend the parents' meeting. A total of 40 preschool children, out of a possible 58, completed the assessments. Of this 40, the parents of 36 children returned the socioeconomic questionnaire. Thereby, a total sample of 36 children was used in the study, 21 (58.3%) of which were male and 15 (41.6%) were female. Twenty-eight participants were four years old (77.8%), four were three years old (11.1%) and four were five years old (11.1%) at the time of the study.

2.4 Measures

2.4.1 Executive function – Early Years Toolbox (EYT).

The Early Years Toolbox (EYT) is an iPad-based assessment that tests cognitive domains of working memory, inhibitory processes and cognitive switching which are three core aspects of

executive functioning (Howard & Melhuish, 2017). The EYT consists of six subtests (Appendix B) however only three were used for this study. The three subtests used each tested visuo-spatial working memory (VSWM; "Mr. Ant" game), inhibition ("Go/No-Go" game), and cognitive switching ("Rabbits and Boats" game) (Howard & Melhuish, 2017). These three were selected as they directly tap into the three core aspects of Miyake and Friedman's conceptualisation of executive function and are the most relevant tasks for this study (Miyake et al., 2000). The ability of the items to measure executive function was reported to be sufficiently high at Cronbach's alpha being within the ranges of 0.74 and 0.95 and sufficiently good validity against other measures (Howard & Melhuish, 2017).

The EYT was administered verbally and visually by means of embedded narration that explained the task to the child, accompanied by a test administrator to facilitate this process (Howard & Melhuish, 2017). The embedded narration is translated for four of the most relevant languages necessary for the sample used in this study (English, IsiXhosa, IsiZulu, Sesotho) (Statistics South Africa, 2011). The translated instructions were used in conjunction with the test administrator's additional translations of the test where needed.

Impulse Control ("Go/No-Go"): This subscale presents a series of fish and shark presented to the participant on the screen. A series of fish and sharks swim across the screen where the participant must tap the screen every time a fish swims across ("Go") and not tap the screen when a shark swims across the screen (inhibiting a learned response, "No-Go"). A point is awarded every time a correct tap is made and every time a correct restraint of tapping is made. This is coupled with auditory feedback with correct responses having a different sound to incorrect responses. Points are deducted when the participant taps the screen incorrectly or misses a correct tap. Participants are given instructions for both "Go" and "No-Go" scenarios

individually, five practice trials for each and combined instructions with 10 mixed practice trials. When the practice trials are complete, the actual game begins consisting of 75 stimuli which are divided into three sections – each section is separated by a brief break and repetition of the instructions. A participant's level of inhibition is determined by an impulse control score which is the percentage of "Go" accuracy multiplied by the percentage of "No-Go" accuracy. Higher scores indicate better performance and final impulse control scores can range from a minimum of 0 to a maximum of 1 (Howard & Melhuish, 2017).

Switch Accuracy ("Rabbits and Boats"): This captured a child's ability to cognitively switch between two rules correctly. This subscale presents the participant with red and blue rabbits and boats. The participant is assessed on whether they can match the given item by colour or by shape depending on what rule has been provided and whether the participant can successfully switch between these rules without the instructions being reiterated to them. Scores for this scale are calculated by summing the performance of two blocks – block one being the accuracy of correct sorting before the rule switch and block two being the accuracy of correct sorting after the rule switch. Each block consists of six trials which means that final switch accuracy scores can range from a minimum of zero to a maximum of 12, higher scores indicating better ability to switch between rules (Howard & Melhuish, 2017).

VSWM ("Mr. Ant"): This subscale assessed the child's ability to hold information in their memory for a short period of time and then be able to reproduce the information after a short delay. The presented information, in the form of coloured dots, would increase in number upon successive and correct responses. This would continue until the child produced successively incorrect responses. The outcome scores are calculated as follows: starting at level one, one point is allocated for each level in which two out of three trials are completed correctly

and thereafter one third of a point is allocated for all subsequent trials. These are then summed to form a point score. With eight levels, each level consisting of three trials per level, this adds up to a maximum possible score of 10.64, with better performance indicated by scores closer to 10.64 (Howard & Melhuish, 2017).

2.4.2 Motor development – Ages and Stages Questionnaire (3rd Edition).

The Ages and Stages Questionnaire – third edition (ASQ-3) is a moderately long measure of physical motor development (Squires & Bricker, 2009). The gross-motor and fine-motor subscales for the age period of 48 months were used in this study (Appendix C). This was deemed appropriate for all participants, even those who were three years old and five years old as the researcher implemented specific inclusion criteria for those participants turning three years old and five years old (see above discussion under Sampling). Inclusion criteria was designed so that any three years old and five year old children that were included in the study were close to four years old with a five month allowance before or after their fourth birthday. Each subscale consisted of six items. The gross motor and fine motor subscales required the child to carry out typical developmental activities and their performance thereof was assessed. The child was either scored 'Yes' (10 points), 'Sometimes' (five points) or 'Not Yet' (0 points) on each item (Squires & Bricker, 2009). Good psychometric properties have been reported for the measure and reliability is acceptable at 0.79 (Kerstjens et al., 2009; van Heerden et al., 2017). The ASQ-3 can be administered by the primary caregiver of the child or an observer and was completed by a member of this study's research team.

Fine Motor: This subscale assessed children's fine motor skills including tasks such as cutting on a straight line, drawing a complete person and colouring within lines. A total minimum score of 0 and maximum score of 60 is possible.

Gross Motor: This subscale assesses each child's gross motor skills such as catching a ball, balancing on one leg and climbing the rungs of a ladder. A total minimum of 0 and maximum score of 60 is possible.

2.4.3 Socio-emotional cognition – Pediatric Evaluation of Emotions, Relationships and Socialisation (PEERS).

The Pediatric Evaluation of Emotions, Relationships and Socialisation (PEERS) scale measures aspects of emotional and social development and consists of four domains: attention, social cognition, social communication and malingering (Beauchamp et al., 2016). These domains are assessed by 12 subtests in a digital game-based format, of which two were relevant for this study's age group – Matching Emo (emotion perception task) and Finding Emo (emotion recognition task) (Beauchamp et al., 2016). Instructions are given in written English and were translated for the participants and reiterated in spoken word as the participants could not yet read. These translations were developed by the research team and sent to more fluent indigenous language speakers for back translation. Once the research team had received the back translations, these were reconciled with the testing administration manual guidelines. These were then piloted before the data collection. As this measure is very new and still in its development stages, validity and reliability is yet to be established.

Emotion Perception: The subscale assessing emotion perception (called Matching Emo) assesses a child's ability to correctly match an emotive word to its corresponding face (e.g. match the word 'happy' to the face expressing a smile), which is understood as emotion perception (Beauchamp et al., 2016). The first practice level consisted of three trials (happy, sad and angry) with three faces for each trial. Thereafter, the real trials presented eight faces for each trial, with more complex emotions like embarrassed, bored and loving. In addition, each trial

allows for three attempts. There are 24 trials in this subscale which makes the maximum total error score 72.

Emotion Recognition: The subscale assessing emotion recognition (called Finding Emo) assesses a child's ability to correctly detect which emotion is the 'odd one out' out of 24 trials, which is understood as emotion recognition (Beauchamp et al., 2016). Each trial presents four faces expressing emotion – three of which express the same emotion, the fourth expressing a different emotion and therefore the 'odd one out'. The outcome scores included the number of correct items and number of errors. One point was allocated for each trial, and the maximum total score for this subscale is 24.

2.4.4 Socioeconomic indicators – SES Survey.

A socioeconomic survey was used which collected data about housing density, amenities and services, perceived safety and household assets within the house itself. The survey was adapted for this study from the enumeration survey used in the Healthy Lifestyle Trajectories Initiative (HeLTI)[2] study. The final item on the survey asks participants to respond to either 'yes' or 'no' as to whether they have a certain item in their house or not. The list was summed out of 13 to form a composite score which was used as an indicator of their socioeconomic status (see Appendix E). This is based on how previous studies have used similar data (Kagura et al., 2016).

Based on literature from previous studies that has been particularly interested in socioeconomic status and cognitive outcomes, number of people in the home (i.e. housing

[2] The HeLTI study is a longitudinal study interested in causes of obesity at pre-natal and post-natal stages and aims to implement interventions to rectify obesity prevalence in both high and middle-income countries (https://www.who.int/maternal_child_adolescent/news_events/news/helti-study-child-obesity/en/).

density) and parental education (both of which were included in the survey) were also of interest (Conger et al., 2010; Hackman & Farah, 2009; Rhoades et al., 2011; Sirin, 2005a). These are reported as percentages in the results section to contextualise the socioeconomic data.

2.4.5 Age information.

Age information was obtained by dates of birth provided by the preschools. These were entered into the EYT programmes before each subscale and thereby the ages of the participants were included in the spreadsheet of EYT scores. The dates of birth were then converted into age in years, age categories coded into nominal variables from one to four and age categories in years and months. Age categories in years and months appear in the following format: three years and six months to three years and 11 months (3:6 – 3:11); four years and 0 months to four years and five months (4:0 – 4:5); four years and six months to four years and 11 months (4:6 – 4:11); and five years and 0 months to five years and five months (5:0 – 5:5).

2.5 Procedure

As mentioned earlier, the research team[3] that was formed to conduct this study consisted of two researchers (CR and SJ) who administered the measures and a local fieldworker (KS) who assisted in translating the measurement instructions. The two researchers were Master's students who collected the data for their respective studies. The local fieldworker was a member of the larger SUNRISE study team and an active community member from Soweto. Prior to actual data collection, the measures and corresponding translations were piloted at two preschools in the west of Johannesburg. Both preschools were similar to the preschools from Soweto and children

[3] CR, SJ and KS denote initials of the people in the research team.

had similar demographics. This allowed the research team to learn that: (1) further translations were needed which were subsequently provided by the research assistant during the actual data collection; (2) the PEERS measure required more administration time than what was initially estimated; (3) the fine-motor items should be done before the gross-motor items as it was more difficult to get the children settled for the fine motor tasks after they had done the gross motor tasks; and (4) the EYT subtests should be administered from least challenging to most challenging which followed the following order: Go/No-Go, Mr Ant, Rabbits and Boats.

Researcher CR conducted the ASQ-3, while SJ conducted the EYT and PEERS which formed two testing 'stations'. A typical testing day would proceed as follows: the researchers and research assistant would arrive at the preschool in the morning at a convenient time stipulated by the principal and teachers. The testing stations would be set up while the children got settled. Children would then be sent to each station for the assessments to be done. Testing commenced with CR and SJ checking the birth date of the child and making sure that consent forms for the child were collected before the actual assessments began. This was followed by explaining what we were doing with the child and asking them if they would like to participate. Once the child gave their assent, the assessments commenced.

When a participant had completed testing at one station, they would move to the other station and participants were swapped in this manner until all participants had been tested on all assessments. Each testing station consisted of a small table and two chairs (one for the participant and one for the researcher). Both testing stations were located in close enough proximity of each other so that quick and seamless swapping of participants could take place. They were, however, not too close to each other to cause distraction. Each preschool was able to provide the research team with enough tables and chairs to conduct the above procedure. One of

the preschools managed to provide us with a separate, quiet room however testing at the other three preschools usually took place outside the classrooms in a sufficiently quiet, vacant space. In addition the research assistant was able to be present at both stations should her help in translating be required.

The station dealing with the ASQ-3 test consisted of the ASQ-3 testing materials which were: a pair of scissors, blank paper, paper printed with the relevant images, the standardised puzzle, pencils and coloured markers and a medium sized rubber ball (Appendix C). The station dealing with the EYT and PEERS consisted only of an iPad. Both ASQ-3 subscales took approximately 10 minutes to complete for each participant. The fine motor items were completed before the gross motor items. The EYT assessments took between 30 – 45 minutes for each participant and were conducted first in the following order: Go/No-Go, Mr Ant, Rabbits and Boats. The subtests were administered from least challenging to most challenging (based on what was learnt from piloting the measures) and in this way fatigue was minimised. Participants were given short breaks in between each EYT subtest while the test administrator prepared for the next subtest to be done (i.e. entering the administrative details such as date of birth, sex, test date, location). Thereafter each participant was given opportunity for a short break before beginning the PEERS. The Matching Emo assessment was conducted first and Finding Emo assessment was conducted last. The total data collection time was 22 days and took place from 06/08/2018 – 28/08/2018.

2.6 Ethical Considerations

Prior to any administration of the above discussed instruments, ethical approval was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical; Protocol Number: M180490; see Appendix E for full clearance certificate).

The children who participated were under the age of 18, therefore consent from their parents/caregivers was required. Information sheets and consent forms were distributed to the parents/caregivers through the preschools. These were sent home with the children and were collected each morning of data collection before testing took place. In addition to this, each child was asked for verbal assent before they participated in the study.

Information sheets and consent forms explained to the caregivers what participation would require of them and of their children, how their identities will be handled and what the research study entailed. They were informed that participation in the study is completely voluntary, there would be no direct benefits, disadvantages or remuneration for participating (or choosing not to participate) in the study. They were also made aware that their children could withdraw at any point of the research process without prejudice (Appendices G-J).

The administration of measures required face-to-face contact with the children as well as a large amount of their personal information. As the research was conducted at the preschools, the researchers had knowledge of the children's full names and dates of birth, the teachers and parents and at times came into contact with many of the parents. The researchers also had contact details and addresses of the children's caregivers in order to follow up on consent forms and socioeconomic surveys. Therefore, the researchers could not provide full anonymity to the participants. However, the researchers did make use of randomly allocated identity codes in place of names and stored all identifying information in password protected devices and locked

storage cupboards (with limited access) at the University of the Witwatersrand. The researchers provided feedback sheets to the caregivers of the participants containing general information on how the children performed overall on the assessment tasks.

2.7 Statistical Analyses

The data was analysed using SPSS 25th edition (IBM Corp, 2017) software as well as Microsoft Excel 2010. Descriptive statistics were used to summarise each variable by means of measures of central tendency, measures of dispersion, percentages and frequencies. Inferential statistics were used to assess the relationships between SES indicators and ECD performance by means of one sample t-tests, independent sample t-tests, Spearman's Rank Order correlations and linear regressions. Post-hoc power analyses were conducted on the linear regressions in order to determine sample size adequacy after the data was analysed using G*Power software (v 3.1.9.4) (Faul, Erdfelder, Lang, & Buchner, 2007).

The EYT and PEERS data were downloaded from storage clouds on which they were automatically saved after completion of each administration. The SES data were collected by physical questionnaires and manually entered onto a digital spreadsheet. EYT data were prepared and cleaned according to their stipulated guidelines. Other data preparation included creating age and sex categories and identifying any errors in the data.

The second step involved obtaining the variable data. All relevant variables for this study were then extracted from their individual spreadsheets and entered onto one 'master' spreadsheet. A final cleaning of this data was done before entering the spreadsheet into SPSS for analysis. Summaries of all variables were created by generating descriptive statistics including

the mean, median, mode, standard deviation, range, variance and skewness and kurtosis values. This then enabled choosing the appropriate statistical tests as well as checking assumptions.

Log transformations were applied to fine motor and gross motor scores where it was appropriate to correct their negative skewness (Field, 2009). Outliers were investigated however, under the guidelines of Field (2009) they were not removed. This is based on the argument that one should only remove an outlier if there is good reason to believe that outlying score comes from a participant that does not fit the target population (i.e. a score that is improbable of the target population) (Field, 2009). Thereby they were not removed as the outliers on the outcome measures did come from participants who were matched to the target population (Field, 2009). One sample t-tests were applied to investigate differences between the study sample's performance and the normative data. Independent samples t-tests were applied to investigate differences in performance between males and females. Assumptions that were tested can be found in Appendix M.

Thereafter, a Spearman's Rank Order correlation was applied to all the relevant variables in order to see which relationships, if any, existed between the dependent and independent variables (Field, 2009). As a sixth step, from guidelines stipulated by (Field, 2009), in order for linear regression to be an appropriate analytic technique, nine assumptions for each variable pair were assessed. These assumptions are identifying outliers; identifying is residuals are normally distributed; assessing if residuals are problematic; checking if independent variables have a variance of zero; multicollinearity; homoscedasticity; independence of errors; linearity and influential cases.

With the exception of linearity, influential cases and two outliers (one on the SES composite score and one on Matching Emo errors) the remainder of the above assumptions were met for the three variable pairs that were analysed with linear regression. For a full summary of each of the assumptions discussed for each variable pair, this can be found under Appendix J.

As a final step, based on whether there were any significant correlations, a series of linear regressions and a multivariate regression analysis were carried out in order to investigate how the variables were correlated (Field, 2009).

Chapter 3: Results

3.1 Independent Variables

3.1.1 Demographic and socioeconomic variables.

A full summary of demographic and SES variables can be found in Table 1 below. A final sample of 36 participants was used in this study. The demographic variables of interest were age and sex. As can be seen in Table 1, 77.8% of the participants were four years old (N = 28), specifically between four years six months and four years 11 months (4:6 – 4:11). Of the 36 participants, 58.3% were male (N = 21) and 41.7% were female (N = 15).

A maximum score of 13 on the SES survey could be achieved, with a higher score indicating better SES. Participants reported possessing an average of eight assets (e.g. motorcar, internet access, television; see Appendix D for full list of assets) in the home (M = 8.33, SD = 1.91). They also reported a minimum of four assets and a maximum of 13 assets. On average, participants had five to six people living in their homes (M = 5.81, SD = 3.39). Regarding the highest education level in the home, 26.4% of people living in the homes of the participants had completed postgraduate education, 52.9% had completed high school, 8.8% had completed primary school only and 11.7% reported ‘other’.

Table 1. *Summary Statistics of Demographic and Socioeconomic Variables.*

		N	Mean	SD	Minimum	Maximum	Percentage
Age Categories	3:6 - 3:11	4	-	-	-	-	11.1
	4:0 - 4:5	11	-	-	-	-	30.6
	4:6 - 4:11	17	-	-	-	-	47.2
	5:0 - 5:5	4	-	-	-	-	11.1
Age (years)	Overall	36	4	0.48	3	5	-
	3 years	4	-	-	-	-	11.1
	4 years	28	-	-	-	-	77.8
	5 years	4	-	-	-	-	11.1
Sex	Male	21	-	-	-	-	58.3
	Female	15	-	-	-	-	41.7
Housing Density	-	36	5.81	3.39	3	16	-
Highest Education Level	Overall	34	-	-	3	6	-
	Completed Primary School	3	-	-	-	-	8.8
	Completed High School	18	-	-	-	-	52.9
	Completed Postgraduate Education	9	-	-	-	-	26.5
	Other	4					11.8
SES	-	36	8.33	1.912	4	13	-

Notes.
Minimum and Maximum columns refer to reported minimum and maximum values by participants.
SES = Socioeconomic composite score.

3.2 Dependent Variables

3.2.1 Executive function.

Impulse Control (Go/No-Go): A summary of executive function variables can be found in Table 2 below. Participants displayed a mean performance of 0.62 where scores could range between a minimum of zero and maximum of one. Independent samples t-tests indicated no significant difference across sex (t (34) = 0.45, p = 0.657; d = 0.14). Though older age categories showed higher mean performance, only the difference between age groups 3:6 – 3:11 and 5:0 – 5:5 was statistically significant with a high effect size (t (6) = -3.146; p = 0.02; d = 2.23). The study's sample averages were higher than normative averages for two age categories, specifically for the pre-schoolers in the 4:6 – 4: 11 and 5:0 – 5:5 categories (see Figure 1 below). A one sample t-test confirmed that the Impulse Control mean for this study's sample is significantly different from the participants used in the normative data (t (34) = 3.24, p = 0.048, d = 0.54; see Figure 1 below) for the 5:0 – 5:5 age group, with the sample group (M = 0.77; SD = 0.07) performing significantly better compared to the norm group (M = 0.65; SD = 0.21).

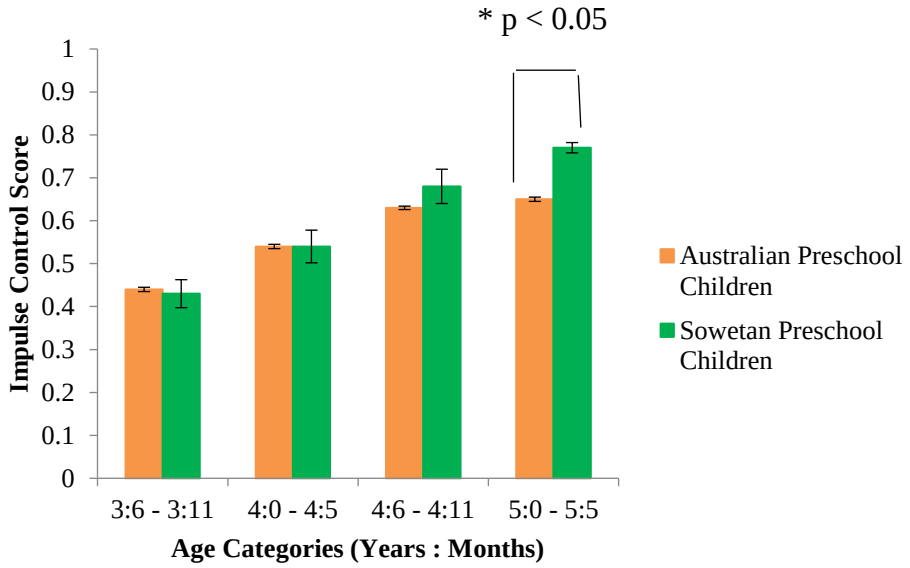


Figure 1. Impulse Control Mean Scores Across Age Categories. Scores as measured by the EYT for the Sowetan sample shown by green bars and scores for the Australian sample shown by orange bars. The Sowetan sample in the 5:0 – 5:5 age group performed better than the Australian sample in the same age group ($p = 0.048$).

VSWM (Mr. Ant): Mean performance of this study's sample on VSWM is shown to be 1.92 where observed scores ranged between 0.33 and 3.00. Independent samples t-test indicates no significant difference across sex (t (34) = 1.37, p = 0.180; d = 0.47). The mean performance scores increased as age increased however independent samples t-tests showed that there were no significant differences between age groups (all p values > 0.08). Interestingly, the sample average scores exceeded that of the normative average scores across all age categories however no significant difference was found between this study's sample and the normative sample (all p values > 0.27).

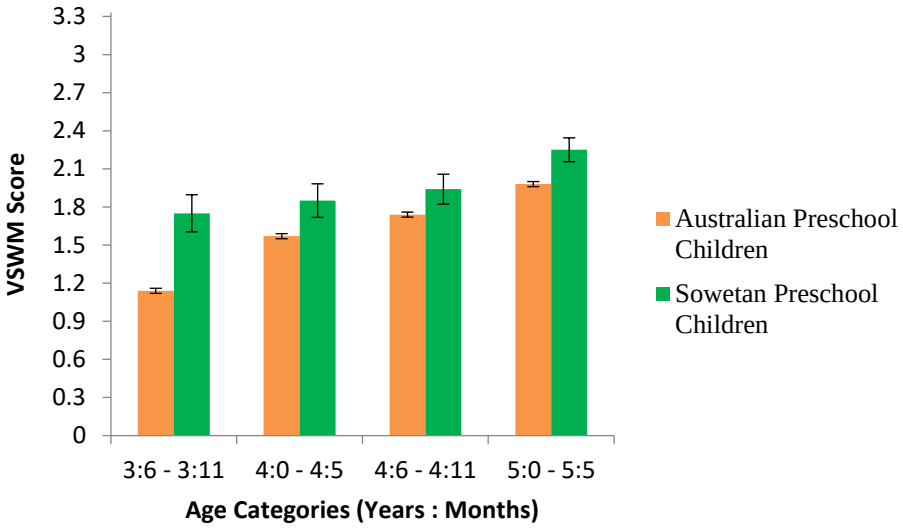


Figure 2. Visuo-Spatial Working Memory mean scores across age categories. Sowetan sample is indicated by green bars and Australian sample indicated by orange bars. No significant differences were found across age (all *p* values > 0.08) or between the sample and norm groups (all *p* values > 0.27).

Switch Accuracy (Rabbits and Boats): The average performance on this task was shown to be at 4.81, with scores able to range from 0 to 12 (see Table 2 below). With exception of the four-year-old age categories (4:0 – 4:5 and 4:6 – 4:11) average scores were higher at older age categories. Between age categories, age group 5:0 – 5:5 showed significantly higher performance than age group 4:6 – 4:11 with a high effect size (t (19) = -2.365, p = 0.029; d = 1.69). With the exception of the 4:6 – 4:11 category, the mean performance of participants in the other age categories exceeded that of norm average scores. For the five-year-old age category, the results of the one sample t-test indicated a strong significant difference between groups (t (34) = 12.84, p = 0.001, d = 2.14), with the sample group performing significantly better (M = 8.75; SD = 0.5) compared to the normative group (see Figure 2 below). Independent samples t-

test confirmed no significant difference across sex (t (34) = 0.42, p = 0.678; d = 0.14).

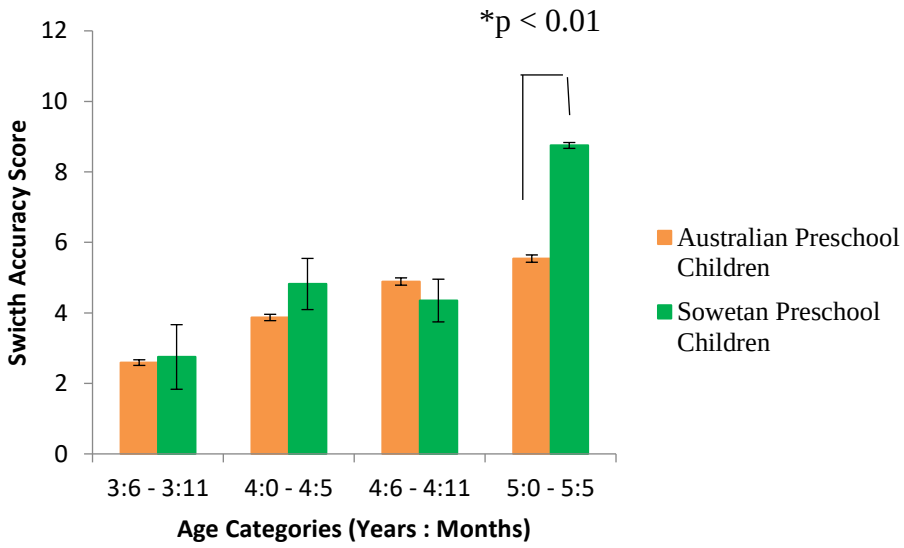


Figure 3. Switch Accuracy Mean Scores Across Age Categories. Scores as measured by the EYT for the Sowetan sample shown by green bars and for the Australian sample shown by orange bars (p = 0.001).

Table 2. *Descriptive Statistics for Executive Function Components as measured by EYT.*

				Minimum		Maximum	
Domain	Measure	Mean	SD	Possible	Achieved	Possible	Achieved
Impulse Control	Go/No-Go	0.62	0.23	0	0.13	1	0.95
Switch Accuracy	Rabbits & Boats	4.81	4.05	0	0	12	11
VSWM	Mr. Ant	1.92	0.72	0	0.33	10.64	3

Notes.
N = 36
VSWM = Visuo-Spatial Working Memory.

3.2.2 Motor development.

Fine Motor: A full summary of descriptive statistics for motor skills can be found in Table 3 below. With a maximum possible score of 60 on this task, the mean performance shown by the sample was at 52.64 (*SD* = 9.06). Mean performance was highest for the 4:6 – 4:11 age group, however decreased for the 5:0 – 5:5 age group. The mean performance of male participants (*M* = 51.43, *SD* = 11.31) compared to the mean performance of female participants (*M* = 55.3, *SD* = 4.17) was not statistically significant (*t* (34) = 0.251; *p* = 0.804; *d* = 0.34). There were no significant differences between age groups (all *p* values > 0.33). There was a statistical significance found on performance on fine motor skills with the study's sample (*M* = 52.64, *SD* = 9.06) performing significantly higher compared to the normative population with a moderate effect size (*M* = 49; *SD* = 11) (*t* (35) = 2.41, *p* = 0.021, *d* = 0.40).

Gross Motor: A maximum score of 60 was also possible on this task. Average performance is shown at 55.28 (*SD* = 7.923; see Table 3 below). Performance differences across age groups were not statistically significant (all *p* values > 0.46). The average performance for female participants (*M* = 55, *SD* = 7.07) is a lower value than that of male participants (*M* = 55.48, *SD* = 8.65), however differences across sex were shown to be non-significant (*t* (34) = -0.617, *p* = 0.541; *d* = 0.08). There was no significant difference between the mean performance of this study's participants (*M* = 55.28; *SD* = 7.92) and the U.S normative data on gross motor skills were significantly lower than that of the normative data (*M* = 55; *SD* = 7) (*t* (35) = 0.21 , *p* = 0.835, *d* = 0.035).

Table 3. *Summary Statistics for Motor Development as measured by ASQ-3.*

					Minimum		Maximum	
Domain	Measure	Age Category	Mean	SD	Possible	Achieved	Possible	Achieved
Gross Motor	Total GM	Overall	55.28	7.92	0	25	0	60
		3:6 - 3:11	57.5	5	0	50	0	60
		4:0 - 4:5	52.27	11.91	0	25	0	60
		4:6 - 4:11	56.18	5.5	0	45	0	60
		5:0 - 5:5	57.5	5	0	50	0	60
Fine Motor	Total FM	Overall	52.64	9.06	0	10	0	60
		3:6 - 3:11	50	9.13	0	40	0	60
		4:0 - 4:5	50	14	0	10	0	60
		4:6 - 4:11	55	4.7	0	40	0	60
		5:0 - 5:5	52.5	6.5	0	45	0	60

N = 36.
Total GM = Total Gross Motor Score.
Total FM = Total Fine Motor Score.

3.2.3 Socio-emotional cognition.

Emotion Recognition: A possible maximum score of 24 could be achieved on this task. Participants scored a maximum of 15 correct scores and a minimum of one. Participants made a maximum of 23 errors and a minimum of nine. The sample showed 35.4% of average correct scores (M = 8.50, SD = 3.317). The age group 5:0 – 5:5 showed the least amount of errors and the highest amount of correct responses compared to the younger age groups, however t-tests showed the differences across age groups to be not significant (all p values > 0.1). The mean errors of this study's sample on correctly finding 'odd' emotions are significantly higher than that of the normative data with a high effect size (t (35) = 5.60, p = 0.00, d = 0.93; see Figure 9

below), with the sample performing worse (*M* = 15.5; *SD* = 3.31) on emotion perception compared to the normative population (*M* = 15.5; *SD* = 3.48). There were shown to be no significant difference in performance between males and females (*t* (34) = -0.15, *p* = 0.88; *d* = 0.05).

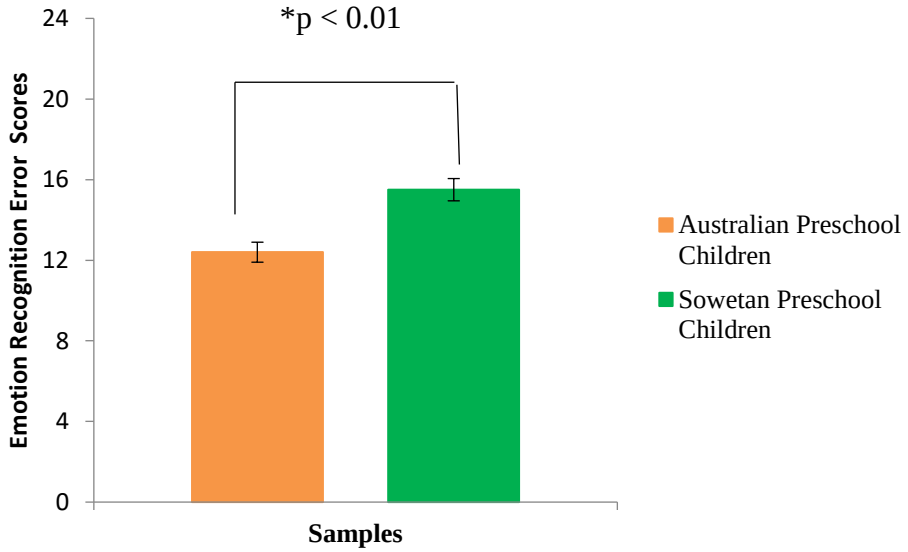


Figure 4. Emotion Recognition Error Scores. Mean error scores are reflected as measured by the PEERS for the Sowetan sample shown by the green bar and the Australian sample shown by the orange bar (p = 0.00).

Emotion Perception: A possible maximum score of 72 could be achieved on this task. Participants scored a maximum of 20 correct scores and 53 errors. Participants also showed 12.7% of correct responses, on average (M = 33.64, SD = 9.12). The 5:0 – 5:5 age group showed the least amount of errors and the most amount of correct responses compared to the younger age groups, however t-tests showed differences across age groups to be not significant (all p values > 0.11). The mean errors on emotion perception for this study's sample were significantly higher than that of the normative data with a high effect size (t (35) =13.1, p = 0.00, d = 2.18; see Figure 7 below), with the study sample showing poorer performance (M = 33.64; SD = 9.13) on the emotion recognition task compared to the norm (M = 13.77; SD = 9.37). Differences across sex were not significant (t (34) =0.6, p = 0.552; d = 0.21).

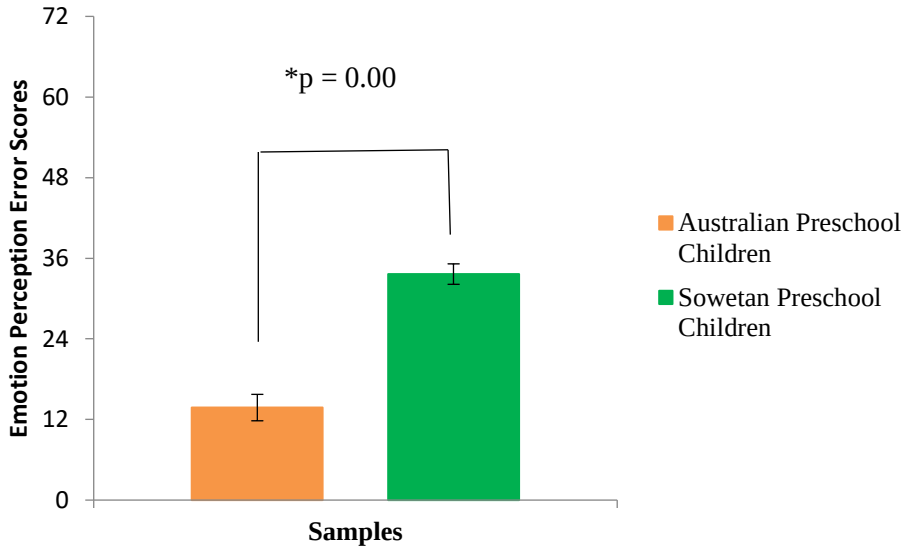


Figure 5. Emotion Perception Error Scores. Mean error scores are reflected as measured by the PEERS for the Sowetan sample shown by the green bar and the Australian sample shown by the orange bar (p = 0.00).

3.3 Correlations and Regression Model

The results of the correlational analyses are shown in Table 4. Age had a weak positive correlation with the Switch Accuracy score (r_s = 0.367, p = 0.028) which indicated that as age increased, performance on Switch Accuracy improved. The socioeconomic composite score has a weak negative correlation with the VSWM score (r_s = -0.342, p = 0.041), indicating that as SES increased (i.e. more access to resources, services, assets) VSWM ability decreased (i.e. ability to maintain and process information worsened) and vice versa. SES had a weak negative correlation with Matching Emo error scores (r_s =-0.334, p = 0.046) showing that as SES increased, errors on the ability to match emotions decreased (and vice versa, i.e. pre-schoolers performed better on emotion recognition). In order to determine whether age and socioeconomic indicator could predict scores on the dependent variables, linear regressions were applied to each correlation pair.

Table 4. *Spearman's Correlations for Demographic, Socioeconomic and ECD Variables.*

		M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age	4	0.478																
2	Sex Categories	0.42	0.5	0															
3	SES total	8.33	1.912	-0.12	0.083														
4	People in home	5.72	3.494	-0.15	0.041	0.177													
5	Total Gross Motor	55.28	7.923	0	-0.1	-0.19	0.099												
6	Total Fine Motor	52.64	9.062	0.037	0.038	0.058	-0.01	0.29											
7	Impulse Control	0.62	0.236	0.304	-0.01	-0.09	0.09	-0.05	.363*										
8	Switch Accuracy	4.81	4.055	**.367***	-0.11	0.052	-0.13	0.054	0.219	0.138									
9	VSWM	1.92	0.722	0.13	-0.27	**-.342***	0.135	.379*	.339*	0.29	.338*								
10	Emotion Recognition (correct)	8.5	3.317	0.279	0.041	0.119	0.029	-0.07	0.141	0.115	0.011	0.162							
11	Emotion Perception (correct2)	9.19	3.861	0.097	-0.07	0.268	0.153	-0.08	0.084	0.136	-0.09	-0.07	.520**						
12	Emotion Perception (errors2)	33.64	9.128	-0.17	-0.04	**-.334***	-0.14	0.084	-0.1	-0.13	0.176	0.103	-.607**	-.920**					
13	Emotion Perception (error1)	0.11	0.398	0	0.158	-0.14	-0.05	0.022	0.294	.356*	-0.24	-0.14	-.373*	-0.08	0.062				
14	Emotion Recognition (errors)	15.5	3.317	-0.28	-0.04	-0.12	-0.03	0.067	-0.14	-0.12	-0.01	-0.16	1.000**	-.520**	.607**	.373*			
15	Total Gross Motor (log)	0.41	0.54	0	0.102	0.194	-0.1	1.000**	-0.29	0.054	-0.05	-.379*	0.067	0.078	-0.08	-0.02	-0.07		
16	Total Fine Motor (log)	0.726	0.448	-0.04	-0.04	-0.06	0.013	-0.29	1.000**	-.363*	-0.22	-.339*	-0.14	-0.08	0.1	-0.29	0.141	0.29	

Notes. N = 36
*p <.05
**p <.01
VSWM = Visuo-Spatial Working Memory
Correct2 = Correct scores on Trial 2
Errors2 = Errors on Trial 2
Errors1 = Errors on Trial 1
(log) = Log Transformation

3.3.1 Age and switch accuracy.

Age was shown to account for 12% of the variance in Switch Accuracy scores ($R^2 = 0.12$; $f^2 = 0.14$) (see Table 5), indicating that 88% of the variance in Switch Accuracy is explained by factors other than age, with a small effect size. The F-statistic (F (1, 35) = 4.86, $p = 0.034$) is significant at the 5% level of significance and is greater than one. This indicates that the regression model yields a significantly better prediction of Switch Accuracy performance than the mean of Switch Accuracy. The B value indicates the gradient of the regression line and shows that if age increases by a unit of one (in this case, one unit is equivalent to one year) the model predicts that Switch Accuracy will increase by three. The t-statistic for the β value is significant (t (1, 34) = 2.20, $p = 0.034$) indicating that the β value is significantly different from 0 however it is not significant for B. Therefore it cannot be concluded that age makes a significant contribution to predicting performance on Switch Accuracy.

3.3.2 SES and VSWM.

SES accounts for 15% of the variance in VSWM scores ($R^2 = 0.15$, $f^2 = 0.17$), indicating that 85% of the variance in VSWM is explained by factors other than SES, with a medium effect size (Cohen, 1988; Cohen, Cohen, West, & Aiken, 2003). The F-statistic (F (1, 35) = 5.80, $p = 0.022$) indicates a significant relationship at the 5% level of significance and is greater than one. This indicates that the regression model yields a significantly better prediction of VSWM than the VSWM mean. The B value indicates the gradient of the regression line, showing that if SES increases by a unit of 1, VSWM decreases by a value of 0.14. The t-statistic is significant (t (1, 35) = 2.20, p = 0.022) indicating that the b values are significantly different from 0 and it can concluded that SES makes a significant contribution to prediction performance on VSWM. See Table 5 for a full summary.

3.3.3 SES and emotion perception.

SES has been shown to account for 7% of the variance in error scores on the emotion perception task ($R^2 = 0.07$). Therefore 93% of the variance in ability to match emotion is explained by factors other than SES. The F-statistic (F (1, 35) = 2.59, $p = 0.117$) is shown to be not significant at the 5% level of significance. Therefore, the regression model does not yield a significantly better prediction of emotion perception than the emotion perception mean. The t-statistic is not significant (t (1, 35) = -1.61, $p = 0.117$). The B value indicates that if SES increases by a unit of one, errors in emotion perception decrease by a value of 1.271, however this was not significant. It can be concluded that SES does not make a significant contribution to predicting performance on emotion perception.

Table 5. *Summary Statistics of Linear Regression Coefficients*.

Dependent Variables	Independent Variables	B	β	*t*	*p*	R^2	R	F	Power (1 –β err prob)
Switch Accuracy	Age	3	0.35	2.20	0.034	0.12	0.35	4.86	0.57
VSWM	SES	-0.14	-0.38	-2.41	0.022	0.15	0.38	5.80	0.68
Emotion Perception	SES	-1.27	-0.27	-1.61	0.117	0.07	0.27	2.59	0.35

Table 6. *Summary Statistics of Multivariate Regression Coefficients*.

Independent Variables	Dependent Variables	R^2	F	*p*
Age and SES	Switch Accuracy	0.1	2.94	0.07

VSWM	0.1	3.08	0.06
Emotion Perception	0.06	2.03	0.15

Chapter 4: Discussion

This study investigated the relationships between SES, demographic indicators and performance on ECD measures. The primary focus of this study was to determine the nature of the relationship that exists between these variables. The hypothesis that was investigated was whether advantageous demographic indicators and higher SES are positively correlated with better performance on ECD measures. The secondary focus of this study was to compare the performance of this study's participants to the measurement norms based on Australian and American samples.

Four key results were found. The better the SES was, the fewer errors were made on emotion recognition. Contrastingly, the better the SES was, the worse the VSWM ability was. The regression analysis showed that SES was found to contribute significantly as a predictor of VSWM ability. In considering context, five-year-old participants of this study showed better performance on ability to control impulses and cognitive flexibility than the five-year-old Australian norm and better fine motor performance than the American norm. However, this study's participants made more errors than the Australian norm on emotion recognition and emotion perception. Lastly, significantly higher scores were found across age groups between the three-year-old age category and the five-year-old age category on the ability to control impulses. Significantly higher scores were also found between the four-year-old and five-year-old age groups on cognitive flexibility. This confirms well-established trends of development improving with increasing age however these results contribute to literature that challenge the prevailing literature's advocacy for a positive relationship between SES and development. These results are discussed in detail in this chapter.

4.1 Executive Function, VSWM and SES

Contrary to the hypothesised relationship, SES showed a negative correlation to the VSWM component of executive function. Furthermore, SES was shown to account for 15% of the variance in VSWM and a significant predictor of VSWM. Although the well-established positive SES-executive function relationship is based on research from high-income countries, some studies in low- and middle-income countries challenge this relationship (see Chow et al., 2001; Gonen et al., 2019; Victora et al., 1990). For South African samples particularly, there is a dearth of literature that specifically investigates the SES-executive function relationship. However, a recent study indicates that South African children from both urban and rural settlements performed either at par or better on all executive function tasks compared to Australian norms (Cook et al., 2019). The negative relationship between SES and VSWM then may be further investigated and explained by protective/promotive and risk factors that are context-specific (Gonen et al., 2019).

Resiliency studies of South African children emphasise the home and learning environments and the relationships with community members within those environments (Dass-Brailsford, 2005). The key 'ingredient' to thriving in socio-economically challenged environments is argued to be stronger and more cohesive community networks that buffer the negative effects of the environment (Dass-Brailsford, 2005; Gonen et al., 2019). In addition, Rybanska and colleagues (2018) reported that children who are exposed to ritualised practices (i.e. firm social behaviours that must be strictly adhered to) perform better on executive functions. These networks and exposure to strict social conventions may be the missing 'ingredient' in higher-income living settlements and this could be a possible explanation as to why a better SES is related to worse VSWM ability.

The demands of low-income learning and living environments may be another factor that contributes to the Sowetan sample showing better performance. A study by Bartie and colleagues (2016) investigated the play activities and behaviour of South African children from a rural and low-income setting. The study identified that children from this setting are challenged with environmental and resource limitations that may not be prevalent in more urbanised and high-income contexts (Bartie et al., 2016). One such observation was that of safety issues and outdoor play. The authors observed that children did not have ample indoor space to play and engage in social behaviour with their peers which forces them to move outside their homes and schools and into the streets, which is an obvious safety hazard. However, they explain that the children were able to problem-solve and enforce their own unique safety precautions in dangerous situations. For example, children would automatically stop their play when they sensed danger, move their play activities to a less dangerous environment and help one another to move out of the dangerous area so that no-one is left behind (Bartie et al., 2016). These can be considered problem-solving skills that children may not have if they do not experience the same challenges as children in rural low-income settings.

4.2 Fine Motor Skills Across Participant Groups

The Sowetan sample showed significantly higher performance on fine motor skills compared to the normative data based on an American sample (van Heerden et al., 2017). This result is also contrary to the positive correlation between SES and ECD advocated for in the literature. The study by Bartie et al. (2016) may explain this finding through their observations on South African children from a rural low-income area in South Africa. The study documented the unique ways that South African children play and navigate their social environment in the context of low-income, very little urbanisation and limited resources (Bartie et al., 2016). Bartie

and colleagues (2016) discuss two interesting findings that emerged from their studies. The first is that they observed that children in this setting were afforded a great deal of time to engage in play, particularly outdoor play. This may be due to the lack of space inside rural school structures. The second is that, due to this lack of space and resources, South African children from the rural setting had to find new and unique ways to play and engage with their peers (Bartie et al., 2016). Due to the limitations on play objects, toys and other resources in rural and low-income settings, children have had to become more creative with their play behaviours and activities and thereby this may enhance their dexterous abilities and may offer a fine motor advantage.

4.3 Socio-emotional Cognition and SES

The relationship between SES and emotion recognition ability in this study showed that children with higher SES made fewer mistakes on the emotion recognition tasks. An early study on emotion recognition and 'sociometric' status indicated that children from higher sociometric contexts were better able to recognise emotions from facial expressions than those from lower sociometric contexts (Edwards et al., 1984). Other studies have also identified a link between higher SES and better ability to recognise emotions however these are particularly outdated (Elfenbein & Ambady, 2002). Some studies have also identified the importance of the environment in early childhood years for emotion processing, however this is mainly done in the context of children who have been exposed to abuse and violence (Pollak & Sinha, 2002). Though children who had a higher SES showed better performance on emotion recognition, the regression analysis showed that SES did not make a significant contribution to predicting performance on emotion recognition. In contrast, results from the one sample t-tests showed that children from this study's sample performed significantly worse on both emotion recognition and

emotion perception compared to the Australian norms, and the mean scores for both tasks were particularly low in comparison to the possible maximum scores that could be achieved on these tasks.

These results bring into the question the Universality Thesis (Crivelli, Jarillo, Russell, & Fernández-Dols, 2016). The Universality Thesis asserts that certain emotions are universally recognisable by people across various cultures and contexts (Crivelli et al., 2016). Research on different cultural groups, including the results presented in this thesis, call the Universality Thesis into question (see Crivelli et al., 2016; Gendron, Roberson, van der Vyver, & Feldman Barrett, 2014; Schimmack, 1996). In a study comparing emotion recognition of two indigenous societies from Papua New Guinea and Mozambique with Spanish participants as controls, Crivelli and colleagues (2016) reported that the two indigenous societies correctly matched emotive words to emotive faces in only half of the trials. This was in contrast to the Spanish controls who achieved correct matching in almost 100% of the presented trials (Crivelli et al., 2016). Another study by Gendron et al. (2014) echo these results by comparing American participants and Namibian people from the Himba ethnic group. American participants were better able to sort images of facial expressions into their corresponding emotion group than the Namibian participants (Gendron et al., 2014).

These trends may be explained by considering the lack of cultural sensitivity of the assessment measure. Shimmack (1996) reports a study comparing emotion recognition between Caucasian and non-Caucasian participants. The results of his study indicated that Caucasian participants were better able to recognise emotions, however, only as a result of the culturally-biased assessment material used. The PEERS measurement tool which was used to assess emotion recognition and emotion perception is still a new and developing tool and has been

based only on a sample of Australian children thus far. The facial emotion content of the games in the tool were specific to the Australian context and South African children from Soweto found the facial content challenging to relate to.

4.3 Study Data versus Normative Data

Based on the vast majority of literature that emphasises higher SES being related to higher cognitive performance, the performance of this study's sample is contrary to the prevailing SES literature. As the normative data for the EYT, ASQ and PEERS have been developed based on performance of participants from high-income countries (EYT and PEERS based on Australian children; ASQ based on American children), it was expected that the Sowetan participants would not perform as well as the Australian and American norms. Interestingly, the study's participants performed better on Impulse Control and Switch Accuracy, but only in the five-year-old age category (five years and 0 months to five years and five months). This could possibly be explained by the links between gross motor skills and executive function. A recent study reports that motor skills are significantly positively related to inhibition (which was measured here by Impulse Control) and working memory however they did not find the same relation with attentional shifting (measured here by Switch Accuracy) (Cook et al., 2019). As has been mentioned previously, South African children show significantly high levels of physical activity (Cook et al., 2019; Draper et al., 2017). A study by Rosey, Keller and Gollomer (2010) on preschool children from the USA illustrated a correlation between inhibition (or impulse control) and co-ordination of motor skills. Another study by Palmer, Miller and Robinson (2013) also reported that American preschool children displayed better ability to sustain attention after exercise.

Therefore, a possible reason why this study's participants outperformed the normative data participants on these two executive function components could be due to the heightened gross motor proficiency of South African children (Tomaz et al., 2019). Diamond and Lee (2011) identified four key factors that are instrumental to success and central to executive function. They are "creativity, flexibility, control and discipline" (Diamond & Lee 2011: 959). Aerobic exercise and engagement in sports have been documented to enhance executive functions and functioning of prefrontal cortex activities (see Hillman, Erickson & Kramer, 2008 and Weinstein et al., 2012). Taking into account heightened physical activity of South African children (Cook et al., 2019; Draper et al., 2017) and the unique problem-solving skills of South African children from low-income settings in play activity (Bartie et al., 2016), these may provide explanations for why Sowetan pre-schoolers displayed better executive function ability than the Australian sample.

Participants of this study had significantly more errors on both emotion recognition and emotion perception compared to the normative data with high effect sizes (Cohen et al., 2003; Field, 2009). This may be explained by own-race bias. Administration of the socio-emotional cognition measure allowed a key contextual limitation to surface. It was observed that the children were not familiar with many of the faces being presented to them and tended to bias their responses towards the faces that depicted a racially 'black' person. In the context of Soweto where approximately 79% of people identify as black African, this is not unexpected. A study done on preschool-aged children showed that ease of recognisability of one's own race is not only an adult phenomenon but can also be observed amongst young children (Pezdek, Blandon-Gitlin, & Moore, 2003). Similar trends of own-race bias have been found in South African adult

samples and thereby further inquiry into South African child samples could be beneficial (Chiroro, Tredoux, Radaelli, & Meissner, 2008).

4.4 Improvement across Age Groups

The inhibition and switch accuracy components of executive function were significantly higher across age groups. For inhibition, the five-year-old age group performed significantly better than the three-year-old age group, specifically between three years and six months and three years and 11 months. For switch accuracy, the five-year-old group performed significantly better than the four-year-old age group, specifically between four years and 0 months and four years and six months. These findings extend the findings of previous studies by adding nuances in months. However the findings also contribute to a mixture of findings where specific age periods are concerned. During the first five years of life, the specific age at which inhibition ability peaks was suggested at two to three years old (Garon et al., 2008). The significantly higher performance on switch accuracy in this study was found in a previous study where better performance was shown in the same age range, however further research into the specific age (in years and months) during the preschool period is needed to confirm this trend (Epsy, 1997).

Possible explanations for the different findings discussed above are two-fold. The significantly different performance between the three-year-old and five-year-old age groups on inhibition may be explained by heightened improvement in complex inhibition ability after three years old. Studies have found that impulse control ability exponentially increases after the three-year mark. A reason for this could be due to the improved ability to process and follow abstract rules after the age of four years old (Zelazo & Frye, 1998; Zelazo, Reznick, & Spinazzola, 1998).

Secondly, the significant improvement between the four-year-old and five-year-old age groups on switch accuracy could be a result of the development of the anterior attention system between three years old and five years old (Akshoomoff, 2002; Colombo, 2001; Corkum, Byrne, & Ellsworth, 1995; Garon et al., 2008; Johnson, Posner, & Rothbart, 1994; Mahone, Pillion, & Hiemenz, 2001). Because switching is dependent on successfully shifting attention, which is highly affected by external environmental factors in the younger ages, the development of focused and sustained attention directly has bearing on the ability to switch between tasks (Colombo, 2001; Johnson et al., 1994). This would explain the significant improvement between four years old and five years old.

4.5 Strengths of the Study

This study has made two key contributions to the literature on ECD and factors that influence it. Firstly, having focussed on in-house indicators of SES, this has added an additional layer to the already existing and valuable literature on the importance of environmental factors on ECD. By adding this additional layer, it may help to complete the picture of how development is shaped by an individual's environment and opens new avenues for future research. Secondly, the literature review discussed how some studies have challenged the prevailing understanding of SES and ECD being positively correlated. In a similar way, this study has contributed to the shift in understanding how SES and ECD are correlated, particularly in low- and middle-income contexts such as Soweto. Having conducted this study on a Sowetan sample from South Africa, this contributes variation to the existing literature and hopefully sparks increased interest in assessing ECD components in similar contexts.

The use of ECD-specific measurements was also a particular strength of this study, considering the lack of validated and age-specific measurement tools, particularly for executive

function in the preschool years (Anderson & Reidy, 2012) and the challenge of maintaining construct validity when adapting adult assessment tools for children (Garon et al., 2008). Two of the measures used in this study were relatively new measures (EYT and PEERS) and therefore piloting them in this study was beneficial in two key ways. Use of these measures ensured that age-appropriate measures were employed. This is valuable as Anderson and Reidy (2012) and Garon and colleagues (2008) have identified the lack of age-appropriate measures for the preschool years. Second, it allows for feedback to the teams who are developing these measures, particularly the PEERS. This feedback also benefits other researchers who may want to use the measures for future studies. Though the PEERS tool is still being developed, the EYT and ASQ-3 worked particularly well in the context of the study. The game-like format of the EYT was a particular strength in piquing the children's interest and encouraging their engagement with the tool.

The translations generated by the research team were also highly valuable in making the measurement tools effective. Having additional translations to the measurement programmes and a fluent indigenous language speaker (local fieldworker) at hand ensured that participants always understood the test instructions completely. This also allowed the administrations to be completed seamlessly as the research assistant was able to explain the instructions immediately. These translations were absolutely vital to the study as the bulk of the Sowetan population are indigenous language speakers (Statistics South Africa, 2011).

4.6 Limitations of the Study

A key limitation of this study was the sample size. Although the final sample of 36 satisfies the Central Limit Theorem (Field, 2009) an initial target sample of 50 total participants was established. However due to time and geographical constraints and the actual administration

time that each measurement took to be completed, only the data from 36 participants was able to be used. Due to the sample size being so small, the chances of not detecting a significant result when there is one (i.e. a Type II error) is increased (Field, 2009). According to guidelines by (Field, 2009), a minimum sample of 60 is enough when one is dealing with six predictors or less. Additionally, it is suggested that for three predictors, a sample of 40 is required in order to obtain a large effect size (Field, 2009).According to Cohen's (1988) conventions, effect size for the negative relationship between SES and socio-emotional cognition was small. A post-hoc power analysis on this relationship, at the 5% level of significance, showed power $(1 - \beta)$ of 0.36 which indicates that the study was underpowered (Faul et al., 2007).

As this study operated as a pilot study for SUNRISE, the SUNRISE team provided this study's research team with the testing iPad. This iPad was the main hardware used to administer the tests as both EYT and PEERS are completely iPad based. This iPad needed to be sent to another research team in September of 2018 which allowed one month for testing to be completed in Soweto. In addition to this, the EYT and PEERS took the longest time to be completed. Though the extra translations provided by the research team worked well, the translated instructions provided by the EYT were often too formal in language and difficult for the children to understand. This required the researchers and research assistant to reiterate the translations in simpler language that was easier to understand, adding extra time to each administration.

A similar limitation occurred with the PEERS. Unlike the YET, the PEERS is not narrated to the participant and the researchers and local fieldworker were required to explain the instructions to the participant for each trial on both subscales that were used. Due to these limitations, an extra 30 minutes (on average) was added to each administration which was

fatiguing to both the researchers and participants. Fatigue was managed by taking short breaks between each measurement (which contributed to the extra time) and structuring the administrations when children were energised and focussed – for example, in the mornings after breakfast, just before lunchtime and just before sleeping time. A recommendation for future use of these measures would be to administer one per day and allow a longer overall duration for data collection.

In addition to the above limitations, the way SES was operationalised must be addressed. The SES score used in the analyses is comprised of either the presence or absence of 13 assets (Appendix E). Previous literature has conceptualised the indication of SES differently, using parental education and income as key indicators (Conger et al., 2010; Rhoades et al., 2011; Walker et al., 2011). Farah (2017) has argued for the consideration of material resources in conjunction with non-material resources, educational level, occupation and area of living as constituting some understanding of an individual's SES. There is also argument for certain SES indicators being more encompassing and representative of SES such as wealth and income (Duncan, Daly, McDonough & Williams, 2002). This could have been a reason why SES was not found to be a significant predictor of emotion perception and future research could further investigate SES indicators in order to understand which indicators are more representative of SES than others. In this study, other socioeconomic indicators (such as highest level of education in the home and number of people in the home) were not significantly correlated with the overall SES composite score or any of the ECD outcome scores. However, literature such as those by Farah (2017) and Duncan et al. (2002) indicate that these other indicators can have an effect on the overall score. These such indicators were not significantly correlated with the SES composite

score or any of the outcome variables, however future studies can consider this and use this to build on further research.

The cultural and contextual barriers that surfaced in administration of the PEERS were also challenges in conducting this study. Firstly, on the task assessing emotion perception, emotive words needed to be narrated to the participants as they could not yet read. Moreover, these emotive words needed to be translated which was mostly, but not always directly possible. Additionally, particularly because most of the participants were four years old, some children had not yet encountered certain emotions or emotive words, even in their preferred language. This was a drawback of the PEERS measurement tool and was an added administration difficulty as this caused participants to guess the answers at times which conflicts with the instructions of the game. This indicated that the tool may not be appropriate for children from diverse contexts during the preschool years. A further limitation to this was that participants tended to be more familiar with the identifiably 'black' faces, displaying an own-race bias, and tended to choose their responses based on this rather than on the test instruction. This was however mitigated by early detection of what the child was doing based on how they chose their answers and effective demonstrations of the correct instructions in the beginning trials where demonstration is allowed. Due to these limitations, errors made on the subscales increased affecting the variance and general goodness of fit (Field, 2009).

4.7 Recommendations for Future Research and Implications

This study has actively contributed to the use and development of ECD-specific measures. By using specialised ECD measures in this study, it encourages further use through exposure to other researchers who may access this study. The limitations of the PEERS measurement discussed above contribute to improving the measure for other studies, despite its

poor fit to the context of this study. The use of these measures identified what is still lacking in the development of ECD measures globally and in contexts similar to South Africa. This is particularly important in considering testing in different languages, which was an important factor in this study. When testing ECD components in the context of low-income settings and diverse cultural representations, this study has highlighted the challenges of using measurement tools that are not contextually sensitive to diverse environments. In relation to emotion recognition and emotion perception tasks on the PEERS assessment, this study has shown that a contextually relevant measurement tool for assessing these domains in the preschool age period is crucial and is a recommendation for future research.

The testing administration in this study drew attention to administering psychological tools in contexts where English is not the most familiar language. The additional translations that were necessary for the children to be able to understand the instructions indicated that assessing the viability and fit of measurement tools before administration and piloting is of utmost importance. For future research, particularly when conducting research amongst young children in diverse and low-income contexts, thorough piloting of measures is strongly recommended and assessing the fit of translated tools with members of the community is encouraged

Assessment in diverse contexts with young children as participants demands an administration procedure that is sensitive to the abilities of children in their specific age categories. The testing administration in this study indicated that collecting data from several assessment tools must be done under the consideration of the attention span of the preschool children being assessed. Due to this study's sample being preschool age, administering three assessment tools per individual participant per day proved to be challenging. Despite enforcement of short breaks, the challenge of administering three assessments per participant was exacerbated by the requirement of extra translations. The necessity of extraneous translations over and above the translations provided by the assessments added significantly extra time to each individual administration. Future research aiming to assess developmental outcomes of young children should take this into account and aim to spread out each assessment to minimise the chances of participants becoming fatigued and losing focus.

In contributing to the literature on ECD and socioeconomic influences on development, the results of this study showed that the positive relationship between ECD and SES that has been established thus far may need to be reconsidered, particularly in low- and middle-income contexts such as Soweto, South Africa. The importance of a secure and prosperous environment for the development of cognitive, motor and socio-emotional skills is well established in the literature. However, emerging studies from low- and middle-income contexts are indicating that children are performing better than expected considering their circumstances (Cook et al., 2019). Future research is encouraged to consider studying development in these contexts in order to generate more knowledge for this trend.

Further research on ECD in the preschool years is particularly important as many of the competencies investigated in this study are important for later predictive school success and

school readiness. Early assessments of cognitive, socio-emotional and motor competencies have two important implications. It can not only potentially save a lot of time and resources in the long term, but it can also prompt early intervention and thereby protect children from joining the formal schooling system without having received adequate support and screening in the early years of child development. Considering that children from low SES environments are more at risk to poor development and lower school readiness (Ramey & Ramey, 2004) this is a crucial factor for South African children and academic achievement in South African schools. Early intervention programmes have yielded success and long-term advantages in previous studies (see Burger, 2010; Ramey & Ramey, 2004) and future research on ECD in the South African context may be valuable for the design and implementation of early interventions.

ECD research in the context of low-income and early interventions raise discussions considering broader implications for policy. The United Nations have made 'quality education' its fourth Sustainable Development Goal (UN News Centre, 2015). In the 2019 State of the Nation Address (SONA), the South African government emphasised the importance of early childhood education and is planning to implement two years of mandatory ECD for all children before beginning Grade One (Ramaphosa, 2019). With this focus on the preschool years, the new relationships that are surfacing between SES and ECD components in the South African context can be particularly important in shaping the implementation of these new policies.

As a final recommendation for future research, the results found in this study suggest further inquiry into age-related improvements with more focus on the neurological structures that underlie cognitive function. This study has investigated ECD components through a cognitive lens, however further inquiry could include the investigation of brain structures that are responsible for the various cognitive competencies that surface during early childhood. This

could add another layer of nuance to the developmental picture and consider ECD in a more holistic way by considering neurological components and using various neuroimaging techniques to visualise brain and neural structures underlying cognitive behaviour.

4.8 Conclusions

This study has shown a number of important findings. Firstly, this study has shown that the well-established positive relationship between SES and ECD that has been established thus far may need to be reconsidered, particularly in low- and middle-income contexts such as Soweto, South Africa. This study has shown that children from lower SES circumstances can, and do, perform as well as their high-income counterparts and in some cases even better. This study has also maintained the consistent finding that performance on ECD measures is not largely different across sex. The widely held belief that females tend to perform better on socio-emotional cognition was also challenged and lends to a larger discourse about sex and gender roles. Lastly, the results of the study have shown potential for further research into the relationships between SES, inhibition, socio-emotional cognition and motor development.

In addition to these conclusions, this study has displayed the challenges of ECD research in unique contexts such as Soweto and the relationship between ECD and SES in contexts that are culturally and ethnically diverse. Globally ECD has garnered much interest in the importance of the early years and unique studies that help to illustrate and pioneer new information about development have the ability to inform policy for the benefit of the participants who make this research possible.

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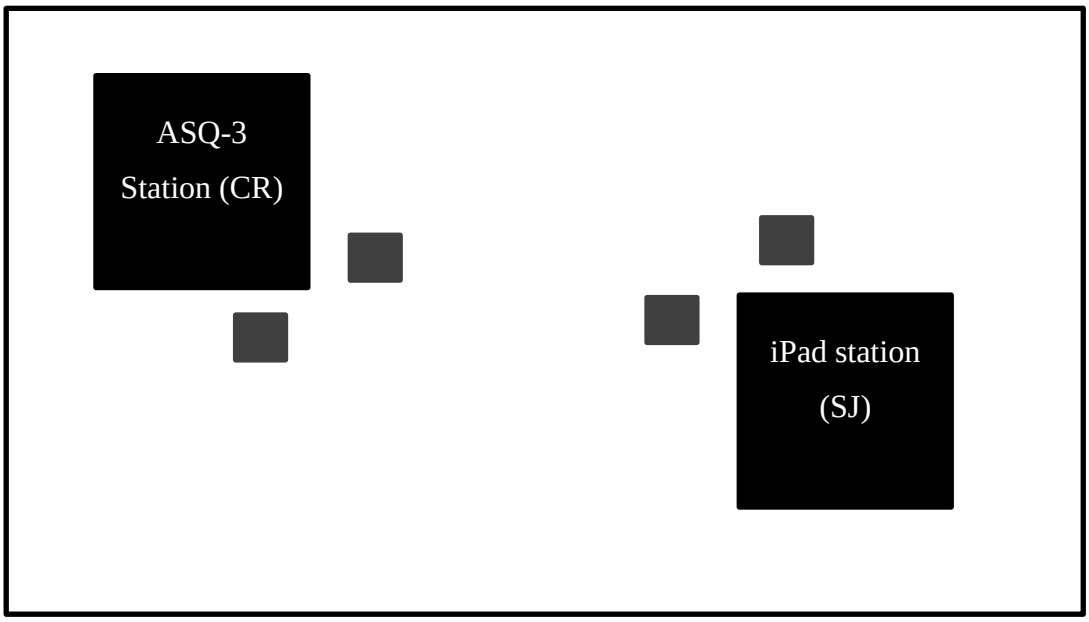
Appendix A: Summary of Measurement Pilot

Context

The piloting of the measures was carried out on 05/07/2018 at two preschools in Johannesburg. These preschools are situated in the east of Johannesburg and children who attended these preschools came from various racial groups, had an even distribution of males and females and would be considered a low- to middle-income context. The EYT, ASQ-3 and PEERS were piloted at both preschools using a variety of children (male and female and across racial groups. In total, five full administrations of all three measurement tools were achieved in the span of two hours and 30 minutes. Most of the children were three years old, turning four in 2018.

Description of Assessment Stations

Two testing stations were set-up for administration – one for the iPad-assessments and another for the ASQ-3. At the iPad station, SJ administered the EYT and PEERS with the iPad set-up on a table and two chairs. SJ sat next to the participants in order to make sure that the participants were understanding the task and provide additional instructions if needed. CR was at the ASQ-3 station administering the fine motor and gross motor items. At the ASQ-3 station, the materials required for the fine motor tasks were on the table with CR seated next to the participant to be able to explain the tasks and assess accordingly. Below is a birds-eye-view diagram illustrating this set-up.



Administration

As we had limited time at the first preschool, only two preschool children were assessed on the EYT and PEERS assessments. Both assessments took approximately 30 minutes to administer to each child. At this stage we started to notice that the EYT and PEERS administrations were going to take longer than initially expected. Participant fatigue was also noticed during the EYT and PEERS administrations. The first preschool did not have a lot of quiet space therefore the environment contributed to some distraction however the children did settle into the games quickly. As we went to the second preschool in the afternoon, when learning time had finished, they were able to offer us a quiet classroom in which to administer the tools which saved time significantly and contributed to less distraction. We were also able to administer the iPad-based assessments and the ASQ-3 in separate areas to avoid distraction.

The iPad-based assessments were conducted at one testing station with SJ and the ASQ-3 was conducted at another station with CR. Children who had completed the iPad-based

assessments would then go to the ASQ-3 station and vice versa and children would be ‘swapped’ between stations until we had assessed all possible children on all assessments. We had quickly realised that the iPad-based assessments were taking a significantly longer amount of time to administer than the ASQ-3. We also started to see that the PEERS was particularly difficult for most of the children to understand and many of them were guessing the answers. We noticed that the EYT and PEERS needed to be translated further in ways that three- to four-year-old children could understand.

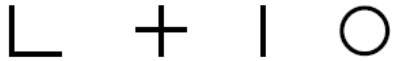
Appendix B: Early Years Toolbox Screenshots



Appendix C: Ages and Stages Questionnaire (3rd Edition)

ASQ-3 — 48 Month Questionnaire — page 4 of 7

FINE MOTOR *(continued)*

	YES	SOMETIMES	NOT YET	
2. Using child-safe scissors, does your child cut a paper in half on a more or less straight line, making the blades go up and down? *(Carefully watch your child's use of scissors for safety reasons.)* 	○	○	○	___
3. Using the shapes below to look at, does your child copy at least three shapes onto a large piece of paper using a pencil, crayon, or pen, without tracing? *(Your child's drawings should look similar to the design of the shapes below, but they may be different in size.)* 	○	○	○	___
4. Does your child unbutton one or more buttons? *(Your child may use his own clothing or a doll's clothing.)*	○	○	○	___
5. Does your child draw pictures of people that have at least three of the following features: head, eyes, nose, mouth, neck, hair, trunk, arms, hands, legs, or feet?	○	○	○	___
6. Does your child color mostly within the lines in a coloring book or within the lines of a 2-inch circle that you draw? *(Your child should not go more than 1/4 inch outside the lines on most of the picture.)*	○	○	○	___

FINE MOTOR TOTAL ___

GROSS MOTOR

		YES	SOMETIMES	NOT YET	
1.	Does your child catch a large ball with both hands? *(You should stand about 5 feet away and give your child two or three tries before you mark the answer.)* 	◯	◯	◯	___
2.	Does your child climb the rungs of a ladder of a playground slide and slide down without help?	◯	◯	◯	___
3.	While standing, does your child throw a ball *overhand* in the direction of a person standing at least 6 feet away? To throw overhand, your child must raise his arm to shoulder height and throw the ball forward. *(Dropping the ball or throwing the ball underhand should be scored as "not yet.")* 	◯	◯	◯	___
4.	Does your child hop up and down on either the right or left foot at least one time without losing her balance or falling?	◯	◯	◯	___
5.	Does your child jump forward a distance of 20 inches from a standing position, starting with his feet together?	◯	◯	◯	___
6.	Without holding onto anything, does your child stand on one foot for at least 5 seconds without losing her balance and putting her foot down? *(You may give your child two or three tries before you mark the answer.)* 	◯	◯	◯	___
			GROSS MOTOR TOTAL		___

Child's name: _____ Date ASQ completed: _____

Child's ID #: _____ Date of birth: _____

Administering program/provider: _____

1. **SCORE AND TRANSFER TOTALS TO CHART BELOW:** See *ASQ-3 User's Guide* for details, including how to adjust scores if item responses are missing. Score each item (YES = 10, SOMETIMES = 5, NOT YET = 0). Add item scores, and record each area total. In the chart below, transfer the total scores, and fill in the circles corresponding with the total scores.

Area	Cutoff	Total Score	0	5	10	15	20	25	30	35	40	45	50	55	60
Communication	30.72		●	●	●	●	●	●	●	○	○	○	○	○	○
Gross Motor	32.78		●	●	●	●	●	●	●	○	○	○	○	○	○
Fine Motor	15.81		●	●	●	●	○	○	○	○	○	○	○	○	○
Problem Solving	31.30		●	●	●	●	●	●	●	○	○	○	○	○	○
Personal-Social	26.60		●	●	●	●	●	●	○	○	○	○	○	○	○

2. **TRANSFER OVERALL RESPONSES:** Bolded uppercase responses require follow-up. See *ASQ-3 User's Guide*, Chapter 6.

1. Hears well? Yes **NO**
   Comments:

2. Talks like other children his age? Yes **NO**
   Comments:

3. Understand most of what your child says? Yes **NO**
   Comments:

Comments:

3. Understand most of what your child says? Yes **NO**
   Comments:

4. Others understand most of what your child says? Yes **NO**
   Comments:

5. Walks, runs, and climbs like other children? Yes **NO**
   Comments:

6. Family history of hearing impairment? **YES** No
   Comments:

7. Concerns about vision? **YES** No
   Comments:

8. Any medical problems? **YES** No
   Comments:

Comments:

8. Any medical problems? **YES** No
   Comments:

9. Concerns about behavior? **YES** No
   Comments:

10. Other concerns? **YES** No
    Comments:

3. **ASQ SCORE INTERPRETATION AND RECOMMENDATION FOR FOLLOW-UP:** You must consider total area scores, overall responses, and other considerations, such as opportunities to practice skills, to determine appropriate follow-up.

If the child's total score is in the ☐ area, it is above the cutoff, and the child's development appears to be on schedule.
If the child's total score is in the ▒ area, it is close to the cutoff. Provide learning activities and monitor.
If the child's total score is in the ■ area, it is below the cutoff. Further assessment with a professional may be needed.

4. **FOLLOW-UP ACTION TAKEN:** Check all that apply.

_____ Provide activities and rescreen in _____ months.

_____ Share results with primary health care provider.

_____ Refer for (circle all that apply) hearing, vision, and/or behavioral screening.

_____ Refer to primary health care provider or other community agency (specify reason): _____.

_____ Refer to early intervention/early childhood special education.

_____ No further action taken at this time

_____ Other (specify): _____

5. **OPTIONAL:** Transfer item responses (Y = YES, S = SOMETIMES, N = NOT YET, X = response missing).

	1	2	3	4	5	6
Communication						
Gross Motor						
Fine Motor						
Problem Solving						
Personal-Social						

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Ages & Stages Questionnaires®, Third Edition (ASQ-3™), Squires & Bricker
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Appendix D: Pediatric Evaluation of Emotions, Relationships and Socialisation

PEERS® subtest descriptions May 2017

Domain	Basic Skill	Name of subtest	Description	Complex Skill	Name of subtest	Description
Attention/Executive	Selective attention	*Friend Find*	Within an array of distractor photos of other people, search for as many photos as possible that display the same person as the target photo. Assesses selective and divided visual attention for social stimuli (faces)	Self-regulation	*Risky Business**	Blow up balloon as big as possible without popping it by tapping the screen quickly, then add it to the balloon bunch. Earn coins for each balloon you successfully blow up without popping.
	Reaction time	*Move Fast*	Tap the objects as quickly as possible until the time runs out. Assesses motor response speed			
	Information processing	*Think Fast*	Quickly name the emotion shown on the illustrated face and then tap it the face to move on. Assesses speed of information processing for emotion labels			
Social Cognition	Emotion perception	*Matching Emo*	Match illustrated faces displaying different emotions with correct emotion labels. Assesses knowledge and recognition of emotion labels	Social information processing	*Social Intent*	Watch brief videos of social situations and respond to multiple choice questions about the scenarios. Assesses intent attribution and responses to social situations
	Emotion recognition	*Finding Emo*	Select the photograph in which a discordant emotion is displayed compared to the others in a grid of 4 static face photographs. Assesses facial emotion recognition	Theory of mind	*Mind Read*	Watch brief videos of social interactions and answer multiple choice questions about the interactions. Assesses physical and mental-state theory of mind
				Moral reasoning	*Multiple Morals*	View three images that tell a social story and say what you would do in if you were in the situation. Then, justify your answer by choosing a reason among multiple choices. Assesses moral decision making and reasoning in social situations
				Social risk	*So Risky**	View static photographs of social situations that involve social risk and respond to multiple choice questions about the situations. Measures propensity for engaging in social behaviours that involve social risk
Social Communication	Non-verbal gestures	*Odd One*	Select the photograph in which a discordant emotion is displayed compared to the others in a grid of 4 static body photographs. Assesses recognition of non-verbal emotional gestures	Social interpretation	*Get This*	Move the cartoons around so that they tell a logical story. Assesses interpretation of conventional social situations
	Social perception	*Social Scenes*	Select the photograph in which a discordant social behaviour is displayed compared to the others in a grid of 4 static social scenario photographs. Assesses interpretational of social intent within social scenes	Prosody	*Say What*	Listen to spoken sentences and select how the speaker is feeling. Assesses emotional prosody in neutral audio sentences
Effort	Malingering	*Try This**	Drag and drop illustrated faces to their correct place. Assesses level of effort during testing via matching of simple emoticons			

Appendix E: Socioeconomic Questionnaire

The following set of questions refer to your current living arrangements, at the place where you spent **most nights in the past 3 months**.

1. How many people **(including yourself)** live in your current home (have stayed most nights in your home over the past 3 months)?

2. Can you list the people who live in your home or have stayed most nights in your home over the past 3 months?

	Relationship to yourself (USE CODES BELOW)	**Age**	**Sex (M/F)**	**Education (USE CODES)**
a.	Yourself			
b.				
c.				
d.				
e.				
f.				
g.				
h.				
i.				
j.				

Relationship Codes:	**Education Codes (state the HIGHEST level):**
1=parent **2=grandparent** **3=your own child** **4=sibling** **5=other relative (including other children, in laws, etc)** **6=spouse/partner** **7=friend** **8=housemate/flatmate/roommate** **9=other: specify**	**1=not in any form of school** **2=currently in preschool or primary school** **3=completed primary school** **4=completed high school (passed Matric)** **5=completed postgraduate education** **6= other: specify**

3. How would you describe the home you are living in? (*tick one*)

Home type	**Tick one**	**Code**
House of brick/ concrete block structure on a separate stand or yard or on a farm		1
Traditional dwelling / hut / structure made of traditional materials		2
Flat or apartment in a block of flats		3
Cluster house in complex		4
Townhouse (semi-detached house in complex)		5
Semi-detached house		6
House / flat / room in backyard		7
Informal dwelling / shack in back yard		8
Informal dwelling / shack not in back yard		9
Room or flatlet on a property or larger dwelling / servant's quarters / granny flat		10

Caravan / tent		11
Other (Specify)		12

4. How many rooms **for sleeping** are there in your current home? Include outside rooms if they are used by household members, but not if rented out. Include any rooms that are used for sleeping, even kitchens, lounges etc.

5. How safe do you feel **walking around** in your neighbourhood (in the area about 20 minutes walk from your home) during the day and at night?

Response	**During the day (tick one)**	**During the night (tick one)**	**Code**
Very unsafe			1
Unsafe			2
Safe			3
Very safe			4

6. Is there a safe place for children to play inside your home?

Yes	No

7. Is there a safe place for children to play outside your home?

Yes	No

8. What is the main source of drinking water for members of your household?
(*Please **tick the box that best applies***)

Water Facility	**Tick One**	**Code**
Piped water (tap) in dwelling		1
Piped water (tap) in site / yard		2
Bottled water		3
Water carrier/ tanker		4
Rain water tank		5
Borehole / well / spring		6
Dam / river / stream		7
Public / communal tap		8
Other (Specify)		9

9. What is this household's main source of water for household use (other than for drinking)?

Water Facility	**Tick One**	**Code**
Regional / local water scheme (operated by municipality or other service provider)		1
Borehole		2
Spring		3
Rain-water tank		4
Dam / pool/ stagnant water		5
River / stream		6
Water vendor		7

Water tanker		8
Other (specify)		9

10. What kind of toilet facilities does your household have?

Toilet Facility	**Tick One**	**Code**
Flush toilet (connected to sewerage system)		1
Flush toilet (with septic tank)		2
Chemical toilet		3
Pit toilet with ventilation (VIP)		4
Pit toilet without ventilation		5
Bucket toilet		6
Other (Specify)		7
None		8

11. Do you share this toilet with other households?

Yes	No

12a. In the past 12 months, were there times when members of your household went hungry because there was not enough food in the house to eat?

Yes	No

12b. If yes, has it happened in the past 30 days?

Yes	No

12c. If yes, has it happened in the past 5 days?

Yes	No

13. Which of the following do you have in your current home (place where you spent most nights in the past three months)? It does not matter who owns/pays for these things. **(*Answer all questions*)**

	Item	**In current home**	
		Yes	**No**
a.	Electricity		
b.	Fridge		
c.	Stove		
d.	Vacuum cleaner		
e.	Washing machine		
f.	MNet/DSTV/Satellite		
g.	DVD Player		
h.	Motorcar		
i.	Television		
j.	Telephone (landline)		
k.	Cell phone		
l.	Computer/laptop		
m.	Internet access		

Appendix F: Ethics Approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Catherine Draper et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180490

NAME: (Principal Investigator)	Dr Catherine Draper et al
DEPARTMENT:	MRC/Wits Developmental Pathways for Health Research Unit HSRC Office, Sweetwaters - KZN
PROJECT TITLE:	International Surveillance study of Movement Behaviours in the Early Years (SUNRISE)
DATE CONSIDERED:	Ad hoc
DECISION:	Approved
CONDITIONS:	A Sub-study under Primary Study M160534 Dr C. Draper. The PI must obtain written permission prior to data collection for each study site and the Provincial Ethics Committee
SUPERVISOR:	
APPROVED BY:	Professor CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	15/05/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **April** and will therefore be due in the month of **April** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Appendix G: Information Sheet for Preschool

MRC/Wits Development Pathways for Health Research Unit
Department of Paediatrics and Child Health

Health behaviours and development of preschool children

Dear Principal,

Who are we, and why are we doing this study?
I am Dr Catherine Draper, a researcher in the Department of Paediatrics at the University of Witwatersrand. Our research team is doing a study about physical activity, screen time and sleep in 4-year-old preschool children, and how this relates to their development and their home circumstances.

How is your preschool involved?
We would like children from your preschool to participate in our study, and for your teachers, and the parents/caregivers of these children to participate in the study as well.

What will we be doing at your preschool?
First, we will measure the children's height and weight. The children will then do some tests to assess his/her physical, social, emotional and cognitive development. Someone who is able to speak the children's home language will help to make sure that they are able to understand the tests and what is happening at all times. Some of the tests are done on an electronic tablet and are enjoyable for children!

We will also place a small electronic device called an accelerometer around the children's waist to measure his/her physical activity levels and the amount of time he/she sleeps at night. The accelerometer is about the same size as a small matchbox, and they will wear it on a belt around his/her waist for eight full days (at school and at home), and while they are sleeping. The only time they should take it off is when they bath, shower or swim. At the same time, we would also like the children to wear a device that is attached to their leg with a sticky bandage. The bandage does not hurt them and should not cause any irritation to their skin. This device is placed in a waterproof pouch and should stay on for 8 days. After 8 days, the investigator will come to your preschool to collect both devices.

All the tests and the height and weight measurements will be done during the day at your preschool, and on the same day. We know that testing can be tiring for children, so we won't require them to spend longer than about 30 minutes per testing session. If they become tired or irritable during the testing, we will allow them to have a break, since we know it can be hard for young children to sit and concentrate for a long time! For the eight days that the children wear the devices, he/she does not need to do anything special, other than continue as he/she would normally with school, playing, activities and sleeping.

We may invite some of your staff to be part of a small group discussion to hear your views about physical activity, screen time and sleep in preschool children. The group will be made up of about 8 parents from your community and will take about 60-90 minutes. At the focus group, a researcher will be present to help guide the discussion. A note taker will also be present, but just to be sure we remember everything that is said, we would like to audio record the discussion as well, with your permission.

Are there any risks to the children related to participating in this study?
There are no physical risks for the children related to participating in this study. None of the tests we will do will put them at risk, or cause them physical harm. If we pick up any developmental problems when we are doing the assessment with the children, we will be able to assist with referring them to someone who will be able to assist them. This might be someone like an occupational therapist, speech therapist, or doctor, depending on the problems your child is experiencing. We will also provide you with feedback at the end of the study.

How will we protect your preschool and the children during the study?
We will not use your name or the children's names or the name of your preschool when we report on the results of our study. Neither the name of your preschool nor the children's name will be linked to any of the data we collect, so your identity will be protected. The recordings and notes from the focus groups and interviews, along with all the other data, will be kept safe by the researchers on the project, and only the researchers will have access to this information. All of the information will be destroyed after 5 years.

You and the children will not be forced to take part in the study, and you will both be free to stop participating at any time if either of your feels uncomfortable or unhappy.

As the research team, we may not be able to keep confidential, information about known or reasonably suspected incidents of deliberate neglect or physical, sexual or emotional abuse of a child. If we are given such information, we may report it to the authorities such as child welfare or the police.

How will you and the children benefit from this study?
There is no direct benefit to you or the children for taking part in the study. However, this study will help us to better understand the behaviours of preschool children, and how this relates to early childhood development. This information will hopefully help us to provide useful advice on how to promote healthy behaviours amongst preschool children, and we believe these healthy behaviours will help them reach their full potential.

If you have any questions about the study, please contact Dr Catherine Draper at 021 650 4570 or catherine.draper@wits.ac.za. Your signature also indicates that you understand the aims of the study and have had the opportunity to ask any questions which have been answered in

your home language. Please also indicate if you give us permission to record the focus group discussion and interview.

If you have any queries about the study, please contact Dr Catherine Draper at (021) 650 4570, University of Cape Town. If you have any questions related to the ethics of this study please contact: Prof Penny, Chairperson of the University of the Witwatersrand, Human Research Ethics Committee (HREC), which is an independent committee established to help protect the rights of research participants at (011) 717 1234 or (011) 717 2301.

Thank you for your time and attention

Kind regards
Dr Catherine Draper

Appendix H: Information Sheet for Parents

MRC/Wits Development Pathways for Health Research Unit
Department of Paediatrics and Child Health

Health behaviours and development of preschool children

Dear parent / legal guardian,

Who are we, and why are we doing this study?
I am Dr Catherine Draper, a researcher in the Department of Paediatrics at the University of Witwatersrand. Our research team is doing a study about physical activity, screen time and sleep in 4-year-old preschool children, and how this relates to their development and their home circumstances.

How are you involved?
We would like you and your son/daughter to participate in our study, since we are also interested in your perspective as a parent (or caregiver) of a preschool child and would like to find out more about your home circumstances.

What will we be doing with your child?
First, we will measure your child's height and weight. Your child will then do some tests to assess his/her physical, social, emotional and cognitive development. Someone who is able to speak your child's home language will help to make sure that your child is able to understand the tests and what is happening at all times. Some of the tests are done on an electronic tablet and are enjoyable for children!

We will also place a small electronic device called an accelerometer around your child's waist to measure his/her physical activity levels and the amount of time he/she sleeps at night. The accelerometer is about the same size as a small matchbox, and your child will wear it on a belt around his/her waist for eight full days (at school and at home), and while they are sleeping. The only time they should take it off is when they bath, shower or swim. At the same time, we would also like your child to wear a device that is attached to their leg with a sticky bandage. The bandage does not hurt them and should not cause any irritation to their skin. This device is placed in a waterproof pouch and should stay on for 8 days. After 8 days, the investigator will come to your child's preschool to collect both devices.

All the tests and the height and weight measurements will be done during the day at your child's preschool, and on the same day. We know that testing can be tiring for children, so we won't require them to spend longer than about 30 minutes per testing session. If they become tired or irritable during the testing, we will allow them to have a break, since we know it can be hard for young children to sit and concentrate for a long time! For the eight days that your child wears the devices, he/she does not need to do anything special, other than continue as he/she would normally with school, playing, activities and sleeping.

What we will be doing with you

Firstly, we would like you to complete 2 questionnaires. One questionnaire will ask you to tell us about your child's physical activity, screen time and sleep, and some things within your home that influence these behaviours. The second questionnaire will ask about your circumstances at home, such as: who lives in the house, access to facilities such as running water and electricity, ownership of certain household goods, use of TV and sugar sweetened beverages, and information about the children in the home. Each questionnaire will take about 20-30 minutes to complete and will be done with you at your home. The questionnaires will be in your home language, or in English, depending on what you prefer.

Secondly, we would like to invite you to participate in an interview and a home observation about the following:

- Personal information about you and your family
- Learning possibilities at home for your preschool child
- The physical environment of your home
- Your beliefs and behaviours as a parent/caregiver
- Your family lifestyle

The interview and observation will take place at your home. The home visit will take about 45 to 90 minutes; this may vary depending on your answers. The interview will be conducted in your home language, or in English, depending on what you prefer. There are no right or wrong answers to the questions you will be asked in the interview, and it is important for you to answer these questions as honestly as possible so that we can fully understand your views on these issues. With your permission, we would like to audio record the interview to help us remember the details more accurately. For the observation, it is important that you and your preschool child are present and awake. Other family members or guests may be present, but their presence is not necessary. During the observation you and your child perform activities and interact as you would do in your day-to-day life.

Thirdly, we may invite you to be part of a small group discussion to hear your views about physical activity, screen time and sleep in preschool children. The group will be made up of about 8 parents from your community and will take about 60-90 minutes. At the focus group, a researcher will be present to help guide the discussion. A note taker will also be present, but just to be sure we remember everything that is said, we would like to audio record the discussion as well, with your permission.

Are there any risks to you or your child related to participating in this study?

There are no physical risks for you or your child related to participating in this study. None of the tests we will do will put your child at risk, or cause them physical harm. If we pick up any developmental problems when we are doing the assessment with your child, we will be able to assist with referring your child to someone who will be able to assist them. This might be someone like an occupational therapist, speech therapist, or doctor, depending on the

problems your child is experiencing. We will also provide you with feedback at the end of the study.

Some of the things we will talk about in the focus group might make you feel uncomfortable or might cause you to feel stressed. They will not be forced to answer any questions if they don't want to. And if you feel uncomfortable or stressed during the focus group or interview, you can let us know that you would like to stop.

How will we protect you and your child during the study?
We will not use your name or your child's name or the name of your child's school when we report on the results of our study. Neither your name nor your child's name will be linked to any of the data we collect, so your identity will be protected.

The focus group discussion will be audio recorded, and your identity will be known to the other focus group participants. We will ask everyone to respect other focus group participants and not share what was said by specific people in the focus group, but we cannot guarantee that they will do this. The recordings and notes from the focus groups and interviews, along with all the other data, will be kept safe by the researchers on the project, and only the researchers will have access to this information. All of the information will be destroyed after 5 years.

You and your child will not be forced to take part in the study, and you will both be free to stop participating at any time if either of your feels uncomfortable or unhappy. If you or your child do not want to participate, this will not affect your involvement in any other activities at their preschool. If you do not wish to give consent, this will not have a negative effect on your relationship with your child's preschool.

As the research team, we may not be able to keep confidential, information about known or reasonably suspected incidents of deliberate neglect or physical, sexual or emotional abuse of a child. If we are given such information, we may report it to the authorities such as child welfare or the police.

How will you and your child benefit from this study?
There is no direct benefit to you and your child for taking part in the study. However, this study will help us to better understand the behaviours of preschool children, and how this relates to early childhood development. This information will hopefully help us to provide useful advice on how to promote healthy behaviours amongst preschool children, and we believe these healthy behaviours will help them reach their full potential.

If you have any questions about the study, please contact Dr Catherine Draper at 021 650 4570 or catherine.draper@wits.ac.za. Your signature also indicates that you understand the aims of the study and have had the opportunity to ask any questions which have been answered in your home language. Please also indicate if you give us permission to record the focus group discussion and interview.

If you have any queries about the study, please contact Dr Catherine Draper at (021) 650 4570, University of Cape Town. If you have any questions related to the ethics of this study please contact: Prof Penny, Chairperson of the University of the Witwatersrand, Human Research Ethics Committee (HREC), which is an independent committee established to help protect the rights of research participants at (011) 717 1234 or (011) 717 2301.

If you are happy to take part in the study, please read and sign the attached consent form and we will commence with the questions.

Thank you for your time and attention

Kind regards
Dr Catherine Draper

Appendix I: Consent Form for Children's Participation

Consent form for child's participation in the study

I agree for my child to be a participant in this study. The goals and methods of the study are clear to me. I understand that the study will involve him/her doing some tests of his/her physical, social, emotional and cognitive development. All the details and purposes of this study have been explained to me. I understand that my child's data will not be anonymous to the researchers involved. I understand that I have the right to refuse for my child to participate in the study.

I agree for my child's participation in the study on condition that:
1. My child can withdraw from the study at any time voluntarily and that no adverse consequences will follow on withdrawal from the study.
2. My child has the right not to answer any or all questions posed in the focus group and not to participate in any or all of the procedures / assessments.
3. The University of the Witwatersrand Human Ethics committee has approved the study protocol and procedures.
4. All results will be treated with the strictest confidentiality.
5. Only group results, and not my child's individual results, will be published in scientific journals and in the media.
6. The study scientific team is committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.

Name of child: _____

Name of parent: _____

Signature / mark / thumbprint of parent: _____

Witness (if mark / thumbprint): _____

Date: _____

Name of research assistant: _____

Signature of research assistant: _____

Date: _____

Appendix J: Consent Form for Parents' Participation

Consent form for parents' participation in the study

I agree to be a participant in this study. The goals and methods of the study are clear to me. I understand that the study will involve completing questionnaires, being interviewed, and possibly being involved in a focus group. All the details and purposes of this study have been explained to me. I understand that my data will not be anonymous to the researchers involved. I understand that I have the right to refuse to participate in the study.

I agree for my participation in the study on condition that:
1. I can withdraw from the study at any time voluntarily and that no adverse consequences will follow on withdrawal from the study.
2. I have the right not to answer any or all questions posed in the questionnaires, interview and focus group and not to participate in any or all of the procedures / assessments.
3. The University of the Witwatersrand Human Ethics committee has approved the study protocol and procedures.
4. All results will be treated with the strictest confidentiality.
5. Only group results, and not my individual results, will be published in scientific journals and in the media.
6. The study scientific team is committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.

Name of parent: _____

Signature / mark / thumbprint of parent: _____

Witness (if mark / thumbprint): _____

Date: _____

Name of research assistant: _____

Signature of research assistant: _____

Date: _____

Consent form for audio recording

I have read and understood the project information sheet, and I understand that it is up to me whether or not the interview and focus group are audio recorded. I understand that if I do not wish to be recorded, it will not in any way affect how the interviewer and focus group facilitator treats me. I understand that if the interview and focus group are recorded, the tape will be destroyed five years after the interview. I understand that I can ask the person interviewing me and facilitating the focus group to stop recording, and to stop the interview and focus group completely at any time. I understand that the information that I give will be treated in the strictest of confidence, and that my name will not be used when the results are typed up.

☐ Yes, I give permission for the interview and focus group to be audio recorded.

☐ No, I do not give permission for the interview and focus group to be audio recorded.

Name of parent: _____

Signature / mark / thumbprint of parent: _____

Witness (if mark / thumbprint): _____

Date: _____

Name of research assistant: _____

Signature of research assistant: _____

Date: _____

Appendix K: Normality and Parametric Indicators for Statistical Analyses

Table 6. *Normality Indicators for variables used in Regressions*.

				Skewness Coefficient[a]	Kurtosis Coefficient[b]	Kolmogorov-Smirnov test (*p* value)	Shapiro-Wilk test (*p* value)	Normal Distribution (Y/N)	Outliers
Age				0.000	1.918	0.000	0.000	Y	1
SES Composite Score	0.012	0.485	0.011	0.250		Y		1	
VSWM	-0.304	-0.646	0.005	0.045		N		0	
Matching Emotion	-0.150	0.413	0.134	0.766		Y		1	

Note. [a]Range = -1 to 1 (normal). [b]Range = -1 to 1 (normal)

Y = Yes. N = No.

Table 7. *Normality Indicators for Regressions.*

		NDR (Y/N)	Residuals (Y/N) [1]	IV Variance of Zero [2]	Homoscedasticity	Multicollinearity [3]	Durbin-Watson	Linearity	Cook's D	Leverage Value
Age	Switch Accuracy	Y	N	0.229	Acceptable	None	0.048	Acceptable	None above 1	None above 0.024
SES Composite Score	VSWM	Y	N	3.36	Acceptable	None	1.754	Not straight	None above 1	3 above 0.024
	Matching Emotic	Y	1	3.36	Acceptable	None	2.444	Acceptable	None above 1	9 above 0.024

Notes. NDR = Normally Distributed Residuals.

Y = Yes. No = N.

[1]No residuals should exceed 3. Residuals are problematic if more than 5% has standard residuals equal to and exceeding 2.

Residuals are problematic if more than 1% of standard residuals equal to and exceed 2.5.

Residuals are problematic if more than 5% has standard residuals equal to and exceeding 2.

[2] Independent variables should not have variance = 0

[3] No correlations above 0.80

Appendix L: Bar Graphs Comparing Mean Scores Across Age, Sex and Sample.

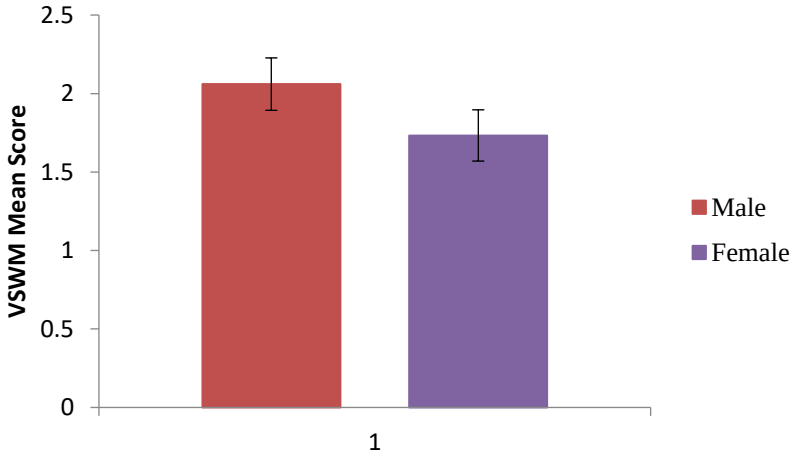


Figure 6. Visuo-Spatial Working Memory Mean Scores Across Sex.

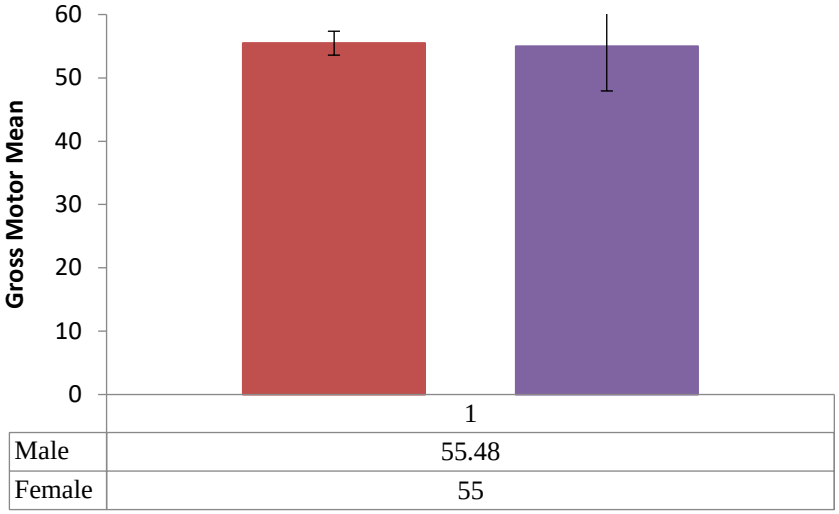


Figure 7. Gross Motor Mean Scores Across Sex.

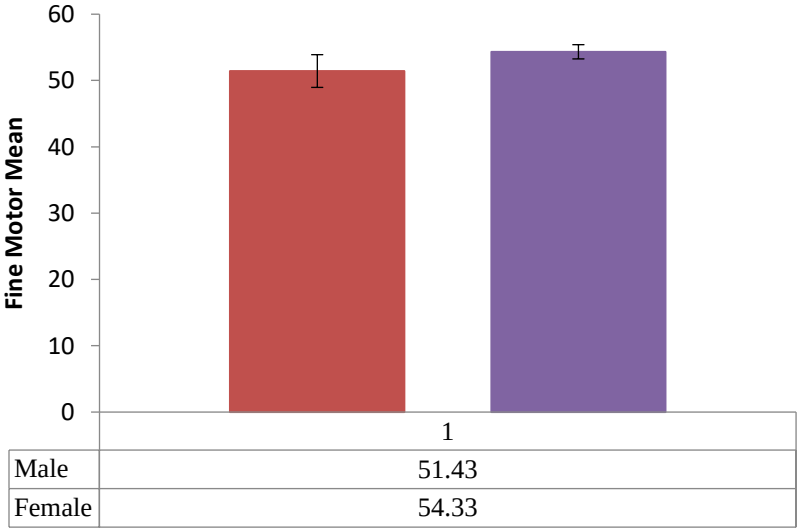


Figure 8. Fine Motor Mean Scores Across Sex.

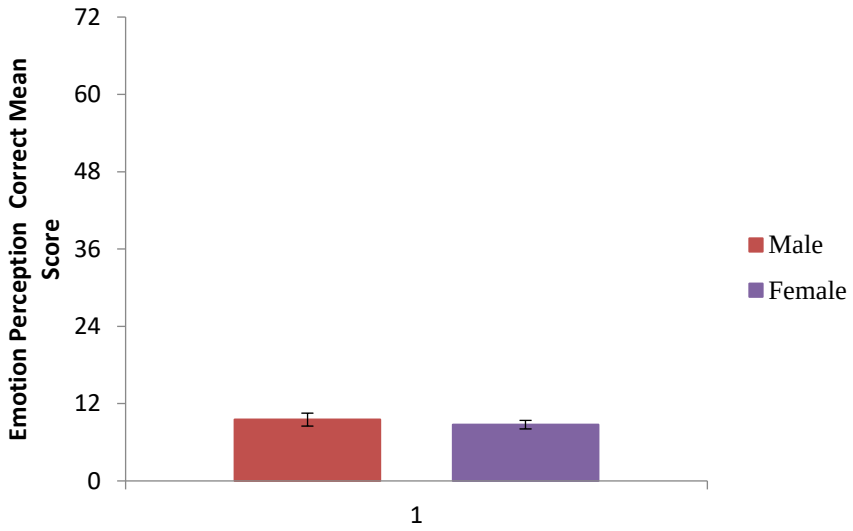


*Figure 9.*Emotion Perception Correct Scores Across Sex.

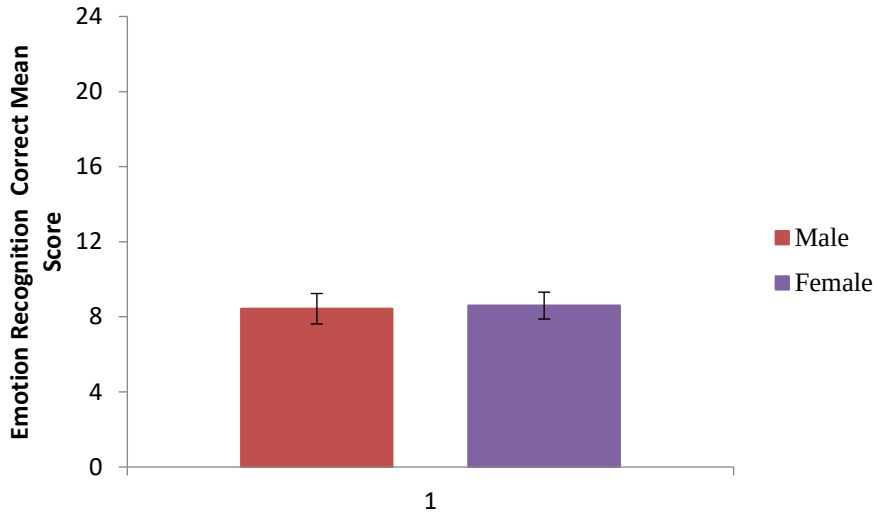


Figure 10. Emotion Recognition Correct Mean Scores Across Sex.

Appendix M: Parametric Assumptions for T-tests

Table 8. *Parametric Assumptions for T-tests*.

Variable	Type	Data Type	Normal Distribution	Homogeneity of Variance (Levene's Test)	Independence of Observations
Age	Independent Variable	Nominal	Y	-	Y
Sex	Independent Variable	Nominal	Y	-	Y
Impulse Control	Dependent Variable	Interval	Y	Met (0.78)	Y
Switch Accuracy	Dependent Variable	Interval	N	Met (0.14)	Y
VSWM	Dependent Variable	Interval	Y	Met (0.51)	Y
Fine Motor	Dependent Variable	Interval	Y	Met (0.052)	Y
Gross Motor	Dependent Variable	Interval	Y	Met (0.71)	Y
Finding Emotion	Dependent Variable	Interval	Y	Met (0.212)	Y
Matching Emotion	Dependent Variable	Interval	Y	Violated (0.00)	Y