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THE DEVELOPMENT OF A VISUAL-MOTOR TREATMENT PROGRAMME FOR PRE-SCHOOL HIV-INFECTED CHILDREN WITH VISUAL MOTOR INTEGRATION DIFFICULTIES

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Declaration

I, Ramona Odejayi, hereby declare that this dissertation is my own work. It is being submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science in Occupational Therapy. It has not been submitted before for any degree or examination at this or any other university.

R Odejayi

19 day of June 2017

Dedication

To God who gives hope and in whom all things are possible

To my husband Ola in admiration and gratefulness for your love, encouragement and wise counsel

To my daughters Eniola and Ayoola who bring wealth and joy in life

To my parents and brothers for giving me a good start in life

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Abstract

The purpose of this study is to add to current research on the impact of HIV on neurodevelopment in children and the nature of neurodevelopmental intervention needed to address the delay. The first phase of the study addressed the extent of visual motor integration delay in preschool children living with HIV. In the second phase of this study a visual motor treatment programme to address the delay specific to preschool children with HIV was proposed.

Seventy-one children attending an HIV clinic were assessed to determine the extent of their visual motor integration delay on the Beery Developmental Test of Visual Motor Integration and the supplemental tests. The children's socioeconomic status was determined based on the Household Economic and Social Status Index II. The results revealed that visual perception was the most affected component with a moderate positive correlation to the CD4 count and CD4% of the sample. The middle to low socioeconomic status of the sample had a mediating effect on the results particularly with visual motor integration in relation to the mothers' level of education and attendance at crèche.

Therefore the proposed visual motor treatment programme had a large emphasis on visual perception using visual information analysis as a means of acquiring skill. The treatment programme emphasised naming and drawing five basic shapes. Due to the scholastic nature of this intervention, the programme was developed to be used in a preschool setting, with the preschool teacher acting as a mediator to ensure skill development and generalisation of concepts learnt to everyday living. Expert review determined content validity which assisted in developing the first draft of the programme known as the 'My Shapes Programme'.

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Operational definitions

Motor Coordination	: Motor coordination is the voluntary control of finger and hand movements requiring eye hand coordination and manual dexterity
Visual Perception	: Visual perception is the process of receiving and interpreting visual information requiring vision, visual perceptual abilities and cognitive abilities
Visual Motor Integration	: Visual motor integration is the coordination of visual perception and finger hand movements

Abbreviations

ABC	Abacavir
AIDS	Acquired immune deficiency syndrome
AOTA	American Occupational Therapy Association
ART	Antiretroviral treatment
AZT	Zidovudine
CT	Computerised tomography
CCMTS	Comprehensive care, management, treatment and support programme
CNS	Central nervous system
Ddl	Didanosine
D4T	Stavudine
EFV	Efavirenz
FSIQ	Full scale intelligence quotient
HAART	Highly active antiretroviral treatment
HEU	HIV exposed uninfected
HUU	HIV uninfected unexposed
HIV	Human immunodeficiency virus
IQ	Intelligence Quotient
IVPP	Integrated visual perceptual program
LOC	Lateral occipital complex
MC	Motor coordination
MSP	My shapes programme
NRTI	Nucleoside Reverse Transcriptase Inhibitors
PACTG	Pediatric AIDS Clinical Trials Group
PMTCT	Prevention of mother to child transmission
PCR	Polymerase chain reaction

SES	Socioeconomic status
SP-VMI	Structured programme of visual motor integration
STI	Sexually transmitted infection
TB	Tuberculosis
VIQ	Verbal intelligence quotient
VMI	Visual motor integration
VP	Visual perception
UNICEF	United Nations Children Fund
WHO	World Health Organisation
WPPSI-R	Wechsler primary and preschool scale of intelligence revised
3TC	Lamivudine

CHAPTER 1: INTRODUCTION

"There is no trust more sacred than the one the world holds with children. There is no duty more important than ensuring that their rights are respected, that their welfare is protected, that their lives are free from fear and want and that they can grow up in peace." Kofi Annan

1.1 Introduction

The estimated number of children living with Human Immunodeficiency Virus (HIV) globally in 2015 is 1.8 million (UNAIDS, 2016). In South Africa alone 240 000 children are infected with HIV (UNICEF, 2015). Children can contract HIV through different modes of transmission with the most recorded cases being through vertical transmission, which is the transmission from mother to child (Barnett & Whiteside, 2006; Department of Health, 2007). As HIV is a neurotrophic virus, it crosses the blood-brain barrier and causes damage to the developing central nervous system from a very early age (Potterton, 2006). Due to the high number of HIV infections present, the neurodevelopment of children infected with HIV has come under close scrutiny by medical and allied health professionals alike.

Neurological imaging such as computerised tomography (CT) scans provide evidence that young children infected with HIV display central nervous system (CNS) abnormalities such as cortical atrophy, calcification of basal ganglia, ventricular enlargement and white matter low attenuation (Blanchette et. al., 2001). Various studies (Mitchell, 2001; Smith et. al., 2008; Van Rie et. al., 2008) have recorded neurodevelopmental delay in the developing brain of HIV positive children with cognitive, motor and language deficits.

A study by Blanchette et. al. (2001) confirms that children infected with HIV through vertical transmission display a significant delay in cognitive and motor performance measures. These significant delays in neurodevelopment in children with vertically transmitted HIV occur at a young age (Bruck et. al., 2001). As the abnormalities occur at a young age, further delay in higher order skills such as language, visual-motor processing and visual memory can be expected in later years (Blanchette et. al, 2001).

Such a delay in language development is representative of the impact of HIV on the level of higher order cognitive function (Coplan et. al., 1998, Smith et. al., 2008). Children infected with HIV are therefore at risk for developing neurodevelopmental delay which continues to affect their development as they grow older requiring ongoing medical treatment and neurodevelopmental intervention.

While many studies on children with HIV have been completed in developed countries, few studies have been done in South Africa. There is a need for more research on the effects of HIV on the neurodevelopment of children in South Africa. Studies that have been implemented so far in South Africa have shown that children with HIV have cognitive, language and motor delay (Potterton, 2006; Baillieu & Potterton, 2008).

A study in Cape Town (Smith et. al., 2008) indicated that children with HIV experience delay in neurocognitive functioning even after commencing Highly Active Antiretroviral Treatment (HAART). This highlights a need for neurodevelopmental intervention in addition to antiretroviral treatment (ART). In the Cape Town study, specific deficits were found in visual-motor integration (VMI) and the related components of visual perception (VP) and motor coordination (MC) (Smith. et. al., 2008).

"Visual-motor integration is the degree to which visual perception and finger hand movements are well coordinated" (Beery, 2006, p.12). VMI is an important aspect of development that has been found to be essential in the development of pre-academic skills such as handwriting (Daly et. al, 2003). It has also been related to the academic performance of school children (Kulp, 1999). Nozyce et. al. (2006) states that the cognitive, motor, language and perceptual delays experienced by children infected with HIV will affect academic performance.

It can be concluded that neurodevelopmental delay, particularly in visual-motor integration in children infected with HIV will affect pre-academic skills at school. There is a lack of research in this area particularly as visual motor integration can impact a child's academic performance in later years (Dankert et. al., 2003).

A study on clinically stable HIV positive school-going children revealed that motor and cognitive deficits are still evident in children despite receiving ART (Nozyce et.

al., 2006). Apart from receiving ART, the timing of ART and the level of CD4 count have an impact on the extent of neurodevelopmental delay (Burns et. al., 2008; Smith et. al., 2008). These are important factors to consider when looking at the extent of neurodevelopmental delay in HIV infected children.

A recommendation from studies in neurodevelopmental delay has been to investigate various neurodevelopmental interventions and the effect of such interventions on children who are infected with HIV (Burns et. al., 2008; Ferguson & Jelsma, 2009; Baillieu et. al., 2008; Van Rie et. al., 2009; Shanbhag et. al., 2005). A study conducted in Soweto, South Africa showed that the implementation of a basic home stimulation programme improved the cognitive and motor development of children with HIV (Potterton, 2010). Although occupational therapists are involved with the intervention for motor and cognitive delay, research on the effects of HIV on visual motor integration and visual perception are not well understood.

Due to a large number of children infected with HIV in South Africa being of a lower socioeconomic status the association between socioeconomic status and the possible delay in VMI development in this group of children must also be considered. Research in South Africa shows that young children from low and middle socioeconomic backgrounds achieve similar scores on the Beery Buktenica test of VMI (Beery VMI), but are significantly lower than those from high socioeconomic backgrounds (Dunn et. al., 2006).

The need for further research to be implemented in South Africa on the prevalence and extent of the neurodevelopmental delay of HIV-infected children, particularly in visual-motor integration due to its effect on pre-academic occupational performance has been highlighted. Apart from determining the possible delay in visual-motor integration, there is a further need to investigate the outcome of intervention strategies to determine if the neurodevelopmental delay can be improved while receiving ART. Therefore the development of a basic visual-motor treatment programme is proposed to improve the neurodevelopment, in particular, the visual motor integration of preschool children infected with HIV.

1.2 Problem Statement

The extent of the visual motor integration delay of pre-school children infected with HIV is unknown. There is a need to determine the nature of intervention strategies to address these difficulties. In addition, there are many factors that can impact on VMI scores with the CD4 count and ART being the most significant. Other factors such as culture, socioeconomic status and the use of the Beery VMI on a South African population need to be considered. These will all be explored in this research study.

1.3 Rationale for the study

Research to investigate the extent of the visual motor integration delay in children infected with HIV is important as an increasing amount of clinically stable children infected with HIV are now entering the schooling sector. While research has shown an improvement in visual-motor skills in children through intervention (Dankert et. al., 2003), there is little known research on the type and outcome of treatment interventions in preschool children with HIV who have visual motor integration delay, particularly in the South African context. This can increase an awareness of the need to provide therapeutic intervention for pre-school children infected with HIV.

1.4 Research Question

- What is the extent of the delay of visual motor integration in pre-school children with vertically transmitted HIV attending a clinic at a public hospital in Johannesburg?
- What visual-motor treatment programme can be developed to treat visual-motor integration difficulties in pre-school children living with HIV?

1.5 Aim

The aim of the study was to determine the extent of the delay of visual motor integration in pre-school children who have vertically transmitted HIV and to compile a basic visual-motor treatment programme for visual motor integration difficulties in pre-school children who have HIV.

1.6 Objectives

To achieve these aims there were two phases in the study, which follow sequentially:

Phase 1

- To determine medical factors related to HIV and the factors indicative of the socioeconomic status of a sample of five-six year old pre-school children living with HIV attending Empilweni clinic
- To determine the visual motor integration, visual perception and motor coordination scores using the Beery VMI test on a sample of five-six year old pre-school children living with HIV attending Empilweni clinic
- To determine the association between the visual motor integration, the visual perception and the motor coordination scores on the Beery VMI test in five-six year old pre-school children living with HIV
- To determine the association between visual motor integration, visual perception and motor coordination scores and medical factors related to HIV as well as the socioeconomic factors in a sample of five-six year old pre-school children living with HIV

Phase 2

- To develop a visual-motor treatment programme for children with HIV attending Empilweni clinic.
- To determine the content validity of the visual-motor treatment programme through initial expert review

1.7 Overview of the study

The study first involved determining the deficits in visual motor integration, visual perception and motor coordination in five-six year old pre-school children who have HIV. A programme to address these deficits was then developed and initially reviewed by experts for content validity. In order to provide more clarity the phases of the research are outlined in greater detail below:

- **Phase 1: Visual motor integration in preschool children living with HIV**

  This phase was a descriptive study to determine the visual motor integration, visual perception and motor coordination delay in five-six-year-old pre-school children living with HIV who receive ART. The socioeconomic status of these children could have also affected their VMI scores so this will be considered in the interpretation of the results in addition to the effect of medical factors related to HIV. The results from this phase of the study guided the development of the visual-motor treatment programme in Phase 2.

- **Phase 2: Development of the visual-motor treatment programme**

  This phase used the steps and criteria of programme development to create a visual-motor treatment programme. The programme was specific to the deficits identified in Phase 1 of the study for five-six year old pre-school children living with HIV in South Africa. The outline of the visual motor treatment programme was sent to experts for initial review to determine content validity.

The phases of the study have been presented in the following chapters:

- **Chapter 1: Introduction**

This chapter introduces the topic, the issues around neurodevelopmental delay and the need for therapeutic intervention particularly to address the VMI difficulties of preschool children with HIV. It is a ‘snapshot’ of the study as a whole by providing a rationale for the study and outlines the research question, aims, objectives and phases of the study.

- **Chapter 2: Literature Review**

This chapter follows a descriptive approach to engaging with current literature and research on the various topics related to the study. The current access to HIV treatment in South Africa, the neurocognitive effects of HIV and the complex interplay between VMI, VP and MC have been critically analysed.

- **Chapter 3: Phase 1 Methodology and Results**

This chapter presents the methodology used to determine the extent of the visual motor integration, visual perception, motor coordination delay and the socioeconomic status of a sample of pre-school children infected with HIV. The results of phase 1 have also been analysed in order to inform the visual-motor treatment programme.

- **Chapter 4: Phase 1 Discussion**

The results of phase 1, which determines the extent of the visual motor integration delay and the factors impacting on the results will be explored in greater detail in this chapter. Some of the factors include socioeconomic status, medical factors and the reliability and validity of the Beery VMI test on a South African population.

- **Chapter 5: Phase 2 The design of a visual-motor treatment programme for pre-school children with HIV**

This chapter outlines the steps of intervention research used in a qualitative approach to compiling the visual-motor treatment programme. The outline of the treatment programme in addition to the theories, frames of reference and other intervention programmes utilised to inform the visual-motor treatment programme have been critically analysed in this chapter. The details around initial expert review for content validity have also been included in this chapter as part of the formulation of the design of the treatment programme.

- **Chapter 6: Conclusion**

The study's ability to meet the objectives outlined will be discussed in this chapter. Limitations and recommendations for further research will also be discussed in this chapter.

CHAPTER 2: LITERATURE REVIEW

"...in serving the best interests of children, we serve the best interests of all humanity."
Carol Bellamy

2.1 Introduction

This chapter begins with a brief overview of the current HIV treatment and statistics on access to treatment in South Africa. The neurological and neurocognitive effects of HIV and its corresponding outfall in visual motor integration, visual perception and motor coordination will be critically analysed. In addition, the importance of visual perception on the academic development of pre-school children and the current developmental norms will be highlighted.

The information for this literature review has been gathered using Pubmed, EBSCO, ERIC, PsycINFO, government policy documents and a hand search conducted at the University of the Witwatersrand Health Sciences Library and the Education Library.

2.2. The current status of children with HIV in South African children.

While the most recent United Nations report published in 2016 revealed a 50% global decrease of new HIV infections amongst children, 150 000 children became newly infected with HIV in 2015 globally (UNAIDS, 2016). Over 90% of children infected with HIV live in the African continent where it is reported only 28% receive the ART they need (UNAIDS, 2013).

The South African journey to providing universal access to ART has been riddled with controversy. The South African's government's failure in responding to the HIV epidemic initially meant that a large number of people became infected at the beginning of the epidemic. This has resulted in the biggest antiretroviral treatment rollout programme in the world. About 4 out of 10 people living with HIV in South Africa received ART according to UNAIDS 2013 estimates (UNAIDS, 2014). The recent Global AIDS Update 2016 report now estimates that 3.4 million people in South Africa are currently receiving ART (UNAIDS, 2016).

Due to the large ART rollout, as of 2015 according to the United Nation's Children Fund (UNICEF) seventh stocktaking report (UNICEF, 2016), an estimated 240 000 children are living with HIV, down from 330 000 children in 2010 (UNAIDS, 2010). This could largely be due to the increase in the prevention of mother to child transmission (PMTCT) resulting in more than 95% of infants born to HIV positive women started on ART. Therefore as of 2015, 74% of children infected with HIV are receiving ART (UNICEF, 2015), and this should increase with the new policies introduced in 2016 to provide greater coverage of treatment with ART (SANAC, 2016).

In order to combat the growing number of children infected with HIV, the government put into place numerous programmes such as the Comprehensive Care, Management, Treatment and Support Programme (CCMTS) in 2003 to the National Strategic Plan on sexually transmitted infections (STIs) and tuberculosis (TB) 2007-2011 (SANAC, 2006). Following this the National Strategic Plan on HIV and AIDS, TB and STIs 2012-2016 (SANAC, 2011) was developed. This plan highlights objectives to prevent new infections and to sustain health and wellness amongst others.

Wachsler-Felder and Golden (2002) indicate that the largest route of transmission of the HIV virus in children under the age of 15 is through vertical transmission (mother-to-child) occurring either in-utero, intrapartum or through breastfeeding. Prevention of mother to child transmission (PMTCT) increased from 57% in 2011 to 62% in 2012 globally (UNAIDS, 2013). Between 2009 and 2015, a 60% decline in new HIV infections was seen for children with South Africa recording an 84% decline, which means that 330 000 new infections were averted. In this country in 2015, only 4.7% of infants exposed to HIV at birth were testing positive at six weeks and were eligible for early treatment with ART (Avert, 2015). While transmission of HIV through blood transfusion or through contaminated blood products can occur, since the universal screening of donated blood commenced in 1985, this mode of transmission has declined (Wachsler-Felder & Golden, 2002).

However being a neurotropic virus, HIV crosses the blood brain barrier damaging the central nervous system (Potterton et. al., 2010; Ferguson & Jelsma, 2009) early in infection (Mitchell, 2001). Therefore children who are HIV positive need to be monitored from an early age.

2.3 The neurological and neurocognitive implications of the HIV virus in children.

A review of literature pertaining to the neuropsychological consequences of HIV in children indicates that the virus invades the central nervous system (CNS) (Wachsler-Felder & Golden, 2002) infecting perivascular macrophages and microglia leading to inflammation, cell death and attrition (Smith et al., 2008). Mitchell (2001) suggests that apoptosis is the probable means by which neuronal damage occurs (Mitchell, 2001). This damage to the CNS leads to an HIV associated encephalopathy (Smith et. al., 2008), which has been known to be an AIDS-defining illness occurring before the child is severely immunocompromised (Mitchell, 2001). Cognitive, motor and behavioural outfalls are the common clinical manifestations seen in children with encephalopathy (Baillieu & Potterton, 2008). These outfalls have been documented to occur in up to 80% of HIV infected children (Smith et al., 2008).

Infants with vertically transmitted HIV infection present with significantly lower scores on the mental scale of the Bayley Scales of Infant Development (Baillieu & Potterton, 2008; Blanchette et. al., 2001) indicating the presence of cognitive impairment. Delays have also been evident in visual-spatial tasks, processing and speed (Van Rie et al., 2009). In addition, language impairments, attention and memory deficits (Mitchell, 2001) are present leading to poor school achievement (Burns et al., 2008), which can eventually lead to earning lower wages as adults (Van Rie et al., 2009).

The CD4 count in children infected with HIV not only determine the extent of the spread of the HIV virus systemically but also the degree of cognitive impairment (Burns et. al., 2008). Burns et. al. (2008) also identified that HIV infected children with a lower CD4 count score lower on visual-spatial orientation, reading and spelling compared to children who have a higher CD4 count. Apart from the cognitive impairment identified in HIV infected children, emotional liability leads to a loss of interest in school performance and social withdrawal (Wachsler-Felder & Golden, 2002).

High maternal viral loads (Mitchell, 2001) and other factors such as limited maternal education, poor household intellectual stimulation and malnutrition can impact negatively on neurocognitive development (Smith et. al., 2008). Due to the weakened immune system of the HIV infected child, other opportunistic infections such as acute bacterial meningitis, cytomegalovirus co-infection, epstein-barr virus associated primary lymphoma, tuberculous meningitis and cryptococcal meningitis also cause damage to the CNS (Smith et. al., 2008).

However, even when factors such as prenatal drug exposure and socioeconomic status are controlled, neurocognitive deficits are still evident with the deficits present from infancy across childhood development (Burns et al., 2008). HIV has been known to "...have a greater effect on development than any other factors including poverty" (Baillieu & Potterton, 2008; p. 120).

2.3.1 HIV associated encephalopathy

Deficits caused by HIV associated encephalopathy (Smith et al., 2008) can be viewed on radiological images. Neuroimaging of the brain of HIV infected children presenting with encephalopathy reveal diffuse atrophy and bifrontal white matter abnormalities (Safriel et al., 2000). Two types of encephalopathy known as progressive and static encephalopathy have been identified in children with HIV. Progressive encephalopathy is characterised by a failure to obtain or the loss of developmental milestones particularly in neurocognitive and motor areas, therefore making it the more severe form of encephalopathy (Smith et. al., 2008; Safriel et. al., 2000; Shanbhag et. al., 2005). Other features include microcephaly, brain atrophy, delay in language skills, irritability, inattention, and spasticity particularly of the lower limbs (Mitchell, 2001). Shanbhag et. al. (2005) describe static encephalopathy as a "...fixed, non-progressive abnormality in either gross motor skills, learning abilities or acquisition of developmental milestones" (p. 651). In contrast to progressive encephalopathy, children presenting with static encephalopathy exhibit better functioning with some deficits still observed in neurocognition (Safriel et. al., 2000).

Factors impacting on the degree of encephalopathy are the age at which infection occurs and the mode of transmission (Mitchell, 2001). Smith et. al. (2008) identified that children who contracted HIV at birth were at greater risk for developing an encephalopathy compared to those who contracted HIV after birth (Smith et. al., 2008). A prospective study of children infected by HIV via vertical transmission discovered a higher incidence of static arrested encephalopathy in 10% of children compared to 1.6% of children who develop progressive encephalopathy (Van Rie et. al., 2009)

The severity of the HIV associated encephalopathy is also dependent on the extent of the atrophy and white matter abnormalities in the child's brain (Safriel et. al., 2000) with basal ganglia calcifications found in up to 33% of HIV-infected children in the global pallidus and putamen bilaterally. Other changes include subcortical frontal white matter and cerebellum calcification (Safriel et. al., 2000). Brouwers et. al. (1995) identified a significant relationship between the level of these CNS abnormalities and the stage of HIV infection. Burns et. al. (2008) also showed that not only does the level of CNS abnormality relate to the stage of HIV infection but also to the degree of the child's motor and cognitive impairment as seen by scores of their participants on the Bayley Scales of Infant Development (Burns et. al., 2008).

In order to manage HIV infections and reduce the effects of the virus on the CNS, specific treatment guidelines are used in South Africa in relation to the treatment for children (Department of Health, 2015).

2.3.2 Implications of early antiretroviral treatment on HIV infection in children

In March 2013 the South African National Department of Health released new ART guidelines for infants and children, which was revised in 2015. The new regimen specifies that all HIV-infected children below the age of 5 years and not 1 year as stated previously (Department of Health, 2007), are eligible to start ART irrespective of their CD4 count (Department of Health, 2015). This decision was based on HIV research that indicates that the neurological and neurocognitive outcome for children with HIV is determined by the age of starting ART with a better prognosis for those receiving ART at an early age (Ferguson & Jelsma, 2009; Resino et. al., 2006; Smith et. al., 2008; Van Rie et. al., 2009); regardless of the CD4 count (Potterton et. al., 2010). Smith et. al (2008) showed during their research that while the commencement of ART in early infancy can lead to a reduction of the effect of HIV on the CNS to less than 2%, neurological and cognitive deficits still persist after treatment (Smith et. al., 2008).

The Department of Health (2015) has specified that the criteria has also changed for children between the ages of 5 - 10 years, with ART commencing either when symptomatic or when CD4 < 500 cells/ɥl is indicated regardless of WHO stage. Children younger than 5 years will receive ART regardless of their CD4 cell count or clinical staging with immediate initiation of ART for infants with the first positive HIV Polymerase Chain Reaction (PCR) test. Children between 3 - 10 years and weighing more than 10kg will continue to receive a Highly Active Antiretroviral Treatment (HAART) combination of Abacavir (ABC) + Lamivudine (3TC) and Efavirenz (EFV) (Department of Health, 2015).

This combination of three antiretroviral agents has led to children experiencing improved virological control with immune reconstitution (Shanbhag et. al., 2005). In fact, drugs such as zidovudine, efavirenz, stavudine and nevirapine, which are part of the South African ART regimen by the Department of Health (2015) have been demonstrated to have better cerebrospinal fluid penetration than other antiretroviral drugs (Department of Health, 2013; Shanbhag et. al., 2005). Research has also indicated that aggressive antiretroviral treatment has been known to "...halt or even reverse the signs of encephalopathy, even in the face of apparently static structural damage such as basal ganglia calcifications and deep white matter abnormalities" (Mitchell, 2001; p.214).

Antiretroviral medication can in certain instances cause multisystem failure or dysfunction, in particular, Nucleoside Reverse Transcriptase Inhibitors (NRTIs) such as zidovudine. However, a detailed review of zidovudine exposed children, who when the drug was used prophylactically in trials conducted by the Pediatric AIDS Clinical Trials Group (PACTG), did not find any detrimental side effects (Mitchell, 2001). Despite the possible above-mentioned adverse effects, clinical research still suggests that combination antiretroviral therapy can improve neurological and neurocognitive functioning and can halt the progress of HIV-associated encephalopathy (Smith et. al., 2008; Mitchell, 2001; Shanbhag et. al., 2005; Potterton et. al., 2010).

The efficacy of the treatment is determined by many factors such as the age of commencing treatment, the quantity of CD4 cells and the viral load (Resino et. al., 2006). While combination antiretroviral therapy is associated with improved neurological function, there is still a significant percentage of children who experience a neurocognitive delay. This can be due to the relationship between systemic and CSF viral load and suboptimal penetration of antiretroviral agents (Shanbhag et. al., 2005). A study conducted by Smith et. al. (2008) discovered that statistically significant changes were present in the CD4 percentage, log 10 and viral load levels six months post HAART but deficits in visual perception and language scores remained unchanged. This finding indicated that while viral levels had decreased, delays in neurodevelopment still remained (Smith et al., 2008). Therefore Van Rie et. al. (2009) highlighted the need for a combination of HAART and neurodevelopmental intervention to maintain the neurodevelopment of HIV infected children.

2.4. The impact of antiretroviral treatment on specific neurocognitive deficits associated with HIV infected children

Many studies have been conducted which depict the specific neurocognitive deficits in children infected with HIV (Puthanakit et. al., 2013; Bocanegra, 2008; Smith et. al., 2008; Fishkin et. al., 2000; Kerr et. al, 2014; Wang et. al., 2011; Wachsler-Felder et. al., 2002). Wachsler-Felder et. al. (2002) in their review of the literature reported on specific cognitive impairments in children with HIV. A French study found that while two-thirds of six year old HIV infected children exhibit normal elementary school performance in tests of general abilities, language and motor function; they displayed visual-spatial impairment and time orientation difficulties (Wachsler-Felder & Golden, 2002). When Lowenthal, et al. (2012) screened for psychosocial dysfunction in 692 HIV-infected treated children in Botswana, delays were identified in attention, problem-solving, planning, visual-spatial processing and visual motor integration. They reported this has far reaching consequences from a functional point of view on activities of daily living such as dressing and handwriting (Lowenthal, et al., 2012).

When looking at the impact of ART on the neurodevelopment of children with HIV; Bocanegra (2008) study of 161 HIV infected children receiving three types of treatment (Mono/Combination Therapy, Mono/Combination converted to HAART, HAART) confirmed better immune functioning in those receiving HAART compared to the other earlier forms of treatment. The study results, however, indicated that neurocognitive areas that develop earlier (language) and those that develop later (visual motor integration) are not impacted by treatment type. This indicates that even HAART does not protect neurocognitive functioning (Bocanegra, 2008). However, a limitation of the research could be that biological and environmental factors were impacting on the neurodevelopment of the participants in the study. Another crucial limitation was the initiation of treatment for the HAART and the Convertors group at the age of six years and so delays in neurodevelopment would have occurred at an earlier age. This also indicates the need for the treatment regimen to be initiated at an earlier age.

So the PREDICT study (Puthanakit et. al., 2013) sought to determine whether the timing of ART intervention at CD4% 15%-24% versus CD4% <15% impacted on neurodevelopmental outcomes of 284 HIV infected children aged 1-12 years at week 144 of treatment. Puthanakit et. al. (2013) conducted neurodevelopmental testing on specific areas such as IQ, memory, visual motor integration, fine motor and behaviour on 284 Thai and Cambodian children aged 1-12 years. The results displayed that HIV infected children at CD4% 15%-24% and <15% performed worse than uninfected children thereby indicating that ART should be initiated in infancy (Puthanakit et. al., 2013). In fact, a study by Laughton et. al. (2012) determined that ART should be initiated in HIV infected children in early infancy before three months of age.

In Puthanakit et. al. (2013) study, neurodevelopment was only assessed once at week 144 and not at initiation. Therefore the impact of ART on neurodevelopment over time could not be determined. Smith et al (2008) in their longitudinal study of 40 ambulant HIV infected children before and after six months of HAART found specific deficits related to language and visual perception. In addition locomotor, hearing, speech and motor performance scored in the mild disability range. The above deficits did not show any statistical difference before and after six months of receiving HAART again indicating that HAART did not impact on neurocognitive functioning. This study did not have control participants in other areas that may impact on neurodevelopment such as socioeconomic status and maternal emotional status.

In order to factor in the impact of socioeconomic status, Fishkin et al., (2000) had matched controls in their study. Fishkin et. al. (2000) study participants expected significant deficits in neurodevelopment, particularly in the frontal and prefrontal brain areas of 40 perinatal HIV infected children aged between 3 - 5 years on the Wechsler Primary and Preschool Scale of Intelligence Revised (WPPSI-R). However, a significant difference was found in the Block Design subtest of the WPPSI-R only, which is associated with parietal lobe function. The block design subtest of the WPPSI-R requires processing speed, visual motor integration, sustained attention, motor speed and coordination which are functions usually associated with the frontal cortex in addition to the parietal lobe (Fishkin et. al., 2000). This study is significant as prior to this study no MRI or CT scan abnormalities were reported in the parietal region (Fishkin et. al., 2000).

Wang et. al., (2011) revealed neurological effects on the Lateral Occipital Complex (LOC) network. This study investigated resting state functional connectivity in 15 participants infected with HIV < 1 year with 15 age-matched controls. The participants underwent structural and functional MRIs and neuropsychological tests assessing motor skills, cognitive flexibility, abstraction, verbal memory, nonverbal memory and visuoconstructional skills. The LOC showed a significant difference in the HIV infected participants, which is known to include the occipital lobe extending laterally towards the occipitotemporal region and dorsally into the posterior parietal region. The posterior parietal region is essential for visual motor integration, which is the integration of visual perception and motor movements. Neuropsychological tests identified correlating deficits in visual motor performance indicating that an alteration in LOC network functional connectivity may cause impaired performance in visual motor integration (Wang et. al., 2011).

While the studies mentioned above have looked at the impact of ART on children infected with HIV, a study by Kerr et. al (2014), hypothesised that neurodevelopmental differences would be lower in children exposed but uninfected by HIV (HEU) compared to those who were unexposed and uninfected by HIV (HUU). The participants used in this study were the controls used in the PREDICT neurodevelopmental study (Puthanakit, 2013) and the analyses were adjusted for socioeconomic status in areas of caregiver education, parent as caregiver, household income, age and ethnicity (Kerr et. al., 2014). The HEU children had statistically lower scores in the Wechsler Verbal IQ (VIQ), Full Scale IQ (FSIQ) and Stanford Binet Bead Memory scores compared to HUU children.

However, in this study, no significant differences were noted in the areas of visual motor integration, cognitive and other behavioural domains (Kerr et. al., 2014).

The above-mentioned studies (Puthanakit et al., 2013; Fishkin et. al, 2000; Wang et. al., 2011; Smith et. al., 2008; Bocanegra, 2008) showed neurodevelopmental deficits in children exposed and infected with HIV of various ages having undertaken ART. Therefore there is '...irreversible but non progressive HIV brain insult even in the presence of successful ART when ART is initiated in older children." (Puthanakit et. al. 2013; p. 506).

2.5. The complex interplay of visual and perceptual client factors on motor and process skills- visual information analysis

"Occupations refer to the everyday activities that people do as individuals, in families and communities to occupy time and bring meaning and purpose to life' (AOTA, 2014; p. S5). Occupations are influenced by client factors, performance skills and performance patterns. Performance skills include motor and process skills, which are learned and developed over time within specific contexts and environments. These motor and process skills require the integration of the body structures and functions of client factors as identified by the WHO International System of Classification and Functioning (AOTA, 2014).

Vision can be considered the most influential body function when learning about the environment. Children are known to use vision and cognition to explore the environment and gain mastery in occupations of activities of daily living, education, play and social participation (Case-Smith, 2005; Kramer & Hinojosa, 1999; AOTA, 2014). Visual information analysis is required to learn and gain mastery from the visual environment. 'Visual information analysis refers to the cognitive skills used for extracting and organising visual information from the environment and integrating this information with other sensory modalities, previous experiences and higher cognitive functions (Kramer & Hinojosa, 1999; p. 205). Visual information analysis is a complex process that requires the integration of the visual receptive and visual cognitive system in order for functional vision to occur (Case-Smith et. al, 2005). Therefore visual information analysis is a frame of reference that is used to '...explain the process by which visual motor and visual perceptual skills develop and the effect of learning on the process of development of these skills." (Vaidya, 2008; p. 9). The frame of reference can be explained in the diagram below:

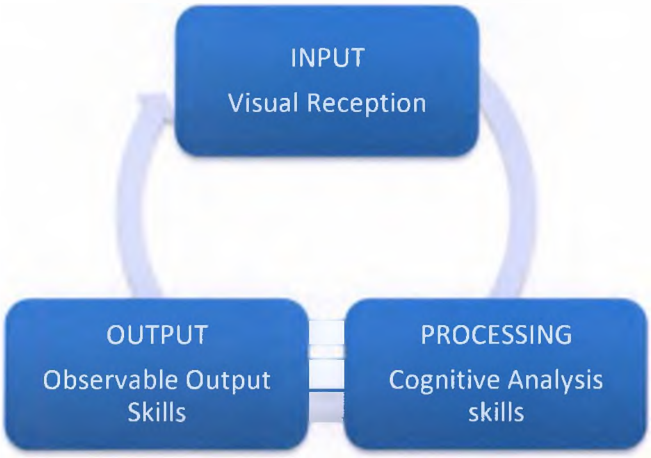


Figure 2.1 Adapted from Visual Information Analysis (Kramer & Hinojosa, 1999; p. 210).

Visual receptive (sensory functions) of visual acuity, visual fields along with adequate oculomotor control are initially needed to attend and focus on a stimulus (Case-Smith et. al., 2005; Vlok et. al., 2011). In fact, Vlok et. al. (2011) goes so far as to recommend that eye exercises are an integral part of activity participation. The integration of visual receptive functions with vestibular, tactile and proprioceptive functions is necessary for visually directed motor performance to take place (AOTA, 2014; Kramer & Hinojosa, 1999).

After the reception of visual information, interpretation of the stimulus needs to occur on a cognitive level. Visual cognitive client factors include visual attention, visual memory and visual discrimination (recognition, matching, categorisation, detection of relationships). The visual perception skills of form and space perception are a part of visual discrimination (Case-Smith, 2005; Kramer & Hinojosa, 1999; Vaidya, 2008). These cognitive analysis skills provide meaning to the stimulus received from visual receptive functions (Case-Smith et. al., 2005; Kramer & Hinojosa, 1999). The development of these skills will have an impact on the motor and process performance skills necessary for adequate occupational performance.

In addition to the visual receptive and visual cognitive client factors already mentioned, motor performance skills of posture, mobility and coordination are impacted by the visual system (Case-Smith et. al., 2005; AOTA, 2014). A study conducted by Smith et. al (2002) revealed that the fine motor components of eye hand coordination and manual dexterity scored a low performance compared to the other areas of grasping and hand use in a sample of HIV positive children measured with the Peabody developmental motor scales. This indicates that aspects of fine motor performance related to motor planning, timing and sequencing are impacted in children with HIV (Case-Smith, et al., 2005).

Along with motor skills, process skills of pacing, organisation of space and objects; and task adaptation can be impacted by visual perception (Case-Smith et. al., 2005; AOTA, 2014). In addition praxis elements of imitating, sequencing and constructing all impact on the performance of goal-directed actions (AOTA, 2014).

Case-Smith et. al. (2005) highlight that children with parietal lobe changes may have difficulty using vision to guide body movements. As mentioned previously Wang et. al. (2011) identified in their study that neurological effects were noted in the posterior parietal region, which is essential for the visual motor integration of visual perception and motor movements. Visual perceptual client factors, motor skills and the resultant visual motor integration should, therefore, be investigated in children infected with HIV to determine if any deficits exist. As can be seen from above, a complex interplay exists between visual skills, visual perception, visual motor skills and praxis, which all inform adequate participation in occupation. This complex interplay can be represented in the diagram below:

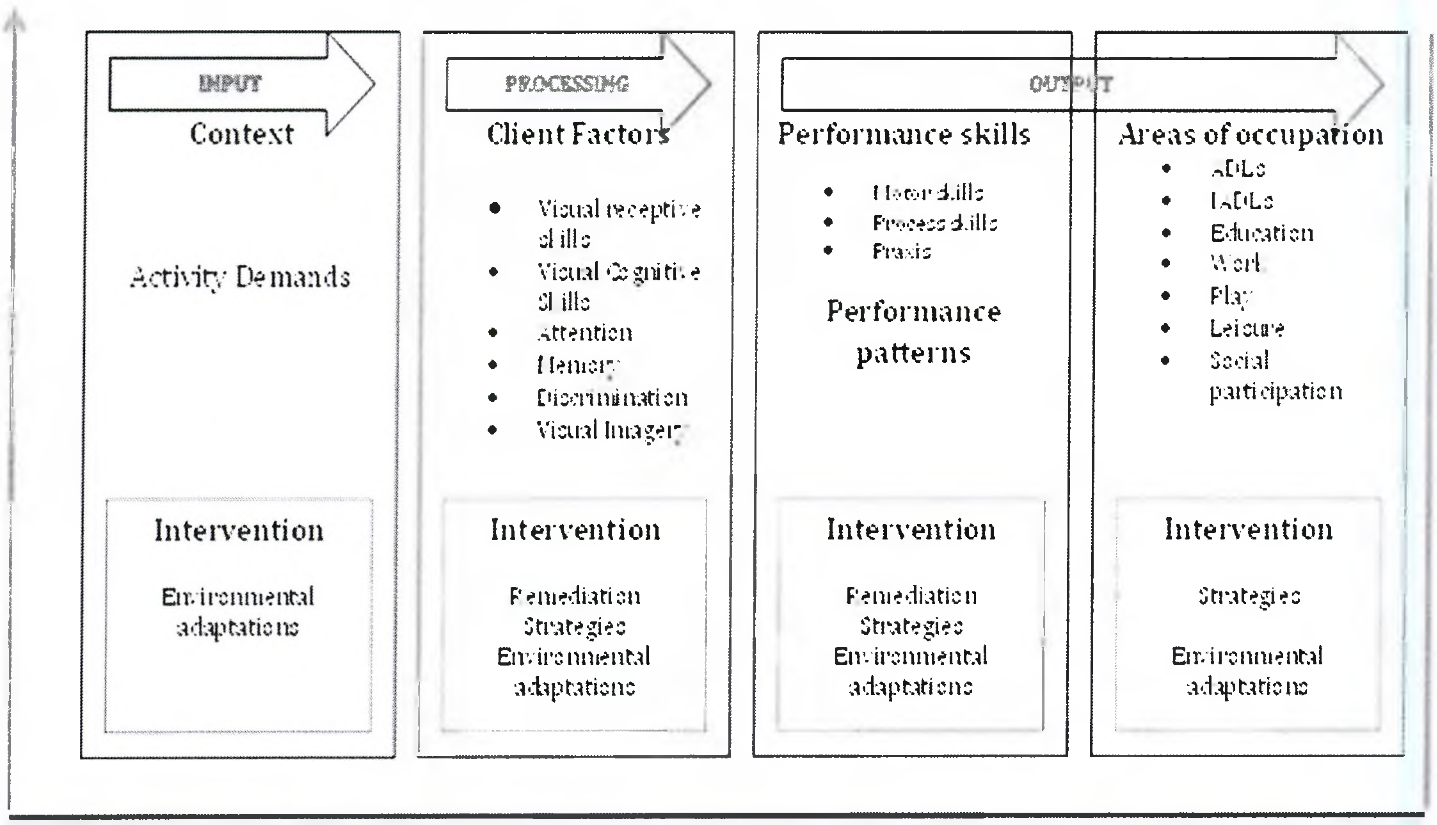


Figure 2.2 Complex interplay of factors impacting on Occupation Visual Processing model (Kramer & Hinojosa, 2010)

2.5.1. Visual Perceptual client factors

Visual perception has been defined as the process of receiving and interpreting visual information (Case-Smith & Clifford O'Brien, 2013; Kulp, 1999). Visual perception is a learnt skill and includes vision, visual perceptual abilities and cognitive abilities (Vlok, 2011).

Visual information is initially received by the eye and then travels via the optic nerve to the occipital cortex. The refined visual information from the occipital cortex then travels via two streams. The dorsal stream leads to the posterior parietal lobe where spatial perception takes place. This includes position in space (spatial relationship of an object to itself or to another), depth perception (distance between objects and backgrounds) and topographic orientation (location of objects and the route towards them) (Case-Smith & Clifford O'Brien, 2013)

The second ventral stream travels to the inferior temporal lobe where object (form perception) takes place. Form perception includes form constancy (recognition of objects remaining the same despite being in various environments, positions and sizes), visual closure (identification of forms when presented in an incomplete form) and figure ground (differentiation between the foreground and background of objects) perception (Case-Smith & Clifford O'Brien, 2013).

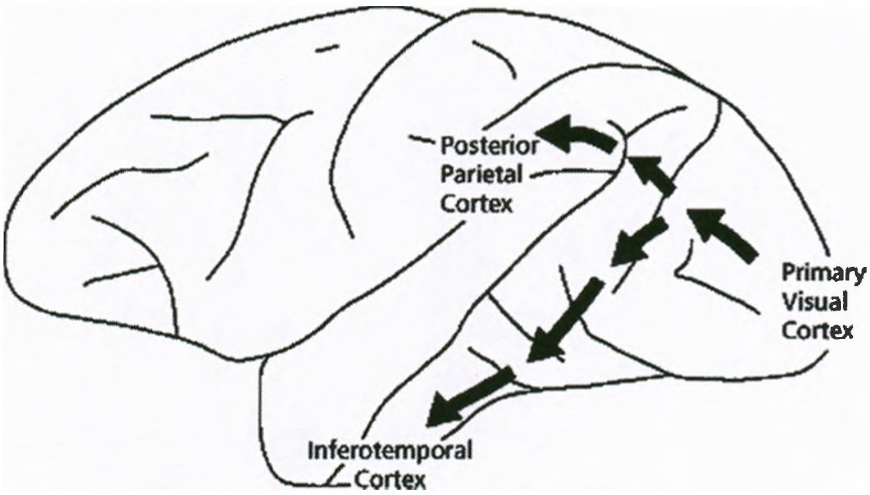


Figure 2.3 A schematic diagram of Ungerleider and Mishkin's original (1982) model of the two streams of visual processing in the primate cerebral cortex. The brain illustrated is that of a macaque monkey. (Milner, et al., 2012)

A stage most often overlooked in visual perception is the final stage of visual information processing which involves utilising the information gathered to problem-solve, reason and think creatively. It is this cognitive reasoning process after interacting with objects in the environment and with people that enable children to fully participate in activities of daily living (Vlok et. al., 2011).

Delayed visual perception can result in difficulties experienced in activities of daily living ranging from self-care activities such as matching, donning and doffing clothes; to play activities such as constructing blocks, building puzzles; and to prewriting skills such as cutting, pasting and colouring. It can also result in difficulties in academic achievement (Case-Smith & Clifford O'Brien, 2013) particularly in the areas of reading, mathematics and writing in the early school years (Kulp, 1999). It is, therefore, essential that visual perceptual skills develop to allow for functional participation in activities of daily living. Theorists have identified the emergence and maturity of visual perceptual skills to coincide with developmental ages (Vlok, et al., 2011), thereby following a sequence of development.

The table below highlights the emergence of visual perceptual skills to coincide with developmental age.

Table 2.1 Developmental Ages for Emergence of Visual Perceptual Skills (Adapted from Frames of reference; Vlok et. al., 2011)

Perception	**Developmental Age**
Object (form)	
Form constancy	3 year old can sort objects on the basis of one dimension such as shape, size or colour. Improves between 3 - 5 years and stabilises at 6 - 7 years.
Visual closure	At 4 months, an infant is able to perceive partially hidden objects as unitary entities.
Figure ground	Improves between 3 - 5 years of age; growth stabilises at 6 - 7 years of age
Spatial	
Position in space	Develops vertical to horizontal (3 - 4 years) to oblique and diagonal (6 years) Further refinement of position in space by 8 - 9 years
Spatial relations	Reaches accurately at 4 - 8 months Understanding of basic size by 3 years Understands concepts of space and time by 7 years Improves to approximately 10 years of age
Depth perception	Evident at 2 months Developed by 4 - 8 months - shows fear of falling off high places like changing table
Topographic orientation	Improves to approximately 10 years of age

Object and spatial perception are abilities that enable visual discrimination to occur. Visual discrimination is an important aspect of visual cognition that enables the detection of features from objects for recognition, matching, categorisation and detection of relationships (Case-Smith, 2005; Kramer & Hinojosa, 1999). The ability to detect similarities and differences between objects is important for perceptual learning to take place (Kramer & Hinojosa, 1999). Recognition requires the ability to detect the features of an object and to compare the features to the stored image. Matching then identifies whether objects are similar or different. Once features have been recognised and matched, objects are then grouped based on common characteristics. Finally, the detection of relationships is needed to determine relationships between objects (Case-Smith, 2005; Kramer & Hinojosa, 1999).

As can be seen, visual perception is a complex process and is essential for learning to take place. Through observation of the environment, people and objects, meaning is derived through cognitive reasoning which allows for children to participate in everyday tasks (Vlok, 2011).

2.5.2. Motor coordination

Motor coordination at a fine motor level involves the use of finger and hand movements (Beery, 2006). Finger and hand movements are essential to complete activities of daily living such as handwriting, cutting and dressing (Case-Smith, 2005; Beery, 2006).

Motor coordination requires the control of voluntary movement which includes body functions such as eye hand coordination, manual dexterity, grasping and hand use (AOTA, 2014; Smith et. al., 2002). A study by Smith et. al. (2002) on the motor skill development of children infected with HIV found delays in gross motor skills and in the fine motor skill areas of eye hand coordination and manual dexterity. Eye hand coordination and manual dexterity require a complex interaction of skill areas such as grading of physical effort, timing, sequencing, motor planning and visual perception. Greater levels of concentration, precision and control are needed particularly in paper pencil tasks of tracing/copying figures (Smith et. al., 2002) that are visually guided (Kulp, 1999).

Poor pencil grip can also impact on motor coordination as identified by Sortor & Kulp (2003). The developmental progression of the pencil grip correlates with the hand's ability to utilise the fingers for digital manipulation of the pencil as observed in the dynamic tripod grasp (Schneck & Henderson, 1990). Other factors impacting on pencil grip include posture and proprioceptive-kinaesthetic feedback (Schneck, 1991). A stable sitting position is required to ensure that proximal stability is maintained to allow for distal arm use (Vlok, 2011).

Due to the many factors impacting on motor coordination (Smith et. al., 2002), intervention in this area requires the use of various activities such as arts and crafts, finger plays and small manipulative activities (Dankert et. al., 2003). The use of these activities with a combination of gross motor, visual motor and visual perception activities has positive effects on the visual-motor skills of preschool children (Dankert et. al., 2003). Therefore motor coordination plays an important role in the development of visual motor integration as young children learn via tactile and kinaesthetic senses and need to relate new visual perceptual concepts at a motor level (Case-Smith & Clifford O'Brien, 2013).

2.5.3. Visual Motor integration

Visual-motor skills, which is also known as visual motor integration (VMI) has been defined by Beery (2006) as the '...degree to which visual perception and finger-hand movements are well coordinated' (p. 12).

Dankert et. al. (2003) further identified visual-motor skills as the integration of visual images of letters or shapes with a motor output. Table 2.2 highlights the emerging ages of design copying which is an indication of the maturation of visual motor integration. The integration of visual and motor skills are therefore multifaceted and are influenced by a number of factors such as pencil grip, fine motor skills, eye hand coordination, kinesthesia, motor planning and visual perceptual skills (Dankert et. al., 2003).

Visual motor integration (VMI) itself is an important component of handwriting (Daly et. al., 2003; Kulp, 1999) with a strong correlation between VMI and the ability to copy letter forms (Daly et. al., 2003). In fact, Case-Smith (2001) even states that VMI is the best predictor of handwriting and is an important pre-writing skill (Daly et. al., 2003).

Table 2.2 Emerging ages of design copying: an indication of visual motor integration development (Adapted from Case-Smith, 2005 & Williams, H., 1993)

Age Level	Performance Task	Characteristic of early development
1 year	Scribbles on paper	Motor expression unrelated to any goal
2 years	Imitates horizontal, vertical and circular marks on paper	Spontaneous motor production but is visually responsive to the scribbles produced
3 years	Copies a vertical line, horizontal line, and circle	Begins to pay attention to the characteristics of the visual model presented for copying
4-5 years	Copies a cross, right oblique line, square, left diagonal line, left oblique cross, some letters and numerals, and may be able to write own name	Begins to make drawings that have angular and smooth contours
5-6 years	Copies a triangle, prints own name, copies most lowercase and uppercase letters	Definite organisation of drawing to visual model presented, copying undergoing refinement

Dankert et. al. (2003) states that good visual-motor development precludes academic performance in kindergarten and primary school. A study by Adi-Japha & Freeman (2001) provides evidence that the motor and visual processes used in drawing geometric figures are the same used in writing letters for pre-school aged children. In fact, children in kindergarten are refining their fine motor and visual perceptual skills that enable visual motor integration for activities such as handwriting (Daly et. al., 2003).

Daly et. al. (2003) conducted a study of 54 typically developing kindergarten children using the Beery VMI, which is a standardised assessment of visual motor integration. Strong positive relationships were identified between the Beery VMI scores and the ability to copy letters legibly. However, only a convenience sample of typically developing children was assessed and the implications for children with disabilities could not be determined.

Children in kindergarten are known to rely more on visual feedback in handwriting and therefore visual motor integration plays an influential role in the early stages of letter formation (Goyen & Duff, 2004). Therefore the development of good visual motor integration is essential for pre-academic (copying shapes) and academic performance (writing letters) of children (Dankert et. al., 2003).

While visual motor integration may play an important role in the handwriting development of kindergarten children, the extent of the association between VMI and handwriting dysfunction in older children cannot be conclusively determined (Goyen & Duff, 2004). Goyen & Duff (2004) study of 35 children with and without handwriting dysfunction in grades 4-6 revealed only a 34% sensitivity of the Beery VMI to handwriting dysfunction. It should also be noted that handwriting is a complex occupation with many underlying performance skills influencing it such as visual-motor abilities, cognitive and perceptual processes, psychosocial, biomechanical and environmental factors (Goyen & Duff, 2004). Therefore clinical judgment and observation are needed to determine the underlying causes of handwriting dysfunction.

While the extent of the association between VMI and handwriting dysfunction in older children is unclear (Goyen & Duff, 2004); other studies have shown a positive correlation between VMI and academic performance (Kulp, 1999; Sortor & Kulp, 2003). This positive correlation is evident particularly between VMI with reading and mathematics performance (Kulp & Sortor, 2003). One may argue that factors such as verbal cognitive ability and intelligence are known to play an important role in reading and mathematics performance (Kulp & Sortor, 2003). However, Kulp & Sortor (2003) conducted a study of 155 children from the second through to the fourth grades while controlling for verbal cognitive ability and intelligence. In their study, a significant correlation was identified between VMI with mathematics score, visual perception and motor coordination with mathematics score and reading.

Visual motor integration, therefore, has an impact on the occupational performance areas of reading, mathematics and handwriting (Kulp, 1993; Kulp &

Sortor, 2003; Case-Smith, 2005). It must also be remembered that other factors that may impact on these occupational performance areas such as verbal cognitive ability, intelligence, psychosocial and biomechanical processes need consideration. Altogether a significant relationship exists between visual analysis, fine motor, visual motor integration with handwriting and mathematical performance of children of average cognitive ability.

2.6. Assessment of Visual Motor Integration

Various studies (Kulp, 1993; Daly et. al., 2003; Kulp & Sortor, 2003; Goyen & Duff, 2004) have used the Beery VMI to assess visual motor integration, visual perception and motor coordination. The Beery VMI 6th edition is a standardised assessment that has been used in numerous studies to determine the visual motor integration of children infected with HIV (Puthanakit et. al., 2013; Smith et. al., 2008). This is because the Beery VMI is a standardised copy forms test (Kulp & Sortor, 2003; Sortor & Kulp, 2003) that is commonly used both in optometric and educational practice (Kulp, 1999). The Beery VMI was first published in 1967 and has undergone numerous revisions to reach its current 6th edition (Goyen & Duff, 2004).

The current 6th edition of the Beery VMI provides normative data for individuals from 2 - 100 years and was standardised on 1737 individuals aged 1 – 18 years in 2009 - 2010. The Beery VMI has short forms for children aged 2 - 8 years and long forms which can be used from 2 – 100 years. Both short form and long form tests can be administered in individual and group settings. The Beery VMI can be administered to individuals of various environmental, educational and linguistic backgrounds (Beery, Buktenica & Beery, 2010).

The Beery VMI consists of three tests and standard scores are provided for the visual motor integration test and the supplemental tests of visual perception and motor coordination (Beery, Buktenica & Beery, 2010). Research has shown that children's performance on a test of visual motor integration is impacted by '…visual analysis/visual spatial ability, motor coordination, visual conceptualisation and/or integration of visual and motor abilities' (Kulp & Sortor, 2003; p. 313).

The visual motor integration test requires copying of geometric forms. The visual perception subtest is motor reduced and asks the individual to identify matching forms for three minutes thereby assessing visual analysis and visual spatial skills. In the last subtest of motor coordination, which requires visual fine motor skills, the individual is required to trace forms by connecting the dots and staying in the paths provided for approximately five minutes (Kulp & Sortor, 2003; Sortor & Kulp, 2003).

The visual perception and motor coordination subtests contain the same forms as the visual motor integration test. As visual/spatial analysis and visual fine motor skills impact on the integration of visual and motor skills, the subtests were included in the Beery VMI to differentiate between these two factors that impact on visual motor integration (Beery & Buktenica, 2010, Kulp & Sortor, 2003). The Beery VMI was administered to 193 children in a study conducted by Kulp & Sortor (2003). In this study, significant correlations were found between the VMI and its supplemental tests and between the visual perception and motor coordination subtests. This therefore supports the argument that visual perception and motor coordination are parts of visual motor integration and increases the clinical value of the Beery VMI. However, there was a significant amount of variance of performance in the VMI unexplained by either subtests indicating that all tests should be administered when assessing VMI (Kulp & Sortor, 2003).

The Beery VMI while having clinical value (Kulp & Sortor, 2003) has also shown significant correlations with achievement test scores (Sortor & Kulp, 2003). The visual perception subtest was found to be significantly related to the Stanford math and reading scores in 155 children from the second through to the fourth grades (Sortor & Kulp, 2003). Sortor & Kulp (2003) study had partial controls for verbal school ability, which is an indication of intellectual/cognitive ability. As it is well known that intellectual/cognitive ability is related to academic achievement, the relationship between the visual perception subtest with the Stanford math and reading scores is significant as it indicates that visual perception should be assessed in children with poor math and reading achievement (Sortor & Kulp, 2003).

While the Beery VMI has shown significant correlations with achievement tests partially controlling for verbal cognitive ability (Sortor & Kulp, 2003), its relationship with broad academic performance needs to be considered. Kulp (1999) conducted a study using the Beery VMI on 191 children from kindergarten through to third grade together with teacher's ratings of academic achievement. Kulp (1999) asserts that teachers' ratings are a primary means of determining children's progress through school. The study results revealed that visual analysis and visual fine motor integration skills are significantly correlated with teacher's ratings in reading, maths, spelling and writing in 7, 8 and 9 year old children (Kulp, 1999). This is significant as previous studies have shown that visual motor integration is an important factor in handwriting readiness in kindergarten and its impact declines in older years as they rely less on visual impact (Goyen & Duff, 2004).

Goyen & Duff (2004) in their survey of the tests used by Occupational Therapists in Australia to assess handwriting caution against using the Beery VMI solely to assess handwriting dysfunction. The Beery VMI is primarily used to assess perceptual-motor ability (Kulp & Sortor, 2003; Sortor & Kulp, 2003; Kulp, 1999). While its results have shown significant correlations with academic achievement (Kulp, 1999; Sortor & Kulp, 2003), it must be noted that these are correlations and not causations of performance (Goyen & Duff, 2004). Therefore Goyen & Duff (2004) advocate a model of practice using clinical reasoning to assess occupational performance. From the above studies (Kulp & Sortor, 2003; Sortor & Kulp, 2003; Kulp, 1999; Goyen & Duff, 2004) it has been shown that the Beery VMI continues to be a reliable and valid standardised assessment to measure visual motor integration in children and that all subtests must be administered due to the variance in performance found between the subtests.

2.6.1. Validity and Reliability of the Beery Developmental Test of Visual Motor Integration on a South African population

As the Beery VMI norms were standardised in the United States, one could argue that the norms may not be an accurate reflection of the South African population. Dunn et. al. (2006) conducted a study which displayed that the Beery VMI yielded a significant correlation of 0.75 with a South African standardised copying test which supports the suitability of the Beery VMI on a multi-ethnic sample. Another study by Vally (2006) on a sample of 5 – 7 year old pre-schoolers in Stellenbosch confirmed the internal consistency of the Beery VMI and displayed no significant differences in scores based on gender, socioeconomic status and language (Vally, 2006).

Rens (2008) conducted a standardisation test of the Beery VMI on 80 South African children with the results revealing statistical differences in the visual motor integration and visual perception scores indicating that the Beery VMI scores should be analysed with caution. Lotz et. al. (2005) conducted a study of visual motor integration functioning using the Beery VMI on a South African middle childhood sample with grade 1 and 2 learners in a disadvantaged peri-urban area. Lotz et. al. (2005) study revealed the VMI scores to be at least one standard deviation below the mean. However the impact of socioeconomic status on the VMI scores needs to be considered as Lotz et. al. (2005) study was conducted in a disadvantaged peri-urban community. The study also showed that the VMI mean scores increased with age to the point that grade 4 learners exhibited VMI scores similar to the Beery VMI standardised group. Therefore one could infer that learners are eventually able to develop their visual motor integration skills (Lotz et. al., 2005).

The above-mentioned studies (Dunn et. al., 2006; Vally, 2006) have shown the Beery VMI to be a reliable and valid assessment measure of VMI for use in a South African population. However, due to statistical differences in VMI and VP scores (Rens, 2008) and the possible impact of socioeconomic status on VMI scores (Lotz et. al., 2005), other factors such as socioeconomic status need to be considered when using the Beery VMI as an assessment measure in a South African population. The Beery VMI however, continues to be a common research tool used to assess VMI in South African studies (Smith et. al., 2008; Rens, 2008; Vally, 2006; Dunn et. al., 2006; Vally, 2006).

2.6.2. Therapeutic intervention for Visual Motor Integration

In order to improve performance, therapeutic intervention particularly in visual perception, has been found to increase visual perception skill as well as academic performance although the improvement in academic performance can be controversial (Kulp, 1999; Kulp & Sortor, 2003; Sortor & Kulp, 2003).

While ART improves the immunological functioning of children infected with HIV, it does not protect neurocognitive functioning (Bocanegra, 2008). Deficits in neurodevelopment particularly in the areas of visual motor integration (Puthanakit et. al., 2013) and visual perception (Smith et. al., 2008) have been identified in children infected with HIV receiving HAART. Baillieu et. al. (2008) highlights the need to focus on improving HIV infected children's neurodevelopmental status due to its effect on school performance, participation and involvement in society through the implementation of holistic programmes involving multiple health professionals (Baillieu & Potterton, 2008).

The implementation of rehabilitation programmes of a social, clinical and scholastic nature (Shanbhag, et al., 2005) can determine whether the impact of the virus can be minimised (Ferguson & Jelsma, 2009). Potterton et. al. (2009) implemented a home stimulation programme that aided in improving the neurodevelopmental status of HIV infected children. The best programmes are those that involve the families and are integrated into the child and family services (Potterton, et al., 2010). The implementation of early intervention programmes together with early initiation of ART will lead to better neurodevelopmental outcomes in children infected with HIV (Smith et. al., 2008).

Dankert et. al. (2003) provided Occupational Therapy intervention to pre-school children with developmental delays. After one year of receiving 30 minute sessions, an improvement was seen in visual motor skills as measured by the Beery VMI. The type of activities used included fine motor arts and crafts activities and gross motor obstacle course activities (Dankert et. al., 2003). Vlok et. al. (2011) advises using an integrated visual perception programme that includes cognitive strategies, visual perceptual abilities and visual exercises. As a result, a holistic integrated therapeutic intervention is required to address the outfall in visual motor integration, visual perception and motor coordination in pre-school children infected with HIV.

2.7 Summary

The South African government's HIV treatment campaign has led to an increase in access to ART for children infected with HIV and concurrently a reduction in the number of children newly infected with HIV. However, the literature has shown that while ART improves virological functioning and can even reverse the signs of encephalopathy, it does not protect neurocognitive functioning. As HIV crosses the blood brain barrier it causes delay particularly in visual motor integration, visual perception and motor coordination. Other factors that can impact this are socioeconomic status and the timing of ART intervention. However, even with all these factors controlled in studies, neurodevelopmental delay still occurs.

While the factors that can impact on VMI have been covered further exploration into the intricacies of socioeconomic status and its impact on VMI is needed. While it is known that neurodevelopmental delay occurs even when socioeconomic status is accounted for, the extent of the impact of socioeconomic status on VMI needs further consideration in this study.

The extent of the delay in visual motor integration particularly within the South African context is largely unknown and further research is required in this area. Due to the impact of HIV on neurodevelopment, motor and process skill areas such as eye hand coordination and manual dexterity are affected. These motor and process skill areas require factors such as grading of physical effort, timing, sequencing, motor planning and visual perception. It has been shown that there is a complex interplay that occurs across visual perceptual client factors and this has an impact on the motor and process skills required for pre-academic functioning. This is important as pre-academic skills are a necessary precursor for academic functioning in later years.

A limitation of this literature review is the lack of information on the impact of the current social and cultural context in South Africa on visual motor integration and on medical factors such as CD4 count and CD4%. Further information is needed to determine the extent of the impact of socioeconomic status on visual motor integration.

This literature review will also benefit from further exploration into the impact of vision on visual motor integration. While vision and visual deficits have been known to impact visual motor integration, it was not included in this literature review as participants with visual deficits that could have a functional impact on visual motor integration were excluded from this research study.

There is limited information in this chapter on the nature and type of neurodevelopmental interventions available for children infected with HIV. Various intervention programmes have been developed to address visual motor delay in children (Tzuriel & Eiboshitz, 1992; Vlok et. al., 2011; Ratzon et. al., 2007; Razel &

Eylon. 1990). These programmes (Tzuriel & Eiboshitz, 1992; Vlok et. al., 2011; Ratzon et. al., 2007; Razel & Eylon. 1990) will be critically analysed in further detail in Chapter 5 of this research study. Neurodevelopmental intervention programmes have also benefitted children infected with HIV (Potterton et. al., 2009) but there is limited visual-motor intervention for preschool children infected with HIV. While intervention programmes have been formulated for children infected with HIV and visual-motor programmes for children with delays in visual motor integration and visual perception; there is a need for Occupational Therapy (OT) based programmes for pre-school children infected with HIV. This is important particularly as OT based programmes have been shown to improve visual perception in pre-school children (Dankert et. al., 2003). Therefore a visual-motor treatment programme is proposed that specifically addresses visual motor integration difficulties in pre-school children infected with HIV.

CHAPTER 3: PHASE 1 METHODOLOGY AND RESULTS

"There can be no keener revelation of a society's soul than the way in which it treats its children." Nelson Mandela

3.1. Phase 1 Methodology: Visual motor integration in pre-school children living with HIV

This chapter will present the methodology used to determine the extent of visual motor integration delay in pre-school children infected with HIV. The participant sample, data collection techniques and outcome measures used will be outlined. The data will be analysed and explored in further detail and the results will be presented in this chapter.

3.1.1 Research design

Phase 1 is a cross-sectional quantitative descriptive study of the visual motor integration, visual perception and motor coordination of five-six year old children infected with HIV. This phase will involve collecting data from the sample participants at one point in time to determine the level of visual motor integration (VMI), visual perception (VP) and motor coordination (MC). Medical and personal information as well as the socioeconomic status (SES) of the participants will be obtained and objectively analysed to determine the association of these factors on the VMI, VP and MC of the sample participants. Therefore this type of research design is most suitable to fulfil the phase 1 objectives.

Ideally the inclusion of a control group in the study was desirable, but ethically this was not possible as the children who could potentially form the control group could not be tested to confirm if they were HIV positive.

3.1.2 Sample selection of participants

The data collection of phase 1 occurred at the Empilweni clinic in Rahima Moosa Hospital. Empilweni clinic is a paediatric treatment clinic located within the hospital and provides clinical care to HIV infected and affected infants, children and adolescents from the areas surrounding the hospital and from the greater Johannesburg region in South Africa. Patients attending the clinic are mostly from middle to low socioeconomic background. Empilweni clinic is one of the largest treatment clinics for children and has 1600 patients who are followed up regularly (ESRU, 2015). Empilweni clinic is also a research clinic and has been conducting clinical trials since 2003 for women and children living with HIV.

The ***inclusion criteria*** for the participants were:

- Ambulant children who were HIV positive through vertical transmission
- Children who were between the ages of five year zero months and five year eleven months.
- Children who have been receiving ART >1 year or if not on ART with CD4% > 15%

The ***exclusion criteria*** for the participants were:

- Prematurity of birth <37 weeks
- Neurodevelopmental delay due to other causative factors such as neonatal hypoxic-ischaemia
- Children with physical manifestations of encephalopathy
- Children with visual deficits that can functionally impact on visual motor integration

Sample size:

A total of 79 participants were required to be representative of the 1600 children attending the clinic according to Cochran's sample size formula with a margin of error of 5% or alpha of 0.05 for phase 1 of the research study (Bartlett et. al., 2001). A sample size of 71 participants was achieved.

3.1.3 Other factors affecting visual motor integration

Apart from the medical outcomes related to HIV which was assessed to determine the severity of HIV and its association with VMI delay in young children, other factors are known to impact on VMI development. Socioeconomic status is another factor that needs to be considered in this study as well.

Socioeconomic status has been shown to be a factor related to VMI delay (Dunn et. al. 2006) but this is controversial as some authors found no difference in VMI scores (Vally, 2006). However in view of the absence of a control group, the socioeconomic background of the children living with HIV was assessed to ensure that the sample was homogeneous for these variables and the possible effect of these variables on the results could be discussed.

3.1.4 Ethical considerations

Ethical clearance was obtained from the University of the Witwatersrand and granted from 18 July 2011 for a period of five years. A further five years of ethical clearance was granted on 29 August 2016 (Appendix A). Permission was also requested from the director of the Empilweni Clinic at Rahima Moosa Hospital (Appendix B) and from the accompanying caregiver of each participant prior to administering the data collection instruments.

Prior to commencing the assessment, the caregivers of the participants were provided with a letter detailing informed consent (Appendix C) and were advised of the following with the assistance of a translator if needed:

- Participation in the study is voluntary
- Participants can undergo an Occupational Therapy assessment if preferred
- Details of participation outlined which included completion of demographic questionnaire, HESSI II, Beery VMI and permission for the researcher to access the participants' medical file
- Withdrawal from the study was possible at any time without consequence
- Results will be made available to the participants in written format and access to Occupational Therapy at the hospital if needed
- Results to be stored safely for a period of 6 years according to Health Professions Council of South Africa regulations
- Provision of researcher and ethics department of the University of the Witwatersrand contact details

If the caregivers of the participants understood and agreed to participate in the study, they were requested to sign consent (Appendix D). Verbal consent was also obtained from the participant prior to commencing the Beery VMI assessment. Please see Appendix E for the verbal assent given by each participant.

3.1.5 Data collection instruments

3.1.5.1 Demographic and Medical Information

A questionnaire developed by the researcher was used to collect demographic information on the participants and their accompanying caregiver. The questionnaire was divided into personal and medical information. Personal information which included the date of birth, gender, sex, home language, the occupation of caregiver, relationship to the child, name of crèche, and birth details were requested from the caregiver. The caregivers were also asked whether the participant had undergone an eye test and the outcome of the eye test to determine the possible functional impact of visual deficits on visual motor integration. Medical information was obtained from the medical file which included details of ART, CD4 count, CD4%, viral load and height/weight of the participant. This information allowed the researcher to determine whether any other variables impacted on the VMI, VP and MC of the participants (Appendix F).

3.1.5.2 The Household Economic and Social Status Index (HESSI) II

Studies have shown that socioeconomic status can impact on neurodevelopment, particularly on VMI development (Dunn et. al., 2006; Smith et. al., 2008). In South Africa a study by Dunn et. al. (2006) revealed that participants from a low and middle socioeconomic status achieved similar scores on VMI. Therefore the SES of the participant sample needs to be considered to determine whether there is a difference in socioeconomic levels and if an association exists between SES and VMI of children infected with HIV in this sample. This is particularly important as for ethical reasons, a control group was not included and therefore could not be used to compare the SES between the sample of HIV infected participants and those unaffected by HIV.

The HESSI II (Appendix G) was used to collect information on the socio-economic status of the participants on indicators of material well-being such as quality of housing and social capital such as mother's education and marital status (Barbarin & Khomo, 1997). The HESSI II is a self-report measure developed and standardised in Soweto, South Africa. It has been used in various studies to give an indication of the socioeconomic status of study participants (Barbarin, 1997; Barbarin & Richter, 2001; Potterton, 2006, Potterton et. al., 2010).

3.1.5.3 The Beery-Buktenica test of visual-motor integration (Beery VMI)

The Beery VMI is a standardised test and was used to assess the participants' visual motor integration, visual perception and motor coordination. The Beery VMI has two supplemental tests of visual perception (VP) and motor coordination (MC), which identify difficulties in areas that contribute to visual-motor integration. This test is also used as a research tool. The Beery VMI has good validity and reliability compared with other perceptual tests. It also has good predictive validity (Beery, 2006) (Appendix H).

The results of the Beery VMI show a statistically significant relationship with mathematical achievement test scores (Sortor & Kulp, 2003). Therefore apart from being used to determine the level of VMI, VP and MC skills, inferences on academic performance can be made although this is to be done with caution.

The Beery VMI has been normed on a population of American children thereby bringing up the issue of the reliability of its norms on South African children. A study of an Eastern Cape Population attempted to standardise the test results. The result of the study showed that South African participants scored better on MC than American participants. There was also a significant difference in VMI scores with the normal distribution of participants scoring in the very low, low and average scale but no participants in the high and very high range (Rens, 2008). Rens (2008) indicates that this could result in a false positive result where children could be identified as experiencing a problem where one does not occur. However, the Beery VMI has been found to be culture free (Beery, 2006) and is a commonly used research tool to determine the VMI, VP and MC of children (Kulp & Sortor, 2003; Sortor & Kulp, 2003).

Validity and reliability

Internal, content and predictive validity and *inter-rater and intra-rater reliability* for the outcome of phase 1 is achieved through the use of the Beery VMI as an assessment measure. Its validity and reliability has been well-researched and is considered an effective measuring tool (Beery, 2006).

The Beery VMI and its supplemental VP and MC tests have an overall average reliability score (interscorer, content and time sampling) of .92, .91 and .90

respectively. The VMI, in particular, has high reliability and validity when compared with other assessment measures of perceptual-motor skills (Beery, 2006).

Content validity is established through vigorous levels of item analyses and selection procedures over the years since its initial formulation in 1967. The Beery VMI is also known to have good predictive validity, particularly when combined with other assessment measures (Beery, 2006).

3.1.6 Research Procedure

The data collection phase occurred once a week for a period of eight months from August 2011 to March 2012 with a three week interval due to the end of year holiday season. On the patients' clinic appointment day, the researcher would outline the purpose of the study and the inclusion criteria with the assistance of a translator to the group of patients in the waiting area.

Upon expressing interest, the participant and accompanying caregiver were taken to a separate room where the details of informed consent and requirements of the data collection instruments were outlined. The data collection phase started upon obtaining consent from the caregiver and verbal assent from the participant. The caregiver completed the demographic questionnaire together with the researcher. The participant then completed the Beery VMI assessment administered by the researcher. Following this, the HESSI II was completed by the caregiver with assistance if needed by the researcher.

The data was then scored and kept by the researcher and the results were placed in the participants' medical file the following week. The details from the participants' medical file were recorded by the researcher, which were located in the file storage area in the clinic.

Throughout the data collection phase, a translator was utilised if needed to ensure that the participants and their caregiver understood the research requirements.

3.1.7 Data Analysis

Demographic data, medical data and the data from the HESSI II were analysed using descriptive statistics including frequencies and ranges The data from the Beery VMI was analysed using descriptive statistics including the mean, central tendency, standard deviation and confidence intervals.

Percentile and z scores were established for the research sample for the visual motor integration, visual perception and motor coordination sections of the Beery VMI test. The frequency of the z scores was compared to a normal distribution.

A chi-squared test was used to determine the significance of the results from the Beery VMI in comparison to the established norms.

Since the z scores for the VMI, VP and MC sections of the test are interval scores, these were correlated using Pearson's correlation coefficients. The correlations were interpreted according to the following criteria (Tomita, Mann, Fraas & Stanton, 2004):

- **0.00 - 0.29** no correlation
- **0.30 – 0.39** a weak correlation
- **0.40 – 0.59** a moderate correlation
- **0.60 – 0.79** a strong correlation
- **0.80 – 1.00** excellent

Correlations were also established between the medical factors and socioeconomic factors related to HIV and the VMI, VP and MC z scores to determine the relationship between these variables.

3.2 Phase 1 RESULTS: Visual motor integration in preschool children living with HIV

3.2.1 Introduction

A sample of 71 children living with HIV who had received ART for more than one year or if not receiving ART with a CD4% >15% was assessed using the Beery VMI test. Due to the cross-sectional nature of the research, there were no drop-outs from the study. During the screening process, 9 participants were found to be ineligible to participate. Three clients received ART < 6 months, 1 client was born premature at 34/40 weeks, 1 client had a history of medical illnesses that would impact on the VMI scores, 2 clients were above the age of 6 years, 1 client presented with a difficult family situation which would have impacted on the HESSI II scores and 1 client was upset during the assessment as he was unwell resulting in termination of the assessment.

3.2.2 Demographic information

Relevant aspects of demographic information for the children are presented in Table 3.1:

Table 3.1 Age and gender of participants (n=71):

	Mean (±SD)	
Age: years (months)	5 years 5 months (64.90±3.8)	
	N	%
Gender		
Male	29	40.85
Female	42	59.15

Of the 71 participants, 59% were female and 41% were male resulting in a near equal distribution of male and female participants. The average age of the participants was 64.90±3.8 (5 years 5 months).

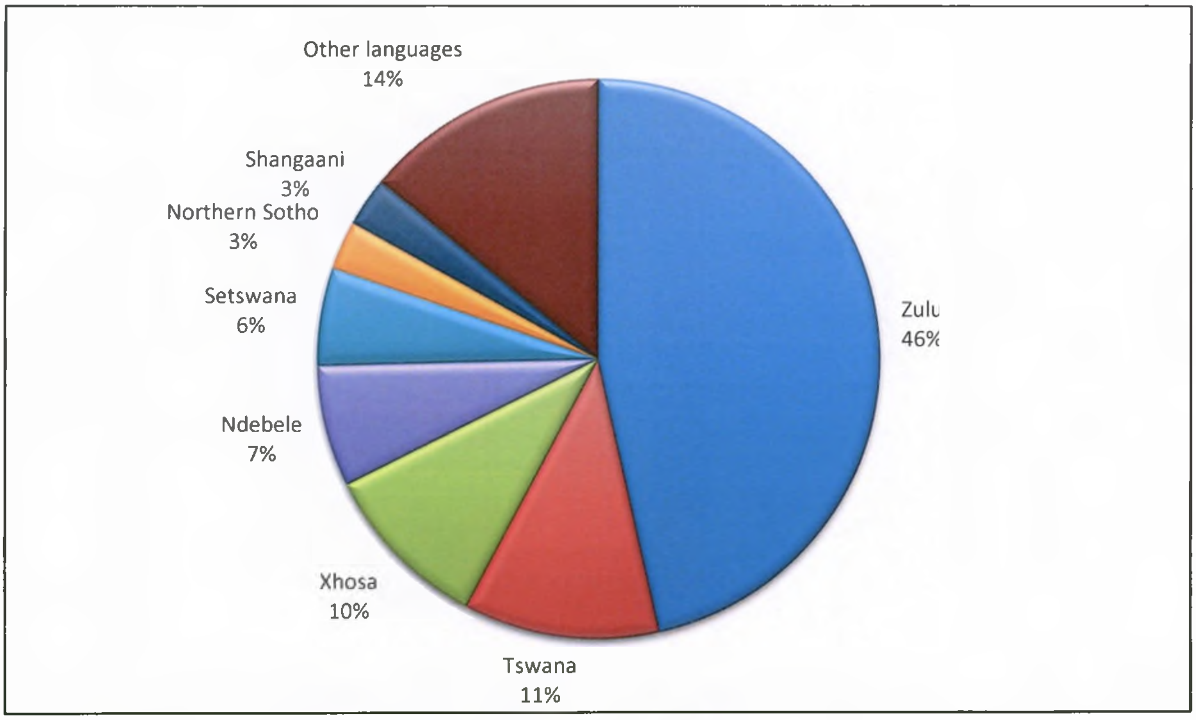


Figure 3.1 Home language of participants (n=71)

The home language of nearly half (46%) of the participants was Zulu while between 3% and 11% of participants spoke Tswana, Xhosa, Ndebele, Setswana followed by Northern Sotho and Shangaani at home. Other languages spoken included English, Sepedi, Sesotho, Sotho, Tsonga, Tswana, Afrikaans and French.

3.2.3. The Household Economic and Social Status Index II

The following table 3.2. include aspects of the HESSI II which outline the socioeconomic status of the sample. This includes demographics of the caregivers and participants which is also an indication of the socioeconomic status of the family.

Table 3.2 Socio-economic status of participants (HESSI II) (n=71):

ITEM	n	%
Marital Status		
Not now living with a partner	35	**48.57**
Living with a partner	36	**51.42**
Mother's education		
Completed < Grade 10	5	7.04
Completed Grade 11	9	12.68
Completed Grade 12	17	**23.94**
Completed 1-2 years at College/Technikon	32	**45.07**
Completed 3-4 years of University	5	7.04
Completed PHD, MD, JD, DDS or doctoral degree	3	4.23
Type of house		
Shack	9	12.68
Room, garage	18	**25.35**
Flat, cottage	15	**21.13**
Home shared with other families	6	8.45
Home not shared with other families	23	**32.39**
Toilet facilities		
Pit or bucket	3	**4.23**
Outside flush toilet	26	**36.62**
Inside flush	42	59.15
Separate room for sleeping		
One bedroom	35	49.30
>One bedroom	33	46.48
No of people in the household	**Mean (±SD)**	
No of adults in the household	1.74 (±1.45)	
No of children in the household	1.01 (±0.83)	

Abbreviations: PHD (Doctor of Philosophy), MD (Doctor of Medicine), JD (Juris Doctor), DDS (Doctor of Dental Surgery)

There were on average two adults and one child living in each household with 51% of the birth mothers reporting they lived with a partner and nearly half (48%) being single parents. Eighty one percent of the parents or caregivers of the participants had either completed four or five years of high school or had short post-high school training.

While a third of the participants live in homes not shared with other families about 8% do share their home with other families. The participants' housing is located in the areas around the hospital which mostly consists of low cost housing.

Nearly a quarter of the participants live in a flat. The conditions for participants living in flats or cottages may be better but the space in these dwellings in this area is also limited even if there is indoor plumbing and electricity.

The remaining 38% live in a shack or room/garage, which indicates a low socioeconomic status. Participants who live in a room/garage have one bedroom for sleeping and those living in a shack do not have a separate room for sleeping. Again, these living conditions may not have amenities such as electricity and 81% of the participants who live in these dwellings do not have indoor plumbing.

The results indicate that the participants come from middle to low socioeconomic backgrounds in terms of the type of dwelling in which they live. The education level of the caregivers was similar and there was little overcrowding in terms of the number of people living together, which was congruent with a middle socioeconomic background.

3.2.4. Medical information of participants

The relevant medical information of participants related to HIV is presented in table 3.3. The participants have been taking ART for a long time on average for 3.5 years (42.44 months $\pm$ 19.0).

Table 3.3 Medical Information of participants (n=71)

	Mean (±SD)
Months on ART	42.44 ± 19.0
CD4 absolute (x10^6/L)	1237.96 ± 551.0
CD4 (%)	31.41 ± 8.8
Height (cm)	106.37 ± 5.7
Weight (kg)	17.34 ± 2.2

Three of the participants were not on ART for various reasons with their CD4% all being above 25%. The lengthy period of time on ART has resulted in the average CD4 percentage to be 31.41% ±8.79 and an absolute CD4 count being 1237.96x10^6/L.

3.2.4.1 Correlation between length of time on ART with CD4 count and CD4%

The length of time on ART was correlated with the CD4 count and CD4% as it is known that the length of time on ART improves virological constitution resulting in higher levels of the CD4 count and CD4%. This is presented in table 3.4 below:

Table 3.4 Correlations between length of time on ART with CD4 count and CD4%

	Length of time on ART
	R
CD4 #	0.38
CD4 (%)	**0.51**
Viral Load	**-0.41**

The results from this table indicate that CD4% has a positive moderate correlation with the length of time on ART. This means that the longer the children are on ART the higher the CD4% is expected to be. Viral load shows a moderate negative correlation with ART which further strengthens the correlation relationship between CD4% and months on ART. However, there was only a weak positive correlation between length of time on ART and with CD4 count.

3.2.5. Beery Developmental Test of Visual Motor Integration

3.2.5.1 Visual motor integration, visual perception and motor coordination

The results of the VMI section of the Beery test as well as the supplemental tests for visual perception and motor coordination are presented in table 3.5. The scores for all three sections of the Beery VMI were normally distributed with a Lilliefors value of greater than .20.

Table 3.5 Mean z scores on the Beery Developmental test of Visual Motor Integration (n=71)

	Raw Score	Standard score	Percentile	Z scores
	Mean (±SD)			
Visual motor integration	11.45 ± 2.48	83.03 ±12.03	18.98 ± 19.4	-1.13 ± 0.8
Visual perception	12.55 ± 3.13	78.49 ±14.81	14.88 ± 19.0	-1.43 ± 0.9
Motor coordination	13.52 ± 3.10	87.08 ±15.27	27.70 ± 25.6	-0.86 ± 1.0

The scores indicate that mean visual motor integration scores fall into the at risk range below average with a mean z score of -1.13. Visual perception mean z scores are also in the at risk range below average at -1.43 while motor coordination mean z scores were in the average range at -0.86 The results indicate that visual perception has been most affected in this sample (Figure 3.2).

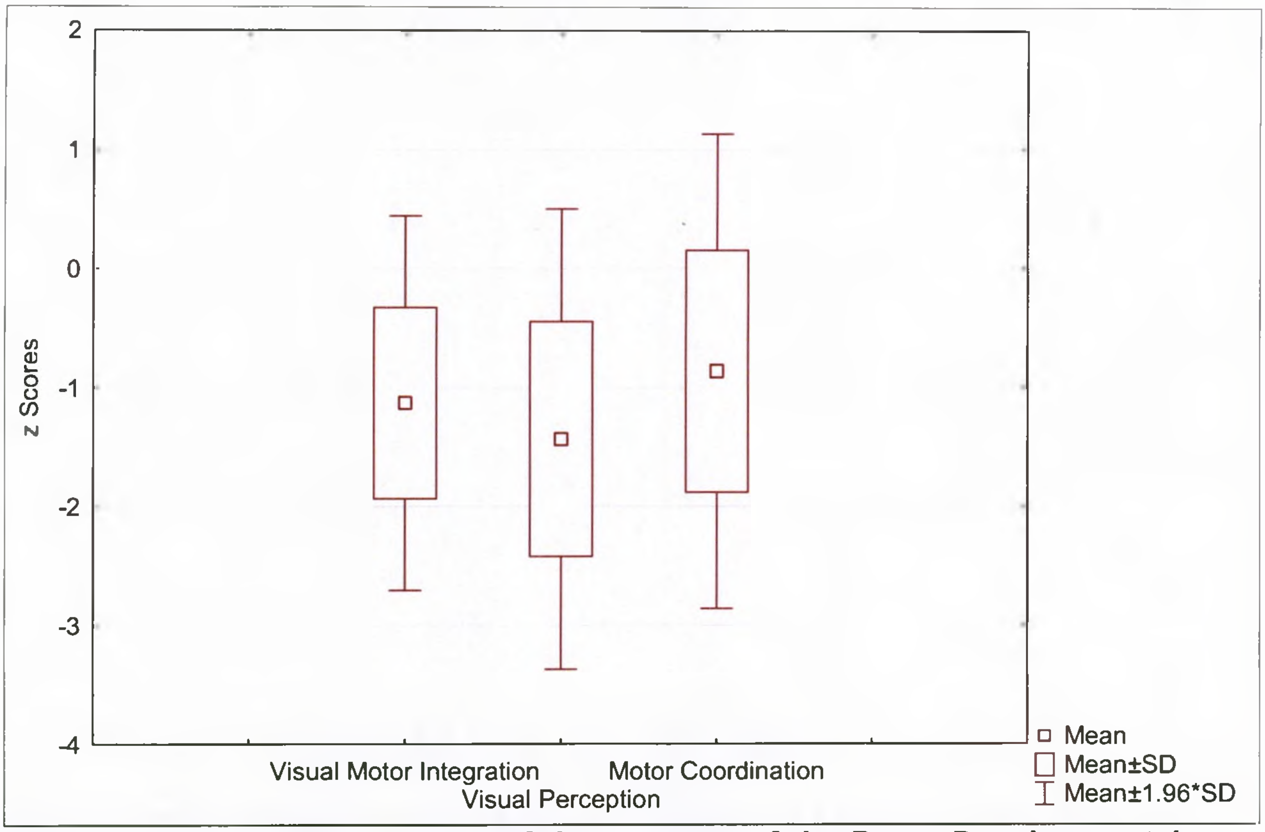


Figure 3.2 Box & Whisker Plot of the z scores of the Beery Developmental test of Visual Motor Integration (n=71)

3.2.5.2. Comparison of Beery Developmental test of Visual Motor Integration for normative data

The mean raw scores are equivalent to the average scores for children of 4 years 6 months for VMI, children of 4 years for visual perception and children of 4 years 7 months for motor coordination. This indicates a deficit of 11 months on the mean VMI raw scores and a deficit of 17 months for visual perception. The mean motor coordination scores show a deficit of 10 months.

When the z scores on the Beery VMI test were compared to a normal distribution it was clear that 13.6% of the sample presented with visual motor integration deficits with z scores below -2 SD, while 20.5 % of the sample presented with deficits for visual perception in this range. The lowest percentage of participants with z scores below -2SD was for motor coordination.

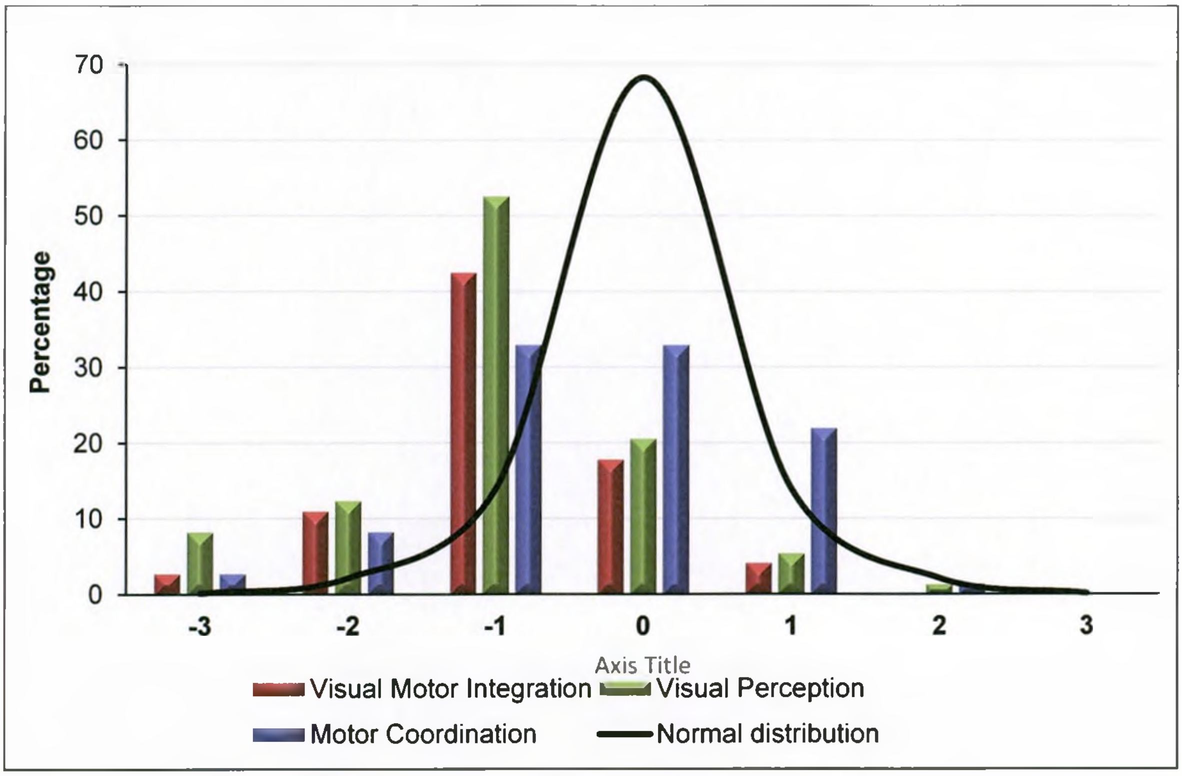


Figure 3.3 Comparison of z scores for participants living with HIV and the normal distribution for z scores on the Beery Developmental test of Visual Motor Integration (n=71)

A chi-squared test was used to determine the significant difference between the frequencies of the z scores obtained for the three sections of the Beery VMI test for the participants and the normal distribution of scores expected. There was a significant difference for the visual motor integration scores (X=56.06, p=0.00), visual perceptual scores (X= 67.03, p= 0.00) and the motor coordination scores (X=34.60 p=0.00).

3.2.5.3 Correlation between the sections of the Beery Developmental test of Visual Motor Integration

The mean z scores for the supplemental VP and MC tests were correlated with the VMI mean z scores on the Beery VMI to determine the association between the different sections of the test (table 3.6):

Table 3.6 Correlation of sub-tests to the Beery VMI (n=71)

	VMI z score	VP z score
	R	r
VP z score	0.34	
MC z score	**0.68**	**0.52**

The results show that the visual perception and motor coordination subtest scores had a positive moderate correlation which was significant ($p<0.5$). The motor coordination supplemental test had a strong correlation with VMI ($p<0.5$) but the correlation of visual perception supplemental test and VMI was weak at $r=0.34$ and not significant.

3.2.5.4 Correlation of socioeconomic factors and z scores on the Beery Developmental Test of Visual Motor Integration

The association of the participants' socioeconomic factors and their mean z scores on the Beery VMI was determined. The results indicate that VMI has a moderate positive correlation with attendance at crèche, day care or nursery/pre-primary school ($r=0.56$, $p<0.5$) as well as the mothers level of education ($r=0.43$, $p<0.5$) (table 3.7). The correlation of the supplemental tests of visual perception and motor coordination to these socioeconomic variables were weak.

Table 3.7 Correlations between socioeconomic factors and z scores on the Beery Developmental test of Visual Motor Integration (n=71)

	Attendance at crèche, day care or nursery/pre-primary school	**Mothers level of education**
	R	R
VMI z score	**0.56**	**0.43**
VP z score	0.32	-0.13
MC z score	0.11	0.33

3.2.5.4. Correlation of medical factors and z scores of the Beery Developmental Test of Visual Motor Integration

In order to further investigate the association of the participants' medical information on the Beery VMI z scores, correlations were determined between these scores and the medical factors related to HIV in the absolute CD4 count, CD4% and the length of time on ART (table 3.8).

Table 3.8 Correlations between CD4 count, CD4% and z scores on the Beery Developmental test of Visual Motor Integration (n=71)

	CD4 count	CD4 (%)
	R	
VMI z score	0.00	0.12
VP z score	**0.56**	**0.46**
MC z score	0.27	0.27

The results indicate that visual perception has moderate positive correlation with CD4 count ($r=0.56$, $p<0.5$) and CD4% ($r=0.46$, $p<0.5$). No correlation was found between visual motor integration and motor coordination with the CD4 count ($r=0.00$, $p<0.5$; $r=0.27$, $p<0.5$) and CD4% ($r=0.12$, $p<0.5$; $r=0.27$, $p<0.5$) respectively.

3.2.6 Summary of Results

This chapter explored the results and methodology of phase 1. Phase 1 was a descriptive cross-sectional study to determine the prevalence and extent of the visual motor integration, visual perception and motor coordination delay in five-six-year-old pre-school children living with HIV who receive ART. As there are other variables that can affect VMI, VP and MC, this chapter also looked at the impact of medical factors such as ART, absolute CD4 count, CD4%, the length of time on ART and other factors such as socioeconomic status on the Beery VMI scores.

The demographic information revealed that there was a near equal distribution of male and female participants with the average age being 64.90 months (5 years 5 months). Further to this, the results of the HESSI II revealed that the participants come from middle to lower socioeconomic status. The possible impact of this on the Beery VMI scores will be discussed in the following chapter 4.

The participants' average time on ART was 3.5 years (42.44 months) resulting in an average CD4% of 31.41% and CD4 absolute count of 1237.96X10^6/L. The length of time on ART showed a positive moderate correlation with CD4% ($r=0.51$) indicating a positive association between ART and CD4%. Interestingly a weak positive correlation ($r=0.38$) exists between the length of time on ART with the

CD4 count. The impact of this on the Beery VMI scores will be explored further in the discussion of phase 1 in chapter 4.

The results of the Beery VMI test reveals that VMI and VP fell in the at risk category below average with a mean z score of -1.13 and -1.43 respectively. Motor coordination mean z scores fall in the average range at -0.86. VP is the most affected in this sample with an average deficit of 17 months on the mean raw score and 20.5% of the z scores falling -2SD below the mean.

The correlation of the subtests of the Beery VMI were analysed as the subtests of the Beery VMI have been known to have positive correlations with each other. A positive moderate correlation exists between VP and MC ($r=0.52$) and a strong correlation between the MC and VMI ($r=0.68$). However, the correlation between VP and VMI ($r=0.34$) is a weak and not significant correlation.

When comparing the Beery VMI scores to normative data, a significant difference exists between the frequencies of the z scores of VMI ($X=56.06$, $p=0.00$), VP ($X=67.03$, $p=0.00$) and MC ($X=34$, $p=0.00$) with the normal distribution of scores. This confirms that a delay exists in VMI and VP in the sample when compared to the normal distribution of scores.

The correlation between medical factors and the Beery VMI scores were also analysed to determine their impact on the scores. VP shows a moderate positive correlation with the CD4 count and CD4% at $r=0.56$ and $r=0.46$ respectively. This indicates an association between VP with CD4 count and CD4 percentage in the sample. However, no correlation was found between VMI ($r=0.00$, $r=0.12$) and MC ($r=0.27$, $r=0.27$) with the CD4 count and CD4% respectively.

There were also weak correlations between the length of time on ART and the Beery VMI scores. Therefore you cannot conclusively argue that the length of time on ART has a positive correlation with the Beery VMI scores.

The participants in this study did not have visual functional deficits that could have impacted on the Beery VMI results. As it is known that visual function can have an impact on VMI, this is a limitation of the research and it is recommended that the visual function of pre-school children infected with HIV is examined due to its possible impact on VMI, VP and MC.

The following chapter will discuss the results from phase 1 in greater detail to determine the association between medical factors, socioeconomic status and the Beery VMI scores. These results will be used to form a framework and to guide the development of the visual-motor treatment programme.

CHAPTER 4:PHASE 1 DISCUSSION

4.1 Introduction

This chapter will discuss the results of phase 1 that was outlined in chapter 3.The chapter will first present the demographic information followed by the discussion of the results in relation to the objectives of the research. The medical factors related to HIV and the factors indicative of the socioeconomic status of the sample of five-six year old pre-school children living with HIV attending Empilweni clinic will be considered as well as visual motor integration, visual perception and motor coordination scores on the Beery VMI test for this sample.

The association between the visual motor integration, visual perception and motor coordination scores with medical factors related to HIV and socioeconomic factors will also be discussed

4.2 Demographics, medical and socioeconomic factors

4.2.1 Demographics

There was a near equal distribution of male and female participants. While gender differences have been reported in the Beery VMI, these differences have not been significant (Beery, 2006). The average age of the participants was 5 years 5 months which is within the age parameters of the study.

Nearly half of the participants spoke Zulu and other participants spoke languages such as Tswana, Xhosa, Ndebele, Setswana, Northern Sotho, Shangaani, English, Sepedi, Sesotho, Sotho, Tsonga, Tswana, Afrikaans and French. This array of languages is representative of the multilingual society of South Africa.

According to the 2011 census, Zulu is the most frequently spoken language in South African households while other spoken languages include Xhosa, Afrikaans, English, Sepedi, Setswana, Tsonga, Siswati, Venda, Ndebele, sign language and other languages in descending order of frequency (Census, 2011). While this is representative of South African society, in Gauteng province a variety of languages are spoken as a first language with the top five being Zulu, English, Afrikaans, Sesotho and Sepedi (Census, 2011). Therefore while the participants in this sample spoke a variety of languages, English is the second most spoken language in Gauteng and therefore exposure and understanding to basic English is expected. Most of the participants were able to understand basic English, which was the language used to administer the data collection instruments with a translator available to assist if required.

The first objective was to determine medical factors related to HIV and the factors indicative of the socioeconomic status of a sample of five-six year old pre-school children living with HIV attending Empilweni clinic.

4.2.2 Medical factors related to HIV

Of the total sample of participants, 39% were taking first line treatment (ABC + 3TC + EFV) and 52% were taking second line treatment (AZT+ddI+Kaletra / ABC+3TC+Kaletra) in accordance with the South African treatment regimen in 2011 when data collection took place (Department of Health, 2007). Seventy-three percent of the participants were taking efavirenz and/or D4T (stavudine) drugs. These drugs have been demonstrated to have better cerebrospinal fluid (CSF) penetration than other ART drugs which can reduce the effect of HIV on the central nervous system resulting in a higher CD4% (Department of Health, 2013; Shanbhag et. al., 2005).

Although the participants in this study have been taking ART for an increased length of time (table 3.3), there were still three participants who had not received ART but who had a CD4% of more than 25%. While the South African government sought to make ART available to all HIV-infected children below the age of 5 years irrespective of their CD4 count (Department of Health, 2015), it is clear that not all children have received ART.

The length of time on ART in this study showed a moderate positive correlation with CD4% (r=0.51) which would have had an impact on the high average CD4% being 31.41%. This result supports research that ART has a positive impact on immunological functioning resulting in a higher CD4 percentage (Smith et. al., 2008).

4.2.3 Factors related to socioeconomic status of a sample of five-six year old preschool children who have HIV

The participants in this study are from middle to low socioeconomic status. This was analysed by looking at the mother's education, family structure (marital status of the mother, household membership) and housing accommodation (type of housing, separate room for sleeping, toilet facilities). A limitation of this study is that a composite score of the socioeconomic status of the participants could not be obtained as not all participants completed all sections of the HESSI II.

4.2.3.1 Mother's education

The education level of the participant's mother is congruent with that of a middle socioeconomic status. This is significant as the level of education is an indication of the material situation of the family (Barbarin & Khomo, 1997) due to the earning capacity of the parent. It is known that the mother's level of education can result in exposure to intellectual stimulation and in this study has led to increased access to social resources with 85% of the participants attending crèche/pre-primary school. In fact, a positive correlation was found between maternal education (r=0.43) and crèche/pre-primary school attendance (r=0.56) with visual motor integration scores on the Beery VMI. This supports research which states that socioeconomic factors such as maternal education and household intellectual stimulation (Smith et. al., 2008) can have an impact on neurodevelopment. Attendance at crèche or pre-primary school brings about exposure to activities such as handwriting and cutting which facilitate the development of visual motor integration (Dankert et. al., 2003).

However, only a weak association existed between crèche/pre-primary attendance and visual perception (r=0.32). This could be due to the fact that visual perception skill acquisition requires focused mediation from an adult (Tzuriel & Eiboshitz, 1992; Case-Smith & O'Brien, 2013) which may not have been possible in the family structure or in the crèche/pre-primary school. Further exploration and research is required to determine the reasons behind a weak association between crèche/pre-primary school attendance and mother's level of education with visual perception.

4.2.3.2 Family structure

Limited overcrowding in the home indicates that the family's social resources are adequate to sustain the family. While nearly half (48%) of the participants' caregiver reported not living with a partner; all of the participants have an adult relative living in the household such as grandparents, uncles or aunts to the participant (table 3.2). Adult relatives sharing a household may be able to provide financial and emotional support to the participant and caregiver as household membership is often considered as an indication of the support available in parenting tasks (Barbarin & Khomo, 1997).

4.2.3.3 Housing accommodation

The participants in this study have a varied range of housing accommodation from 38% who live in a shack/room/garage, a third who live in homes not shared, nearly a quarter who live in a flat/cottage and only 8% who share homes (table 3.2). While this may be an indication of middle to low socioeconomic status in terms of the type of dwelling in which they live, one must remember that the housing options available to families at the time were based on the range of homes provided by the government during the period of apartheid. Despite this, housing accommodation continues to be an important indicator of the material well-being and essentially the socioeconomic status of a family (Barbarin & Khomo, 1997).

4.3 Visual motor integration, visual perception and motor coordination

4.3.1 Visual motor integration

The second objective of the study was to determine the visual motor integration, visual perception and motor coordination scores using the Beery VMI test on a sample of five-six year old pre-school children who have HIV.

About 56% of the study sample scored below average on the VMI with a mean standard score of 83.03 ±12.03 (table 3.5). This is similar to the mean VMI standard score of 83.14±13.28 from the study conducted by Bocanegra (2008) on the sample of participants who received HAART. Interestingly the number of months receiving ART are both similar at 42.44 months for this study and 43.2 months for Bocanegra (2008) study. However while one could argue that the length of time on ART could have had an impact on the VMI scores, no correlation (r=-0.21) was found between the length of time on ART and VMI z scores in this study. This result together with other studies, indicate that ART does not improve neurodevelopment (Bocanegra, 2008; Smith et. al., 2008). The implications of this will be discussed further in section 4.5.1.

4.3.2 Visual perception

The visual perception (VP) scores were the most affected in this sample. Seventy-three percent of the participants in this study scored below average falling in the low category with a mean percentile of 14.88 ±19.0. This is similar to Smith et. al. (2008) South African study where the participants achieved a mean percentile VP score of 13.6±24. The average age of the participants in Smith et. al. (2008) study was 60±46 months which is similar to the average age of 64.90±3.8 months for this study. The SES from both studies was also similar with the participants coming from a middle to low SES for this study and a low SES for Smith et. al.(2008) study. It is well known that SES can impact on VMI and VP but the question remains as to the extent of the impact on this study compared to that of HIV on neurodevelopment, which will be further explored in section 4.5.2.

Interestingly the mean VP percentile scores from both studies were the same despite the participants in this study being on ART for an average of 42.44±19.0 months, which is longer than the 6 months of Smith et. al.(2008) study. However similar to VMI, there was no correlation between the length of time on ART and VP z scores (r=0.07) in this study indicating that length of time on ART does not seem to improve VP functioning. From the results of this study and that of Smith et. al. (2008) study, it has been shown that visual perceptual deficits exist in pre-school children infected with HIV despite being on ART for a length of time. This necessitates neurodevelopmental intervention as ART does not seem to improve VP functioning. A limitation of this study is that a baseline score of VP was not obtained prior to receiving ART and so the longitudinal impact of ART on VP functioning could not be determined to further strengthen this premise.

4.3.3 Motor coordination

While forty-six percent of the sample scored below average in motor coordination (MC) the mean score falls in the average category. The participants had a mean percentile MC score of 27.70 ±25.6 which is higher than Smith et. al. (2008) mean percentile MC score of 17.61 ±6.5. The length of time on ART again does not seem to have an impact on the MC scores as no correlation (r=-0.01) was found between length of time on ART and MC scores for this study. The average mean score for motor coordination could be due to a number of factors which will be explored in section 4.3.7.

4.3.4 Visual motor integration and visual perception delay

The results from this study and other similar studies (Bocanegra, 2008; Smith et. al., 2008) indicate that HIV does impact VMI and VP resulting in a delay. It is recommended that VMI and VP in HIV infected children are assessed to determine the presence of such deficits due to the impact of VMI and VP on activities of daily living such as reading and mathematics (Kulp, 1999; Kulp & Sortor, 2003). The correlation between medical factors and SES with VMI and VP scores will be explored in section 4.5. of this chapter.

4.3.5 Visual motor integration compared to norms

A significant difference was found in the frequencies of the VMI, VP and MC z scores when compared to the normal distribution of scores. In fact, a deficit of 11 months existed on the mean VMI raw scores with 13.6% scoring in the very low category (z score of below -2.00) when compared to 2% on the Beery VMI norms.

The percentage of very low scores in this study was also lower than Rens (2008) study where only 1% achieved very low scores. Rens (2008) study looked at the VMI, VP and MC of 79 South African primary school students of varying SES aged 7 years 0 month to 7 years 3 months. While this study and Rens (2008) study had participants from middle to low SES, Rens (2008) study looked at the scores of typically developing children with no statistical difference found in the scores between the low and middle SES. Therefore it seems that HIV may have a greater impact on VMI than SES, a factor that will be explored further in section 4.5.2. A limitation of this study is that a matched control group with participants of similar SES but uninfected by HIV was not possible and this is recommended for further studies.

4.3.6 Visual Perception compared to norms

The distribution of VP scores is also skewed like the VMI scores when compared to the Beery VMI norms with half (52.5%) of the participants scoring in the below average category (mean z score between -1.99 and 0.00). About 20.5% of the participants scored in the below average low category (mean z score below -2.00) which is a higher percentage affected when compared to the VMI scores of this study. This indicates that VP is the most affected in terms of prevalence and extent of delay in this study. Rens (2008) study of typically developing children with no statistical difference in VP scores between middle and low SES, had 36% of the participants who scored average and above. This is higher than the current study of whom only 27% scored average and above. As Rens (2008) study was on typically developing children, the VP scores in this study are similar to those who exhibit a mild developmental disability. Therefore it appears to be evident that HIV may have an impact on VP scores causing a developmental delay.

Another factor to note is that both VMI and VP have the most prevalent scores falling below average and fewer participants falling in the low and high categories when compared to the Beery VMI distribution norms (figure 3.3). This could be due to a combination of many factors such as the intake of ART, length on ART and the impact of HIV itself on VMI and VP. The correlation between the medical factors and the SES with the VMI and VP scores will be explored further in section 4.5.

4.3.7 Motor Coordination compared to norms

More than half (54.9%) scored in the average category and above with the mean z score falling in the average category. This is an interesting finding as HIV has been known to cause motor delays (Ferguson & Jelsma, 2009; Potterton, 2006) specifically in areas of eye hand coordination and manual dexterity (Smith et. al., 2002), which are both aspects of the fine motor coordination needed to complete the MC subtest of the Beery VMI.

When compared to Smith et. al. (2008) study where the participants scored an average mean percentile of 17.61±16.5, this study's participants achieved a higher mean score at 27.70±25.6. Again one could argue that the length of time on ART could have had an impact on MC scores but this is not the case as no correlation (r=-0.01) was found between length of time on ART and MC z scores in this study.

The participants from Rens (2008) standardisation of the Beery VMI study on a typically developing South African population on the other hand, had a higher percentage (100%) falling in the average category when compared to this study.

So while the MC scores are average for this study, they fall below the distribution of the Beery VMI norms in the average category (figure 3.3) and below the distribution of Rens (2008) standardisation of the Beery VMI South African study.

Therefore it appears that MC is still impacted by HIV as the scores do not follow a normal distribution curve. Having said this, a limitation of this study is the lack of comparison of scores with a matched SES control group of participants who are uninfected by HIV to further strengthen the premise that HIV also impacts on MC in addition to VMI and VP.

4.4 Association between the visual motor integration, the visual perception and the motor coordination on the Beery VMI test

The third objective was to determine the association between the visual motor integration, the visual perception and the motor coordination scores on the Beery VMI test.

The positive moderate correlation between VP and MC (r=0.52) scores and the strong correlation between VMI and MC scores (r=0.68) support research that the Beery VMI has significant correlations with its subtests (Kulp & Sortor, 2003).

However, VP showed a weak correlation with VMI (r=0.34). About 29.5% of the participants scored below average in VP z scores while scoring average in VMI. Av-Itzhak & Obler (2008) discovered that 9% of their total sample who performed poorly in visual perception scored within the norm for VMI. Kulp & Sortor (2003) also found a significant amount of variance of performance in the VMI unexplained by either subtests.

While the variances in the Beery VMI have been found in typically developing children (Kulp & Sortor, 2003; Av-Itzhak & Obler, 2008); it is possible that the

Beery VMI subtest highlighted possible delays in development of the sample of typically developing children that were previously unknown.

Despite these variances, the Beery VMI is still a well-known research tool (Beery, 2006) and has been used extensively in various studies to determine the visual motor integration of participants infected by HIV (Smith et. al., 2008; Puthanakit et. al., 2013; Bocanegra, 2008). The difference in correlation between VP and VMI subtest scores in this study indicates then that all subtests of the Beery VMI should be administered when assessing visual motor integration.

4.4.1 Comparison to norms for South African studies

While the results from this study displayed difficulties in visual motor integration and visual perception, one could argue that the Beery VMI norms may not be an accurate reflection of the South African population. Dunn et. al. (2006) conducted a study which showed that the Beery VMI yielded a significant correlation of 0.75 with a South African standardised copying test, which supports the suitability of the Beery VMI on a multi-ethnic sample such as seen in this study. Another study by Vally (2006) on a sample of 5 - 7 year old pre-schoolers in Stellenbosch confirmed the internal consistency of the Beery VMI and displayed no significant differences in scores based on gender, socioeconomic status and language. While Rens (2008) standardisation test of the Beery VMI on 80 South African children revealed statistical differences in the VMI, VP and MC scores, the results from this study are lower than Rens (2008) study.

Therefore even when compared to other standardisation studies of the Beery VMI on a South African population and to studies with matched control groups for SES on typically developing children (Rens, 2008; Dunn et. al., 2006; Vally, 2006) the results confirm Potterton et. al. (2010) assertion that HIV is a major determinant of dysfunction in neurodevelopment. In fact when Smith et. al. (2008) compared the neurocognitive scores of the HIV infected participants in their study with uninfected children from low socio-economic communities in other studies, verbal and non-verbal intelligence were lower in HIV infected children and similar to the performance of children who had a mild developmental disability.

This study also supports research that the Beery VMI can continue to be used as a tool to assess visual motor integration in children (Kulp, 1993; Daly et. al., 2003;

Kulp & Sortor, 2003; Goyen & Duff, 2004). Again all subtests of the Beery VMI must be administered as variances have been found between the subtests (Kulp & Sortor, 2003; Av-Itzhak & Obler, 2008).

As no matched control group for SES was used in this study the implication of the impact of having different levels of SES (middle and low SES) on the results of the preschool HIV infected children in this study will be further explored in the next section 4.5.

4.5. The association between visual motor integration, visual perception and motor coordination scores and medical factors related to HIV as well as factors related to socioeconomic status.

The last objective was to determine the association of medical factors related to HIV and factors related to socioeconomic status to the visual motor integration, visual perception and motor coordination scores. The following section will look at the association of medical factors related to HIV on the visual motor integration, visual perception and motor coordination scores of the participants in this study.

4.5.1 CD4 count and ART impact on visual perception

While ART has been known to have a positive effect on immunological functioning, the question remains as to the efficacy of ART on neurodevelopment, in particular on VMI, VP and MC.

It is possible then that while there was no correlation between the length of time on ART with the VMI, VP and MC scores, the combination of ART drugs with better CSF penetration used by the participants may have had had a positive impact by minimising the extent and prevalence of delay seen in VMI, VP and MC in this study. Further research is needed to determine the efficacy of various combinations of ART drugs on the prevalence and extent of delay on VMI, VP and MC of HIV infected participants.

Another significant finding from this study is that visual perception had a moderate positive correlation with CD4 count (r=0.56) and CD4% (r=0.46). This is by far the most significant finding indicating that the higher the CD4 count or CD4%, the higher the visual perception scores. The correlation between CD4 count and

CD4% with visual perception also indicates the need for further research into the impact of the HIV virus on the developing brain. This is important particularly in the neurological regions of the occipital lobe, posterior parietal and inferior temporal regions where visual information processing occurs.

Wang et. al (2011) identified significant differences in the lateral occipital complex (LOC) of HIV infected children when compared to age-matched seronegative control participants. The LOC is known to play an important role in object recognition and appears to be a network that analyses object shape (Grill-Spector et. al., 2001). Object or form perception is an important aspect of visual perception (Case-Smith & Clifford O'Brien, 2013). Difficulties experienced with form perception will impact on the cognitive analysis skills required to provide meaning to a visual stimulus (Case-Smith et. al., 2005; Kramer & Hinojosa, 1999). This will have a domino effect on motor and process skills, praxis and the ability to participate in daily activities such as handwriting, matching and mathematics (Case-Smith & Clifford O'Brien, 2013; Kulp, 1999).

The extent of the delay falls just below average particularly for VMI, which indicates that the neurological and neurocognitive outcome was possibly impacted by the early age of commencement of ART (Ferguson & Jelsma, 2009; Smith et. al., 2008; Resino et. al., 2006; Van Rie et. al., 2009). Again a limitation of the study is that the participants' VMI scores could not be calculated prior to commencing ART so the impact of ART on the extent of the delay in VMI could not be determined.

The impact of the CD4% level on visual perception and type of ART drugs on visual perception and visual motor integration has implications for the nature of the visual-motor treatment programme to be developed. In addition, the neurological findings impacting on the CNS area where visual perception takes place suggests that children infected with HIV will also benefit from a visual-motor assessment as part of their routine medical check-up due to the implications of delayed visual perception on activities of daily living.

4.5.2 Socioeconomic factors and visual motor integration, visual perception and motor coordination

Various studies (Puthanakit et. al., 2013; Bocanegra, 2008) have analysed the VMI delay of HIV infected children from middle to low socioeconomic status. Puthanakit et. al. (2013) study participants from middle to low socioeconomic status with a CD4% between 15% and 24% had a mean low standard score of 72 which is equivalent to a scaled score of 4. Bocanegra (2008) study participants of HIV infected children receiving HAART from a low socioeconomic status achieved a mean VMI standard score of 83.14 which is equivalent to a scaled score of 7. This is similar to the mean VMI standard score of 83.03 equivalent to a scaled score of 7 achieved by the participants in this study who were from a middle to low socioeconomic status. While socioeconomic status can have an impact on neurodevelopment, these studies have shown that VMI delay was found in participants infected with HIV from a low socioeconomic status (Bocanegra, 2008) and middle to low socioeconomic status (Puthanakit et. al., 2013) similar to the VMI scores achieved by the participants in this study.

It is necessary to isolate socioeconomic status as a variable In order to determine the extent of the impact of socioeconomic factors on the VMI of HIV infected children. Dunn et. al. (2006) investigated whether socioeconomic factors influenced scores achieved on the Beery VMI test on typically developing multi-ethnic preschool children in South Africa. Interestingly participants from a middle and low socioeconomic status achieved similar mean scaled scores in visual motor integration at 10.4 and 10.6. Lotz et. al. (2005) conducted a study to determine the visual motor integration scores of a group of learners from a disadvantaged peri-urban South African community from a lower, middle and upper socioeconomic status. Again the mean scores of participants from the middle and low socioeconomic status were similar with mean standard scores of 92.11 and 88.84 respectively.

Therefore two conclusions can be put forward when comparing the results of the above studies to each other (Dunn et. al., 2006; Lotz et. al., 2005; Puthanakit et. al., 2013; Bocanegra, 2008) and to the results of this study. The first conclusion is that the different socioeconomic status levels from this study may not have had an impact on the results of this study as the above studies (Dunn et. al., 2006; Lotz et. al., 2005) show no difference in visual motor integration scores between participants from middle and low socioeconomic status.

Another conclusion that can be put forward is that HIV continues to be a major determinant of the extent of VMI delay as the VMI scores of the HIV infected participants from a middle to low socioeconomic status (Puthanakit et. al., 2013; Bocanegra, 2008) as the VMI scores of this study are lower when compared to the VMI scores of typically developing children in South Africa (Dunn et. al., 2006; Lotz et. al., 2005).

Smith et. al. (2008) also discovered that verbal and non-verbal intelligence performances were lower in HIV infected children when making crude comparisons of neurocognitive scores with other studies of HIV uninfected children from low socioeconomic status. In fact, Smith et. al. (2008) compared the performances to children who have a mild developmental disability.

Despite this Smith et. al. (2008) acknowledges that while it is difficult to change the poverty-related parameters that impact on the intellectual development of children in South Africa, changes to development through intellectual stimulation can be made possible through the utilisation of existing social structures such as child care facilities and toy libraries. As more than three quarters of the participants in this study attended crèche/pre-primary school, they would have been exposed to handwriting, colouring and craft activities. This exposure would have had a positive impact on visual motor integration scores in this study by reducing the extent of the delay.

Therefore the above studies (Puthanakit et. al., 2013; Bocanegra, 2008; Dunn et . al., 2006; Lotz et. al., 2005; Smith et. al., 2008) and the results from this study have shown that the VMI scores of HIV infected children from middle to low socioeconomic status are lower than those of typically developing children from a similar socioeconomic status. Therefore socioeconomic status can be seen as a mediating variable that has a moderating effect on the impact of HIV on VMI but that HIV continues to be a major determinant of the extent of VMI delay in HIV infected children.

However, there were some limitations in this study that if addressed in future studies, can further strengthen the above proposed conclusions. These limitations will be highlighted in the next section.

4.6 Limitations of the Study

- In three instances a translator who spoke the participants' first language was not available. The possibility then arises that the participants and their caregiver did not fully comprehend the instructions. While this only occurred in three instances, this can impact on the participants' performance on the assessment measures, which is a limitation of the research.
- When analysing the socioeconomic levels of the study participants, a composite score of the HESSI II could not be obtained as not all participants completed all sections of the HESSI II resulting in the socioeconomic status of the participants being determined qualitatively.
- Another limitation of this study is that a matched control group of participants from a similar socioeconomic status but uninfected with HIV was not possible for ethical reasons and so the impact of socioeconomic status as a mediating variable on the extent of delay in VMI and VP could not be conclusively determined.
- While there was no correlation between length of time on ART with VMI, VP and MC, a limitation of this study is that a baseline score of VP could not be obtained prior to receiving ART and so the longitudinal impact of ART on VP scores could not be determined to further strengthen the premise that ART does not protect neurodevelopment.

4.7 The need for neurodevelopmental intervention

In phase 1 of this study, the positive effect of long-term ART has been evident in the relatively high CD4 count of the participants. This is significant as the level of CD4 count can determine the extent of the spread of the virus systemically and the degree of cognitive impairment (Burns et. al., 2008). A stronger CD4 count will also decrease the likelihood of opportunistic infections such as bacterial meningitis and the presence of optical diseases that can negatively impact the visual motor area (Smith et. al., 2008; Pizzo & Wilfert, 1998).

As a result, the extent of the delay is not too extreme in visual motor integration and visual perception with motor coordination scoring a low average. Another significant finding is that visual perception is moderately correlated to the CD4 count and CD4% even with the CD4 count being relatively high and the long-term taking of ART. Therefore the researcher recommends that the visual motor integration and visual perception level of children infected with HIV be assessed as part of their routine developmental monitoring. In addition, the level of CD4 count and CD4% can be an indication of the level of visual perception delay. While the Beery VMI has been widely used as a research and clinical tool in this aspect (Kulp, 1999), due to the variances in correlation between the subtests of the Beery VMI found in this study, it is advisable that all subtests of the Beery VMI be administered.

As a longitudinal visual motor assessment was not part of the research the impact of ART on visual motor functioning over a period of time and before commencing ART could not be obtained. However, Smith et. al. (2008) determined that ART does not protect neurocognitive functioning and this is further evident in the below average VMI and VP scores found in this study and in the absence of correlation between the length of time on ART with VMI and VP scores.

Socioeconomic status in particular maternal education and attendance at crèche/pre-primary school has been shown to positively correlate with VMI scores in this study and has been known to influence neurodevelopment in general (Smith et. al., 2008). However in this study socioeconomic status is more of a mediating variable that moderates the impact of HIV on VMI and VP.

While not having a matched control group of participants of similar middle to low SES uninfected with HIV is a limitation of this study, other studies have shown that participants from a middle to low SES do not achieve significant differences in their VMI scores (Dunn et. al., 2006; Lotz et. al., 2005).

So even though the participants in this study had a high average CD4% and were taking ART drugs reported to have better CSF penetration, the VMI and VP scores were still below average with a low average motor coordination. In fact, the scores achieved were lower when compared to other studies of typically developing children of similar socioeconomic status in a South African population (Rens, 2008; Dunn et. al., 2006; Vally, 2006).

This supports research studies that state that neurocognitive deficits, particularly visual perceptual deficits exist in children infected with HIV and receiving ART (Puthanakit et. al., 2013, Bocanegra, 2008; Smith et. al., 2008) and that HIV is a major determinant of neurodevelopmental delay (Baillieu & Potterton, 2008).

Therefore a combination of ART and neurodevelopmental intervention such as a visual-motor treatment programme is recommended to improve the neurodevelopment of HIV infected children (Van Rie et. al., 2009) and to address the delays in VMI and VP.

It is well known that occupational therapy intervention can improve visual motor skills (Dankert et. al., 2003) and visual perceptual skill (Kulp, 1999; Kulp & Sortor, 2003; Sortor & Kulp, 2003). Therefore before looking at the impact of a visual - motor treatment programme on the VMI and VP of HIV infected children, the nature of the visual-motor treatment programme needs to be explored first.

As visual perception is the most affected in this study correlating with CD4 count and CD4%, the visual-motor treatment programme needs to have a strong visual perception element. This is essential as this study has shown that not only is visual perception impacted from a skill level (Smith et. al., 2008), but also that the LOC responsible for object recognition is neurologically affected (Wang et. al., 2011).

Aspects of motor coordination skills should also be included in the visual-motor treatment programme to facilitate normal development and integrate visual perception and motor skills for visual motor integration. The following chapter will explore the type of visual-motor treatment programme needed based on the results from phase 1 of this study and the corresponding literature review.

CHAPTER 5: PHASE 2 METHODOLOGY AND DISCUSSION

"You must work - we must all work to make the world worthy of its children."
Pablo Casals

5.1 Phase 2 Methodology: Development of a visual-motor treatment programme for children with HIV in South Africa

This chapter presents the development of the treatment programme for the VMI and VP deficits identified in phase 1 for children living with HIV in South Africa. In addition to the analysis of the published papers, books, journal articles and official documents, the results and data analysis of the sample participants from phase 1 provided the intervention level for the visual-motor treatment programme. The research design is based on principles of programme development proposed by Fraser & Galinsky (2010). Only the first two steps of programme development were included as part of this study and the discussion for each component is included in the description of the development of steps followed.

Step 1 includes developing problem and programme theories by examining the literature to identify the risk, promotive, and protective factors related to VMI deficits in children with HIV. Mediating factors which may support the development of VMI in the programme also needs to be identified as well as the level of intervention needed, the setting in which intervention can be offered and the agents required to offer the intervention. Finally, the theory of change and principles to support this are discussed and defined.

Step 2 specifies the programme structures and processes which include developing the first draft of the programme and submitting it for expert review. The essential elements of the programme will be specified and the fidelity of the programme established for the draft of the programme. However, the piloting and finalisation of the programme fell outside the scope of this study. The first two steps of programme development described by Fraser & Galinsky (2010) in intervention research have been outlined in figure 5.1:

STEP 1 **Develop problem and programme theories**	Develop problem theory of risk, promotive and protective factors Develop programme theory of malleable mediators Identify intervention level, setting and agents Develop theory of change and theoretical principles
STEP 2 **Specify programme structures & processes**	Develop the first draft and submit for expert review Specify essential programme elements *Pilot programme and measures (i.e. outcome and fidelity measures)*

Figure 5.1 Steps in Intervention Research (Fraser & Galinsky, 2010; p.463)

5.2. Step 1: Develop problem and programme theories

5.2.1. Theory of risk, protective and promotive factors for neurodevelopment in children with HIV

5.2.1.1 Risk factors

The risk factors for neurodevelopmental delay particularly visual perception delay in children living with HIV have been described in the literature review in chapter 2. These factors include the neurological effect of HIV on the developing brain as it is able to cross the blood brain barrier at the early stages of infection into the central nervous system resulting in VMI and VP delay (Wang et. al., 2011; Bocanegra, 2008; Smith et. al., 2008).

Other factors such as high maternal viral loads, age at which infection occurs and the mode of transmission determine the extent of VMI and VP delay due to their impact on the CD4 count thereby affecting the extent of spread of the HIV virus systemically (Mitchell, 2001).

5.2.1.2 Protective factors

In terms of protective factors, the effects of long-term ART has not shown to protect neurocognitive functioning (Bocanegra, 2008; Smith et. al. 2008). The effects of ART on visual motor and perceptual functioning over a period of time could not be obtained in this study. However, Puthanakit (2013) determined that

HIV-infected children performed worse on the Beery VMI than uninfected children after 144 weeks of treatment on ART.

This study results showed that the length of time on ART correlated moderately with CD4% resulting in a relatively high CD4%. Interestingly the CD4 count and CD4% of the participants correlated moderately with the visual perception scores obtained. This is significant as the level of CD4 count can determine the extent of the spread of the virus systemically and the degree of cognitive impairment (Burns et. al., 2008).

The combination of ART drugs used by participants in this study could be a protective factor due to its increased CSF penetration resulting in a relatively high CD4 count. As mentioned in the previous chapter, a higher CD4 count will also decrease the likelihood of opportunistic infections that can impact on the visual-motor area (Smith et. al., 2008; Pizzo & Wilfert, 1998).

5.2.1.3 Promotive factors

A promotive factor is the level of the CD4 count and CD4%, which are medically related to HIV. A high CD4 count and CD4% seems to indicate not only the strength of virological constitution but also a positive correlation with the extent of visual perception delay in this study.

Even with a high CD4 count and CD4%, a promotive approach calls for the visual perception status of children infected with HIV to be monitored and included during neurodevelopmental assessments using all subtests of the Beery VMI. If any deficits are found in visual perception and visual motor integration, then OT is recommended to address this as it has been known to improve visual-motor skill (Dankert et. al., 2003).

However, the risk factors for neurodevelopmental delay particularly in visual motor integration could be the malleable mediators related to environmental factors. These environmental factors could also be impacting on the neurodevelopment of the participants in the study. In this study however it would appear that the greatest risk posed by HIV is the delay in visual perception rather than visual motor integration or motor coordination.

5.2.2 Develop programme theory of malleable mediators

Further risk factors resulting in deficits in VMI of children living with HIV were described in chapter 3. These factors have been previously associated with a delay in VMI and include socioeconomic status, maternal level of education and household intellectual stimulation (Smith et. al., 2008).

Although the participants came from both low and middle socioeconomic backgrounds, some socioeconomic factors may have impacted on the living conditions of some children such as their access to resources in terms of materials and stimulation. Research indicates that this can negatively affect the development of VMI, when due to financial constraints, children either do not attend nursery school or attend overcrowded and poorly resourced facilities (Dunn et al., 2006). However, in this study maternal level of education and household intellectual stimulation have not posed as much of a risk factor as most of the mothers had completed high school and 85% of the participants were attending crèche/pre-primary school with this attendance correlating moderately with VMI scores (r=0.56). The level of maternal education also had a moderate positive correlation to the VMI scores for this study (r=0.43).Therefore it must be assumed that malleable mediators in terms of demographic environmental factors have a role to play in the development of VMI for the participants living with HIV, but not necessarily for visual perception and motor coordination.

5.2.3 Identify intervention level, setting and agents

5.2.3.1 Intervention level

Chapter 3 added to the problem theory and assisted in identifying the intervention level by determining the extent of the delay in visual motor integration and visual perception in preschool children infected with HIV as part of phase 1 of the research study.

The deficits in the visual-motor area indicated approximately 40% of participants were at risk for delay in visual motor integration with a z score of -1SD just below average and 13.6% recorded dysfunctional scores below -2SD. Visual perception was the most affected with more than half of the participants scoring at -1SD deviation below the mean and 20.5% having scores indicating dysfunction or delay below -2SD. Motor coordination showed a lesser deviation from the normal curve and therefore has fewer risks for delay than the other aspects of visual motor integration.

Therefore as a result of this, the visual-motor treatment programme will have a large focus on developing visual perception including VMI, which is also at risk of a delay. Fine motor coordination will also be included to ensure ongoing development in this area. These three aspects will all form part of the programme as VMI in particular, is known as the '...degree to which visual perception and finger hand movements are well coordinated (Beery, 2006; p.12). This is important as this study in addition to other studies (Smith et. al., 2008; Bocanegra, 2008) have shown that VMI and VP delay exists even in the presence of ART.

A bottom-up step by step approach was employed by the researcher when conducting the research following Fraser & Galinsky (2010)'s design. This chapter will explore and delve into the frames of reference and models used to design the visual motor treatment programme followed by the completed presentation of the visual motor treatment programme. Current neurodevelopmental treatment programmes for pre-school children will also be critically analysed to inform the development of the visual-motor treatment programme.

5.2.3.2 Setting

Further research is needed to identify the appropriate type and nature of social, clinical or scholastic therapeutic interventions to ensure effective improvements in neurodevelopment of children with HIV (Shanbhag et. al., 2005). Potterton et. al. (2009) advises that the "...most effective programmes (1) provide learning opportunities for children and their families, (2) are targeted towards younger more disadvantaged children, (3) are of longer duration, and (4) are integrated into other child and family services" (p. 548).

In order to be integrated into child and family services, the setting of the visual motor treatment programme is within the community in a preschool setting. This is particularly evident as more than three quarters of the participants from phase 1 attended crèche/pre-primary school. In addition, a visual motor treatment programme will provide an additional educational resource to the teachers and support household intellectual stimulation.

5.2.3.3 Agents

Various research studies have recommended the need to create structured therapeutic interventions to improve the neurodevelopment of children with HIV (Potterton et. al., 2009; Burns & Hernandez-Reif, 2008; Shanbhag et. al., 2005, Van Rie et. al., 2008; Van Rie et. al., 2009; Baillieu & Potterton, 2008). Provision of intervention can promote and increase visual perception skill (Kulp, 1999; Kulp & Sortor, 2003; Sortor & Kulp, 2003). Occupational Therapy intervention in particular, has been shown to increase visual motor skills in preschool children (Dankert et. al., 2003). In order for effective therapeutic intervention to take place, a structured set of guidelines is necessary to guide workers with less clinical expertise (Potterton et. al., 2009). Therefore as the setting for the visual motor treatment programme occurs in a preschool, it is well matched for a teacher to be the agent to deliver the programme under the guidance of the structured visual-motor treatment programme.

5.2.4 Theories of change for visual motor integration

A number of theories were incorporated into the development of the programme that supports change in neurocognitive function in children. These theories have included a South African Occupational Therapy model to be culturally relevant and educational theorists as learning forms a large part of the visual motor treatment programme. Content specific frames of reference have also been utilised to guide the content of the programme.

5.2.4.1. Developmental approach:

The developmental frame of reference has undergone various changes over the years. The developmental frame of reference is appropriate as a background for activities, as it has evolved into an adapted frame of reference that includes multiple areas of development.

With the emergence of occupation centred practice, the emphasis is now on the culturally relevant roles that the child is able to achieve within the environmental context (Rodger, 2010). While it goes without saying that developmental milestones, in particular visual perceptual and cognitive milestones, are sequential or hierarchical, this does not take into account the overall skill acquisition that is required. Kramer & Hinojosa (1999) argue that the developmental perspective forms a foundational knowledge that is essential but refrains from presenting a specific developmental frame of reference due to the multiple levels and areas of development that can occur in a child.

The four intervention programmes analysed by the researcher all utilise the developmental approach with each programme adopting the area of development relevant to the programme's focus.

Therefore the researcher has utilised an overarching developmental approach bearing in mind the multiple levels of visual perceptual, motor and cognitive development in a five-six year old child as well as the most effective learning strategies for that stage of development. While phase 1 of the research has shown deficits in single areas such as visual perception and visual motor integration, an occupation centred outcome resulting in the visual motor treatment programme's focus on shapes has been chosen to be environmentally relevant to the child's role as learner.

A top-down approach has also been utilised due to the cognitive strategies needed to assist the learner to acquire a new skill with frames of reference such as the visual perception and the acquisitional frames of reference (Rodger, 2010). In addition, the application of the overarching developmental approach is evident in the use of age appropriate visual perceptual forms for the skill acquisition of naming and drawing of shapes.

5.2.4.2. Model of creative ability:

The model of creative ability is a South African model which provides a framework for evaluation and treatment of an individual's occupational performance in their activities of daily living. It is particularly useful in providing principles of treatment specific to the client's level of occupational performance. The model details how *motivation* is the innate urge to master the environment resulting in *action*, an exertion of motivation into activities with an end product. It was established by Vona Du Toit in the 1970s and has been applied to paediatrics with developmental stages for each age group (Crouch & Alers, 2005). The stages are described below relevant to the age group of the sample participants from phase 1:

Table 5.1. Vona du Toit Model of Creative Ability applied to paediatrics (Crouch & Alers, 2005; p. 276).

Motivation level	Action level	Key Components
Self-presentation	**Explorative 2 years – 5 years**	Materials are explored to determine their properties
		Products largely unplanned but with 4-5 steps an end product can be made.
		No norms of quality/speed
		Develops task concept
		Tool manipulation explored and tested
		Development of basic concepts occur
		Fantasy play and role modelling enjoyed
Passive Participation	**Experimental Nursery/Primary school child**	Consolidated task concept
		External motivation required
		Tools handled more product centred
		Practice leads to skill
		Product evaluation is necessary but negative evaluation not well accepted
		Active learning but not self-directed

This model was used to choose creative activities and to guide clinical reasoning to determine the "just right fit" in participation. Therefore the model was utilised to inform principles of treatment for the 5 year 0 month to 5 year 11 month age group. This included principles of handling, presentation and structuring to determine the right level of participation.

The sample participants' average age group was 64.90±3.8 (5 years 5 months) and 86% (n=71) of the sample participants attended crèche/pre-primary school. Therefore the combination of the age and education level along with the below average VP and VMI results influenced the explorative-experimental level of action chosen for the visual motor treatment programme. The explorative-experimental level of action provides a 'just right challenge' to the programme participants through the following:

- Exploration of shapes using playdough, stencils and wooden blocks
- Number of steps from 3-5 in the activity with an end product encouraged to stimulate task concept
- Use of tools such as pencil, paintbrush and colouring pencils to allow for exploration while developing fine motor skills

- Presentation of the activity as a whole by the teacher followed by step by step instructions
- Discussion of end products at the end of the session without emphasis on quality of end product.

5.2.4.3 Acquisitional frame of reference:

The acquisitional frame of reference utilises a top down approach to learning or acquiring a skill for performance within an environment. The primary goal is to master the skill or subskill required in each activity (Rodger, 2010; Kramer & Hinojosa, 1999). The aim of the visual-motor treatment programme called My Shapes Programme (MSP) is to recognise, identify and draw five basic shapes. The acquisitional frame of reference is therefore appropriate due to its emphasis on skill acquisition through the implementation of learning strategies and theories.

This frame of reference utilises the environment to 'nurture' and encourage mastery of skill within the physical, social and/or cultural environment external to the body. It is expected that through environmental interaction, adaptive behaviour and mastery of skill will occur (Kramer & Hinojosa, 1999). This is achieved in the MSP through the following ways:

- The physical environment is a learning environment in the pre-school with specific desk arrangements to encourage learning through modelling of behaviour by the teacher and observation of peers.
- Tools such as the pencil, colour pencil and paintbrush are educational and developmentally appropriate for the five-six year age group as they encourage mastery of the pencil grip skill.
- Positive reinforcement provided by the teacher through modelling of activities, encouraging successful attempts to recognise and identify shapes through verbal comments, facial expression and body language. At this phase, negative evaluation is not recommended as children at this developmental level require positive reinforcement to optimise performance.
- Use of a story as a narrative to introduce a new shape being learnt as part of the context of the social environment.

As the programme requires skill development, cognitive principles and strategies from other theorists have been used to enhance the learning process.

5.2.4.4 Feuerstein's mediated learning experience:

Feuerstein's mediated learning experience (MLE) stipulates that a child's cognitive performance can be modified through an intervention that involves a mediator. The intervention provided by the mediator is intentional with the mediator filtering, naming and relating stimuli to each other to create new cognitive structures with the child responding to this interaction (Tzuriel & Eiboshitz, 1992).

The IVPP (Vlok et. al., 2011) and the SP-VMI (Tzuriel & Eiboshitz, 1992) are both short-term intervention programmes that use Feuerstein's MLE to drive learning and skill mastery. For an interaction to become a mediating interaction, the mediator should be able to '...transcend the here-and-now, relate to other situations, to add meaning to the stimulus, to regulate behaviour, to boost feelings of competence" (Kozulin et.al., 2010; p. 2). This is therefore the role that the teacher in the MSP is expected to take to facilitate learning and mastery of the ability to identify and draw shapes.

Feuerstein's MLE was suggested for use in the treatment programme by the expert review as a visual-motor treatment programme is therapist directed. The MLE has been used in the treatment programme by focusing on the interaction between the teacher and the learners. The teacher is the mediator who intentionally provides an interaction that involves naming the shapes and encouraging the recognition of everyday objects that have the shape being learnt during circle time and discussion at each session. Above all the teacher is to aid in boosting feelings of competence to encourage active participation and skill mastery in the learner.

5.2.4.5 Visual Information Analysis: Frame of Reference for Visual Perception

Visual information analysis as a frame of reference for visual perception is pivotal to the MSP. It is a frame of reference that is used to '...explain the process by which visual motor and visual perceptual skills develop and the effect of learning on the process of development of these skills" (Vaidya, 2008; p. 9). The expert review has identified the visual perception frame of reference as a "most appropriate frame of reference" and "to guide the grading of activities and level of expectation required by the task in line with developmental assumptions" (Appendix M).

Visual cognitive functions of visual information analysis such as visual attention, visual memory, visual discrimination and visual imagery have influenced the structuring of activities and activity requirements.

Visual attention and visual memory have been facilitated through the use of cognitive strategies. Visual attention has been enhanced through the activity requirements that provide a 'just right fit'. Visual memory has been achieved through mediation and modelling from the teacher and the principles adopted from the Agam program (Razel & Eylon, 1990). The Agam program has been shown to have transferable skills on visual identification, visual memory and reproduction skills. From the Agam program learning stages such as identifying the shape to be learnt, storing the shape in memory, retrieving the shape from memory and reproducing the shape in various formats has been applied to the MSP (Razel & Eylon, 1990).

The Agam program (Razel & Eylon, 1990) included the following approach in their activities:

1) Structured approach to passive identification of the concept presented by the teacher;
2) Active discovery of the concept in simple form, for example, looking for the object in the classroom;
3) Active discovery in visual analyses, for example, finding squares in books and
4) Present task demanding recognition from a memory of combinations based on the concept, for example, looking for a particular shape amongst other shapes.

Each session in the MSP followed this structure in the following manner:

1) Story time where the teacher passively introduces the shape being learnt
2) Active discovery of the shape through looking for everyday objects of the shape being learnt and through making 3D objects of the shape
3) Active discovery in visual analyses through tracing and drawing the shapes

4) Present task demanding recognition from memory by identifying same size shapes, matching shapes to each other and identifying shapes amongst others in latter sessions
5) Repeated presentation of the same concept in large number of activities per session

5.2.4.6. Theoretical principles for the intervention programme for visual motor integration and the My Shapes Programme

The researcher has critically analysed the theories, approaches and strategies of relevant intervention programmes. The intervention programmes have underlying theoretical principles, which have been summarised in table 5.2

As the outcome of the MSP is to learn a skill, various cognitive strategies that have been implemented in the intervention programmes have been utilised to aid the learning process. *Circle time* and the *discussion* at the end of each session provide the opportunity for the teacher to act as the mediator, in addition to providing cues and feedback while the learners are at the workstations. Visualisation occurs when learners are drawing the shape in the air and when learners are feeling the shape with vision occluded at the beginning of the session. Other cognitive strategies utilised are inherent in the treatment programme itself through the grading of sessions following typical perceptual motor development, active involvement required of the learners and the repetition of concepts learnt throughout the programme.

Table 5.2 Theoretical principles of intervention programmes for visual motor integration

Programme	Theoretical Principles
Integrated Visual Perceptual Program (IVPP) **Vlok et. al. (2011)**	5 stage problem solving structure Cognitive strategies (preferred learning method, repetition, cues and feedback, questions, verbalisations, visualisation, scaffolding, shaping, modelling of behaviour and self-evaluation) "Just right fit" of activities Enable mastering of visual perceptual skills through graded activities Learner should perceive success in participation in activities Active involvement for optimal learning of form and spatial orientated academic tasks Include components for development of visual system in program
SP-VMI for preschool children **(Tzuriel & Eiboshitz, 1992)**	Phases of the program are congruent with perceptual-motor developmental stages Visual-motor tasks are constructed so that the level of difficulty increases by very small steps guaranteeing opportunities for success Teaching process guided by MLE principles, especially intentionality and reciprocity, transcendence, meaning, feelings of competence and regulation of behaviour Instructions and modes of operation given to the child are simple, structured and modelled
Short term Graphomotor Program **(Ratzon et. al., 2007).**	Based on motor learning theories where the practised task is similar to the required assignment Multisensory theory Association between dexterity skills and normal development of visual motor proficiency
Agam Program **(Razel & Eylon, 1990)**	Repeated presentation of same concept in large number of activities Combination of concepts taught after mastery of individual concepts Minimal use of verbal instruction as relying on visual domain to develop visual language and visual cognition

The theories described above together with the four intervention programmes have informed the content of the treatment programme and have led to the formation of treatment guidelines for the MSP. The table below describes the treatment principles with their application in the MSP and its theoretical background (table 5.3).

Table 5.3 My Shapes Programme principles, application & theoretical background

Programme Principles	Programme Application	Theoretical background
Narrative element when introducing a new concept	Story time during circle time	Acquisitional frame of reference
Allow children to physically explore new form	Workstation 1 playdough, stencil and block activities	Model of Creative Ability
Integrate visual-cognitive-representation of form	Grading from Workstation 1 through to Workstation 2	Visual information analysis
Repetition of activities to gain task mastery while varying tasks for generalisation of concepts learnt	Utilising the same material while increasing complexity of activity requirements from session to session	Model of Creative Ability Visual Information Analysis
Utilisation of various tools	Workstation 1 and Workstation 2	Model of Creative Ability Acquisitional Frame of Reference
Include elements of action-exploration of each form	Learners seated in shape around teacher during circle time Drawing shape in air during discussion at session end	Acquisitional Frame of Reference Visual Information Analysis
Presentation of demo model of completed product	Beginning of Workstation 1	Model of Creative Ability Feuerstein's MLE
Verbalisation of shape characteristics upon shape introduction	Circle Time and Discussion	Model of Creative Ability Visual Information Analysis
Identification and generalisation of shape to everyday objects	Circle Time and Discussion	Feuerstein's MLE Visual Information Analysis

5.3. Step 2: Specify programme structures and processes:

Step 2 involves forming the first draft and discussion of the expert review of the programme and essentially the design of the intervention (Fraser & Galinsky, 2010). In order to determine the content validity of the MSP, the theories that inform the content, activity requirements, handling, structuring and grading of the programme to develop the programme theory was selected by the researcher at the initial stage of programme development. These have been explained in section 5.2.4. The following section will explore the rationale behind the MSP, logistical elements of the programme and present the programme itself.

5.3.1 Develop the first draft

5.3.1.1 Rationale for the 'My Shapes Programme'

The 'My Shapes Programme' was developed as a result of many contributing factors such as the results from phase 1, developmental level of five-six year old children and its relevance to their occupational performance.

Education is an important occupation of preschool children. Part of the educational curriculum for five-six year old children is the learning of shapes. To be able to recognise, identify and draw shapes requires the visual motor integration skill of being able to copy a triangle, cross, square and diagonal lines which are developmentally expected by five-six years of age (Case-Smith, 2005). This ability requires visual discrimination for object recognition, matching, categorisation and detection of relationships. Visual perception skills of form and spatial perception are essential in order for visual discrimination to take place (Case-Smith, 2005; Kramer & Hinojosa, 1999). In addition to this is the motor aspect that requires pencil grip and control.

As visual motor integration and visual perception have an impact on occupational performance areas of reading and handwriting (Kulp, 1993; Kulp & Sortor, 2003; Case-Smith, 2005), the programme was developed to be administered by pre-school teachers in a pre-school or crèche setting.

Therefore a shapes programme that incorporates the skills of visual perception and visual motor integration with an occupational performance area as an outcome is most suited particularly within the educational context. The visual-motor treatment programme will seek to fulfil much of Potterton et. al. (2009) stated characteristics of effective programmes. It provides a learning opportunity for children, is targeted towards younger children from a low socioeconomic status through the use of low cost resources and is integrated into the educational service. This programme is recommended to be used in conjunction with a normal preschool stimulation programme or curriculum to the discretion of the preschool teacher.

5.3.1.2 Key 'My Shapes Programme' elements:

Aim of the programme

The aim of the programme is for preschool children to be able to identify and draw five basic shapes - circle, square, rectangle, triangle and oval. Learners should also be able to recognise and match the shapes with differences in size and direction.

Theme

The sessions are based around the daily adventures of two children Thabo and Jessica. They will introduce each session as part of 'story time' and will also appear in the accompanying workbook.

Programme delivery

The programme has 12 sessions of 45 minutes in length. Due to the preschool learner's unique developmental level, part of the session involves play-based exploration with the use of modelling and demonstration from the teacher resulting in an end product. The other part of the session is a paper-pencil task using individual workbooks.

Each session is divided into different activities:

Circle Time: This is an introduction to the session and is a discussion/story time. The learners are seated around the teacher in the shape that is being learnt for that session.

Workstation 1 and 2: The learners will be divided into two groups. One group will work at workstation 1 and the other group will work at workstation 2. At the end of

10 minutes, the teacher will direct the learners to move to the alternative workstation. This set up provides a movement break which will assist with the learner's concentration levels. Each workstation will have the desks arranged to face each other. This allows the teacher to circulate between the workstations to demonstrate the activities as necessary.

Discussion: This is the last activity in each session. The learners are again gathered around the teacher similar to the physical structuring of *circle time*. This provides the learners with the opportunity to provide feedback on the shape learnt and for the teacher to continue the mediation process of consolidation and generalisation of the concept to everyday objects.

5.3.1.3. My Shapes Programme (MSP)

The general activities included in the MSP are in table 5.4. For further detail please refer to Appendix I for the manual and Appendix J for the workbook.

Table 5.4 Brief Outline of the My Shapes Programme

SESSION	OUTCOME	CIRCLE TIME	WORKSTATION 1 (Activity)	WORKSTATION 2 (Workbook)	DISCUSSION/ ACTIVITY
SESSION 1 **Recognising the circle**	Identify everyday circle objects Make/trace/draw circle	Story time Identify circle objects Feel circle objects with vision occluded	Make playdough circles Play with circle objects	Trace outline of circles Colour/decorate pictures	Discuss circle Draw circle in the air Identify circle objects
SESSION 2 **Telling the difference: circle shapes**	Sort/match different sized circles Draw a circle	Match paper cut-out circles of different sizes	Match circle templates to make a caterpillar	Draw a circle Identify circles of same sizes	Colour in pictures Decorate with glitter
SESSION 3 **Recognising the square**	Identify square objects Make/trace/draw square	Story time Identify square objects Feel square objects with vision occluded	Paint square stencils	Trace outline of squares Colour/decorate pictures	Discuss square shape Draw square in the air Identify square objects
SESSION 4 **Telling the difference: Square shapes**	Sort/match different sized squares Draw a square	Match square stencils of different sizes	Place square wooden blocks to fit into square stencils Make a square cardboard box	Draw a square Identify same size squares Match circles/ squares	Colour in pictures Decorate with glitter
SESSION 5 **Recognising the rectangle**	Identify rectangle objects Make/trace/draw rectangle	Story time Identify rectangle objects Feel rectangle objects with vision occluded	Make rectangle shapes using matchsticks (copy from model on table) Paint on pre-cut rectangular cards	Trace outline of rectangles Colour in pictures	Discuss rectangle shape Draw rectangle in the air Identify rectangle objects
SESSION 6 **Telling the difference: rectangle shapes**	Sort/match different sized rectangles Draw a rectangle	Match rectangle stencils of different sizes	Place square wooden blocks to fit into rectangle stencils Make a rectangle envelope	Draw a rectangle Identify same size rectangles Match rectangles, squares & circles	Colour in pictures Decorate with glitter

SESSION 7 **Recognising the triangle**	Identify triangle objects Make/trace/draw triangle	Story time Identify triangle objects Feel triangle objects with vision occluded	Make triangle using play dough/cookie cutters/ keyway sticks	Trace outline of triangle Colour in pictures	Discuss triangle shape Draw triangle in the air Identify triangle objects
SESSION 8 **Telling the difference: triangle shapes**	Sort/match different sized triangles Draw triangle	Match triangle stencils of different sizes	Make a kite	Draw a triangle Identify same size triangles Match rectangles, squares, circles and triangles	Colour in pictures Decorate with glitter
SESSION 9 **Recognising the oval**	Identify oval objects Make/trace/draw oval	Story time Identify oval objects Feel oval objects with vision occluded	Make oval shapes out of playdough	Trace outline of oval Colour in pictures	Discuss oval shape Draw oval in the air Identify oval objects
SESSION 10 **Telling the difference: oval shape**	Sort & match different sized ovals Draw oval	Match oval stencils of different sizes	Make oval shaped butterfly/flower	Draw an oval Identify same size oval Match circles, squares. rectangles, triangles and oval shapes	Colour in pictures Decorate with glitter
SESSION 11 **Recognising the shapes**	Recognise and name the shapes learnt	Discuss each shape Draw shapes in the air Identify shapes Determine shapes with vision occluded	Exploration of different shapes learnt using play dough involving copying shapes/sequence of shapes made by teacher	Draw different shapes in workbook Match shapes (size and pattern remain the same)	Discuss different shapes learnt
SESSION 12 **Telling the difference: size & direction**	Recognise the shape Match the same shape in various sizes	Story time Discuss how a shape can change in size and direction	Make the same shape but of different sizes using play dough	Draw shape in the workbook Match similar shape but of different size and orientation	Discuss various shapes learnt throughout the program

As with any intervention programme, logistical elements such as the number of sessions and length of intervention time need to be considered. As part of informing the content validity of the programme, the researcher has analysed four treatment programmes. Two of the programmes utilise a short-term intervention approach with the logistical elements recorded below:

Table 5.5 Logistical elements of intervention programmes

Programme	Criteria	Length
Integrated Visual Perceptual Program (IVPP) **(Vlok et. al. 2011)**	6:6yr– 7:6yr Develop VP skills in learners with VP problems	10 one hour group sessions
Short term Graphomotor Program **(Ratzon et. al., 2007)**	First grade learners Short-term intervention on visual motor skills in first grade students from low socioeconomic background	12 weekly forty-five minute sessions to 2 learners at a time

The IVPP (Vlok et. al., 2011) did not display any significant changes in visual perception although functional improvements were observed. Vlok et. al (2011) recommends a longer period of intervention with the optimal number of weeks requiring further research. On the other hand, the short term graphomotor programme (Ratzon et. al., 2007) runs for 12 sessions with learners making significant gains in the graphomotor and fine motor subtest of the assessment measures used. This is a successful short-term intervention as it is usually long-term interventions lasting for 7 months or more that show success in the skills being practised (Ratzon et. al., 2007).

In response to this Ratzon et. al. (2009) compared delivery methods of three successful short-term intervention programmes that brought about significant improvement in visual-motor skills. This study revealed that short-term interventions have practical positive outcomes as they can save resources to the educational system, enable children to rapidly catch up with their peers and continue to develop in the academic area without any significant gaps (Ratzon et.

al., 2009). This is relevant to the South African context where low cost, effective intervention for maximum impact is needed. Ratzon et. al (2007) also previously discovered that in order for a short-term intervention to be successful, focused practice on desired skills needs to occur.

Expert review advised that a 45-minute session is too long for the tasks required of the MSP. However, another expert advised that the time should be adequate for cognitive strategies of repetition, settling of the group and to allow for individual differences. The 45-minute long session was recommended for the learner to be able to “bridge and get inner meaning of the activity” and for mastery of skill with the assistance of feedback and mediation from the teacher.

In light of all the analyses, the MSP is an intervention programme that runs for 12 weeks with 45 minute long sessions. The emphasis of each session is on focused practice as advised by Ratzon et. al (2007) on the skill of recognition, identification and drawing of five basic shapes.

5.3.1.4 Grading of the ‘My Shapes Programme’

The principles identified have together shaped the grading of content throughout the programme. Grading has occurred in the MSP across different levels. The most apparent level is through the progression of visual perceptual forms. The developmental progression of forms has informed the different types of shapes used and the grading of shapes from one session to another.

Furthermore, the results from phase 1 have defined the parameters of the developmental forms used and thereby the specific shapes utilised in the treatment programme. The results from phase 1 VMI scores display the standard deviation of forms to be from the circle to the left oblique line and for VP scores from the matching of the circle to the triangle. The Beery VMI (2010) developmental milestones up to the age of 5 years 11 months advises that it is developmentally appropriate for a five-six year old child to be able to copy a 3 line cross and match the circular triangle form. Therefore the MSP itself has focused on five basic shapes – circle, square, rectangle, triangle and oval, with the integration of these shapes amongst other shapes in pictures. These five basic shapes have included the oblique lines and the use of patterns similar to the 3 line cross to challenge learners who function at a higher level.

As there are two workstations, they have been graded across different tracks. Grading occurs within a session from manipulating concrete objects in Workstation 1 to tracing/drawing and matching on a paper pencil level in Workstation 2. Grading also occurs from session to session at each Workstation. Workstation 1 has focused on the 3D manipulation of the shapes being learnt at a concrete level. Therefore grading at this workstation has occurred on the number of steps included in the activity and the nature of the activities from an explorative to a constructive nature. This progression has been described in greater detail in the table below:

Table 5.6 Grading of Workstation 1

Workstation 1 Session Outcome	No. of activities	Type of activity
1.Identify/make circle	1	Free play exploration with playdough & circular objects
2.Sort/match circle	2 parts of 1 activity	3 step constructive activity to match circles to make a caterpillar
3.Identify/make square	1	Free play exploration with square stencils
4.Sort/match square	2	Free play exploration with square wooden blocks Constructive 3 step activity to make a cube
5.Identify/make rectangle	2	Partial explorative constructive activity with keyway sticks Partial explorative constructive activity with rectangular sponges and paint
6. Sort/match rectangle	2	Partial explorative constructive activity of wooden blocks into rectangular stencils Constructive 5 step activity to make a rectangular envelope
7.Identify/make triangle	1	Free play exploration with playdough & triangular shapes
8.Sort/match triangle	1	Constructive 3 step activity to make a kite
9.Identify/make oval	1	Free play exploration with playdough & oval objects
10.Sort/match oval	1	Constructive 2 step activity to make a butterfly/flower
11.Recognise/name shapes	1	Guided playdough exploration of shapes
12.Match shapes	1	Guided playdough exploration of shapes of different sizes

As visual perception forms a strong part of the MSP, the visual discrimination aspects of recognition, matching, categorisation and detection of relationships have informed grading in the programme.

Table 5.7 Grading of Workstation 2

Workstation 2 session outcome	Visual cues	Drawing	Matching
1.Trace circle	Full	3 pictures Trace circular objects	_
2.Draw/match circle	Partial	2 pictures Draw circle	1 picture Same size /pattern
3.Trace square	Full	3 pictures Trace square objects	_
4.Draw/match square	Partial/ minimal	2 pictures Draw square	3 pictures Same size/different pattern Match circle/square
5.Trace square	Full	3 pictures Trace rectangle objects	_
6.Draw/match rectangle	Partial/ minimal	2 pictures Draw rectangle	3 pictures Same size/different pattern & orientation Match circle/square/rectangle
7.Trace triangle	Full	3 pictures	_
8.Draw/match triangle	Partial/ minimal	2 pictures Draw triangle	3 pictures Same size/different pattern & orientation Match circle /square /rectangle/ triangle
9.Trace oval	Full	3 pictures Trace oval	_
10.Draw/match oval	Full/ partial/ minimal	2 pictures Draw oval	2 pictures Same size/different pattern & orientation Match circle /square /rectangle/ triangle/ oval
11.Draw shapes	Minimal	2 pictures per shape Draw shape Draw everyday object	_
12.Match shapes	_	_	2 pictures Find shape amongst picture

Introduction

Aim of the program
The aim of the program is for preschool children to be able to recognise and identify 5 basic shapes - circle, square, rectangle, triangle and oval. Learners should also be able to recognise and match the shapes with differences in size and direction.

Theme: The sessions are based around the daily adventures of Thabo and Jessica. They will introduce each session and will also appear in the accompanying workbook.

Program delivery
Due to the preschool learner's unique developmental level, part of the session involves play-based exploration with use of modeling and demonstration from the teacher.

The session is divided into different activities:

Outcome: This includes the aim each session for each learner.

Activity: Circle Time

Setting the scene: This element includes details regarding the set-up of the workstations. The teacher is encouraged to set – up the workstations and to have the necessary materials ready before each session to ensure smooth running of the session.

Discussion: During this time learners sit around the teacher while the teacher introduces the session for the day.

This is the idea light bulb. Helpful hints are included which can be used according to the teacher's discretion.

Workstation 1 and 2: The learners will be divided into two groups. One group will go to workstation 1 and the other group will go to workstation 2. At the end of 10 minutes the teacher will direct the learners to move to the alternative workstation. This set up provides a movement break which will assist with the learner's concentration levels.

Each workstation will have the desks arranged facing each other to encourage modeling and participation of the learners. The set-up arrangement is detailed in the diagram below:

Desk	Desk
Desk	Desk

OR

Desk
Desk

List of materials needed

1. Samples of round objects e.g. ball,
2. 4 tubs of play dough
3. Cookie cutters (round, square, triangle, rectangle)
4. 4 X Pritt glue
5. Pencils
6. Crayons
7. Erasers
8. Sharpener
9. Glitter
10. Round stickers
11. 10 paper cups
12. Buttons of varying sizes (two of the same size)
13. 1 piece of string for each learner
14. 1 roll of sticky tape per table
15. 10 square shaped sponges
16. A4 paper
17. Coloured A4 paper if available
18. Paint
19. Tissues
20. Garbage bags to be used as aprons
21. 20 square wooden blocks
22. 1 X Business card
23. 1 X Envelope
24. 2 X box of matches / keyway sticks
25. Sponges with varying shapes and sizes (square, circle,
26. 1 X party hat
27. 1 X clothes hangar
28. 1 X egg
29. 1 X small rugby ball /picture of rugby ball

Session 1: Recognising the circle

Outcome:

- The learner will identify everyday objects that look like a circle with assistance.
- The learner will be able to make a 3D image of a circle.
- The learner will be able to trace and draw a circle with visual cues.

Materials needed:

- Samples of round objects e.g. ball,
- Play dough
- Cookie cutters (round)
- Pritt glue
- Pencils, crayons
- Glitter
- Round stickers

Activity 1.1: Circle time

Discussion: 10 minutes

The teacher has the learners seated in a circle around her. The teacher introduces the program advising that the learners will be learning about shapes – identify, draw and 'tell the difference" between shapes of various sizes.

Story...

"In a small suburb of Johannesburg, Thabo and Jessica were friends. They lived next to each other and went to the same school. They spent a lot of time playing together during school and after school.

Thabo and Jessica loved learning new things at school. They were especially excited about the different shapes they were learning. That day on the way home from school, Thabo and Jessica were talking about the circle shape.

'Its so easy to draw a circle!' exclaimed Thabo. "Yes!" replied Jessica. "You just start at the top and then you go round and round." On the way home Thabo and Jessica were trying to identify circle shapes around them. They were able to pick out a soccer ball, the sun and even the moon!

The teacher will then talk about everyday objects that are round in shape such as a soccer ball, sun, and moon.

> The teacher can ask the learners to close their eyes and will pass around everyday objects that are round in shape and have the learners feel the object.
>
> The teacher will encourage the learners to identify everyday objects that are round in shape.

Activity 1.2: Circle time:

Workstation 1: 10 minutes

Setting the scene: Play dough, round cookie cutters, bottle caps, buttons will be placed at the centre of each table. At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Each learner will make a circle using play dough.

The cookie cutters and other everyday round objects such as bottle caps and buttons will be available for the learners to play with. The learners can hide objects in the play dough.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, round stickers available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will trace the outline of circles and stick stickers when requested in the workbook.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Discussion: 5 minutes

The teacher will facilitate a discussion and feedback session with the learners summarising the shape of the circle. The learners will be encouraged to 'draw the circle' in air using large arm movements and to identify a few objects that look like a circle.

Session 2: Telling the difference: circle shapes

Outcome:

- The learner will sort and match circles of varying sizes with assistance
- The learner will be able to draw a circle

Materials needed:

- Pre-cut paper circles of varying sizes (see appendix)
- 10 paper cups
- Buttons of varying sizes (two of the same size)
- 1 piece of string for each learner
- 1 roll of sticky tape per table

Activity 2.1: Circle time

Discussion: (10 minutes)

The teacher has the learners seated in a circle around her.

The teacher will summarise the previous day's session and will outline today's session – tell the difference and match circles of different sizes.

The teacher can hold up paper cut-out circles of two different sizes and show the learners how circles of a similar size match together. The teacher can then ask learners to point out which same sized circles match compared to others.

Activity 2.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: 3 paper cups with the circle size template pasted on the outside will be placed at the centre of the workstation. The other pre-cut circle templates will be scattered across the table. (Tupperware containers can be used to store the pre-cut circle templates if available).

The learners will match the pre-cut circle templates to its corresponding size on the paper cups and place the circles in the paper cups.

Making a caterpillar: Once matching is complete, each learner will take a paper cup, empty out the circle templates and line the circles on a horizontal line next to each other. The teacher will hand out a piece of string to each learner who will place the string along the middle of the lined circles. The learner will then place the sticky tape to stick each string onto the circle to make a caterpillar.

The learners can colour in the caterpillar and draw a face on the front circle.

Grading at Workstation 2 is based on the visual cues used, the number of pictures per session, matching shapes of various sizes, patterns and direction as well as matching across different shapes.

Table 5.7 indicates that grading of visual cues occurs from full to minimal use of visual cues such as tracing the shape on dotted lines to drawing the shape with only a starting dot as a visual cue (See Appendix J). Grading also occurs with an increase in the number of pictures used in each session. In addition, as the sessions progress, the complexity of matching increases from one shape to multiple shapes; and from matching across sizes with different patterns and changes in direction. The programme was then submitted for expert review as part of step 2 in a separate pilot study.

5.4 Pilot study - Expert review for content validity

After identifying the intervention level, setting, agents and theories of change for VMI, a first draft of the manual was developed. This consisted of an overview of the MSP, session goals, basic content and elective activities as advised by Fraser & Galinsky (2010) to reinforce the core content of the programme. Once completed this was sent to experts for review to determine content validity of the programme (Fraser & Galinsky, 2010).

Selection criteria of experts:

- Working experience in paediatric Occupational Therapy for more than 7 years
- Background in relevant fields such as HIV, programme development, visual motor integration

5.4.1 Sample:

Four experts consented to review the treatment programme once completed. Consent was obtained from the experts in March 2012. However, only two experts responded and reviewed the treatment programme. This could have been due to the delay in sending out the treatment programme as this occurred one year post receiving consent in May 2013.

5.4.2 Ethical considerations:

Informed consent was obtained from the experts upon written agreement via email (Appendix K). Prior to receiving the treatment programme, experts were emailed a letter which included details of involvement in the research. Telephonic conversation also occurred to further clarify details of involvement and the study. Experts agreed within ten days of receipt of the initial email and signed informed consent was obtained. The details around informed consent sent to the experts are as below:

- Participation in the study is voluntary
- Objectives and outline of the study
- Withdrawal possible at any time without consequence

Upon agreement the experts signed consent and emailed it back to the researcher.

5.4.3 Research procedure:

The first draft outline of the treatment programme was completed at the end of May 2013 and was emailed to the experts. This consisted of an email summary of the study, outline of the treatment programme and questionnaire (Appendix L). Within ten days two experts reviewed the first draft outline and emailed the questionnaire with additional comments to the researcher.

Two experts did not respond to the researcher. After the initial email, three further emails were sent at one week and then one month intervals with no response received.

The comments received from the two experts were analysed by the researcher and changes were made to the outline of the MSP, which subsequently informed the content and layout of the MSP.

5.4.4 Results:

A summary of the results of the experts' comments from the questionnaire is presented below. They have been presented by order of the sub-headings included in the questionnaire. Discussion of the expert review has occurred concurrently throughout this chapter. (See Appendix M for feedback from the experts).

5.4.4.1 Treatment programme theories:

Model of Creative Ability: Appropriate for use in creative activities with typically developing children and those who have a psychiatric diagnoses. However, due to the young age of participants in this study (5 years), it would be more appropriately used to inform clinical reasoning on the approach used to establish the level of participation to guide scaffolding in activities to achieve a 'just right fit' in participation.

Developmental frame of reference: Very appropriate frame of reference for use as a background for activities with children. This would be useful to guide clinical reasoning and logical sequence of developing patterns to find a baseline in the programme for grading of activities.

Visual perception frame of reference: An appropriate frame of reference especially if therapist directed. It would be useful to understand the complexity of visual perception using an information processing approach as highlighted by Kramer & Hinojosa (1999).

Feuerstein's MLE: Appropriate to use to develop the skills needed to differentiate, understand, make meaning of and bridge everyday activities.

Piaget's assimilation and accommodation: Not appropriate for the programme. However, another expert advised that it would be a good theory to understand and use in grading visual perception tasks in collaboration with the understanding of natural developmental stages. The researcher decided not to use this concept in the MSP due in part to the discrepancy between expert views but also as other cognitive strategies were deemed more appropriate for the MSP.

5.4.4.2 Other theories to be included:

Motor development: As VMI is a learnt skill with a strong motor performance component it was advised that motor learning and learning theories be included in the MSP.

However, the results of phase 1 did not reveal a large developmental delay in motor coordination so motor learning was not included in the MSP. As VMI has a motor component to it and a deficit was identified in phase 1, the acquisitional frame of reference was incorporated due to its emphasis on learning and cognitive strategies.

5.4.4.3 Forms and shapes used:

The expert review recommended the use of play dough to reproduce shapes while discussing the shape in sessions. This has been incorporated in sessions throughout the MSP. It was also recommended that the workbook forms start with simple lines and directionality, judging start and stop, size and distance followed by moving to drawing the shape. This recommendation was also applied throughout the workbook.

5.4.4.4 Format of treatment programme:

Time of each session: The time (45 minutes per session) was advised as being adequate to achieve each session outcome to bridge and gain inner meaning of the activity, including time for repetition and individual differences. Another expert advised that 45 minutes would be too long for each session. The researcher therefore incorporated movement breaks in each session by changing workstations, moving from circle time and discussion/feedback to the different workstations.

Number and style of sessions: The experts advised that it would be useful to discuss the goal of the session in the introduction section for the participants to obtain a big picture. The experts commented that shape exploration would enhance active learning and the opportunity to learn from peers at workstation 1 and that the workstation 2 workbook activity would provide the participant with the opportunity to apply learnt knowledge. A closure and feedback section was recommended to recap the activity and evaluate the goal reached. The MSP therefore, has four sections to it following a combination of the recommendations from the experts and literature review conducted by the researcher.

5.4.4.5 Practical strategies suggested for the content of each section:

Introduction: Include a song regarding the shape and encourage sitting in the shape being learnt; include a starting point on how to form the shape

Workstation 2 workbook: Include pasting stickers; tracing on broken lines before attempting free drawing

Further development required: Experts recommended that sessions include time for discussion and feedback; match same sized shapes; reproduce and differentiate between a circle and a square; refine grading of reproduction of the shape being learnt.

The practical strategies provided by the experts, where relevant, with the findings from phase 1 and literature search, were incorporated into the MSP.

5.4.4.6 Grading:

Experts commented on the appropriateness of the method used for grading shapes but recommended further variation in grading similarities and differences.

Further comments:

- Compare the square with the rectangle in sessions
- Increase the focus on diagonals
- Include feeling a shape with vision occluded to facilitate shape learning
- Focus on the mediation process provided by the teacher
- Include task evaluation at the session end
- Include eye hand coordination and memory strategies
- Include identification of similarities and differences between shapes
- Increase the focus on grading the reproduction of shapes

The above comments were integrated into the programme and assisted in formulating the first draft of the MSP.

5.5 The way forward for the My Shapes Programme

The MSP has been formulated to target five-six year old children infected with HIV. The results from phase 1 of the study have shown the impact of HIV on the visual perception of children. Therefore a large focus has been on developing visual perception skill through the occupational performance area of shape learning.

Having said that the MSP's limitation occurs at Step 2 of Fraser & Galinsky (2010) steps in intervention research where the program structures and processes are specified. The first draft of the MSP has received feedback from two experts on the MSP outline and theoretical background (See Appendix M for feedback provided by experts). Changes were then made to the MSP's outline based on the expert's feedback resulting in the development of the current MSP.

The MSP will benefit from further rounds of review and comments from up to three experts until all comments have been fully addressed. Following this, a pilot study can be undertaken to test the programme's implementation ability. Variables such as delivering the programme within the time allocated, sequencing of content, engagement of participants and relevance to cultural context will be needed in this step of the pilot study. It is recommended that this occurs until the programme is fully feasible within the cultural context, well matched with theory and potentially effective (Fraser & Galinsky, 2010).

As the MSP has been formulated within the educational context, there is limited opportunity for caregivers to receive feedback. The researcher has made provision for the workbook to be kept by the learner. However, an evaluation section to be completed by both the teacher and learner followed by a face to face consultation with caregivers will ensure further generalisation of concepts in the home environment.

Despite ongoing challenges, the MSP has the potential to assist educators to facilitate and mediate the learning of shapes due to the extensive theoretical background supporting each chosen activity. Further expert review, pilot studies and eventual efficacy studies will solidify and refine the programme to make it viable for general use.

CHAPTER 6: CONCLUSION

"Let us sacrifice our today so that our children can have a better tomorrow"

A.P.J. Abdul Kalam

This study set out to add to the growing research on the neurodevelopment of preschool children infected with HIV in South Africa. This study occurred in two phases to determine the extent of the visual motor integration delay in these children and the nature of the visual motor treatment programme needed to address this delay.

The first step of Fraser & Galinsky (2010) steps to intervention research was to develop the problem theory of risk which occurred in phase 1. A review of current literature showed that children infected with HIV are at risk for developing neurodevelopmental delay as HIV crosses the blood brain barrier causing neurological changes particularly in the LOC, which is responsible for form identification (Potterton, 2006; Mitchell, 2001; Wang et. al., 2011; Grill-Spector et. al., 2001). This delay exists even when taking ART as shown in studies with a matched control group for SES and timing of ART intervention (Fishkin et. al., 2000; Puthanakit et. al., 2013). Therefore although other factors impact on neurodevelopment such as SES and ART, HIV continues to be a major determinant of neurodevelopmental delay (Baillieu & Potterton, 2008).

HIV has been found to cause a delay in visual perception and visual motor integration (Wang et. al., 2011; Smith et. al., 2008; Bocanegra, 2008). It is important therefore that delays in visual perception are addressed as it is necessary for visual information analysis to explore the environment and gain mastery in educational activities (Case- Smith, 2005; Kramer & Hinojosa, 1999; AOTA, 2014). Visual perception and visual motor integration are integral to the development of prewriting and handwriting skills, which are necessary for educational purposes (Case-Smith et. al., 2005).

The results from phase 1 supported the conclusion that HIV is a major determinant of neurodevelopmental delay, particularly in visual perception. Visual perception was the most affected in this study in terms of the extent and prevalence of the delay and also showed a positive moderate correlation with CD4 count and

CD4%. This indicates that the extent and prevalence of visual perception delay is related to the level of the CD4 count and CD4%. This has clinical and research implications on the extent of visual perception delay as CD4 count and CD4% are known to be an indication of the virological constitution and the extent of systemic spread of HIV (Shanbhag et. al., 2005).

Visual motor integration was also affected in this study though not to the same extent or prevalence as visual perception. Interestingly visual motor integration showed a positive moderate correlation with the socioeconomic factors of the maternal level of education and the participants' attendance at crèche. However, these were environmental factors impacting on visual motor integration and so not as significant as the intrinsic association between visual perception with medical factors such as CD4 count and CD4%.

Even though the participants in this study had a high average CD4%, had been on ART for an increased length of time and were taking ART drugs reported to have better CSF penetration, visual perception and visual motor integration were still at risk for delay; while only a third of the participants were at risk for motor coordination delay. In addition, there was no correlation between length of time on ART with the Beery VMI scores which adds to research studies that show a weak association between length of time on ART and neurodevelopment (Puthanakit et. al., 2013; Smith et. al., 2008). This indicates the need for a visual-motor treatment programme to address the deficits.

The middle to low socioeconomic status of the participants was a mediating factor impacting on the VMI, VP and MC scores of the participants. Even when compared to other standardisation studies of the Beery VMI on a South African population (Rens, 2008; Vally, 2006) and when matched for SES on typically developing children (Dunn et. al., 2006; Lotz et. al., 2005), participants in this study had lower scores for VMI and VP. Again these results confirm Baillieu & Potterton (2008) assertion that HIV is a major determinant of dysfunction in neurodevelopment.

Despite the increase in the utilisation of ART in South Africa with 74% of HIV infected children currently receiving ART, this study together with other studies (Bocanegra, 2008; Smith et. al., 2008; Puthanakit et. al., 2013) has shown that ART does not protect neurodevelopment. Therefore the results have shown that a combination of ART and neurodevelopmental intervention is necessary, particularly one of a scholastic nature.

This leads to step 2 of Fraser & Galinsky (2010) model which involves specifying the programme structures and compilation of the first draft of the My Shapes Programme in phase 2. An educational setting was chosen for the MSP as visual-motor performance precludes academic performance in kindergarten and primary school (Dankert et. al, 2003).

As visual perception is a focus in the programme, visual analysis and visual spatial skills were facilitated through matching shapes of various sizes, direction and pattern. The visual motor output resulted in the drawing of the five basic shapes. This area was the focus as occupational therapy intervention particularly in visual perception has been found to improve visual perception skill resulting in better academic performance (Kulp, 1999; Kulp& Sortor, 2003; Sortor & Kulp, 2003).

An overarching developmental approach was utilised to support typical visual perception and visual motor integration development in the MSP. The model of creative ability (Crouch & Alers, 2005) informed clinical reasoning and treatment principles to provide a 'just right fit' in participation. Visual information analysis as a frame of reference for visual perception was central to the programme development and together with the acquisitional frame of reference and cognitive principles, encouraged the skill development of naming and drawing the five basic shapes chosen for the MSP.

The theories utilised together with four key intervention programmes provided the theories of change to develop the first draft outline of the MSP. Critical analysis of the four intervention programmes informed the logistical elements of 45 minute long sessions for 12 weeks. Expert review in determining content validity also added to the first draft of the MSP.

There are certain key elements to the MSP as a visual-motor treatment programme that is specific to pre-school HIV infected children within the South African context. A major focus of the MSP is in the pre-school teacher acting as a mediator to facilitate learning and bridging of the shapes learnt to everyday activities. The teacher also acts as a role model together with peers to encourage learning. Opportunity for providing feedback to enhance memory and concept learning occurs in two instances during the session. Progression from one shape to another occurs across and within sessions in two levels at the workstations. Grading at workstation 1 occurs from simple explorative 3D activities to more complex constructive activities with increasing steps. The second level of grading occurs at workstation 2 with the visual cues used, number of pictures, matching shapes of various sizes, patterns and direction as well as matching across different shapes. The aim of using the above strategies is to not only name and draw five basic shapes but to also generalise the shapes learnt to everyday living.

There are several limitations in this research study. The first is a lack of a control group for socioeconomic status to confirm whether it is indeed a mediating variable between HIV and neurodevelopment. A composite score of the HESSI II could not be obtained as not all participants completed the HESSI II and so the results were analysed using frequency data. A baseline score of visual perception and VMI followed by another score after taking ART for a period of time, can also determine if length of time on ART has limited association with VP, VMI and MC on the Beery VMI test.

The MSP will benefit from further rounds of expert review before undergoing a pilot study to determine its implementation ability. Further efficacy studies thereafter will ensure its viability for general use to develop the visual perception and visual motor integration of pre-school children infected with HIV.

6.1 Clinical Implications

- The visual motor integration, visual perception and motor coordination of children infected with HIV needs to be assessed as part of routine neurodevelopmental monitoring
- All subtests of the Beery VMI must be administered when assessing the visual motor integration, visual perception and motor coordination of children infected with HIV
- A low CD4 count and/or CD4% can indicate low visual perception functioning.
- Visual perception is significantly impacted by HIV resulting in visual perceptual delay.

- Visual-motor intervention for pre-school children infected with HIV should focus largely on visual perceptual deficits with an additional focus on visual motor integration and motor coordination.

6.2 Research recommendations

- Further research between experimental and matched control groups with similar SES but uninfected with HIV to exclude SES as a mediating variable between HIV with visual perceptual and visual motor integration delay.
- Measure baseline score for visual perception and visual motor integration after a period of time on ART to determine the longitudinal impact of ART on visual perception and visual motor integration.
- Further expert review of the first draft of the MSP to confirm content validity.
- A Pilot study of the MSP to test the programme's implementation ability.
- Conduct efficacy tests and test the programme in practice settings to further develop the MSP Programme.
- Publish the MSP and develop training materials to disseminate the programme findings and materials.
- Visual-motor intervention on preschool children infected with HIV while assessing VMI, VP and MC scores before and after the intervention to determine the efficacy of the intervention.

References

1. Adi-Japha, E. & Freeman, N. (2001). Development of differentiating between writing and drawing systems. *Developmental Psychology*, 17 (1), 101-114.

2. AVERT 2015 HIV and AIDS in South Africa. [Online]. Available: http://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/south-africa#footnote27_ifahooc. [7 February 2017].

3. Avi-Itzhak, T. & Obler, D. (2008). Clinical value of the VMI supplemental tests: a modified replication study. *Optometry and Vision Science,* 85 (10), 1007 – 1011.

4. Bailey, D. (1997). *Research for the Health Professional: A practical Guide.* 2nd ed. Philadelphia: F.A. Davis Company.

5. Baillieu, N. & Potterton, J. (2008). The Extent of Delay of Language, Motor, and Cognitive Development in HIV-Positive Infants. *Journal of Neurologic Physical Therapy,* 32, 118-121.

6. Barbarin, O. & Khomo, N. (1997). Indicators of Economic Status and Social Capital in South African Townships: What Do They Reveal About the Material and Social Conditions in Families of Poor Children? *Childhood,* 4 (2), 193-222.

7. Barbarin, O & Richter, L. (2001). Economic Status, Community Danger and Psychological Problems among South African Children. *Childhood,* 8, 115-133.

8. Barnett, T. & Whiteside, A. (2006). *AIDS in the Twenty-First Century: Disease and Globalization.* New York: Palgrave Macmillan.

9. Bartlett, J., Kotrlik, J., Higgins, C. (2001). Organisational Research: Determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal,* 19(1), 43–50.

10. Beery, K. (2006). *Beery VMI with Supplemental Developmental Tests of Visual Perception and Motor Coordination.* Minneapolis: NCS Pearson Incorporated.

11. Beery K., Buktenica N., & Beery N. (2010). *The Beery–Buktenica Developmental Test of Visual–Motor Integration: Administration, scoring, and teaching manual (6th ed.).* Minneapolis, MN: Pearson.

12. Blanchette, N., Lou Smith, M., Fernandes-Penney, A., King, S., Read, S. (2001). Cognitive and motor development in children with vertically transmitted HIV infection. *Brain and Cognition, 46 (1-2), 50-53.*

13. Bocanegra, M. (2008). *Medication, Treatment and Neurocognitive Functioning in Perinatal HIV.* Miami: Dissertation of the University of Miami.

14. Botha, J. & Pienaar, A. (2008). The motor development of 2 to 6-year old children infected with HIV. *South African Journal for Research in Sport, Physical Education and Recreation,* 30(2), 39-51.

15. Brouwers, P., Tudor-Williams, G., DeCarli, C., Moss, H., Wolters, P., Civitello, L., Pizzo, P. (1995). Relation between stage of disease and neurobehavioral measures in children with symptomatic HIV disease, *AIDS,* 9(7), 713-720.

16. Bruck, I., Tahan, T., da Cruz, C., Martins, L., Antoniuk, S., Rodrigues, M., de Souza, S., de Bruyn, L. (2001). Developmental milestones of vertically HIV infected and seroverters children. *Arq Neuropsiquiatr*, 59 (3-B), 691-695.

17. Burns, S., Hernandez-Reif, M. (2008). A review of Paediatric HIV Effects on Neurocognitive Development. *Issues in Comprehensive Pediatric Nursing,* 31,107-121.

18. Cambridge Advanced Learner's Dictionary. (2005). Cambridge: Cambridge University Press.

19. Case-Smith, J. & Clifford O'Brien, J. (2013). *Occupational Therapy for Children.* 6th ed. Philadelphia: Elsevier Health Sciences.

20. Center for Disease Control and Prevention Evaluation Brief no. 7. 2006. Gaining consensus among stakeholders through the nominal group technique. [Online]. Available: www.cdc.gov/HealthYouth/evaluation/pdf/brief7.pdf. [18 May 2011].

21. Census in brief 2011 Statistics South Africa. [Online]. Available: http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf. [21 February 2017].

22. Coplan, J., Contello, K., Cunningham, C., Weiner, L., Dye, T., Roberge, L., Wojtowycz, M., Kirkwood, K. (1998). *Early language development in children exposed to or infected with Human Immunodeficiency Virus.* [Online]. Available: http://www.pediatrics.org/cgi/content/full/102/1/e8. [8 January 2011].

23. Crouch, R. & Alers, V. (2005). *Occupational Therapy in Psychiatry and Mental Health.* 4th ed. London: Whurr Publishers Ltd.

24. Daly, C., Kelley, G., Krauss, A. (2003). Relationship between Visual-Motor Integration and Handwriting Skills of Children in Kindergarten: A Modified Replication Study. *American Journal of Occupational Therapy,* 57, 459-462.

25. Dankert, H., Davies, P., Gavin, W. (2003). Occupational Therapy Effects on Visual-Motor Skills in Preschool Children. *American Journal of Occupational Therapy,* 57, 542-549.

26. Department of Health. (2007). *Clinical tract – An approach to paediatric HIV infection.* [Online]. Available: http://www.doh.gov.za/docs/misc/hiv/manual/approach_paediatrics.pdf. [1 November 2010].

27. Department of Health. (2015). *National Consolidated Guidelines for the Prevention of Mother-to-child Transmission of HIV (PMTCT) and the Management of HIV in Children, Adolescents and Adults.* Pretoria: National Department of Health.

28. Department of Health. (2013). *The South African Antiretroviral Treatment Programme.* Pretoria: National Department of Health.

29. Dunn, M., Loxton, H., Naidoo, A. (2006). Correlations of scores on the developmental test of visual motor integration and copying test in a South African multiethnic preschool sample. *Perceptual and Motor Skills,* 103, 951-958.

30. Ecran, Z., Ahmetoğlu, E., Aral, N. (2011). Investigating the visual-motor integration skills of 60-72 month old children at high and low socio-economic status as regard the age factor. *International Education Studies,* 4 (3), 100-104.

31. Epstein, L., Sharer, L., Oleske, J., Connor, E., Goudsmit, J., Bagdon, L., Robert-Guroff, M., Koenigsberger, M. (1986). Neurologic manifestations of Human Immunodeficiency Virus infections in children. *Paediatrics,* 78, 678-687.

32. Empilweni Services and Research Unit. (2015). [Online]. Available: http://www.esru.co.za/Home/AboutUs.aspx. [1 March 2015].

33. Ferguson, G. & Jelsma, J. (2009). The prevalence of motor delay among HIV infected children living in Cape Town, South Africa. *International Journal of Rehabilitation Research,* 32, 108-114.

34. Fishkin, P., Armstrong, D., Routh, D., Harris, L., Thompson, W., Miloslavich, K., Levy, J., Johnson, A., Morrow, C., Bandstra, E., Mason, C., Scott, G. (2000). Brief report: relationship between HIV infection and WPPSI-R performance in preschool-age children. *Society of Pediatric Psychology,* 25 (5), 347 - 351.

35. Fraser, M. & Galinsky, M. (2010). Steps in Intervention Research: Designing and Developing Social Programs. *Research on Social Work Practice,* 20 (5), 459-466.

36. Grill-Spector, K., Kourtzi, Z., Kanwisher, N. (2001). The lateral occipital complex and its role in object recognition. *Vision Research,* 41, 1409 – 1422.

37. HIV and AIDS and STI Strategic Plan for South Africa, 2007 – 2011 (Draft 9). 2007. [Online]. Available: http://www.doh.gov.za/docs/misc/stratplan/2007-2011/part1.pdf. [8 January 2011].

38. Kassam-Adams, N., Marsac, M., Kohser, K., Kenardy, J., March, S., Winston, F. (2015). A New Method for Assessing Content Validity in Model-Based Creation and Iteration of eHealth Interventions. *Journal of Medical Internet Research,* 17 (4). doi: 10.2196/jmir.3811.

39. Kerr, S.J., Puthanakit, T., Vibol, U., Aurpibul, L.,Sophan, V., Kosalaraksa, P., Kanjanavanit, S., Hansudewechakul, R., Wongsawat, J., Luesomboon, W., Ratanadilok, K., Prasitsuebsal, W., Pruksakaew, K., Van der Lugt, J., Paul, R., Ananworanich, J., Valcour, V. (2014). Neurodevelopmental outcomes in HIV-exposed-uninfected children versus those not exposed to HIV. *AIDS Care,* 26 (11), 1327 – 1335.

40. Kozulin, A., Lebeer, J., Madella-Noja, A., Gonzalez, F., Jeffrey, I., Rosenthal, N., Koslowsky, M. (2010). Cognitive modifiability of children with developmental disabilities: A multicentre study using Feuerstein's Instrumental Enrichment- Basic program. *Research in Developmental Disabilities.* doi:10,1016/j.ridd.2009.12.001.

41. Kramer, P. & Hinojosa, J. (1999). *Frames of Reference for Pediatric Occupational Therapy.* 2nd ed. Philadelphia: Lippincott Williams & Wilkins.

42. Kramer, P. & Hinojosa, J. (2010). *Frames of Reference for Pediatric Occupational Therapy.* 3rd ed. Philadelphia: Lippincott Williams & Wilkins.

43. Kulp, M.(1999). Relationship between Visual Motor Integration Skill and Academic Performance in Kindergarten through Third Grade. *Optometry and Vision Science,* 76 (3), 159-163.

44. Kulp, M. & Sortor, J. (2003). Clinical Value of the Beery Visual-Motor Integration Supplemental Tests of Visual Perception and Motor Coordination. *Optometry and Vision Science,* 80 (4), 312-315.

45. Laughton, B., Cornell, M., Grove, D., Kidd, M., Springer, P., Dobbels, E., Van Rensburg, A., Violari, A., Babiker, A., Madhi, S., Jean-Philippe, P., Gibb, D., Cotton, M. (2012). Early antiretroviral therapy improves neurodevelopmental outcomes in infants. *AIDS,* 26: 1685 - 1690.

46. Lowenthal, E., Lawler, K., Harari, N., Moanogwe, L., Masunge, J., Masedi, M., Matome, B., Seloilwe, E., Gross, R. (2012). Rapid psychosocial function screening test identified treatment failure in HIV+ African youth. *AIDS Care,* 24(6), 722–727.

47. Lowenthal, E., Cruz, N., Yin, D. (2010). Neurologic and Psychiatric Manifestations of Pediatric HIV Infection. In: *HIV curriculum for the Health Professional.* 4th ed. Houston: Bayor College of Medicine.

48. Lotz, L., Loxton, H., Naidoo, A. (2005). Visual-motor integration functioning in a South African middle childhood sample. *Journal of Child and Adolescent Mental Health,* 17(2), 63-67.

49. Milner, A., Ganel, T. & Goodale, M. (2012). Does grasping in patient DF depend on vision? *Trends in Cognitive Sciences,* 16(5), 256-257.

50. Mitchell, W. (2001). Neurological and Developmental Effects of HIV and AIDS in Children and Adolescents. *Mental retardation and developmental disabilities,* 7, 211–216.

51. Nozyce, M., Lee, S., Wiznia, A., Nachman, S., Mofenson, L., Smith, M., Yogev, R., McIntosh, K., Stenlay, K., Pelton, S. (2006). *A Behavioral and Cognitive Profile of Clinically Stable HIV-Infected Children.* [Online]. Available: http://www.pediatrics.org/cgi/content/full/117/3/763. [8 January 2011].

52. Pizzo, P. & Wilfert, C. (1998). *Paediatric AIDS: the challenge of HIV infection in infants, children and adolescents.* 3rd ed. New York: Lippincott Williams & Wilkins.

53. Potterton, J. (2006). *A longitudinal study of neurodevelopmental delay in HIV infected children.* Unpublished research thesis. Johannesburg: University of the Witwatersrand.

54. Potterton, J., Stewart, A., Cooper, P., Becker, P. (2010). The effect of a basic home stimulation programme on the development of young children infected with HIV. *Developmental Medicine and Child Neurology,* 52, 547-551.

55. Puthanakit, T., Ananworanich, J., Vonthanak, S., Kosalaraksa, P., Hansudewechakul, R., Van der Lugt, J., Kerr, S.J., Kanjanavanit, S., Ngampiyaskul, C., Wongsawat, J., Luesomboon, W., Vibol, U., Pruksakaew, K., Suwarnlerk, T., Apornpong, T., Ratanadilok, K., Paul, R.,Mofenson, L., Fox, L., Valcour, V., Brouwers, P., Ruxrungtham, K. (2013). Cognitive function and neurodevelopmental outcomes in HIV-infected children older than 1 year of age randomized to early versus deferred antiretroviral therapy: the PREDICT neurodevelopmental study. *The Pediatric Infectious Disease Journal,* 32 (5), 501-508.

56. Ratzon, N., Efraim, D., Bart, O. (2007). A Short-Term Graphomotor Program for Improving Writing Readiness Skills of First-Grade Students. *The American Journal of Occupational Therapy,* 61, 399-405.

57. Ratzon, N., Lahav, O., Cohen-Hamsi, S., Metzger, Y., Efraim, D., Bart, O. (2009). Comparing different short-term service delivery methods of visual-motor treatment for first grade students in mainstream schools. *Research in developmental disabilities,* 30, 1168 – 1176.

58. Razel, M. & Eylon, B. (1990). Development of Visual Cognition: Transfer Effects of the Agam Program. *Journal of applied developmental psychology,* 11, 459 – 485.

59. Rens, Z. (2008). *The Standardisation of The Beery-Buktenica Developmental Test of Visual-Motor Integration with Supplemental Developmental Tests of Visual Perception and Motor Coordination (4th edition, revised, 1997) on an Eastern Cape Population aged 7 years 0 months to 7 years 3 months.* Unpublished Research Report. Johannesburg: University of the Witwatersrand.

60. Resino, S., Resino, R., Micheloud, D., Gutiérrez, D., León, J., Ramos, J., Ciria, L., de José, I., Mellado, J., Muñoz-Fernández, Á. (2006). Long-Term Effects of Highly Active Antiretroviral Therapy in Pretreated, Vertically HIV Type 1- Infected Children: 6 Years of Follow-Up. *Clinical Infectious Diseases,* 42, 862 - 869.

61. Rodger, S. (2010). *Occupation-Centred Practice with Children.* West Sussex: Wiley-Blackwell.

62. Safriel, Y., Haller, J., Lefton, D., Obedian, R. Imaging of the brain in the HIV-positive child. (2000). *Pediatric Radiology,* 30, 725 - 732.

63. Schneck, C.M. (1996). Visual Perception. In Case-Smith,J., A. S. Allen, & P. Pratt (Eds.) *Occupational Therapy for children* (3rd ed, pp. 357 - 386). St Louis: Mosby.

64. Schneck, C., Henderson, A. (1990). Descriptive analysis of the developmental progression of grip position for pencil and crayon control in nondysfunctional children. *The American Journal of Occupational Therapy, 44 (10), 893-900.*

65. Shanbhag, M. C., Rutstein, R. M., Zaoutis, T., Zhao, H., Chao, D., Radcliffe, J. (2005). Neurocognitive Functioning in Pediatric Human Immunodeficieny Virus Infection: Effects of Combined Therapy. *Archives of Pediatrics and Adolescent Medicine,* 159, 651 – 656.

66. Smith, M., Danoff, J., Parks, R. (2002). Motor Skill Development of Children with HIV Infection measured with the Peabody Developmental Motor Scales. *Pediatric Physical Therapy,* 14 (2), 74-84.

67. Smith, L., Adnams, C., Eley, B. (2008). Neurological and neurocognitive function of HIV-infected children commenced on antiretroviral therapy. *South African Journal of Child Health,* 2 (3), 108-113.

68. Sortor, J. & Kulp, M. (2003). Are the Results of the Beery-Buktenica Developmental Test of Visual-Motor Integration and Its Subtests Related to Achievement Test Scores? *Optometry and Vision Science,* 80 (11), 758-763.

69. South African National AIDS Council (SANAC). (2006). *HIV & AIDS and STI, STRATEGIC PLAN FOR SOUTH AFRICA 2007-2011,* Pretoria: South African National AIDS Council (SANAC).

70. South African National AIDS Council (SANAC). (2011). *National Strategic Plan on HIV, STIs and TB 2012-2016.* Pretoria: South African National AIDS Council.

71. South African National AIDS Council (SANAC). (2016). *SANAC applauds Health Minister's move to treat everyone with HIV.* [Online]. Available: http://sanac.org.za/2016/05/25/sanac-applauds-health-ministers-move-to-treat-everyone-with-hiv/. [18 October 2016].

72. Tague, N. (2005). *The Quality Toolbox.* 2nd ed. Milwaukee: American Society for Quality, Quality Press.

73. Tomita, M., Mann, W., Fraas, L., Stanton, K. (2004). Predictors of the use of assistive devices that address physical impairments among community-based frail elders, *Journal of Applied Gerontology*, 23, 141–155.

74. Tzuriel, D. & Eiboshitz, Y. Structured Program of Visual-Motor Integration (SP-VMI) for Preschool Children. (1992). *Learning and Individual Differences,* 4 (2), 103 – 124.

75. UNAIDS. (2010). *Global report: UNAIDS report on the global AIDS epidemic 2010.* Joint United Nations Programme on HIV/AIDS (UNAIDS). [Online]. Available: http://www.unaids.org/globalreport/documents/20101123_GlobalReport_full_en.pdf. [11 February 2011].

76. UNAIDS.(2013). *Global report: UNAIDS report on the Global AIDS Epidemic 2013.* [Online]. Available:http://www.unaids.org/sites/default/files/media_asset/UNAIDS_Global_Report_2013_en_1.pdf . [4 October 2016].

77. UNAIDS. (2014). *South Africa HIV Epidemic Profile.* [Online]. Available: http://www.unaidsrstesa.org/wp-content/uploads/2015/05/UNAids-Profile-South-Africa.pdf-18-Feb.pdf. [4 October 2016]

78. UNAIDS. (2016). *Global AIDS Update.* [Online]. Available: http://www.unaids.org/sites/default/files/media_asset/global-AIDS-update-2016_en.pdf [4 October 2016]

79. UNICEF. (2015). Seventh Stocktaking Report 2016. [Online]. Available: http://data.unicef.org/topic/hivaids/protection-care-and-support-for-children-affected-by-hiv-and-aids/ [31 January 2017].

80. Vaidya, D. (2008). *Visual motor and Visual Perceptual Deficits in Children with Demylienating Disorders.* New York: State University of New York.

81. Vally, Z. (2006). *The Beery Developmental test of Visual Motor Integration: A Reliability Study.* Unpublished research report. Stellenbosch: University of Stellenbosch.

82. Van Rie, A., Mupuala, A., Dow, A. (2008). *Impact of the HIV/AIDS Epidemic on the Neurodevelopment of Preschool-Aged Children in Kinshasa, Democratic Republic of the Congo.* [Online]. Available: http://www.pediatrics.org/cgi/content/full/122/1/e123. [8 January 2011].

83. Van Rie, A., Dow, A., Mupuala, A., Stewart, P. (2009). Neurodevelopmental Trajectory of HIV-Infected children Accessing Care in Kinshasa, Democratic Republic of Congo, *Journal of Acquired Immune Deficiency Syndromes,* 52 (5), 636 – 642.

84. Vlok, E. D., Smit, N. E. & Bester, J. (2011). A Developmental approach: A Framework for the development of an integrated Visual Perception programme. *South African Journal of Occupational Therapy,* 41(3), 25-33.

85. Wachsler-Felder, J. & Golden, C. (2002). Neuropsychological consequences of HIV in children: a review of current literature. *Clinical Psychology Review,* 22(3), 441-462.

86. Wang, X., Foryt, P., Ochs, R., Chung, J.H., Wu, Y., Parrish, T., Ragin, A. (2011). Abnormalities in resting-state functional connectivity in early human immunodeficiency virus infection. *Brain Connectivity,* 1 (3), 207-217.

Appendix A: Ethical clearance certificate

R14/49 Ms Ramoa Charlene Odejayi

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160876

NAME: (Principal Investigator)	Ms Ramoa Charlene Odejayi
DEPARTMENT:	Occupational Therapy
PROJECT TITLE:	Development of a Visual Motor Treatment Programme for Pre School HIV Infected Children
DATE CONSIDERED:	26/08/2016
DECISION:	Approved unconditionally
CONDITIONS:	Renewal for the Period August 2016 - August 2021 Previously M110524
SUPERVISOR:	Mrs Denise Franszen
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	29/08/2016

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 in Room 10004, 10th floor, Senate House/2nd Floor, Phillip Tobias Building, Parktown, 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 August and will therefore be due in the month of August each year.

Principal Investigator Signature _______________ Date _______________

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ms Ramona Charlene Odejayi

CLEARANCE CERTIFICATE	**M110524**
PROJECT	The Development of a Visual-Motor Treatment Programme for Pre-School HIV-Infected Children
with	Visual Motor Integration Difficulties
INVESTIGATORS	Ms Ramona Charlene Odejayi.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	27/05/2011
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 18/07/2011 **CHAIRPERSON** ....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs Denise Franzsen

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix B: Permission letters from Rahima Moosa Hospital

RAHIMA MOOSA MOTHER & CHILD HOSPITAL

health
for a better life

Dr Edward Hank
Clinical Manager and Superintendant
Rahima Moosa Mother and Child Hospital
Tel: (011) 470 9031
Fax: (011) 477 4117
E-mail: Edward.Hank@gauteng.gov.za

Professor Cleaton-Jones
Chair of the Wits University
Human Ethics Research Committee

8 August 2011

Dear Professor Cleaton-Jones,

Protocol title: The development of a visual-motor treatment programme for pre-school HIV-infected children with visual motor integration difficulties

On behalf of the hospital management I would like to confirm our approval for the conduct of the above named study at our institution. This study will be conducted in the Empilweni Clinic who have through it's head, Professor Coovadia, provided permission to do so. The researcher will be able to access hospital records provided she has ethics approval and receives signed informed consent from the caregiver of the study participant.

Yours faithfully

____

Dr Edward Hank – BSc Hons B Pharm, MBBCh

Cc – Mrs S Jordaan – CEO, Rahima Moosa Mother and Child Hospital
- Prof A Coovadia – Head HIV Services, Rahima Moosa Mother and Child Hospital,

Department of Paediatrics and Child Health

Appendix C : Information letter for caregivers of participants of Phase 1

INFORMATION SHEET

Dear Parent/Legal Guardian,

Good day to you and your family. Thank you for taking the time to read this letter. My name is Ramona Odejayi and I am an Occupational Therapist. I am doing research to see what difficulties your child might experience understanding shapes and using a pencil to draw. These skills are important to reach before a child goes to school. From this research, I want to understand how well your child can do these things. The title of my research is: *The development of a visual-motor treatment programme for pre-school HIV-infected children with visual motor integration difficulties.*

I am inviting you and your child to take part in this research. Your participation is voluntary and you do not have to take part if you do not want to. If you would like your child to be assessed by a therapist instead of taking part in this research, you can do so. If you wish to take part in this research, we would like you to complete a questionnaire with your details and another questionnaire on your family, yourself and where you live. I will then assess your child and ask him/her to draw pictures for me and to point to different pictures. It will take 20 minutes to fill in the questionnaires and 30 minutes to complete the assessment on your child.

I am also asking for permission to look at your child's hospital file to get information. Any information you give me will be kept private and stored in a safe place for 6 years according to the Health Professions Council of South Africa (HPCSA) regulations.

The benefits of taking part in this research will let you know what the level of your child is in a certain area and if the assessment shows that your child needs help then I will provide you with the names of occupational therapists that can further assess and treat your child. If you agree to take part in this research and then decide you want to withdraw, you can do so at anytime with no consequences. If you have further questions regarding the study, you are more than welcome to contact me on 084 527 0123. Questions on ethics or complaints can be directed to the Secretary of the Wits ethics committee, Anisa Keshav at 011 7171234.

If you would like to be part of this research, please sign the form on the next page.

Thank you,

Ramona Odejayi

Appendix D : Informed consent signed by caregivers of participants of Phase 1

INFORMED CONSENT

Parent/ Legal Guardian

I ....(name of parent/legal guardian) agree that.. (name of child) can take part in this research. I agree that the medical records of .... (name of child) can be accessed by Ramona Odejayi.

I understand that I can withdraw from this research at anytime.

Signed..

Dated...

Researcher.......................................

Code..

Appendix E: Verbal assent from participants of Phase 1

VERBAL ASSENT

Child

My name is Ramona and I am doing a research study. A research study is a way in which one can learn about something. In this research study I would like to look at how children copy things so that other children can be helped.

If you agree to do this study, I would like you to look at some drawings. We will be drawing some shapes, looking and pointing at different pictures.

You will not be hurt in any way by doing this research study. You do not have to do this study if you do not want to. If at anytime you want to stop you just have to tell me you want to stop. No one will be angry with you.

Before you say *'yes'* or *'no'*, you can ask me any questions you have about the research study. If you join the research study, you can ask questions at anytime.

If you want to do this, will you come with me and do this drawing.

Witness...

Dated..

Researcher.......................................

Appendix F: Demographic questionnaire

DEMOGRAPHIC QUESTIONNAIRE

- CODE:____
- Date of birth:______________________________________
- Sex (circle appropriate): M / F
- Home Language: __________________________________
- Occupation of parent/legal guardian: ______________________
- Caregiver Relationship to child: __________________________
- Name of school/creche (if applicable):______________________
    - Grade (if applicable):______________________
    - No. of hours spent at school/creche: ___________
- Has your child had an eye test? Yes / No
- Was your child born at 9 months gestation? Yes / No
- Were there any problems after birth? Yes / No

MEDICAL INFORMATION

- Date of Diagnosis __________________________________
- Medical history____________________________________
- Date of Commencement of ART ________________________
- Present medication ________________________________
- Date of report/test_______________
- CD4 Count____________________
- CD4 % ______________________
- Viral Load ____________________
- Height_______________________
- Weight_______________________

Appendix G: HESSI II

Household Economic and Social Status Index (HESSI)
(Barbarin, et al, 1995)

Code ____________________

I. **Family Structure/Household** Composition(Score 1-10)

Ia. Marital Status of Mother

1. Never married, not now living with a partner
2. Married, but not living now with a partner (e.g. divorced, separated)
3. Widowed
4. Never married, but now living with partner
5. Married and currently living with partner

Ib. Household Membership. How many people currently reside in the household?____

Number 18 and older______
Number 6-18 yrs old
Number under 6 yrs old _______

Ic. Are there adult relative now residing in the household?

0. No 1. Yes.

If yes who are they in relationship to the child?_____________________

II. **Social Status••** (Education, Occupation, [2—181)

A. Mother's Education: What is the highest level of education attained by mother?

1. Less than Standard 3
2. Primary School (Standard 3—4)
3. Junior Secondary (Standard 5—7)
4. Senior Secondary (Standard 8—9)
5 Matric/High School graduate/vocational training diploma
6. 1--2 yr College, Technikon
7. 3--4 yrs of University
8. PhD, MD, JD, DDS or other doctoral degree

B. Education of Mother's Partner: What is the highest level of education attained?

1. Less than Standard 3
2. Primary School (Standard 3—4)
3. Junior Secondary (Standard 5—7)
4. Senior Secondary (Standard 8—9)
5. Matric/High School graduate/vocational training diploma
6. 1--2yr College, Technikon
7. 3--4 yrs of University
8. PhD, MD, JD, DDS or other doctoral degree

What are the occupation and industry of the primary wage earners in the house?

Occupation   Industry

1. ______________________________
2. ______________________________
3. ______________________________

Access to Finances Who in the family earns money? Check all that apply.

____BTT mother
____Partner
____Parent
____Parent Pension,
____Sibling/Aunt/Uncle

III. **Housing Accommodation.**

A.In what type of housing do you live?

0. None, homeless
1. Shack
2. Hostel
3. Room, garage
4. Flat, cottage
5. Home shared with other family(ies).
6. Home that is not shared with other families.

B. Does your home have

1) A Separate Kitchen?	0. No	1 Yes
2) A Separate Bathroom?	0. No	1 Yes

a) In your home how many separate rooms are there just for sleeping?
(circle one number)

0 1 3 4 or more.

b) What type of toilet facilities does your home have:
0. None
1. Pit or Bucket
2. Outside flush toilet
3. Inside flush

c) Do you own or rent a home.
0. Neither
1. Rent
2. Purchasing on Bond
3. Own

d) How much do you pay monthly for rent or bond? R______

For Service Charges R_______
For Electricity:__________________
(highest in the last year) R________
(the lowest) R_______

Does the place you live in have a. .

a) Refrigerator	0. No	1.Yes
b) Television	0. No	1.Yes
c) Telephone	0. No	1.Yes
d) Car	0. No	1.Yes
e) Video recorder	0. No	1.Yes
f) Washing machine	0. No	1.Yes
g) Microwave oven	0. No	1.Yes

h) In the past, have your children gone hungry because you did not have food?:
3. No, never
2. Rarely
1. Often
0. All the time

IV. **Savings**: (Score 0-3)
a) Do you have savings or participate in a savings plan?
0. No 1.Yes
b) Do you have life insurance
c) 0. No 1.Yes

Maternal Well-being

Do you have any problems you might like to talk over with a doctor?
0. No
1. Yes (specify)

During the past 3 months have you had any physical or emotional condition for which you have been receiving treatment or taking medication?

0. No
1. Yes (specify)

During the past 3 months have you been anxious, worried or upset?

Extremely so—to the point of being sick or almost sick
Very much so
Quite a bit
Some--enough to bother me
A little bit
Not at all

During the past 3 months, have you felt so sad, discouraged, hopeless or had so many problems that you wondered if anything was worthwhile?

Extremely so—to the point that I have just about given up
Very much so
Quite a bit
Some—enough to bother me
A little bit
Not at all

In any one year have you had at least 12 drinks of any kind of alcoholic beverage? Yes No

Have you ever had any serious physical handicap?
0 No 1 Yes

Have you ever been a patient (or outpatient) at a mental hospital, mental health ward of a hospital, or a mental health clinic for any personal emotional, behaviour, or mental problem?:

Yes, during the past year
Yes, more than a year ago
No

Neighbourhood Safety

A. In general how safe is the area in which you live?

1. Extremely dangerous
2. Dangerous
3. Safe
4. Extremely Safe

B. How much do you worry about your child getting hurt when s/he is outside of your home?

1. Never
2. Sometimes
3. Often
4. All the time

Satisfaction with Family Life (Support)

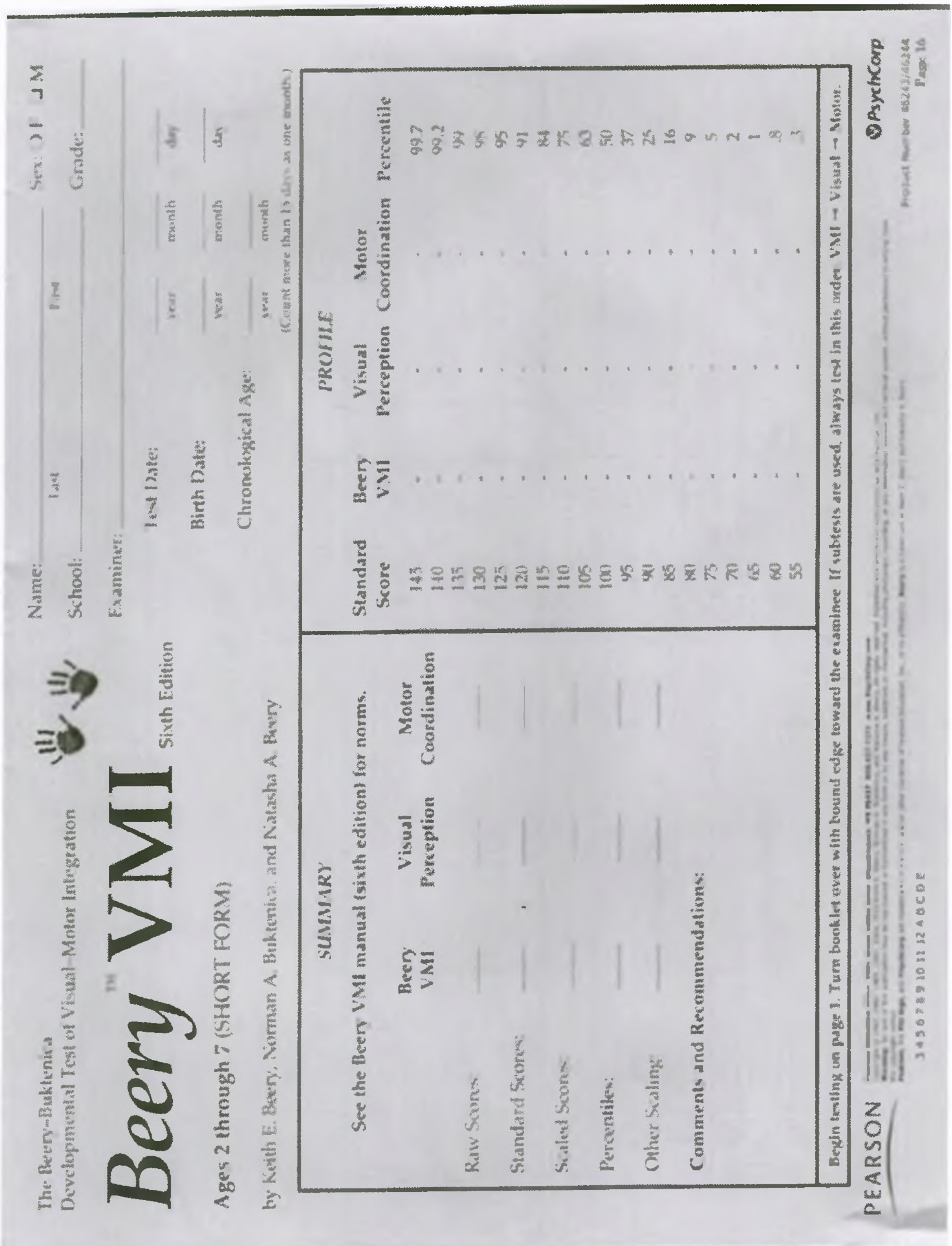
My family has a lot of problems:

1. Not True
2. Sometimes True
3. Often True
4. Always True

My family is always there for me when I need them.

1. Not True
2. Sometimes True
3. Often True
4. Always True

Appendix H: Beery VMI



The Beery–Buktenica
Developmental Test of Visual–Motor Integration

Beery™ VMI Sixth Edition

Ages 2 through 7 (SHORT FORM)

by Keith E. Beery, Norman A. Buktenica, and Natasha A. Beery

Name: ______ Last ______ First ______ Sex: ☐ F ☐ M

School: ______ Grade: ______

Examiner: ______

Test Date: ______ year ______ month ______ day

Birth Date: ______ year ______ month ______ day

Chronological Age: ______ year ______ month

(Count more than 15 days as one month.)

SUMMARY

See the Beery VMI manual (sixth edition) for norms.

	Beery VMI	Visual Perception	Motor Coordination
Raw Scores:	____	____	____
Standard Scores:	____	____	____
Scaled Scores:	____	____	____
Percentiles:	____	____	____
Other Scaling:	____	____	____

Comments and Recommendations:

PROFILE

Standard Score	Beery VMI	Visual Perception	Motor Coordination	Percentile
145	-	-	-	99.7
140	-	-	-	99.2
135	-	-	-	99
130	-	-	-	98
125	-	-	-	95
120	-	-	-	91
115	-	-	-	84
110	-	-	-	75
105	-	-	-	63
100	-	-	-	50
95	-	-	-	37
90	-	-	-	25
85	-	-	-	16
80	-	-	-	9
75	-	-	-	5
70	-	-	-	2
65	-	-	-	1
60	-	-	-	.8
55	-	-	-	.3

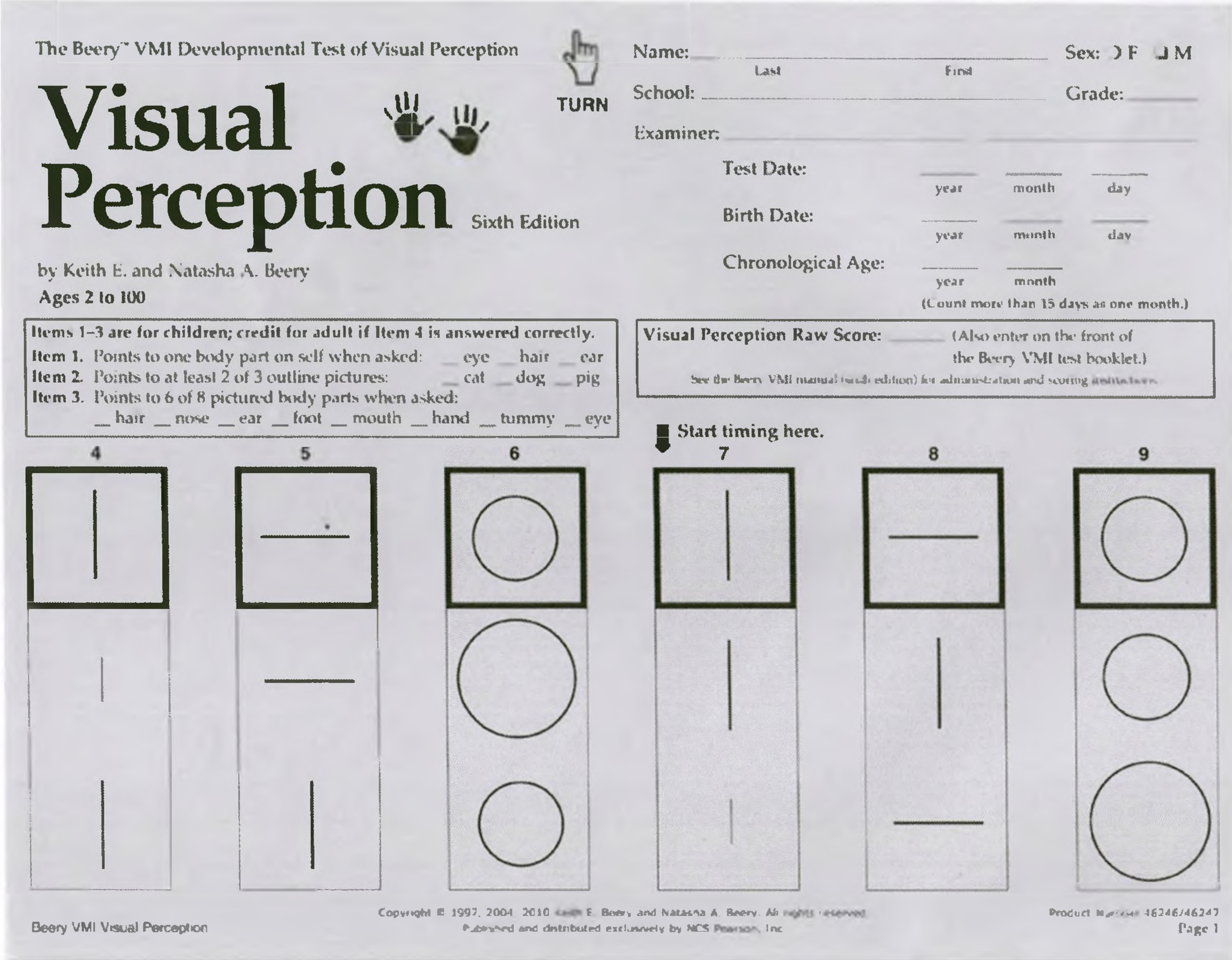
Begin testing on page 1. Turn booklet over with bound edge toward the examinee. If subtests are used, always test in this order: VMI → Visual → Motor.

PEARSON

PsychCorp

Product Number 46243/46244
Page 16

3 4 5 6 7 8 9 10 11 12 A B C D E



The Beery™ VMI Developmental Test of Visual Perception

TURN

Visual Perception

Sixth Edition

by Keith E. and Natasha A. Beery

Ages 2 to 100

Name: ______ Last ______ First ______ Sex: ❑ F ❑ M

School: ______ Grade: ______

Examiner: ______

Test Date:	year	month	day
Birth Date:	year	month	day
Chronological Age:	year	month	

(Count more than 15 days as one month.)

Items 1–3 are for children; credit for adult if Item 4 is answered correctly.

Item 1. Points to one body part on self when asked: __ eye __ hair __ ear

Item 2. Points to at least 2 of 3 outline pictures: __ cat __ dog __ pig

Item 3. Points to 6 of 8 pictured body parts when asked:
__ hair __ nose __ ear __ foot __ mouth __ hand __ tummy __ eye

Visual Perception Raw Score: ______ (Also enter on the front of the Beery VMI test booklet.)

See the Beery VMI manual (sixth edition) for administration and scoring instructions.

Start timing here.

Beery VMI Visual Perception

Product Number 46246/46247

Page 1

The Beery™ VMI Developmental Test of Motor Coordination

Motor Coordination

Fifth Edition

by Keith E. and Natasha A. Beery

Ages 2 through 18

TURN

Name: ______________________ Sex: ❍ F ❑ M
Last First

School: ______________________ Grade: ______

Examiner: ______________________

Test Date:	year	month	day
Birth Date:	year	month	day
Chronological Age:	years	months	

(Count more than 15 days as one month.)

Motor Coordination Raw Score ______ (Also enter on the front of the Beery VMI test booklet.)

See the Beery VMI manual (fifth edition) for administration and scoring instructions.

Let's Draw!

Use a No. 2 pencil (or another pencil with soft black lead) or a ballpoint pen with black ink.
Remember, you get one try with no erasing.
Keep the booklet straight in front of you and don't tilt it.
Just do the best you can on both the easy ones and the hard ones.

Don't skip any!

Please turn the page from the top to begin.

Product Number 46220/46221

Page 1

Appendix I: Programme manual

My Shapes Programme

Table of Contents

Workstation 2: 10 minutes

Setting the Scene: Pencils, crayons, round stickers available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will draw a circle following the faint visual cues.
-
- The learners will identify circles of same sizes on worksheets.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Session 3: Recognising the square

Outcome:

- The learner will identify everyday objects that look like a square with assistance.
- The learner will be able to make a 3D image of a square.
- The learner will be able to trace and draw a square with visual cues.

Materials needed:

- 10 square shaped sponges
- Paper
- Paint
- Tissues
- Garbage bags to be used as aprons
- Square cardboard stencils (See appendix)

Activity 3.1: Circle time

Discussion: (10 minutes)

The teacher has the learners seated in a square shape around her.

Story…

Thabo and Jessica were so excited about what they had learnt at school that day. 'I didn't know that a piece of bread has a square shape!" exclaimed Jessica. "And that it has 4 same sides." replied Thabo.

They were so busy talking while kicking a round soccer ball when suddenly Thabo kicked the ball into the window. "CRASH!" the window broke into pieces. "Oh no!" said Thabo. "My mum will be so angry with me," he wailed. "I'm sorry Thabo" then Jessica paused…"Look! The window has a square shape. It has 4 same sides!"

The teacher introduces the session advising that the learners will be learning about a square shape. The teacher can emphasise that a square has '4 same sides'.

The teacher will then talk about everyday objects that are square in shape such as a window, bread.

The teacher can ask the learners to close their eyes and will pass around everyday objects that are round in shape and have the learners feel the object.

The teacher will encourage the learners to identify everyday objects that are square in shape.

Activity 3.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: Each learner will have a piece of paper to paint with. Square shaped sponges, paint brushes, paint, tissues and square cardboard stencils will be placed at the centre of each workstation. The learners will each wear a garbage bag with holes cut out for the arms as an apron.

The learners will be given the opportunity to paint using the square sponges, paintbrushes, square stencils.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, round stickers available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will trace the outline of squares in their workbook.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Discussion: 5 minutes

The teacher will facilitate a discussion and feedback session with the learners summarising the shape of the square. The learners will be encouraged to 'draw the square' in the air using large arm movements and to identify a few objects that look like a square.

Session 4: Telling the difference: square shapes

Outcome:

- The learner will sort and match square of varying sizes with assistance
- The learner will be able to draw a square with visual cues

Materials needed:

- 20 square wooden blocks
- Cardboard square stencils of various sizes (See appendix page)
- Pre-cut box template (See pdf document titled cube.pdf for template and appendix)
- Pencils
- Crayons
- Erasers
- Sharpener

Activity 4.1: Circle time

Discussion: (10 minutes)

The teacher has the learners seated in a square shape around her.

The teacher will summarise the previous day's session and will outline today's session – tell the difference and matching squares of different sizes.

The teacher can hold up cardboard square stencils of various sizes emphasising the difference between big and small.

The teacher can then ask learners to point out which same sized squares match compared to others.

Activity 4.2: Activity time

Workstation 1: 10 minutes

Setting the scene: Square wooden stencils to be placed at the centre of the table with the square wooden blocks. Square cardboard box templates for each learner. To be placed in front of each seat.

The learners will place the square wooden blocks into the square wooden stencils with the matching sizes next to each other.

Making a square cardboard box: See appendix

The teacher can demonstrate each step at the Workstation.

Workstation 2: 10 minutes

Setting the Scene: Pencils, crayons available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will draw a square following the visual cues.

The learners will identify squares of same sizes on worksheets.

The learners will match squares and circles along the page.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Session 5: Recognising the rectangle

Outcome:

- The learner will identify everyday objects that look like a rectangle with assistance.
- The learner will be able to make a 3D image of a rectangle.
- The learner will be able to trace and draw a square with visual cues.

Materials needed:

- 1 X A4 paper
- 1 X Business card
- 1 X Envelope
- 2 X box of matches / keyway sticks
- Pre-cut rectangle shaped card per learner (See appendix)
- 5 rectangular shaped sponges of varying sizes
- Paint
- Garbage bags for aprons with holes cut for the arms

Activity 5.1: Circle time

Discussion (10 minutes)

The teacher has the learners seated in a rectangle shape around her. The teacher introduces the session advising that the learners will be learning about a rectangle shape.

Story...

Thabo and Jessica were sitting at the dining table completing their homework. They were thinking very hard so they didn't talk for a while. Suddenly..."Sho! I've finished it finally!" shouted out Jessica. "Let me see." said Thabo. "That looks so nice Jessica. Your drawing is so neat. " "Thanks Thabo!" replied Jessica. "Now all I have to do is put it in an envelope to take to school tomorrow" continued Jessica. "Yes and don't forget..." started Thabo. "An envelope has a rectangle shape – 2 long and 2 short sides!" They both cried out together.

The teacher can emphasise that the rectangle has 2 long, 2 short sides.

The teacher will then talk about everyday objects that are rectangle in shape such as A4 paper, business card, and envelope.

The teacher can ask the learners to close their eyes and will pass around everyday objects that are rectangle in shape and have the learners feel the object.

The teacher will encourage the learners to identify everyday objects that are rectangle in shape.

Activity 5.2: Activity time

Workstation 1: 10 minutes

Setting the scene: A box of matches/ keyway sticks will be placed at the centre of the work-station.

The learners will be encouraged to make rectangle shapes using the matchsticks. The teacher can make a model and leave it at the workstation for the learners to copy.

The teacher will then give each learner pre-cut rectangular shaped cards and encourage the learners to paint on the cards using rectangular shaped sponges.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will trace the outline of rectangles in their workbook.

The learners can colour in the pictures when finished.

Discussion: 5 minutes

The teacher will facilitate a discussion and feedback session with the learners summarising the shape of the rectangle. The learners will be encouraged to 'draw the rectangle' in air using large arm movements and to identify a few objects that look like a rectangle.

Session 6: Telling the difference: rectangle shapes

Outcome:

- The learner will sort and match rectangle of varying sizes with assistance
- The learner will be able to draw a rectangle with visual cues

Materials needed:

- 20 square wooden blocks
- Rectangle stencils of various sizes (See appendix)
- Pritt glue
- Glitter
- Pre-cut rectangle templates for the envelope (square sheet of paper) / learner (See appendix)

Activity 6.1: Circle time

Discussion (10 minutes)

The teacher has the learners seated in a rectangle shape around her.

The teacher will summarise the previous day's session and will outline today's session – tell the difference and matching rectangles of different sizes.

The teacher can hold up cardboard rectangle stencils of various sizes emphasising the difference between big and small.

The teacher can then ask learners to point out which rectangle sized squares match compared to others.

Activity 6.2: Activity time

Workstation 1: 10 minutes

Setting the scene: Rectangle cardboard stencils to be placed at the centre of the table with the square wooden blocks.

The learners will place the square wooden blocks into the rectangle cardboard stencils with the matching sizes next to each other.

Making a rectangle envelope: Each learner will have a cutout rectangle template in front of them. Follow the instructions to make the rectangle envelope.

The teacher can demonstrate each step at the Workstation.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will draw a rectangle following the visual cues.

The learners will identify rectangles of same sizes on worksheets.

The learners will match rectangles, squares and circles along the page.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on

Session 7: Recognising the triangle

Outcome:

- The learner will identify everyday objects that look like a triangle with assistance.
- The learner will be able to make a 3D image of a triangle.
- The learner will be able to trace and draw a triangle with visual cues.

Materials needed:

- 1 X party hat
- 1 X clothes hangar
- Play dough
- Cookie cutters
- Keyway sticks / match sticks with the heads cut off
- Pencils
- Crayons

Activity 7.1: Circle time

Discussion (10 minutes)

The teacher has the learners seated in a triangle shape around her.

Story…

"Watch out!" cried Jessica, as a branch went flying through the air just missing Thabo's head. "Its so windy today. I feel like I can just stick my arms out and start flying." replied Thabo. Jessica immediately began to stick her arms out and pretended to fly. "I'm coming to catch you!' said Jessica. "You can't catch me! " replied Thabo. "I can fly faster than an aeroplane!" exclaimed Thabo.

Thabo and Jessica kept on playing like this until they saw something stuck in a bush. "What's that?" wondered Thabo. "Lets go and see." said Jessica. As they walked closer they could make out an object with 6 sides. "Oh look, it's a kite!' cried Thabo. "Yes you are right." said Jessica. Remember what we learnt at school today Jessica," said Thabo. "A triangle has 3 sides and this kite looks like 2 triangles stuck together." said Thabo.

The teacher introduces the session advising that the learners will be learning about a triangle shape.

The teacher will then talk about everyday objects that are triangular in shape such as a party hat, clothes hangar.

The teacher can ask the learners to close their eyes and will pass around everyday objects that have a triangular shape and have the learners feel the object.

Activity 7.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: Each learner will make a triangle using play dough.

The cookie cutters, keyway sticks will be available to make triangular shapes on the play dough.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

The learners will trace the outline of triangles in their workbook. The learners can colour in the pictures when finished.

Discussion: 5 minutes

The teacher will facilitate a discussion and feedback session with the learners summarising the shape of the triangle. The learners will be encouraged to 'draw the triangle' in air using large arm movements and to identify a few objects that look like a triangle.

Session 8: Telling the difference: triangle shapes

Outcome:

- The learner will sort and match triangles of varying sizes with assistance
- The learner will be able to draw a triangle with visual cues

Materials needed:

- 20 square wooden blocks
- Triangular stencils
- Glue
- Pencil, crayons

Activity 8.1: Circle time

Discussion (10 minutes)

The teacher has the learners seated in a triangular shape around her.

The teacher will summarise the previous day's session and will outline today's session – tell the difference and match triangles of different sizes.

The teacher can hold up cardboard triangular stencils of various sizes emphasising the difference between big and small.

The teacher can then ask learners to point out which triangular sized stencils match compared to others.

Activity 8.2: Activity time

Workstation 1: 10 minutes

Setting the scene: Materials to make a kite to be placed at the centre of the table.

Making a kite: See appendix for further details.

The teacher can demonstrate each step at the Workstation.

Workstation 2: 10 minutes

Setting the Scene: Pencils, crayons available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will draw a triangle following the visual cues.
- The learners will identify triangles of same sizes on worksheets.
- The learners will match rectangles, squares, circles and triangles along the page.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Session 9: Recognising the oval

Outcome:

- The learner will identify everyday objects that look like an oval with assistance.
- The learner will be able to make a 3D image of an oval.
- The learner will be able to trace and draw an oval with visual cues.

Materials needed:

- 1 X A4 paper
- 1 X egg
- 1 X small rugby ball /picture of rugby ball
- Pencil, crayons
- Play dough
- Cookie cutters

Activity 9.1: Circle time

Discussion: 10 minutes

The teacher has the learners seated in an oval shape around her. The teacher introduces the session advising that the learners will be learning about an oval shape.

Story...

"What a long day its been!" said Jessica. "Yes," replied Thabo. "Two tests in the same day and then a soccer game. I am so tired." yawned Thabo. "And hungry, I can't wait to eat when we get home." said Jessica. "What shall we eat?" said Thabo who began to walk faster as he started to think about food. "How about eggs?" said Jessica. "Yes that's a great idea!" replied Thabo. "Eggs and bread...yummy!" said Thabo. "And don't forget", said Jessica. "Yes eggs have an oval shape" said Thabo "with long round sides!"

The teacher can emphasise that the oval has long round sides.

The teacher will then talk about everyday objects that are oval in shape such as an egg, rugby ball.

The teacher can ask the learners to close their eyes and will pass around everyday objects that are oval in shape and have the learners feel the object.

The teacher will encourage the learners to identify everyday objects that are oval in shape.

Activity 9.2: Activity time

Workstation 1: 10 minutes

Setting the scene: Play dough will be placed in the centre of the table with oval shapes/cookie cutters.

The learners will be encouraged to make oval shapes using the play dough.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will trace the outline of ovals in their workbook.
- The learners can colour in the pictures when finished.

Discussion: 5 minutes
The teacher will facilitate a discussion and feedback session with the learners summarising the shape of the oval The learners will be encouraged to 'draw the oval' in air using large arm movements and to identify a few objects that look like an oval.

Session 10: Telling the difference: oval shapes

Outcome:

- The learner will sort and match an oval of varying sizes with assistance
- The learner will be able to draw an oval with visual cues

Materials needed:

- Oval stencils
- Pencils, crayons
- Paper
- Pritt Glue

Activity 10.1: Circle time

Discussion: 10 minutes

The teacher has the learners seated in an oval shape around her.

The teacher will summarise the previous day's session and will outline today's session – tell the difference and match oval shapes of different sizes.

The teacher can hold up cardboard oval stencils of various sizes emphasising the difference between big and small.

The teacher can then ask learners to point out which same sized ovals match compared to others.

Activity 10.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: The teacher will lay out the materials to make the butterfly or flower such as paper, glue, crayons, scissors.

Making paper art: Cut out the shapes and stick them together to make a flower/ butterfly

The teacher can demonstrate each step at the Workstation.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will draw an oval following the visual cues.
- The learners will identify oval of same sizes on worksheets.
- The learners will match circles, squares, rectangles, triangles and ovals along the page.

The learners can colour in the pictures when finished. They can also decorate with glitter using Pritt glue to stick the glitter on.

Session 11: Recognising the shapes

Outcome:

- The learner will be able to recognise and name the shapes learnt.

Materials needed:

- Play dough
- Cookie cutters
- Pencils
- Crayons
- Workbook
- Shape stencils (circle, square, rectangle, triangle, oval)

Activity 11.1: Circle time

Discussion: 10 minutes

The teacher introduces the session advising that it will involve a summary of the shapes learnt. The teacher will then go through each shape with the learners demonstrating how to make the shapes 'in the air'.

- Circle : Start at the top and go round and round
- Square: 4 same sides
- Rectangle: 2 long and 2 short
- Triangle: 3 sides
- Oval: Long round sides

The teacher can hold up the various shapes asking the learners to identify them.

The teacher can ask the learners to close their eyes and will pass around everyday objects of the various shapes and ask the learners to guess the object and its shape.

Activity 11.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: Place play dough at the center of the workstation with the various shaped cookie cutters.

Allow the learners to explore and experiment with the play dough making various shapes. This will be a time of exploration and consolidation of the shapes learnt.

The teacher can ask the learners to make a particular shape before moving to the next shape or to make a sequence of shapes. Alternatively the teacher can allow for general exploration of making the different shapes learnt.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will draw the different shapes in the workbook.
- The learners will match the different shapes learnt. (Note : shapes will be of the same size and pattern).

Discussion: 5 minutes

The teacher will facilitate a discussion and feedback session with the learners summarising the various shapes learnt throughout the session.

Session 12: Telling the difference: size and direction

Outcome:

- The learner will be able to recognise the shape
- The learner will be able to match the same shape in various sizes and direction.

Materials needed:

- 1 X A4 paper
- Shape stencils (circle, square, rectangle, triangle, oval)
- Play dough
- Different shaped cookie cutters
- Pencils, crayons

Activity 12.1: Circle time

Discussion: 10 minutes

The teacher introduces the session advising that it will involve recognising the shapes while they are in different sizes and direction.

Story...

Thabo and Jessica were walking home from school. "I can't believe we have finished learning about shapes." said Jessica. "Yes its been fun to see how things around us actually have different shapes. " replied Thabo. "I know!" exclaimed Thabo quickly as an idea came to him. "Lets see what objects we can see around us that look like the shapes we have learnt" suggested Thabo. "That's a great idea", said Jessica. "I'll start", she continued.

"The sun is round like a circle." said Jessica. "Good one! My lunch box is square because it has 4 same sides." said Thabo with satisfaction. "My turn! My A4 notepad is a rectangle because it has 2 long and 2 short sides." said Jessica. "And my chocolate Easter egg is an oval with long round sides." said Thabo. "And don't forget my hat has a triangular shape" said Jessica. "Yes with 3 sides!' replied Thabo.

"What are we going to do now that we have finished school and its holiday time?" asked Jessica. "Oh don't worry I'm sure we can find some fun games to play" assured Thabo. "Yes I'm sure too" said Jessica. Thabo and Jessica continued chatting as they made their way home....***the End.***

The teacher can hold the same shape e.g. triangle and rotate it in different directions or have different sizes of the same shape to help the learners consolidate matching a shape while being of a different size or orientation.

Activity 12.2: Activity time:

Workstation 1: 10 minutes

Setting the scene: Place play dough at the centre of the work-station with the various shaped cookie cutters.

The learners will start with one shape and make different sizes of the same shape before moving onto the next shape.

At the end of 10 minutes the teacher will ring a bell/timer and the learners will swap workstations.

Workstation 2: 10 minutes

Setting the Scene*:* Pencils, crayons, available at the centre of each workstation. Each chair will have a workbook with the learner's name written on it.

- The learners will draw the different shapes in the workbook.
- The learners will match the different shapes learnt of various sizes and orientation.

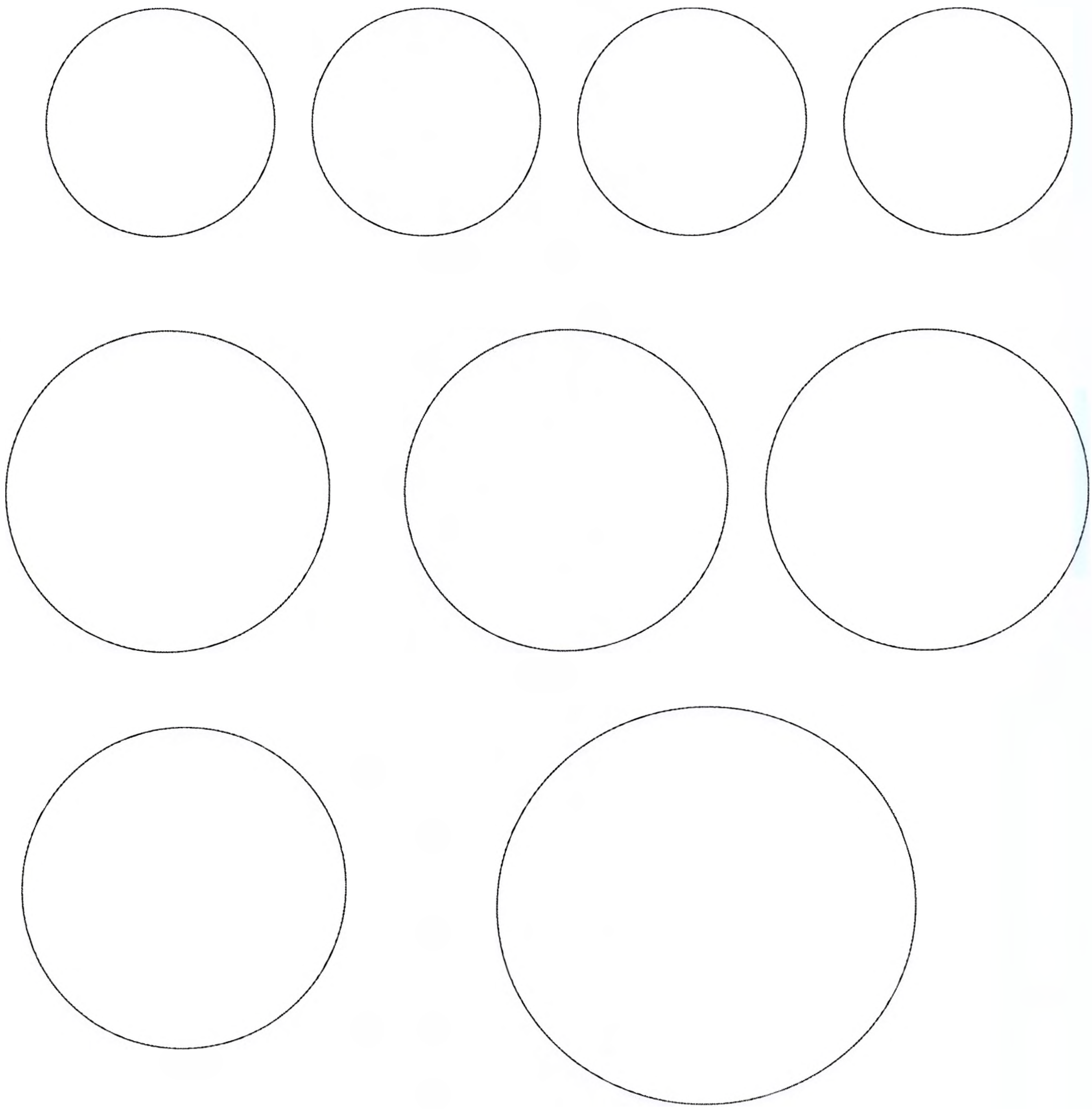
Discussion: 5 minutes

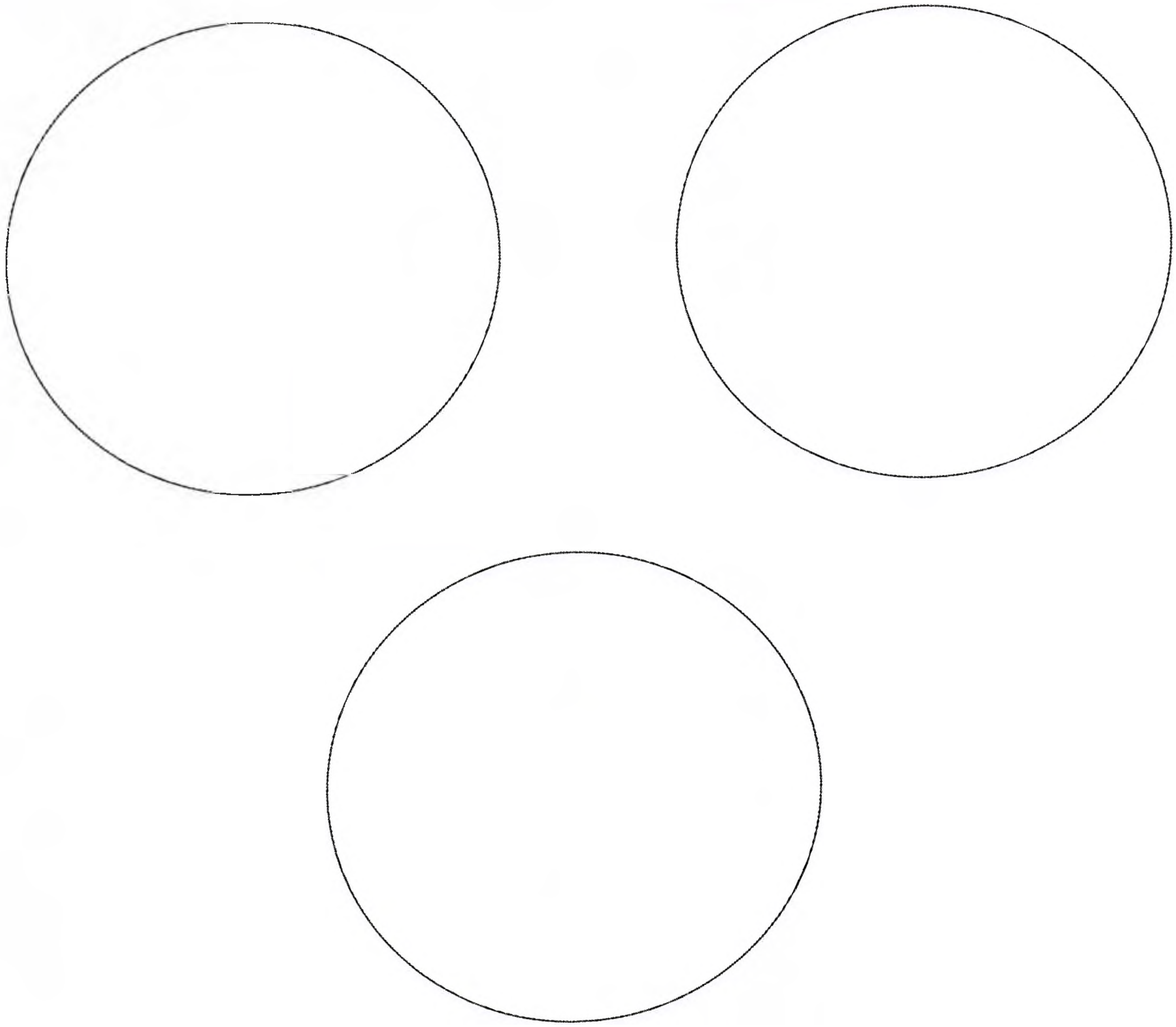
The teacher will facilitate a discussion and feedback session with the learners summarising the various shapes learnt throughout the session.

APPENDIX

SESSION 2

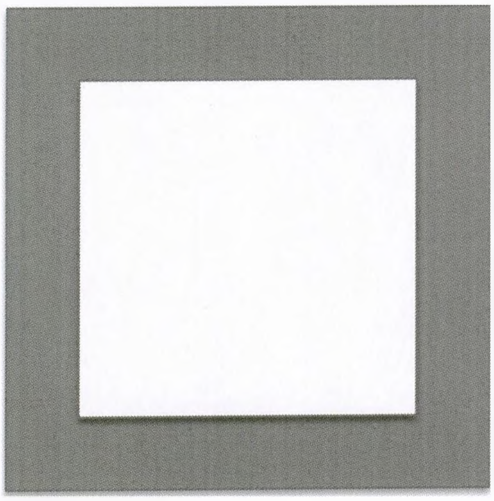
Pre-cut circles of varying sizes

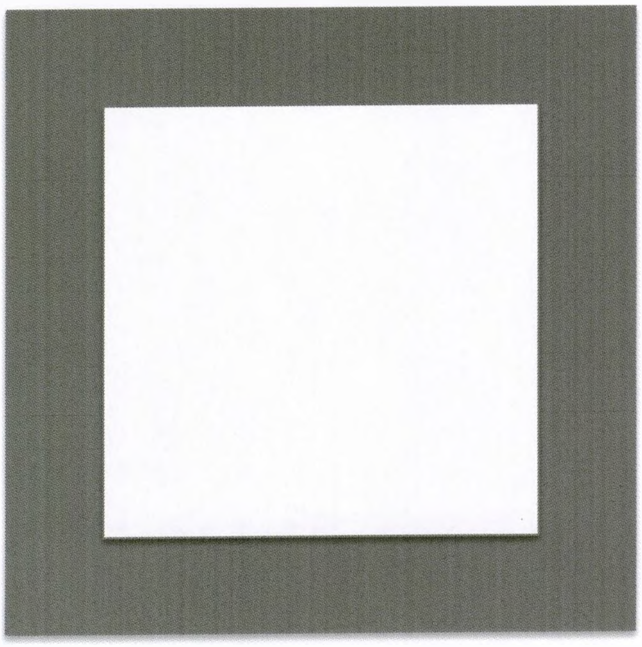




SESSION 3

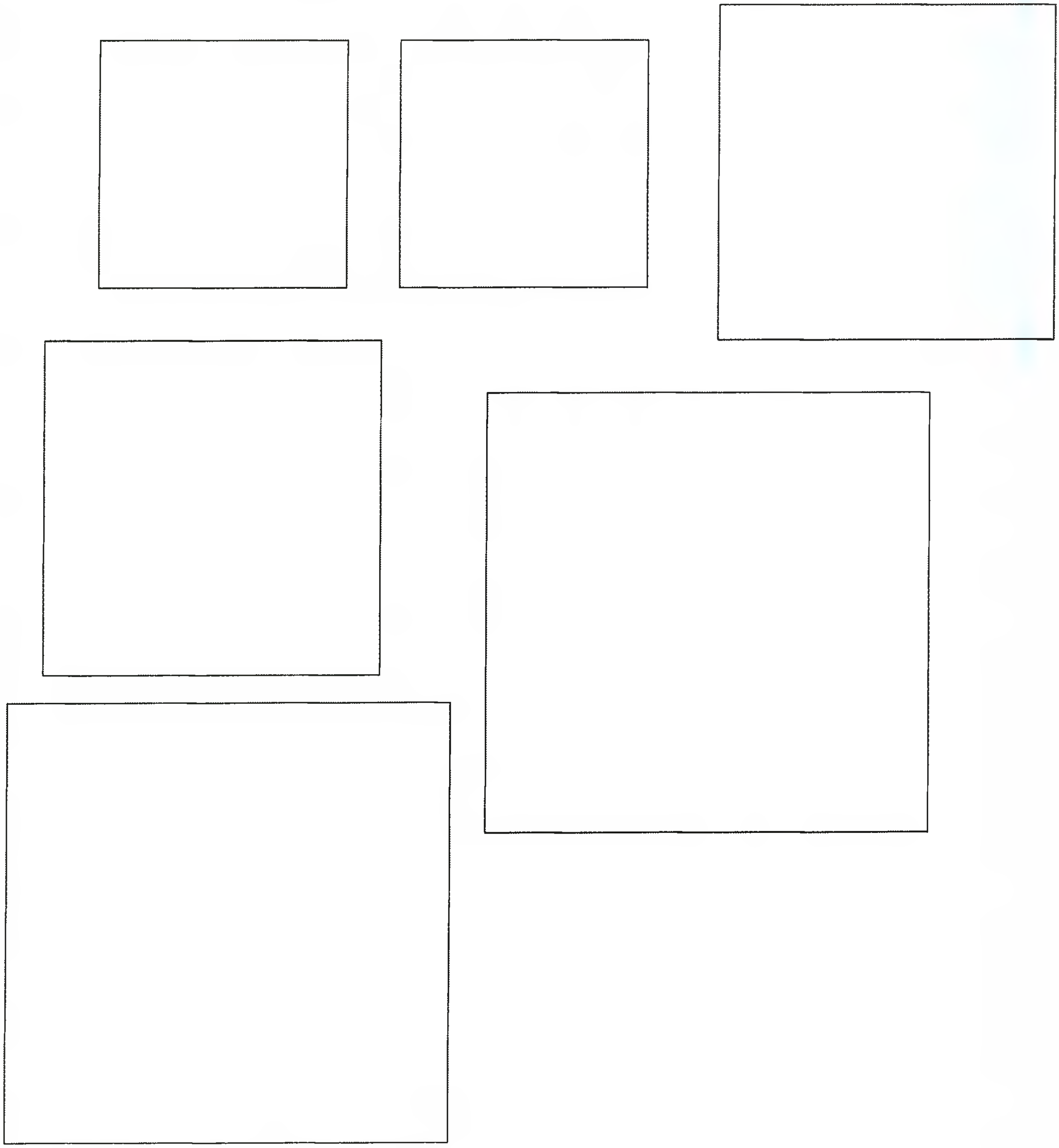
Square stencils





SESSION 4

Cardboard square stencils



Cardboard box cube template

Instructions:

- See pdf cube template
- Print out on A4 page
- Cut out the template
- Fold along the inside lines
- Assemble into a cube by gluing along the inside tabs.

http://www.firstpalette.com/tool_box/printables/cube.html

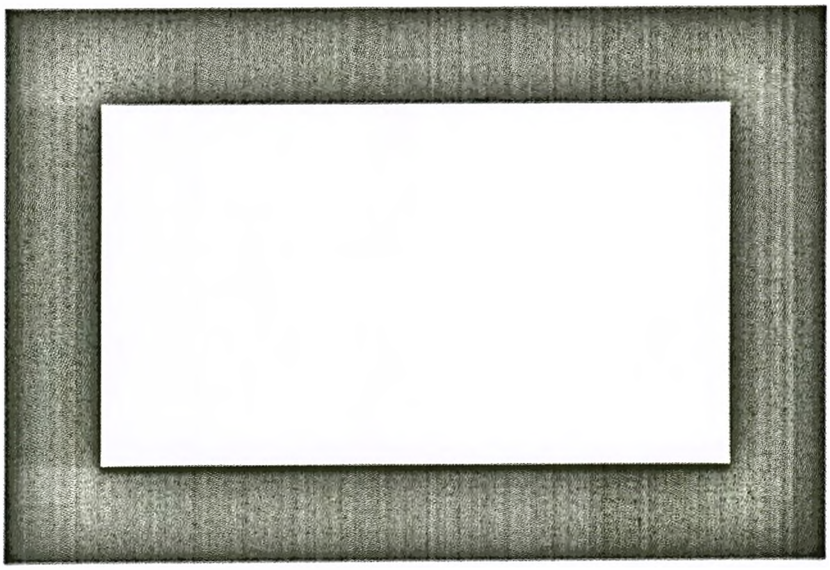
SESSION 5

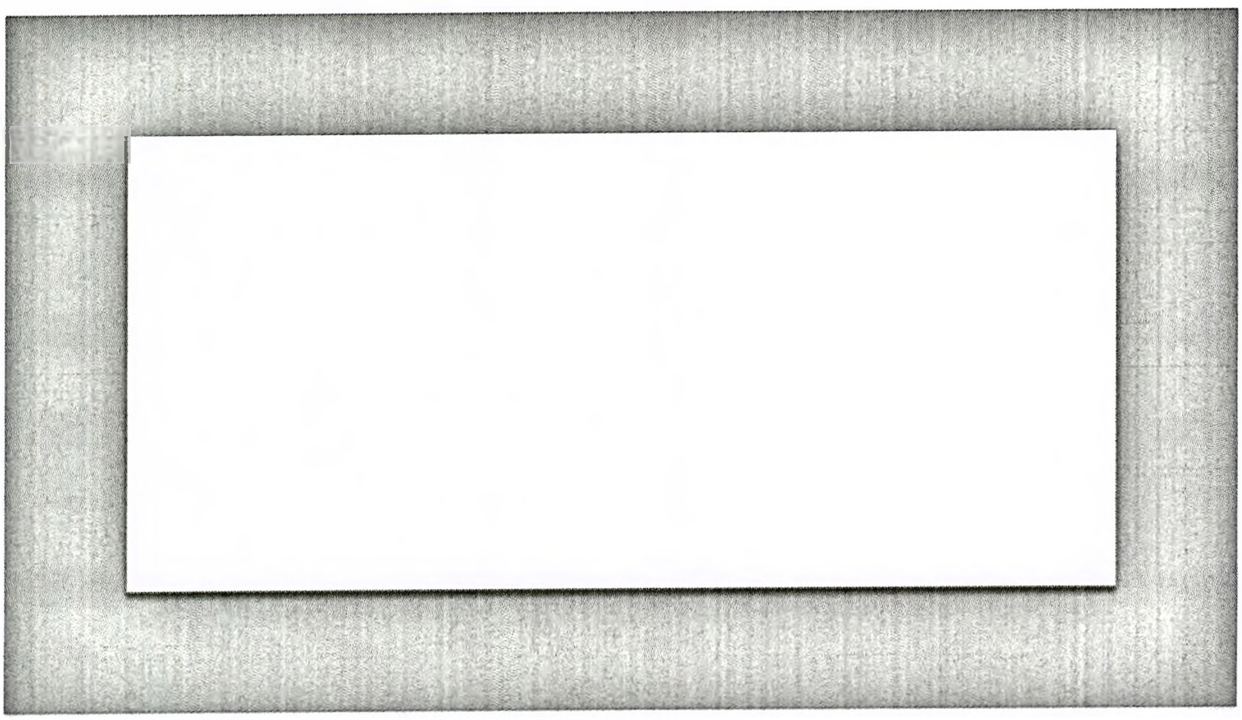
Rectangular shaped card

- Cut along the outside edge
- Fold along the dotted line

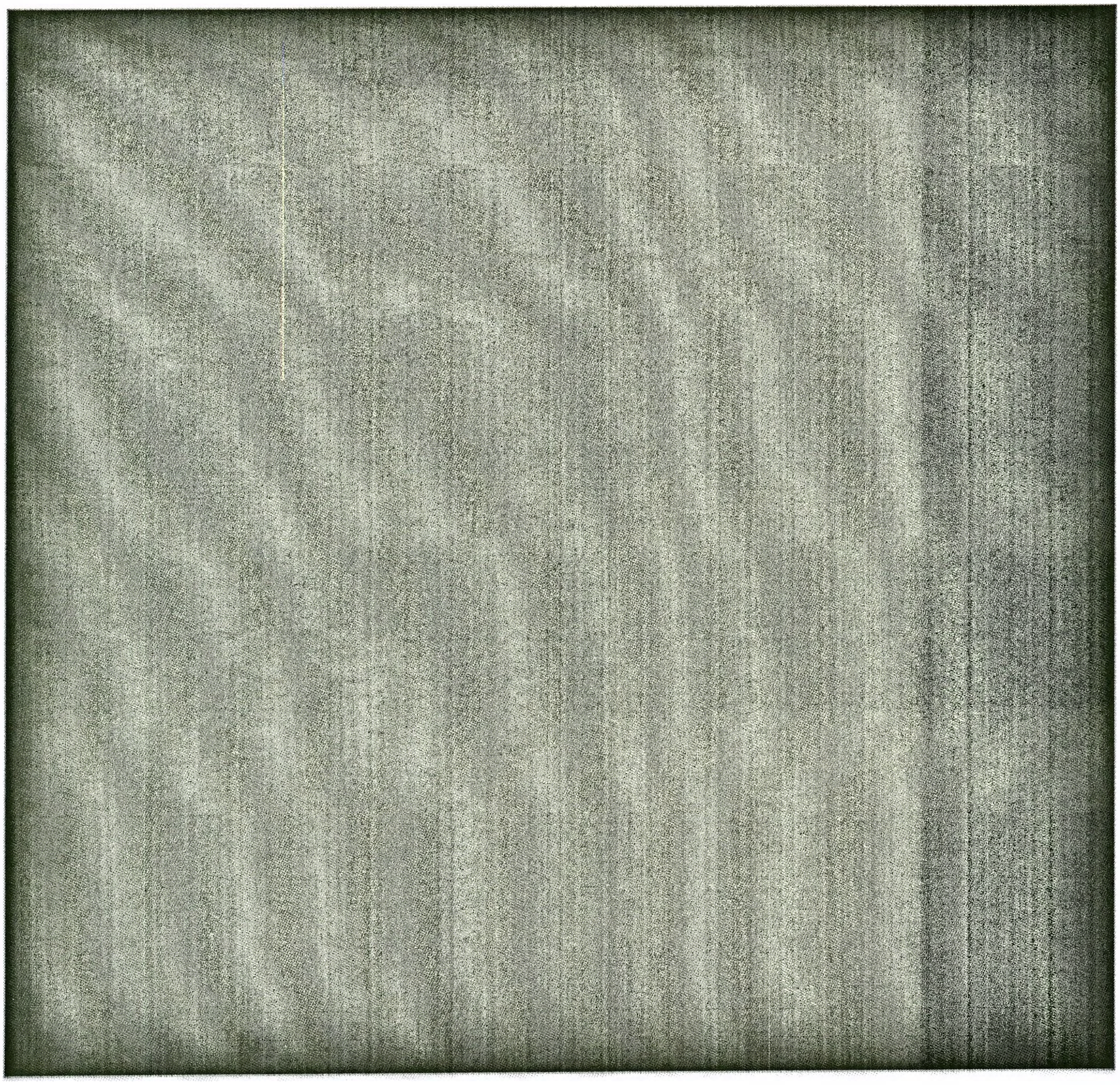
SESSION 6

Rectangle stencils

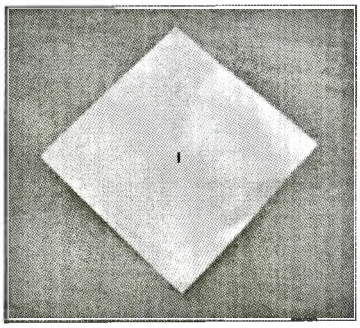




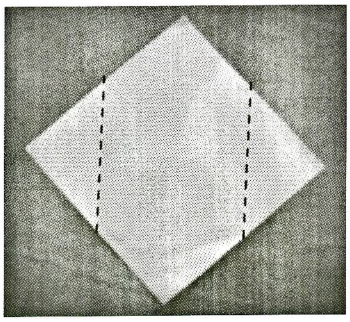
Rectangle envelope template



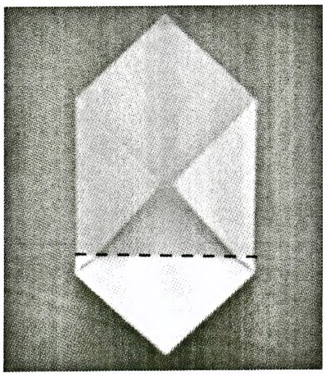
Place the square piece of paper with the points facing top, bottom and sides.



Bring the right point to the left point and pinch the centre. Unfold back to the square piece of paper.

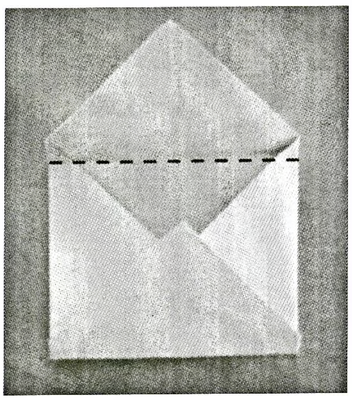


Fold the side points to the centre.

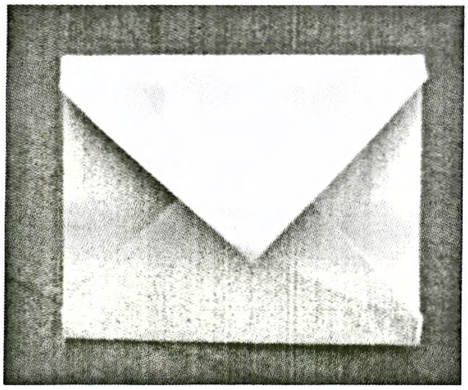


Bring the bottom point to just above the centre.

Fold the top point



down just past the side folds

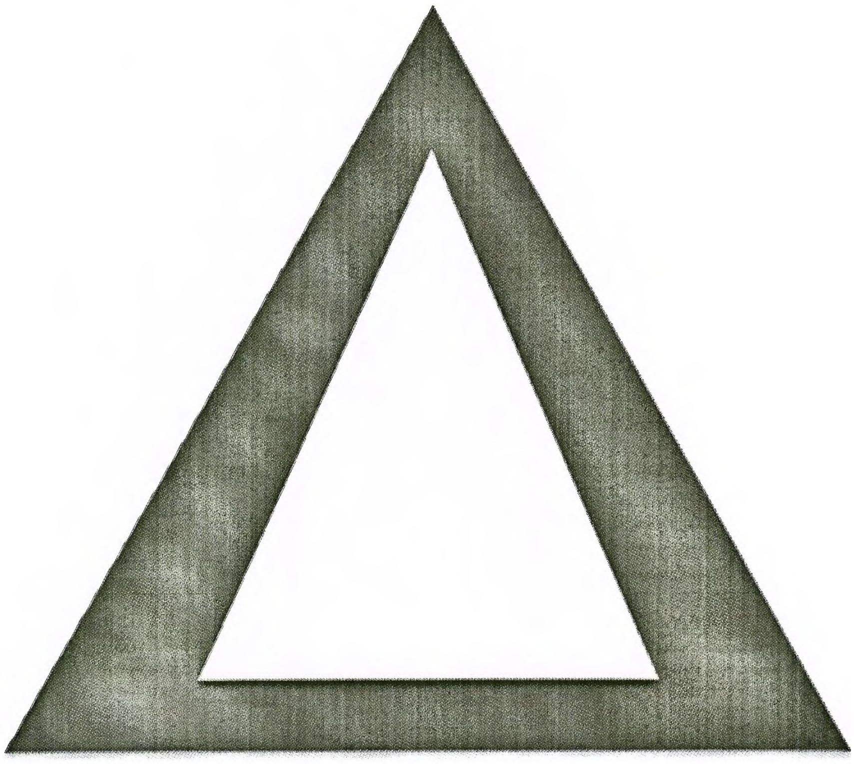


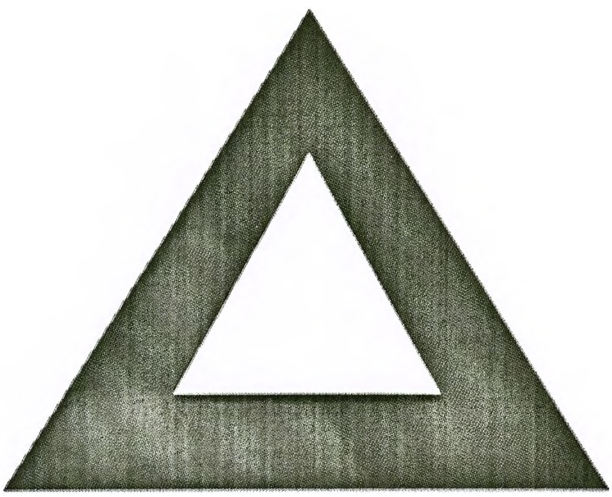
Now the envelope is ready!

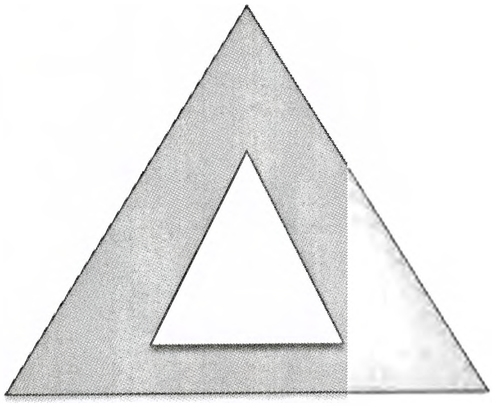
http://www.ucandostuff.com/Guide-37

SESSION 8

Triangle stencils

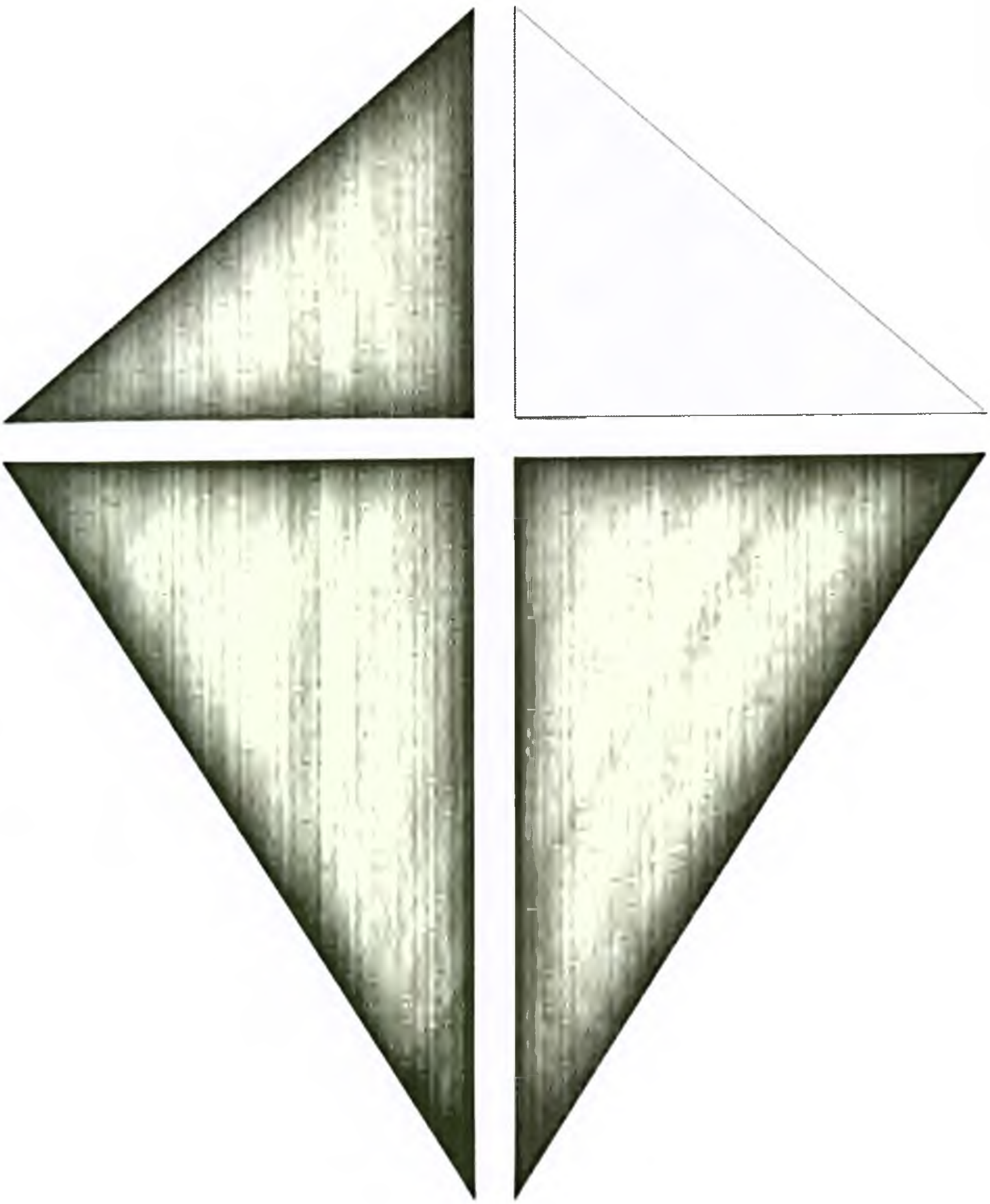




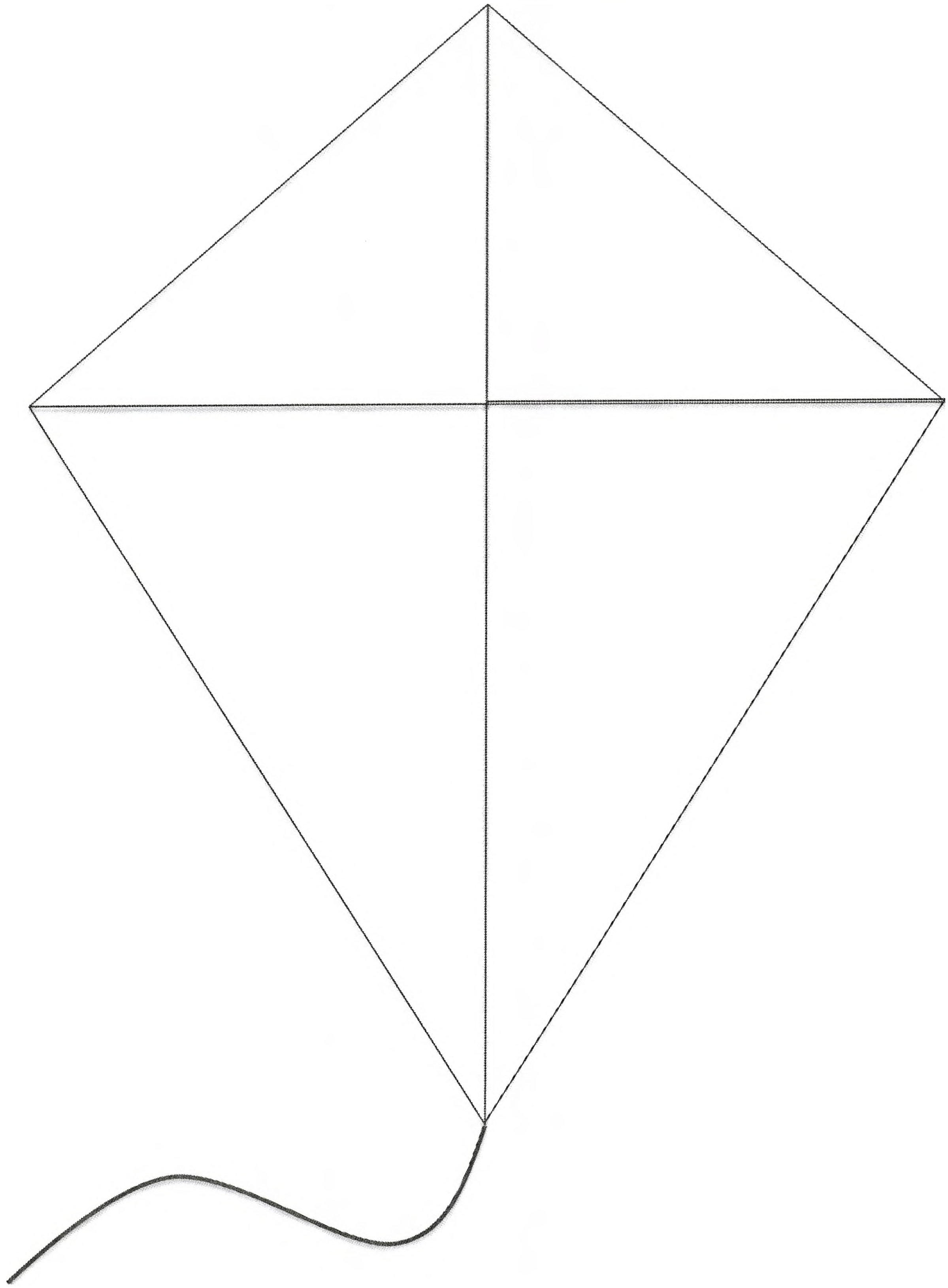


Kite template

Cut out the triangle shapes

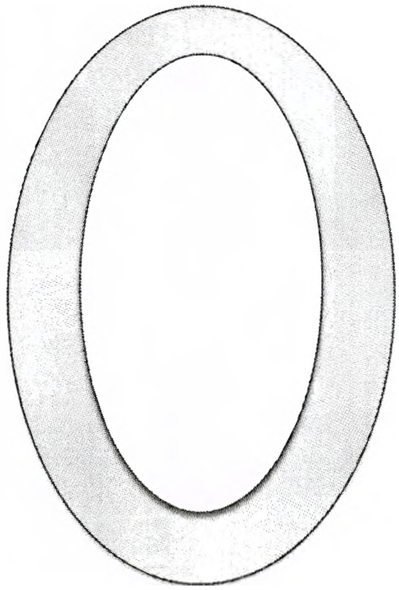


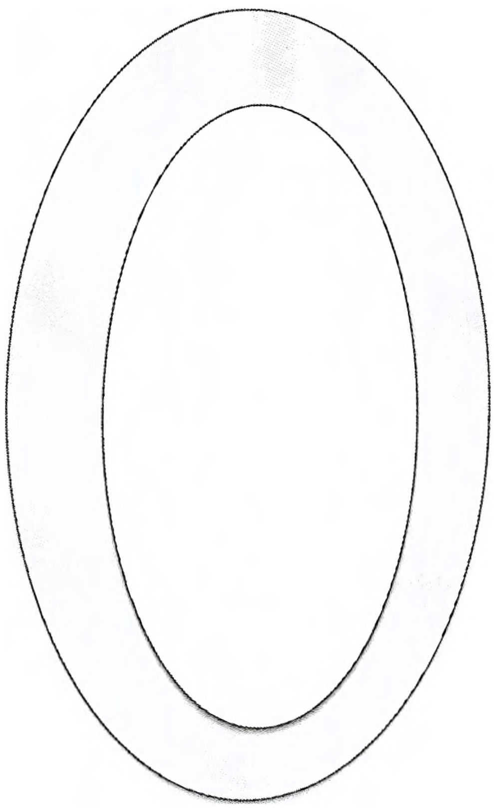
Glue the pieces on the template below. Colour in when you are done!



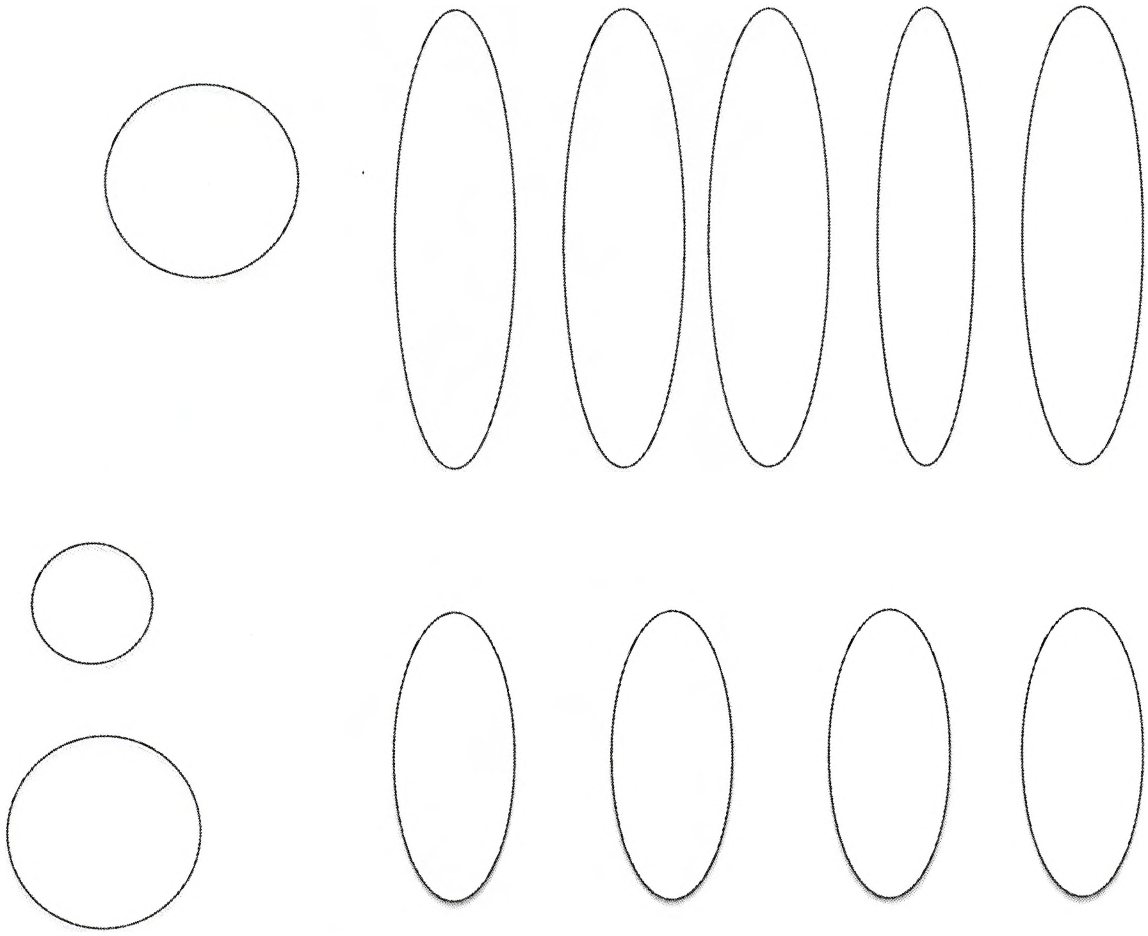
SESSION 10

Oval stencils





- Cut out the shapes
- Stick them on a piece of paper to make a flower or a butterfly



Appendix J: Programme workbook

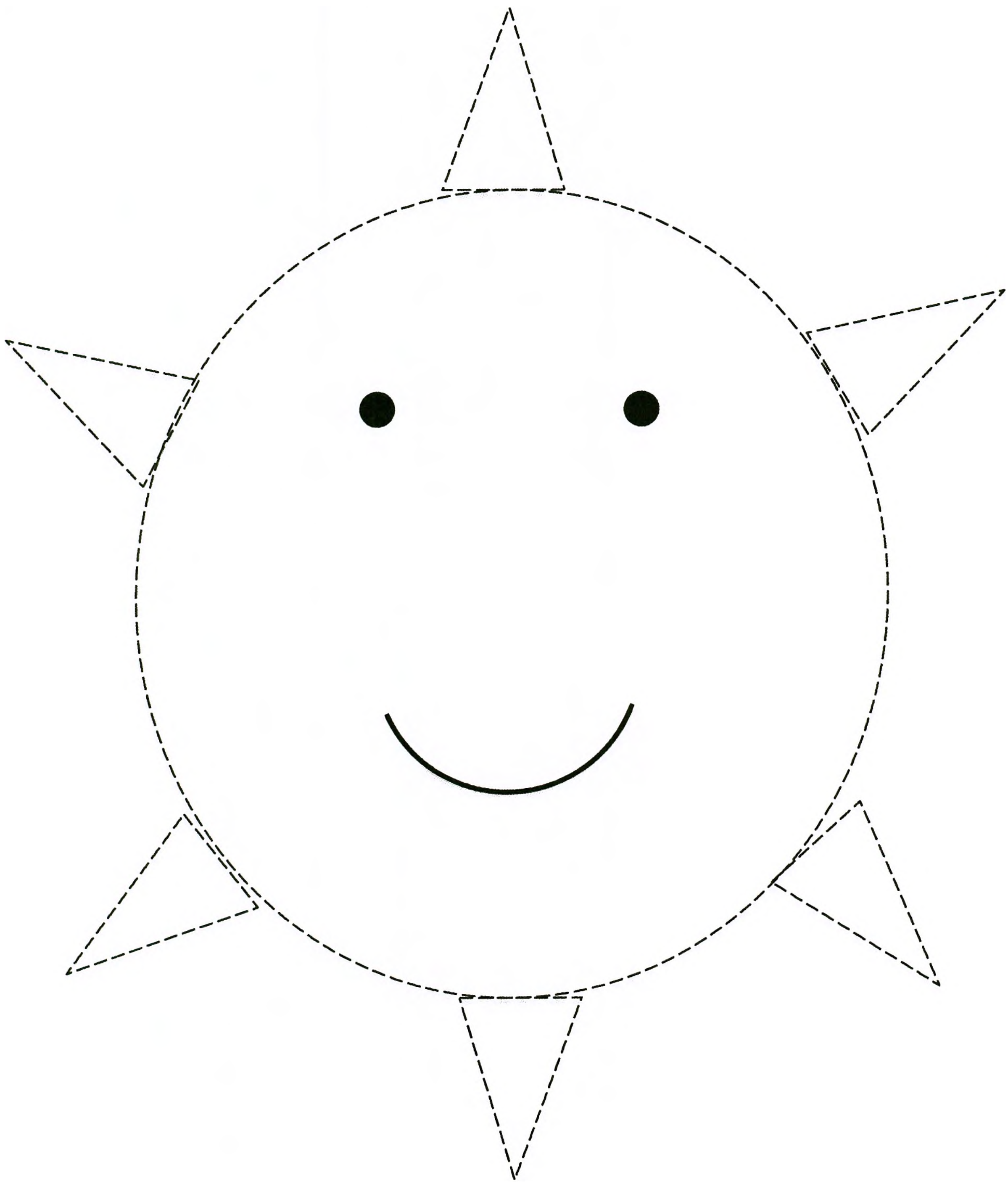
My Shapes Preschool Program

This book belongs to

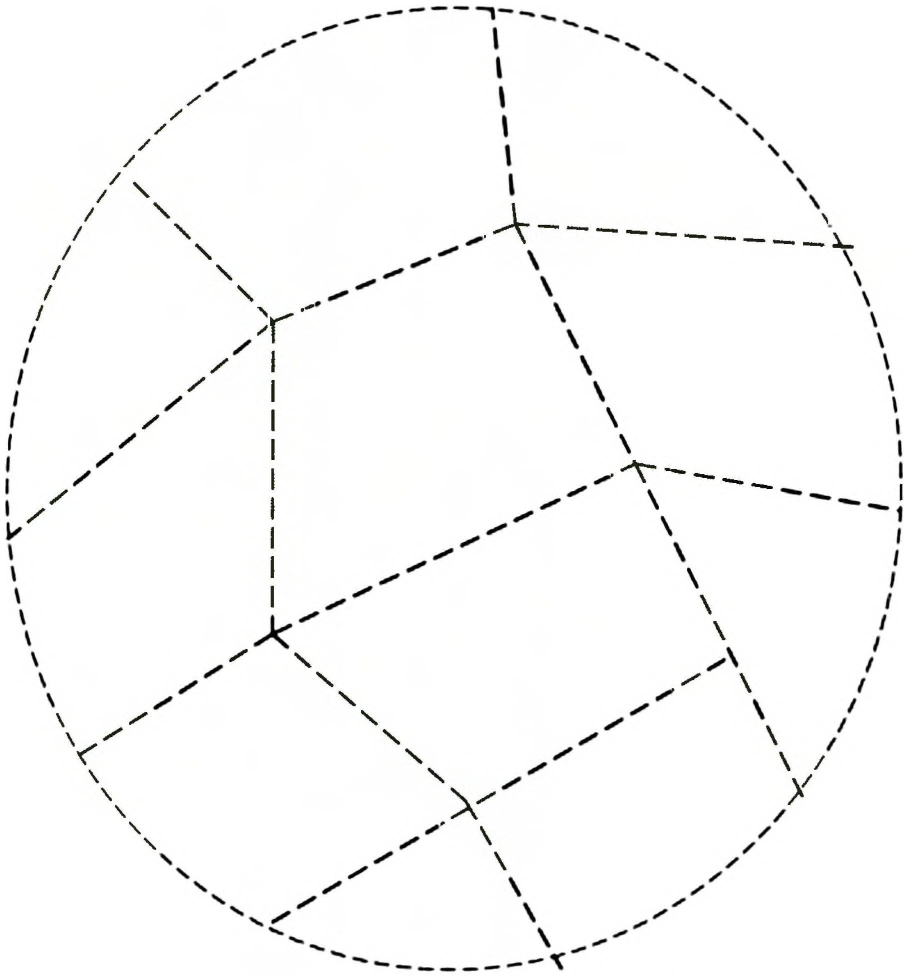
____

SESSION 1

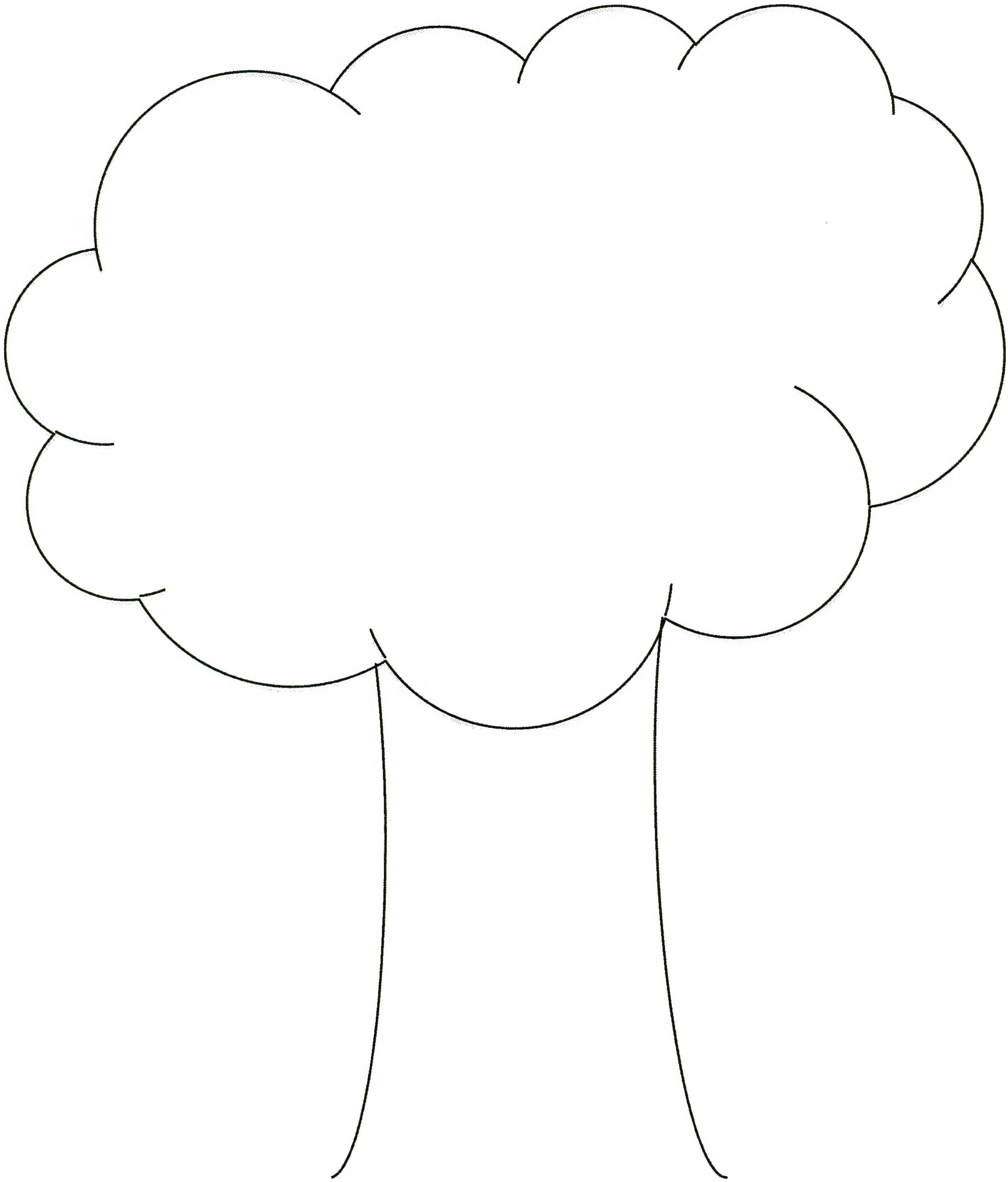
Help Jessica trace the sun. Colour in when you are done!



Trace the soccer ball that Thabo is playing with. Colour in when you are done!

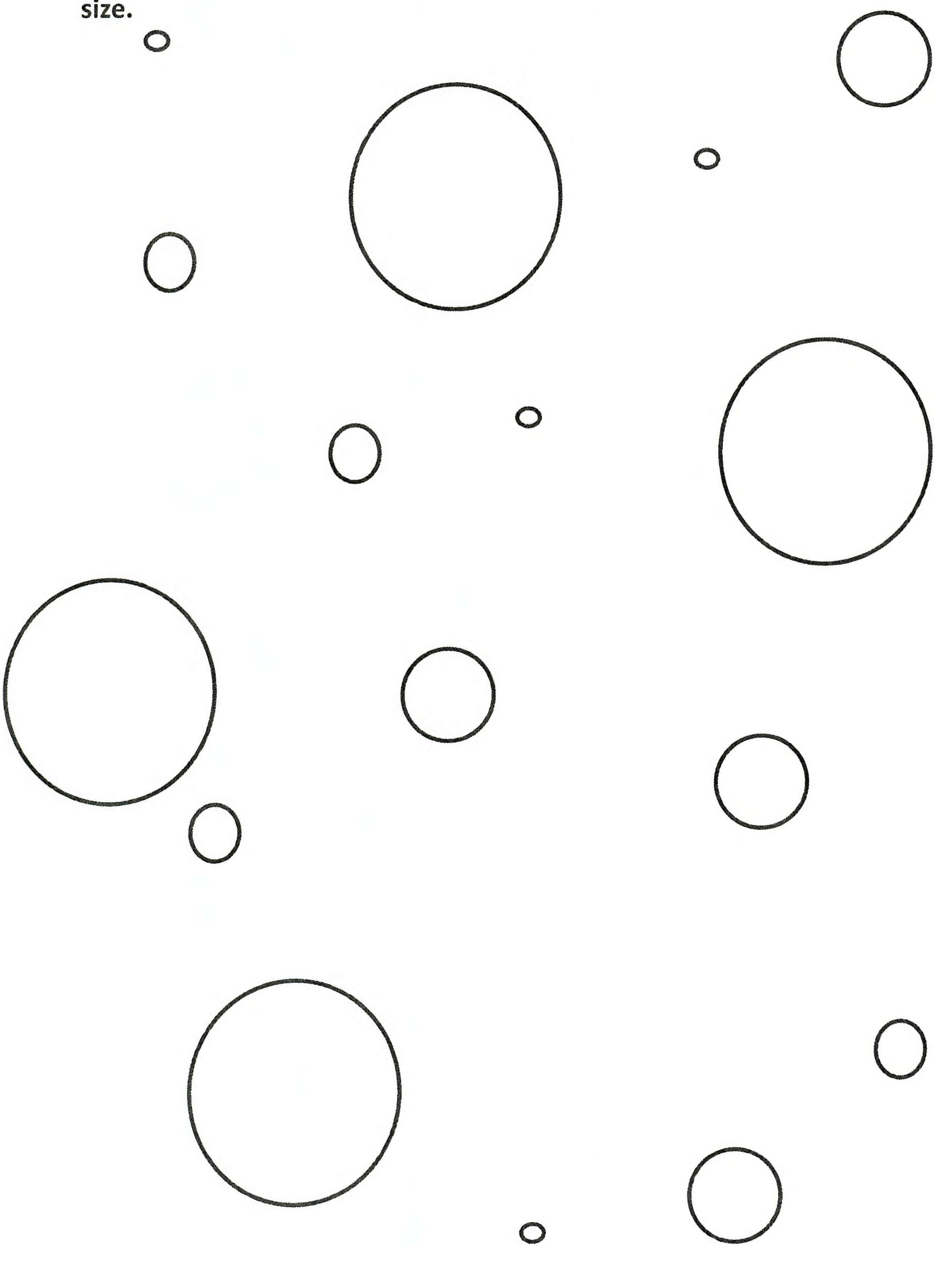


Stick the round circles on the tree!

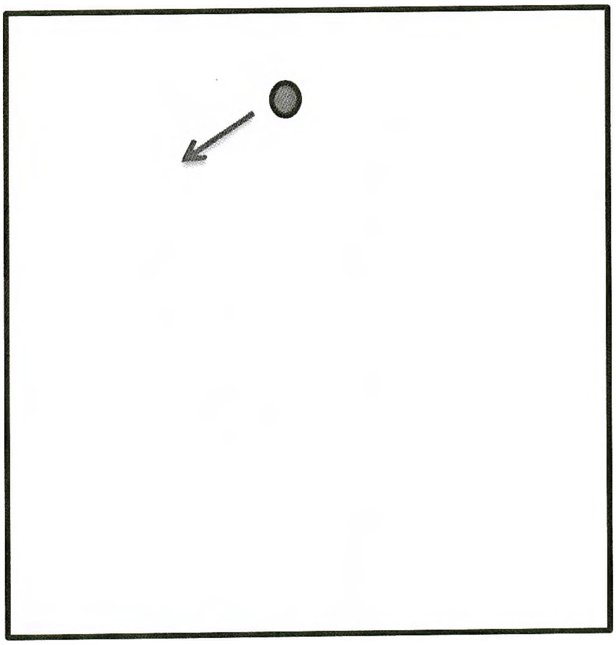


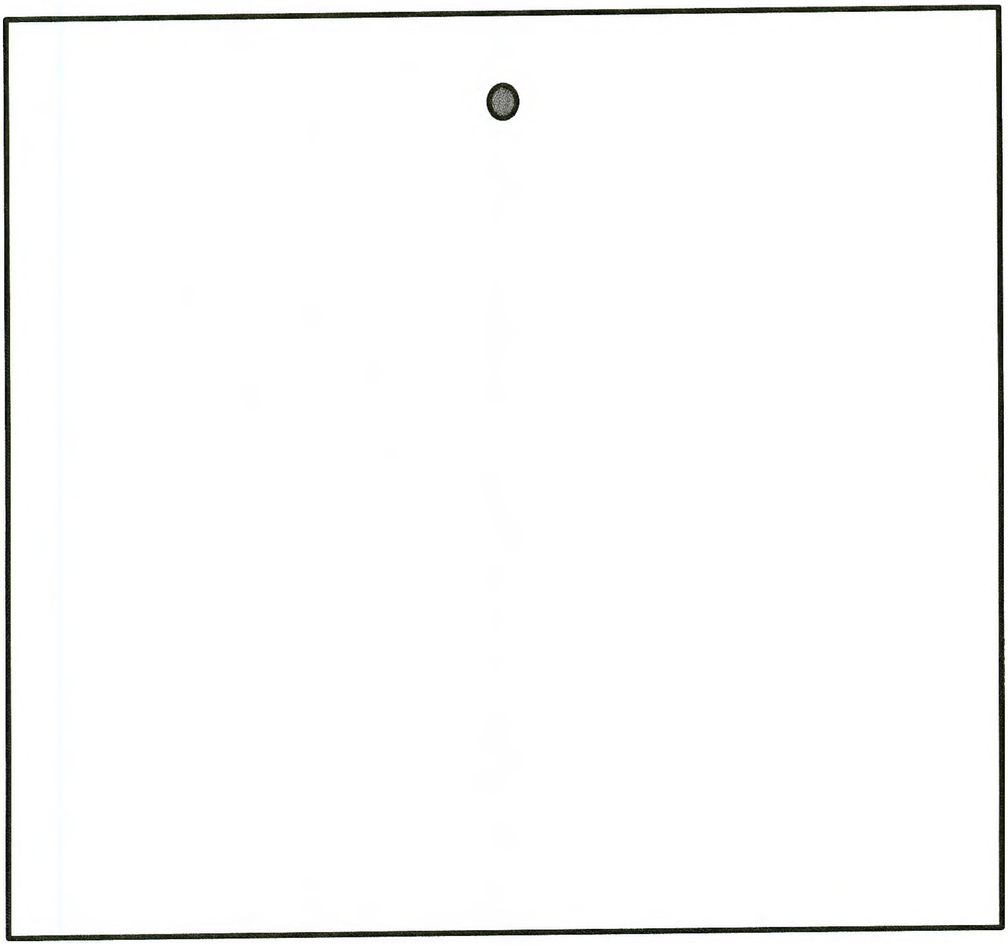
SESSION 2

Thabo and Jessica are blowing bubbles! Find 4 bubble circles of the same size.



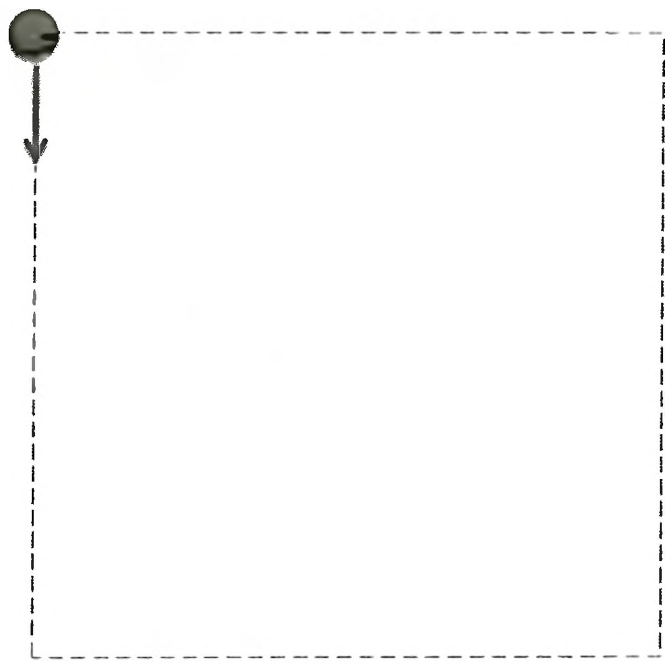
Draw circles within the boxes! Start at the dot and remember to go round.

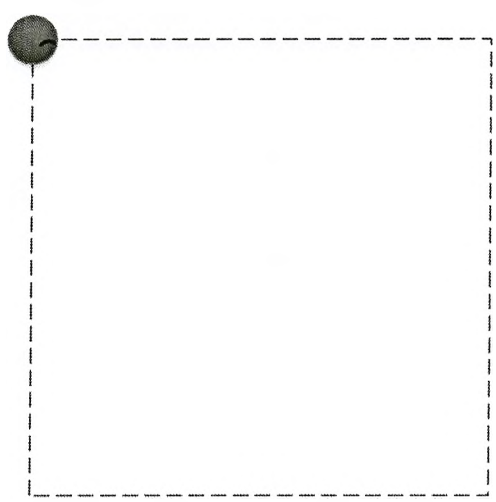




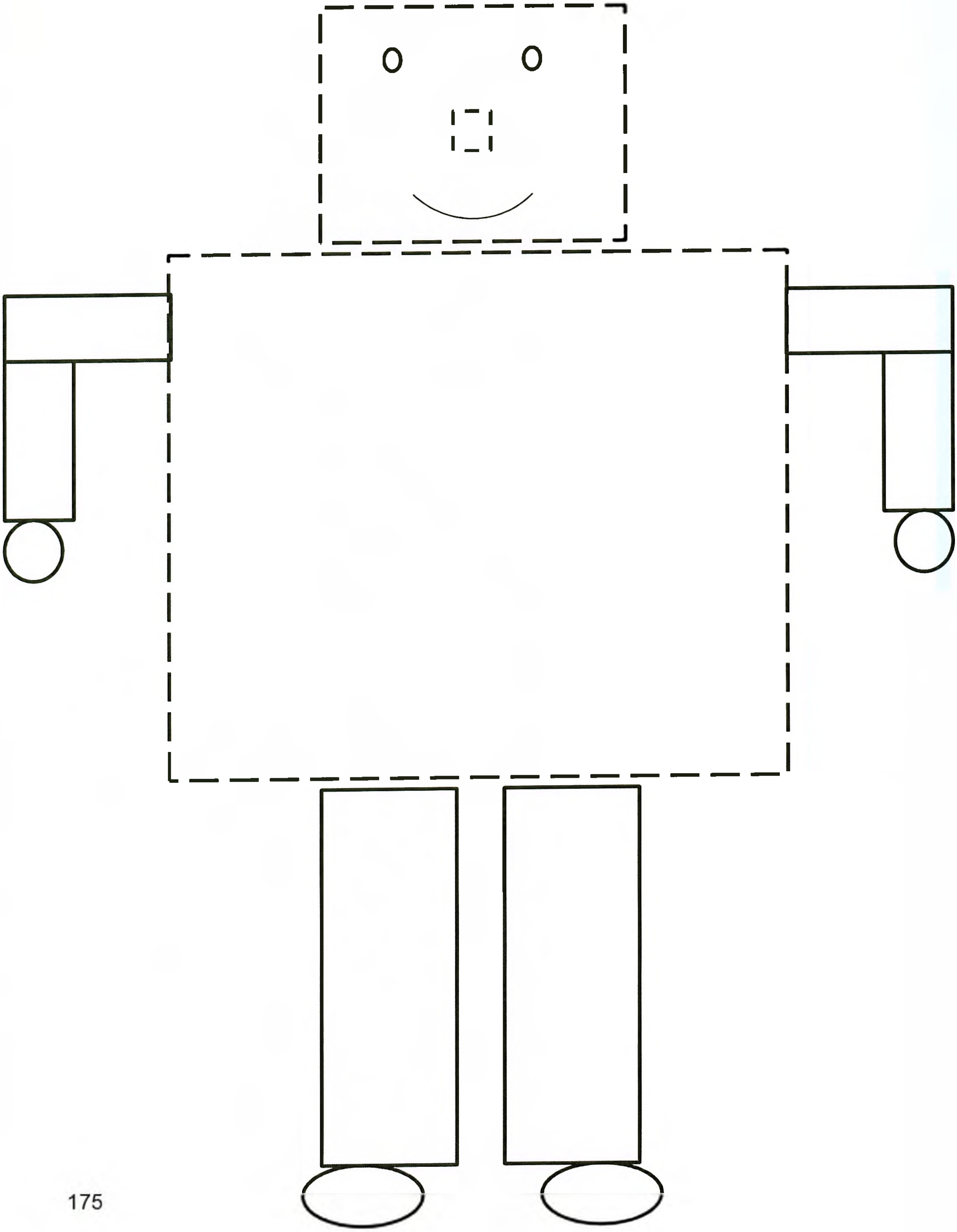
SESSION 3

Help Thabo trace the outline of the square. Start at the dot.

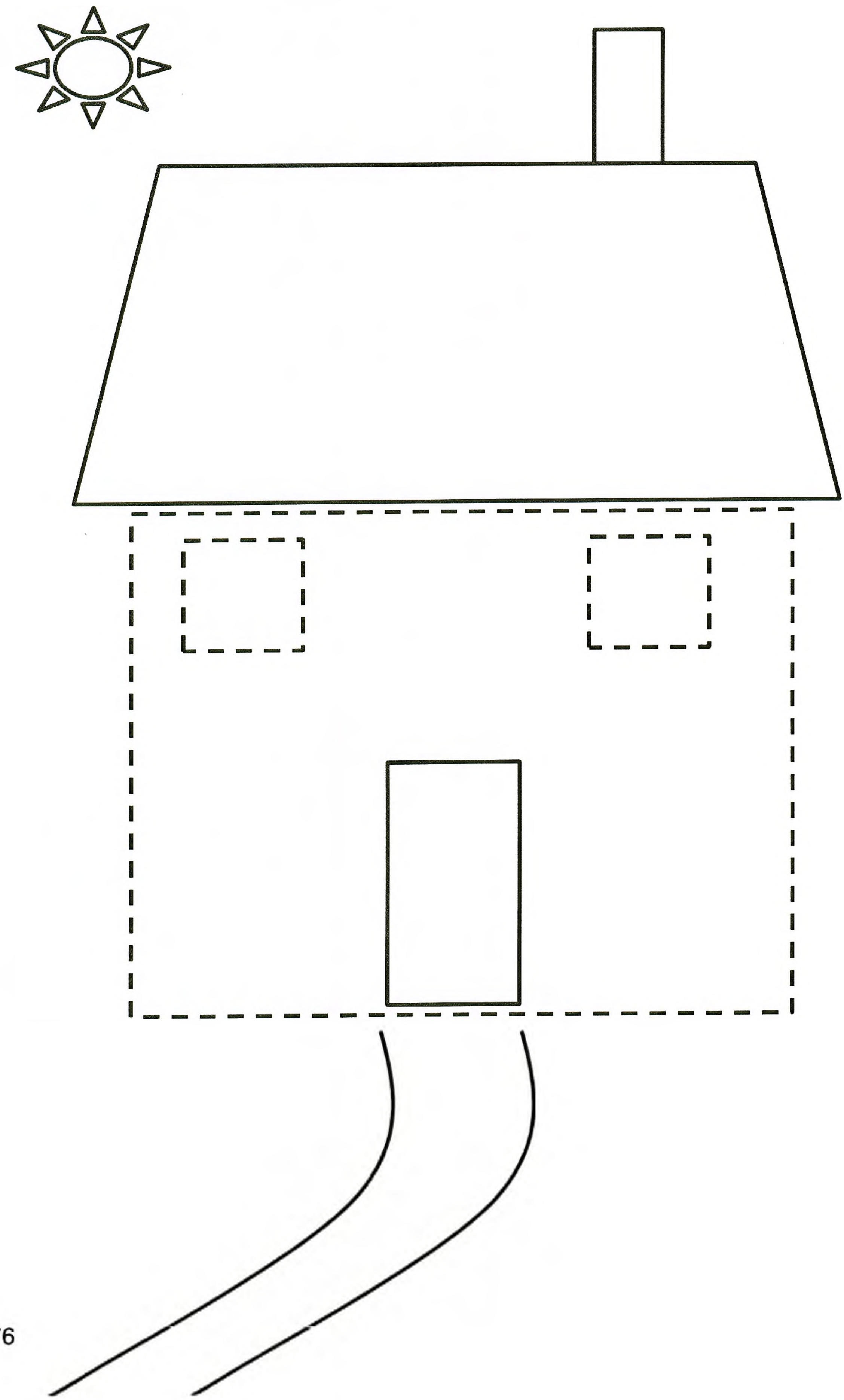




Trace the square pieces on the robot that Thabo has drawn. Stick strips of tissue on the robot when you are done!

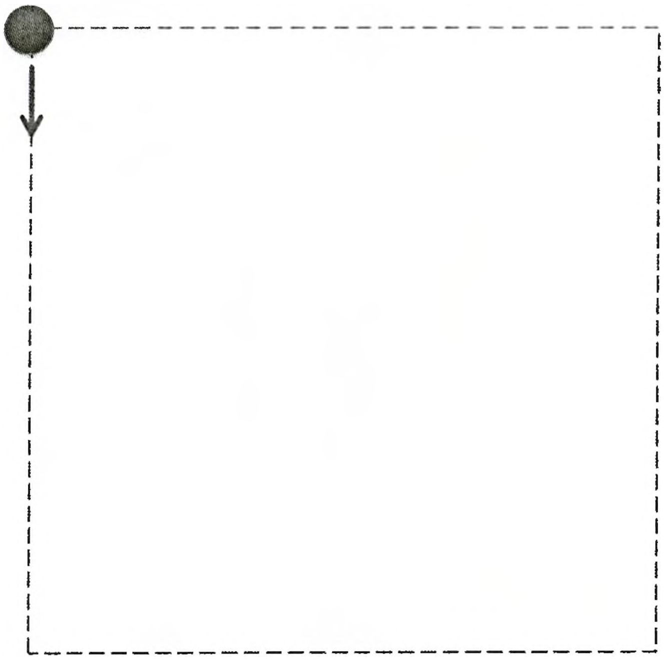


Trace the squares in Jessica's house. Stick strips or balls of tissue in the house or colour in when you are done!

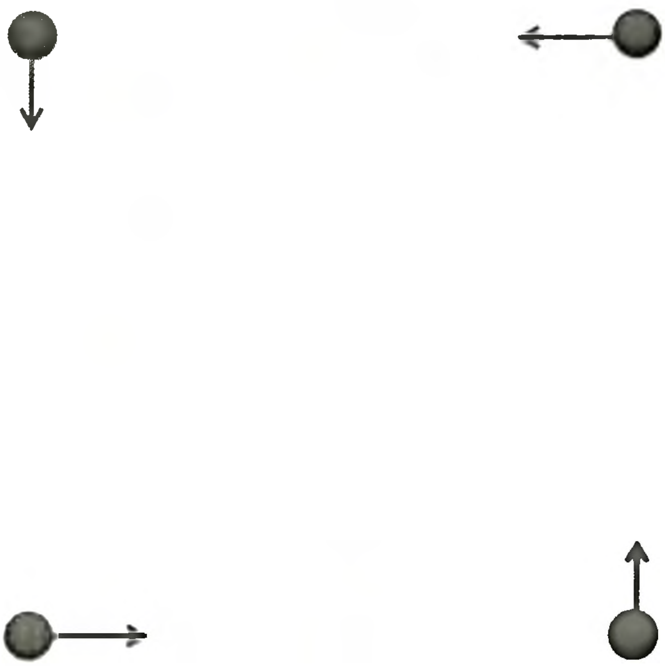


SESSION 4

Help Jessica trace the outline of the square. Start at the dot!



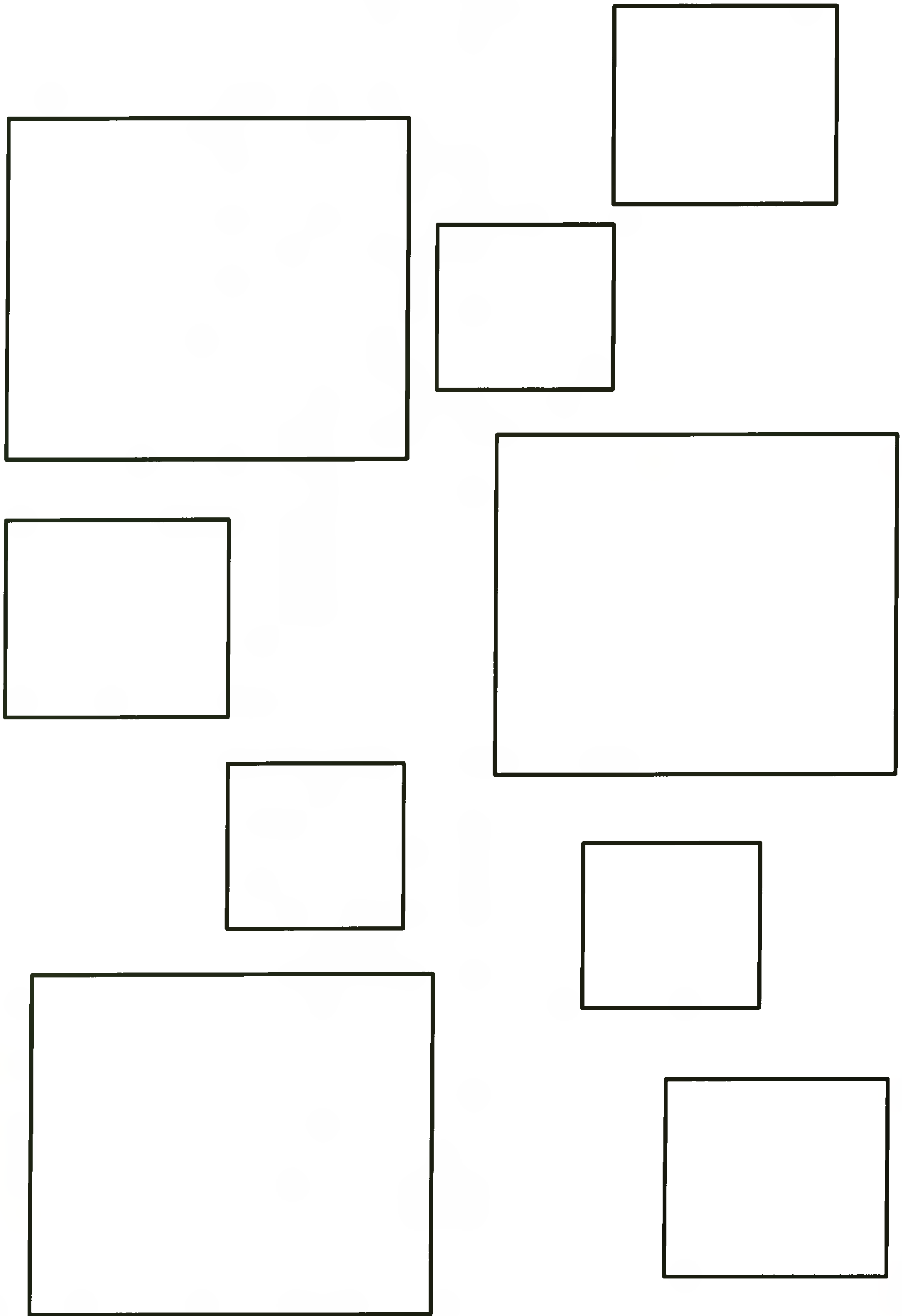
Join the dots to make a square



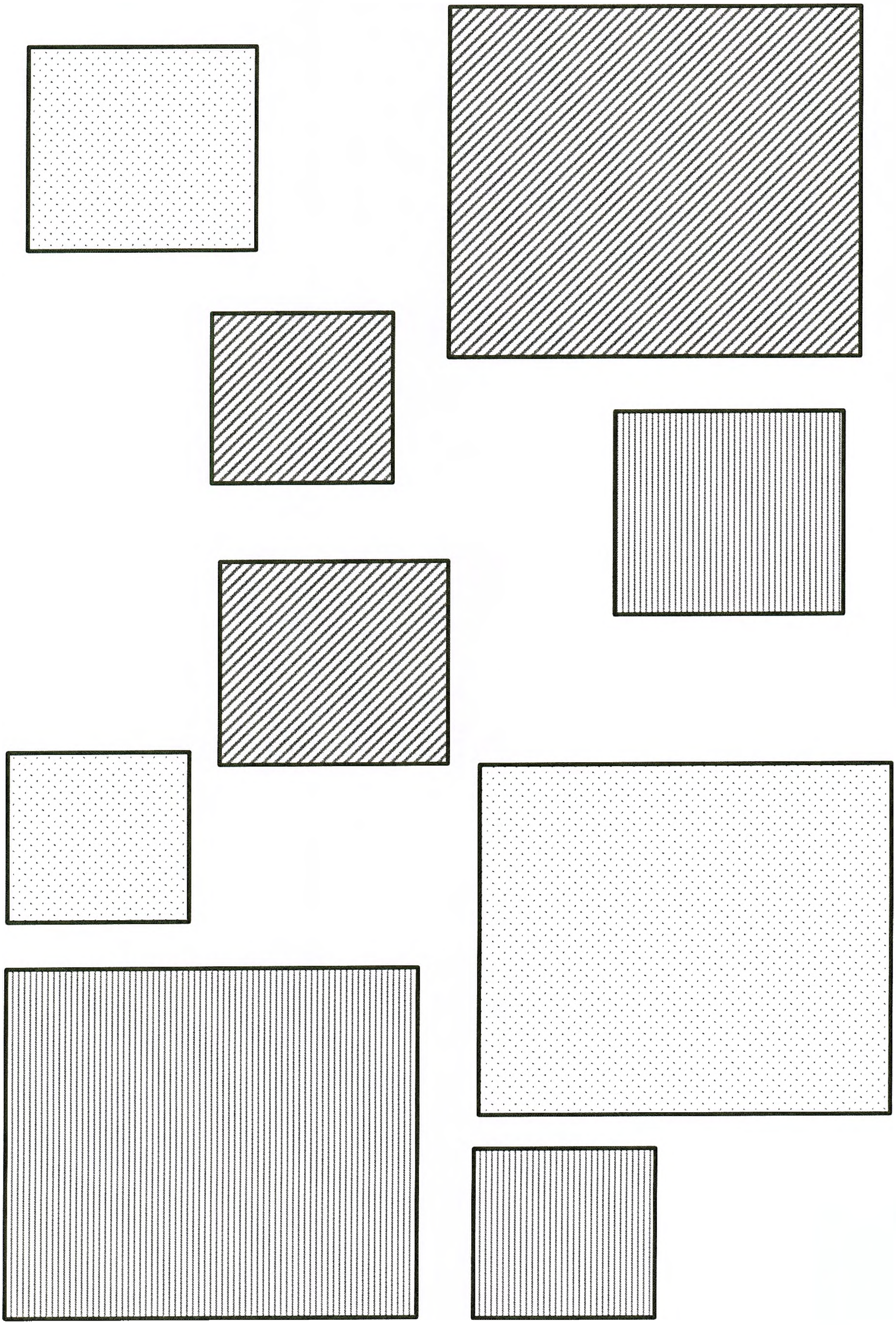
Join the dots to make a square

Now try and draw a square by yourself! Start at the dot.

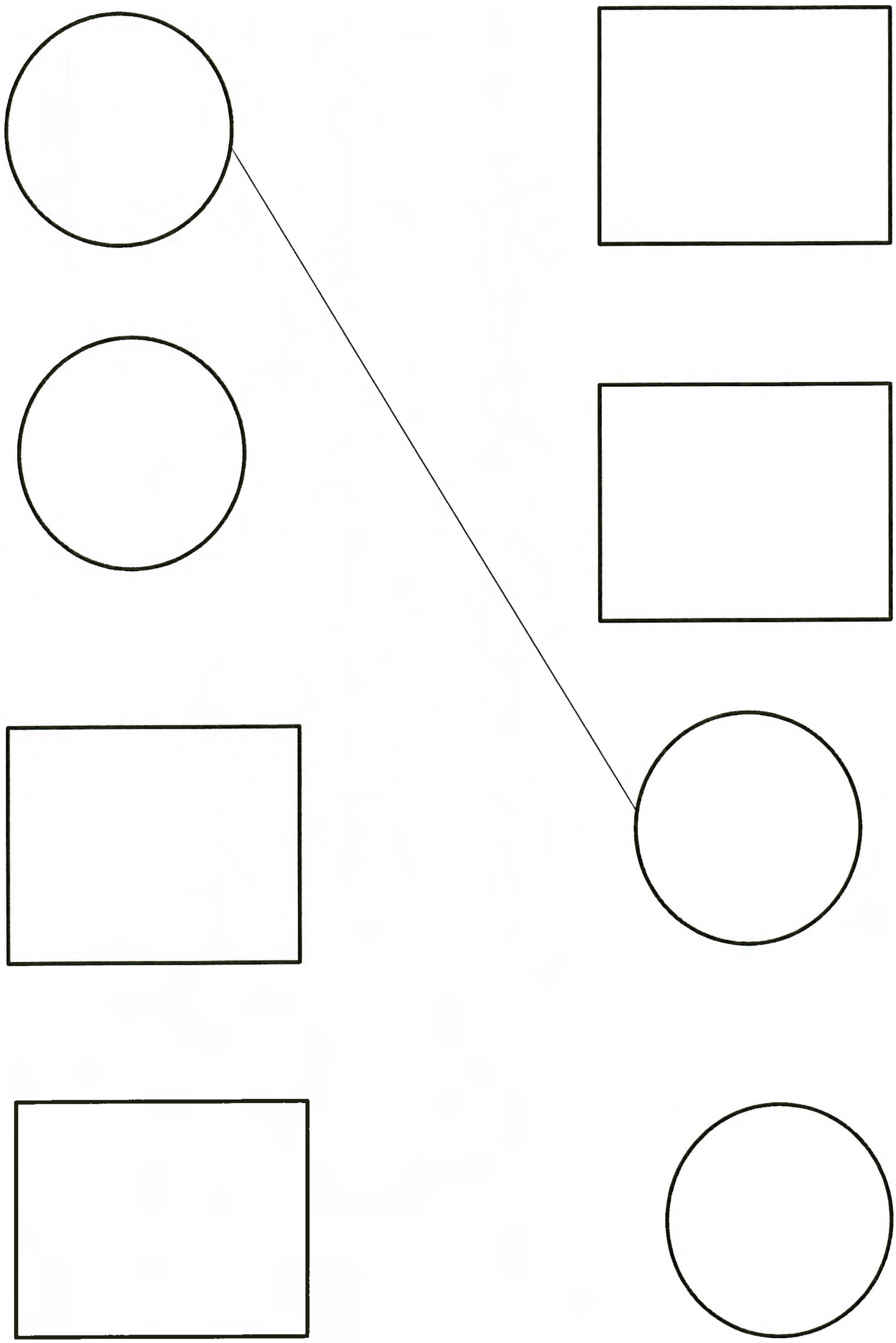
Find 3 squares of the same size. Use the same colour for the same size



Find 3 squares of the same size. Use the same colour for the same size

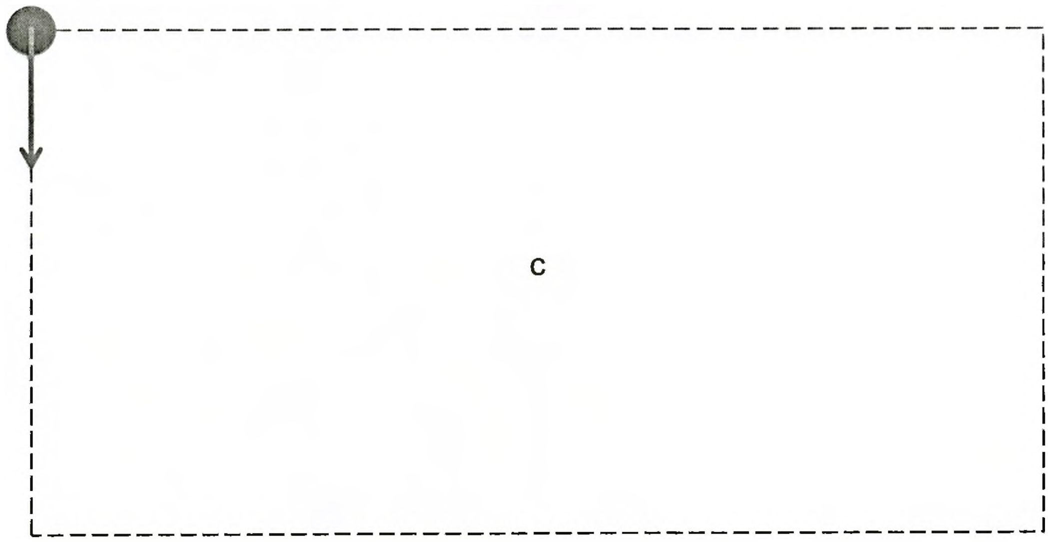


Now draw a line to match the same shape!

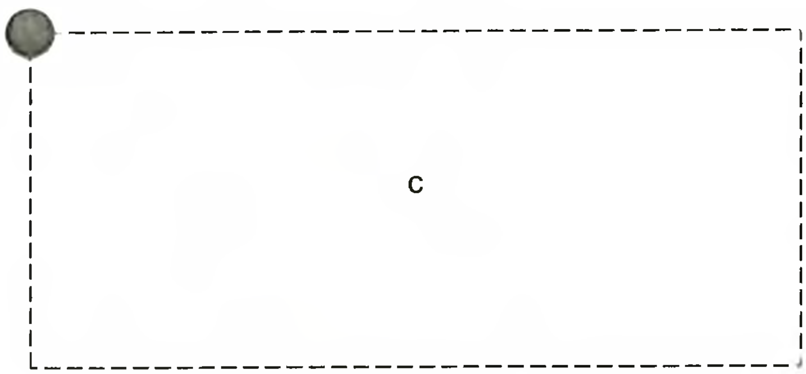


SESSION 5

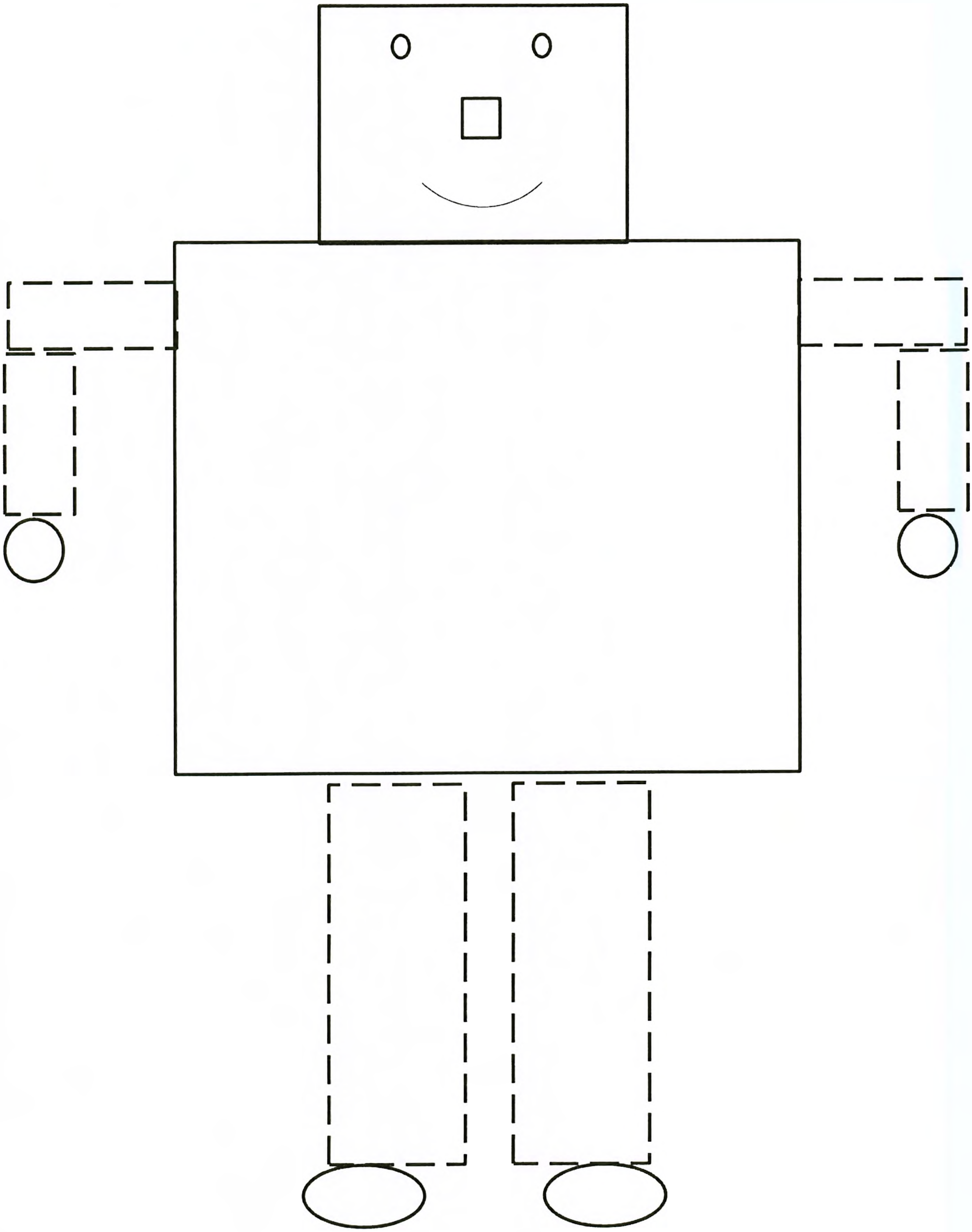
Help Thabo trace the outline of the rectangle. Start at the dot!



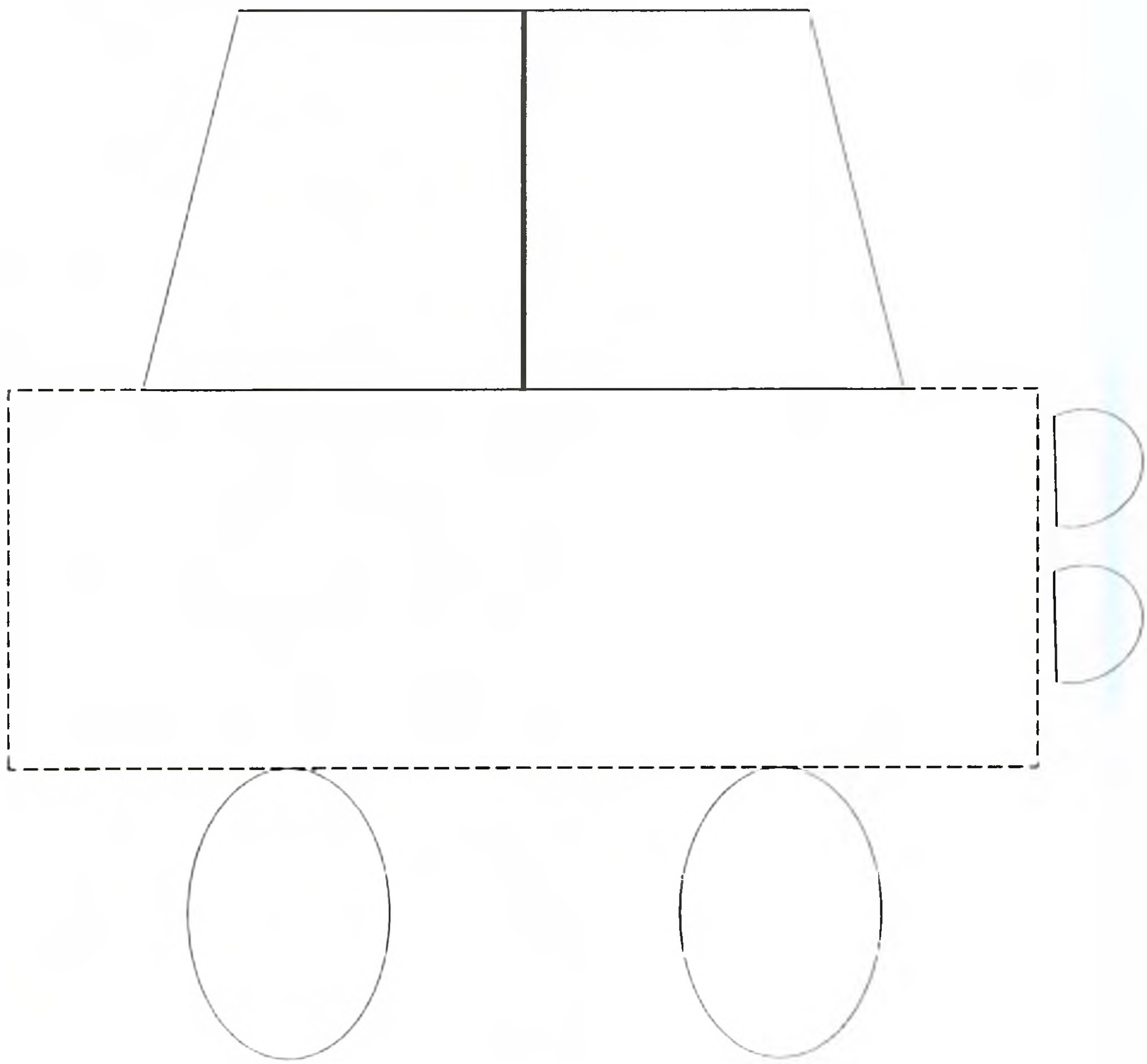
Now try again!



Now help Jessica trace the rectangles in the picture! Hint: the rectangles have dotted lines.

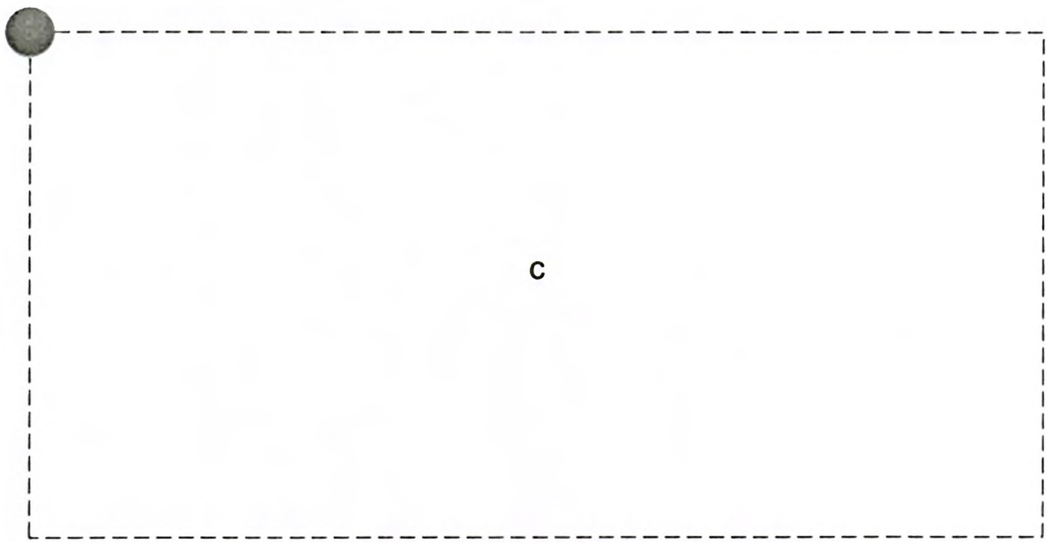


Try and find the rectangles in Thabo's car picture.



SESSION 6

Help Jessica trace the rectangle. Start at the dot.

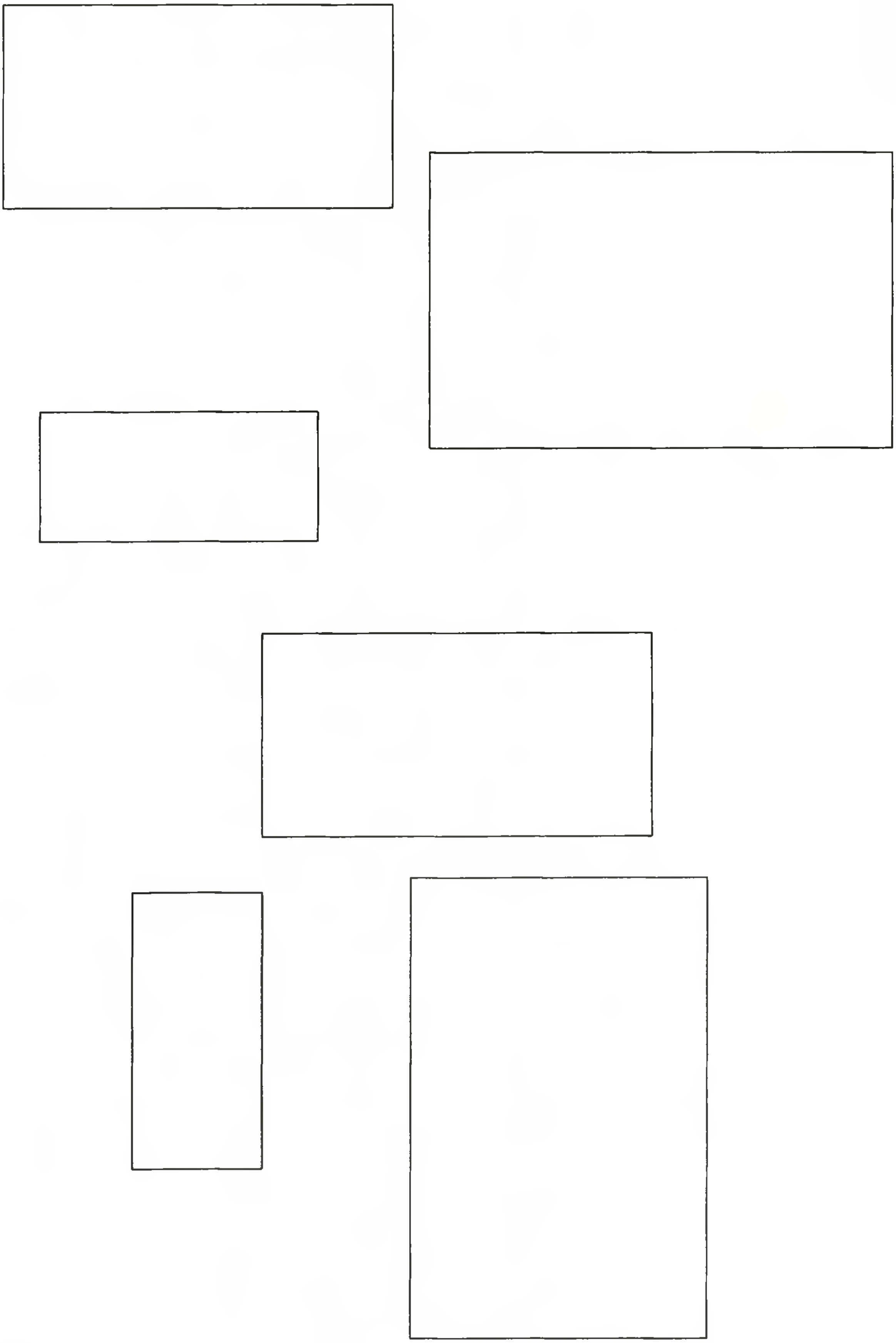


Join the dots to make a rectangle.

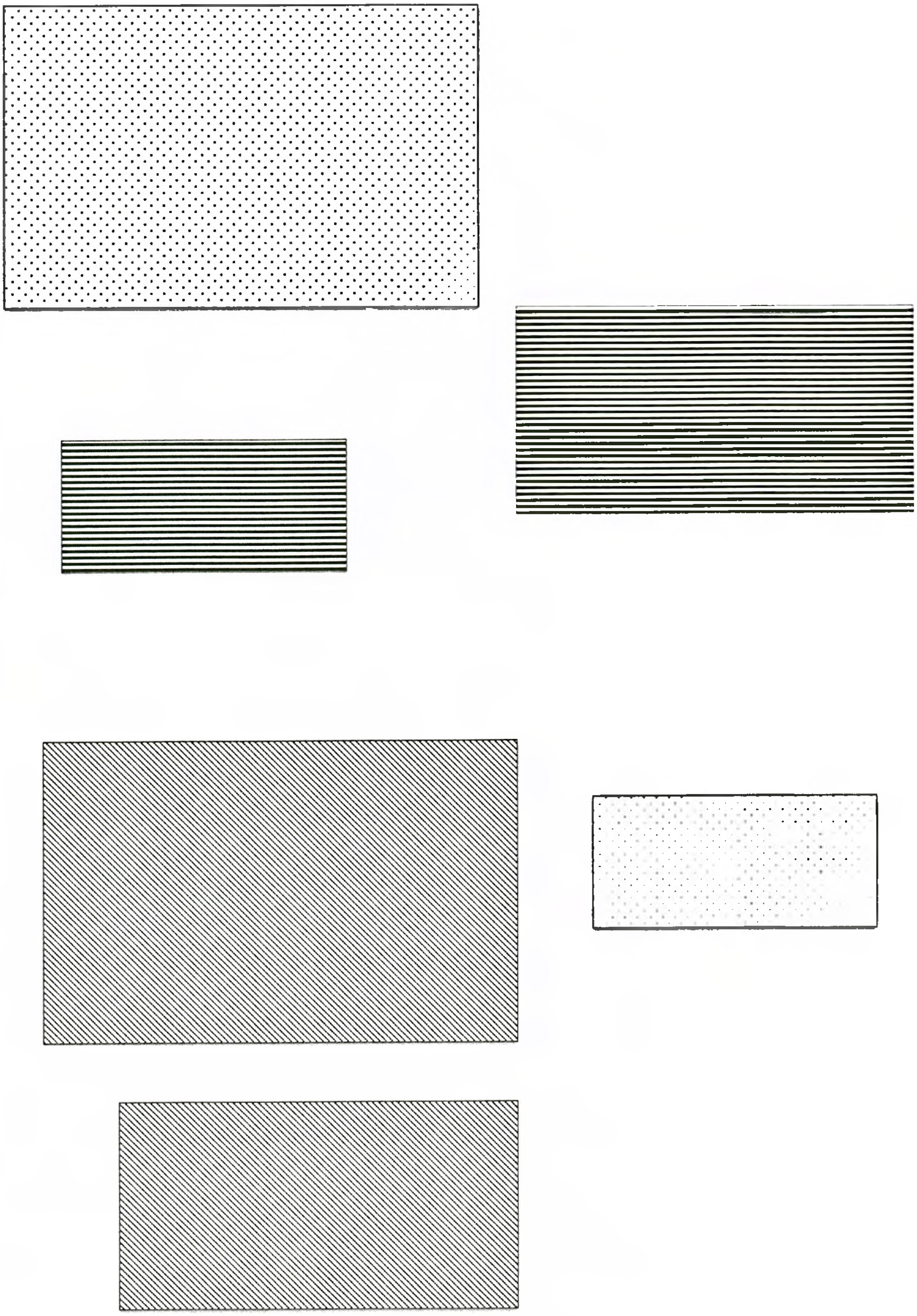
Join the dots to make a rectangle!

Now try and draw a rectangle by yourself. Start at the dot!

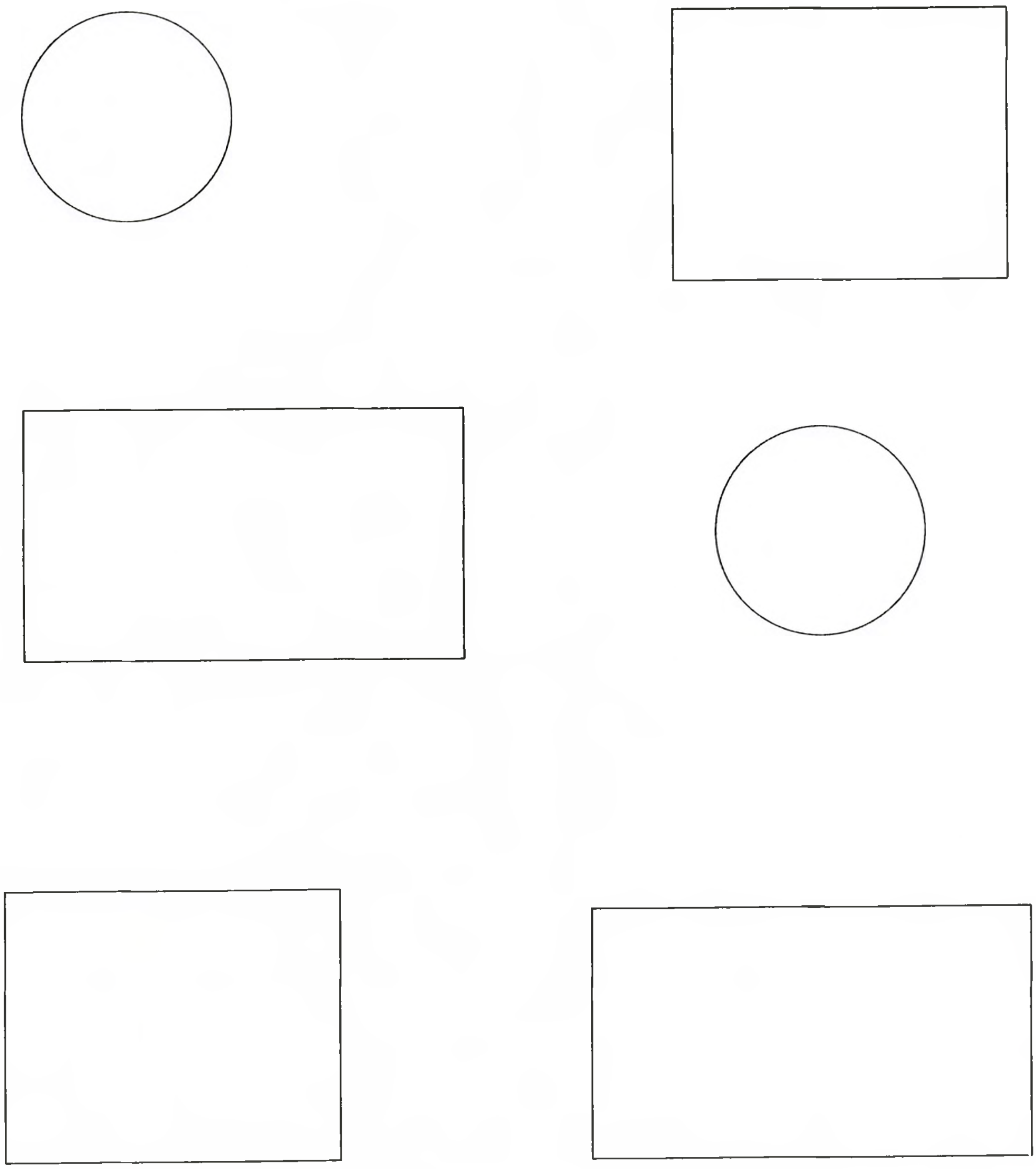
Now try and find rectangles of the same size!



Find the rectangles of the same size!

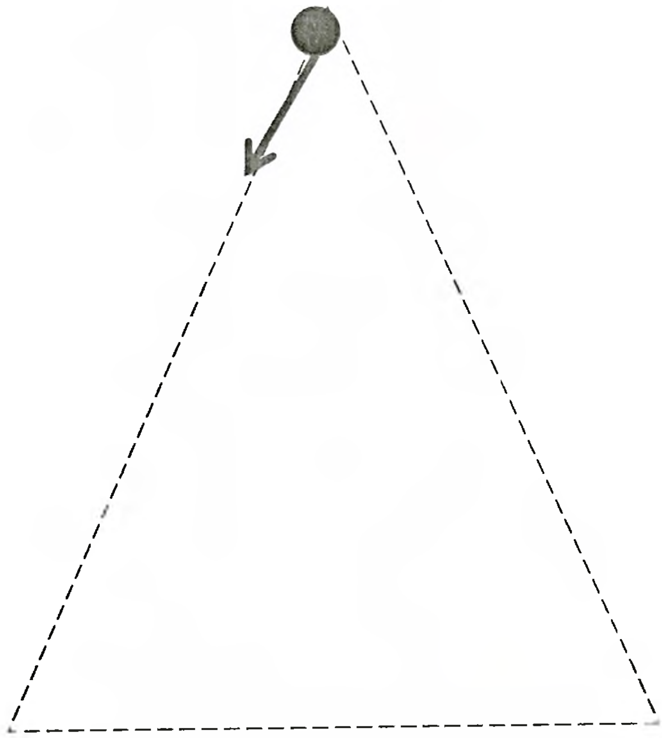


Now draw a line to match the same shape!

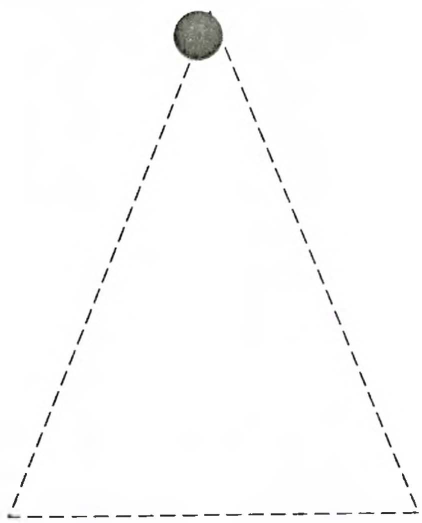


SESSION 7

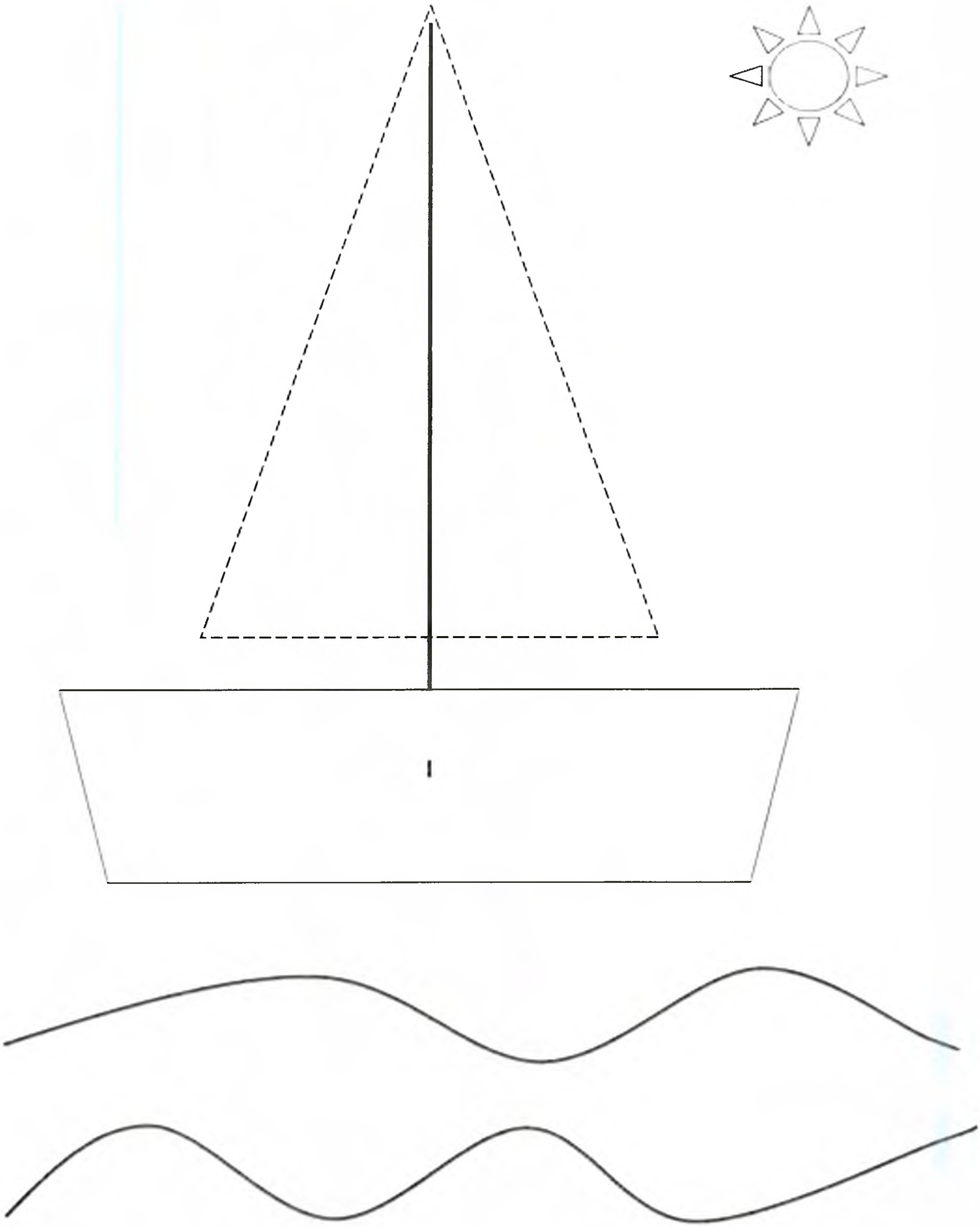
Help Thabo trace the outline of the triangle. Start at the dot!



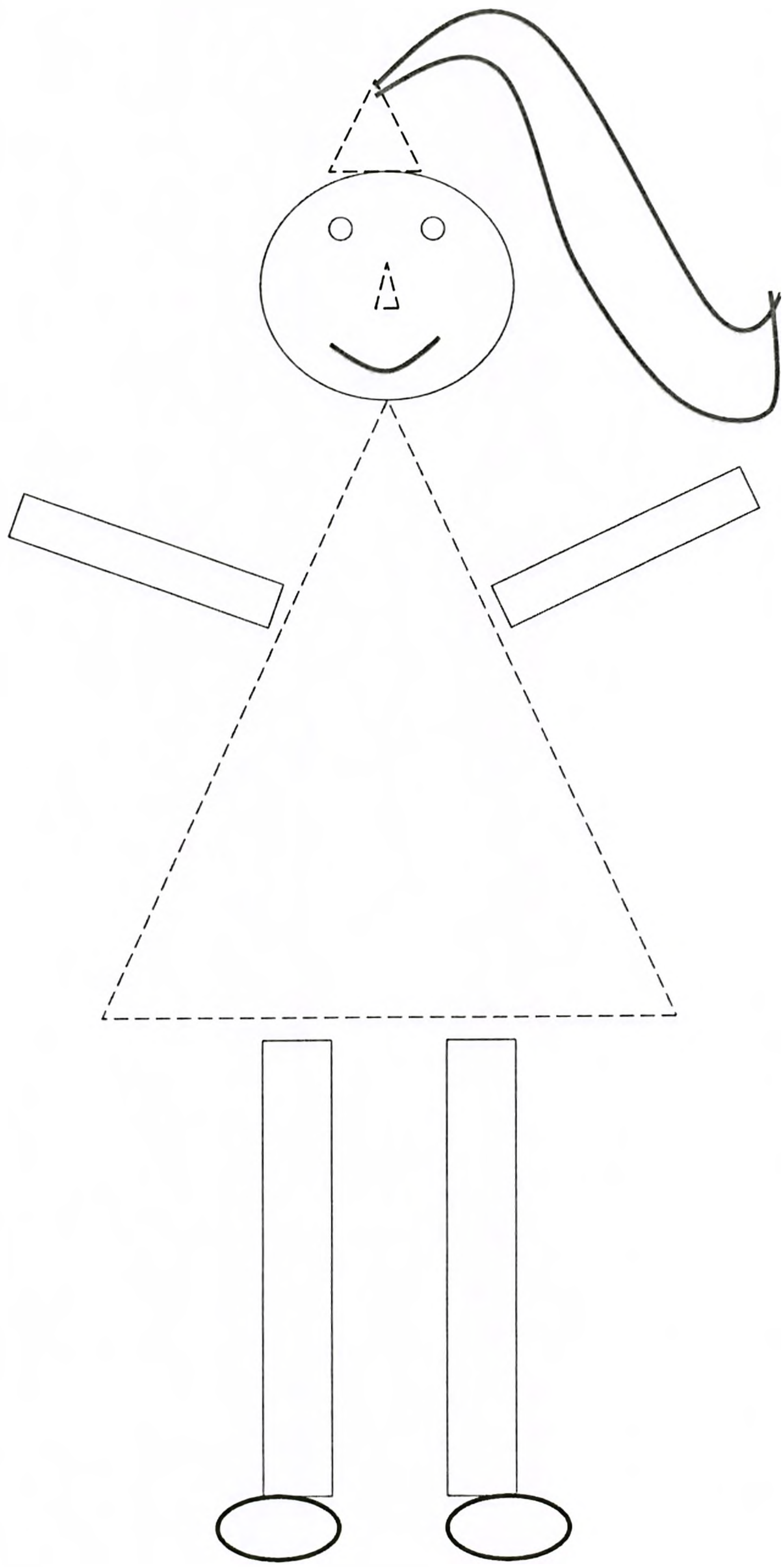
Try again!



Now find Thabo's triangle and trace it!

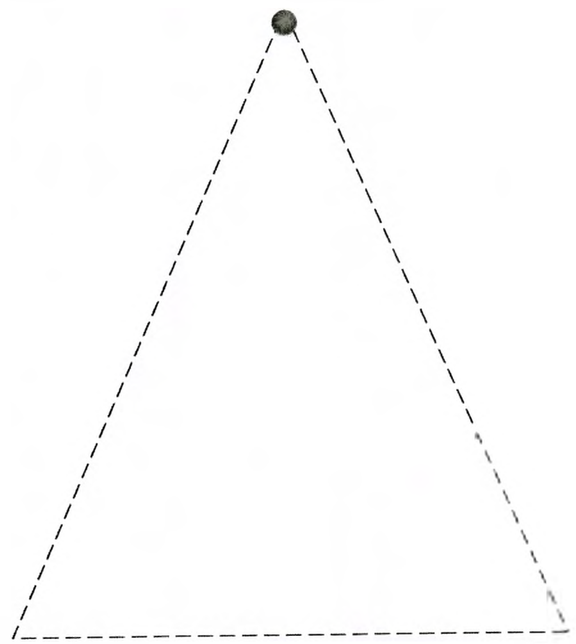


Try and find Jessica's triangle and trace it!

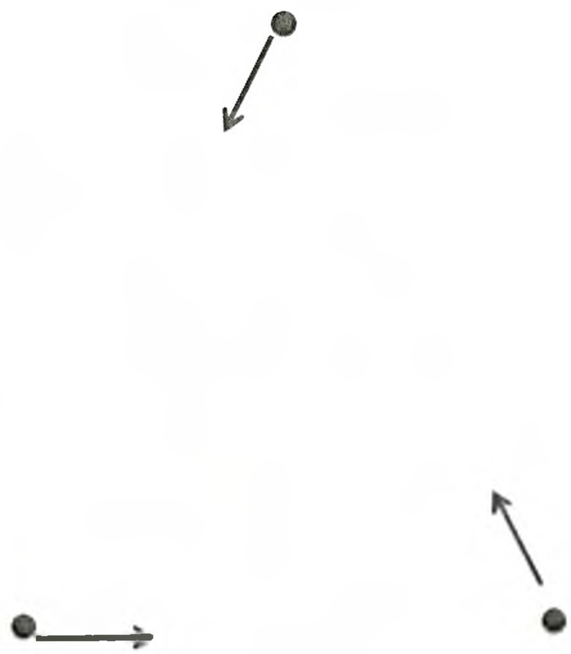


SESSION 8

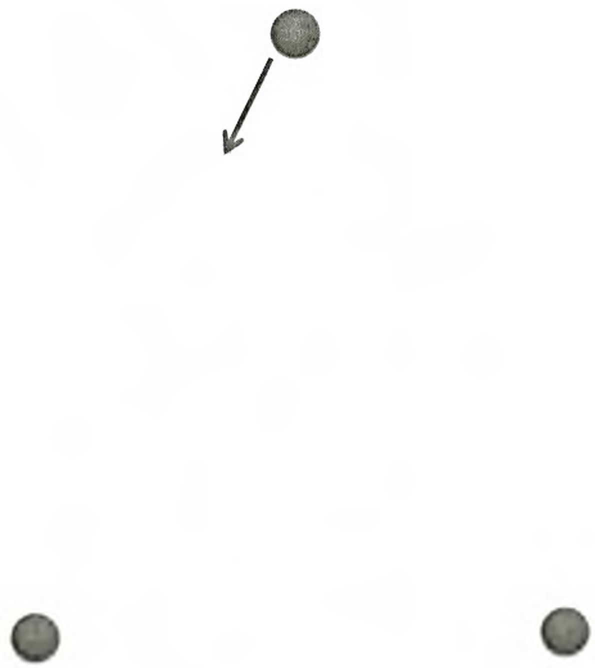
Trace Thabo's triangle. Start at the dot.



Join the dots to make a triangle

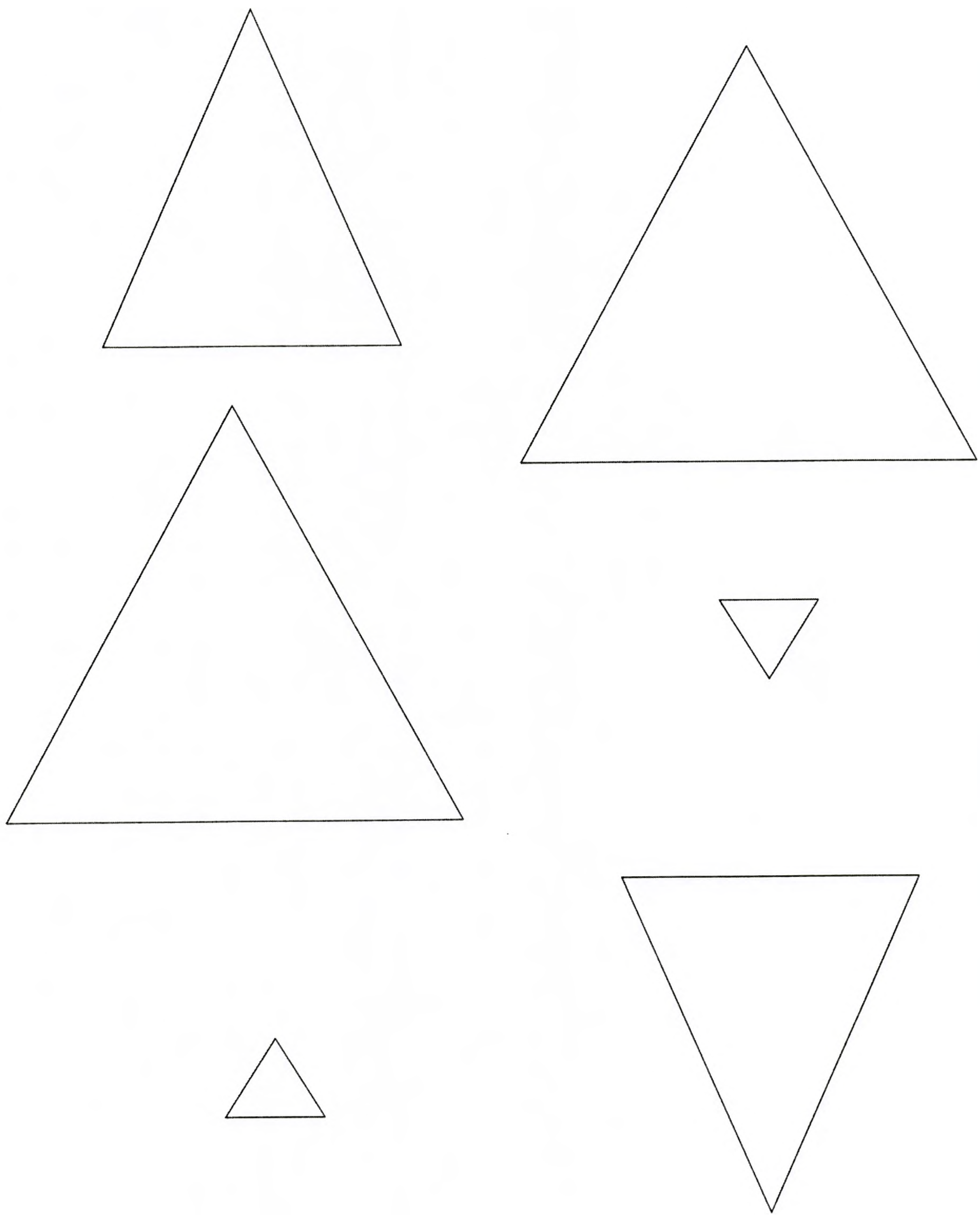


Join the dots again to make a triangle!

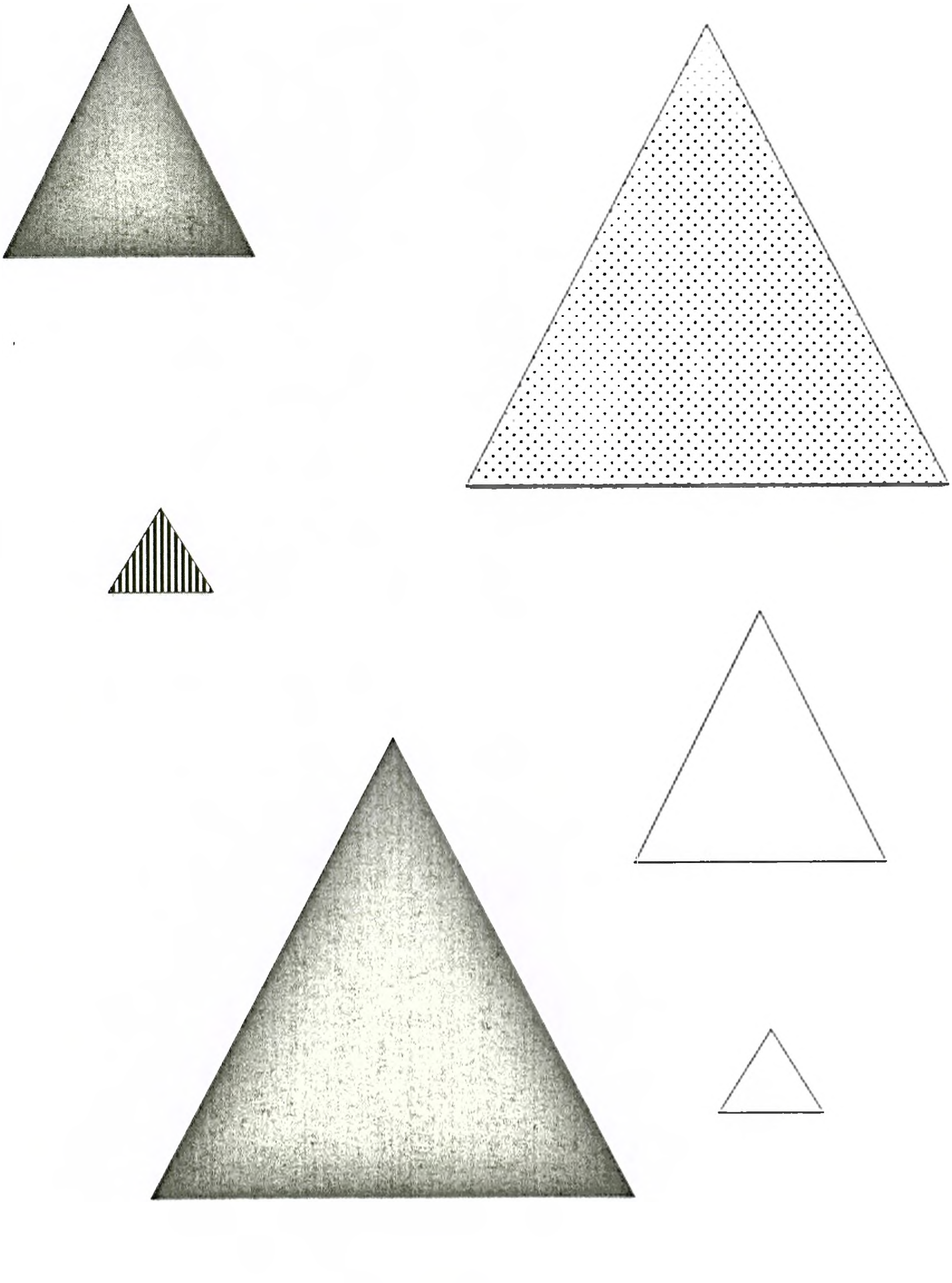


Now try and draw a triangle by yourself. Start at the dot!

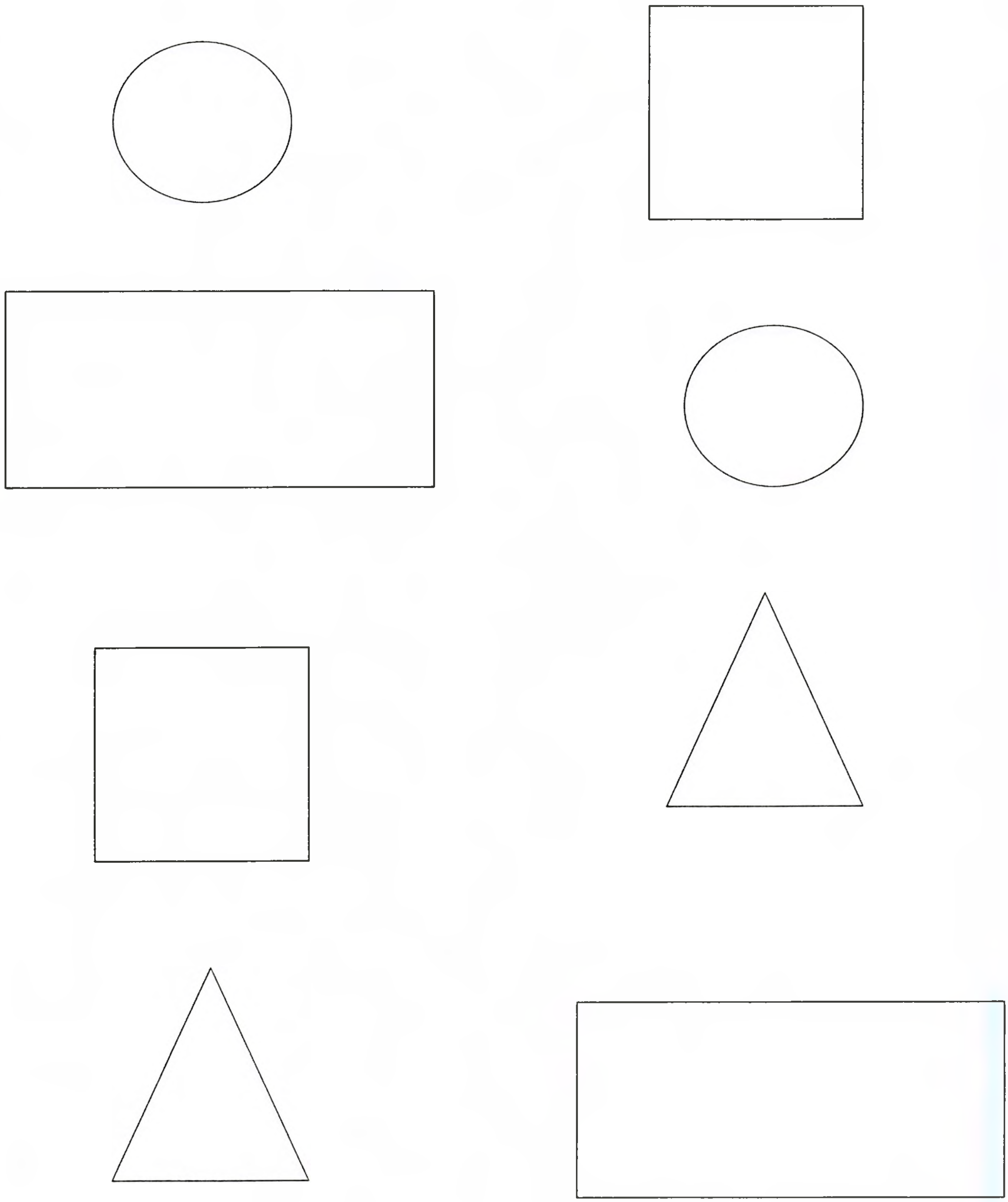
Try and find triangles of the same size!



Now see if you can find triangles of the same size!



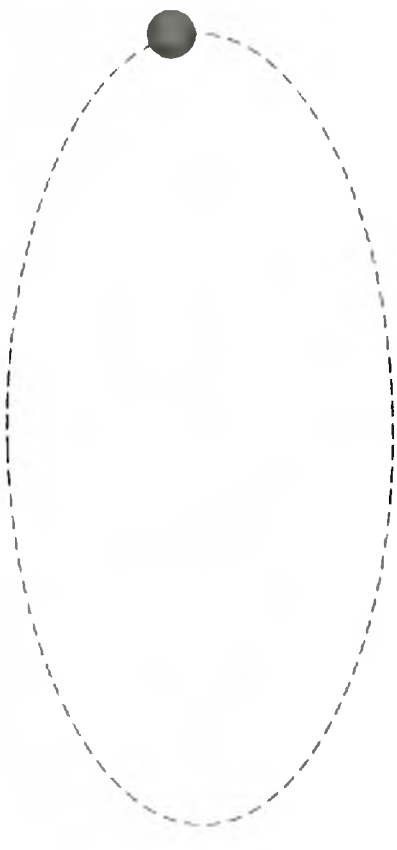
Draw a line to match the same shape!



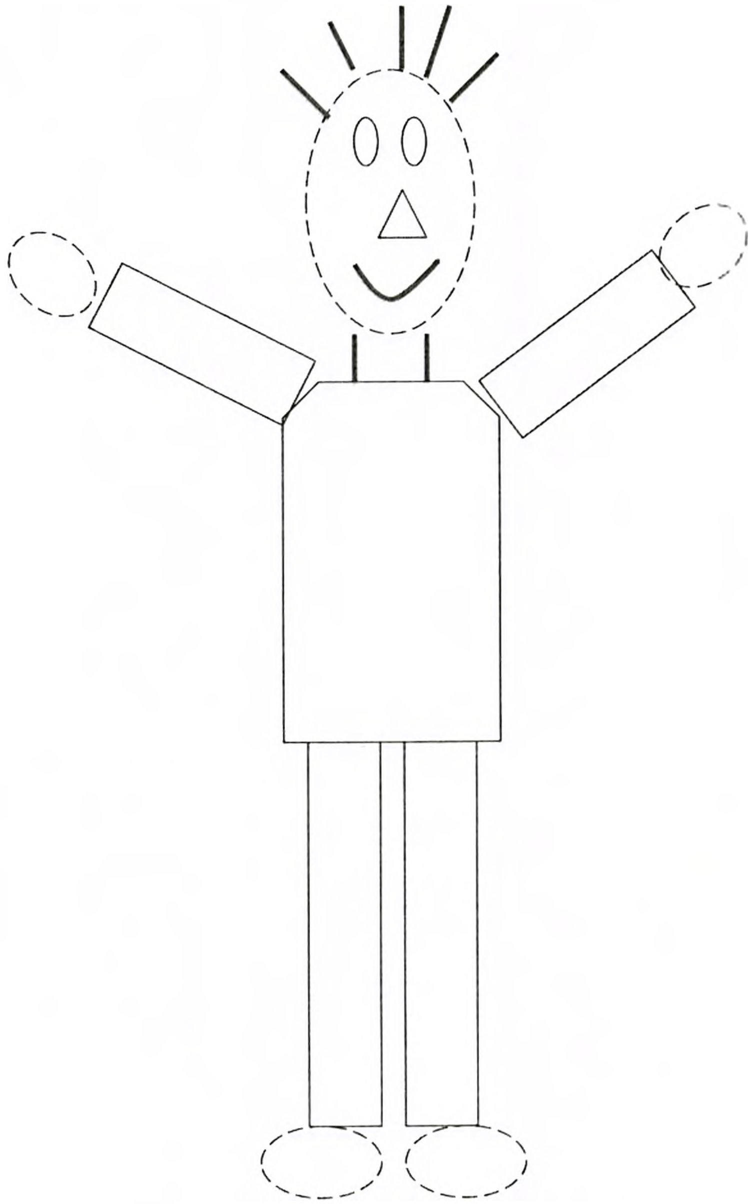
SESSION 9

Trace Jessica's oval. Start at the dot!

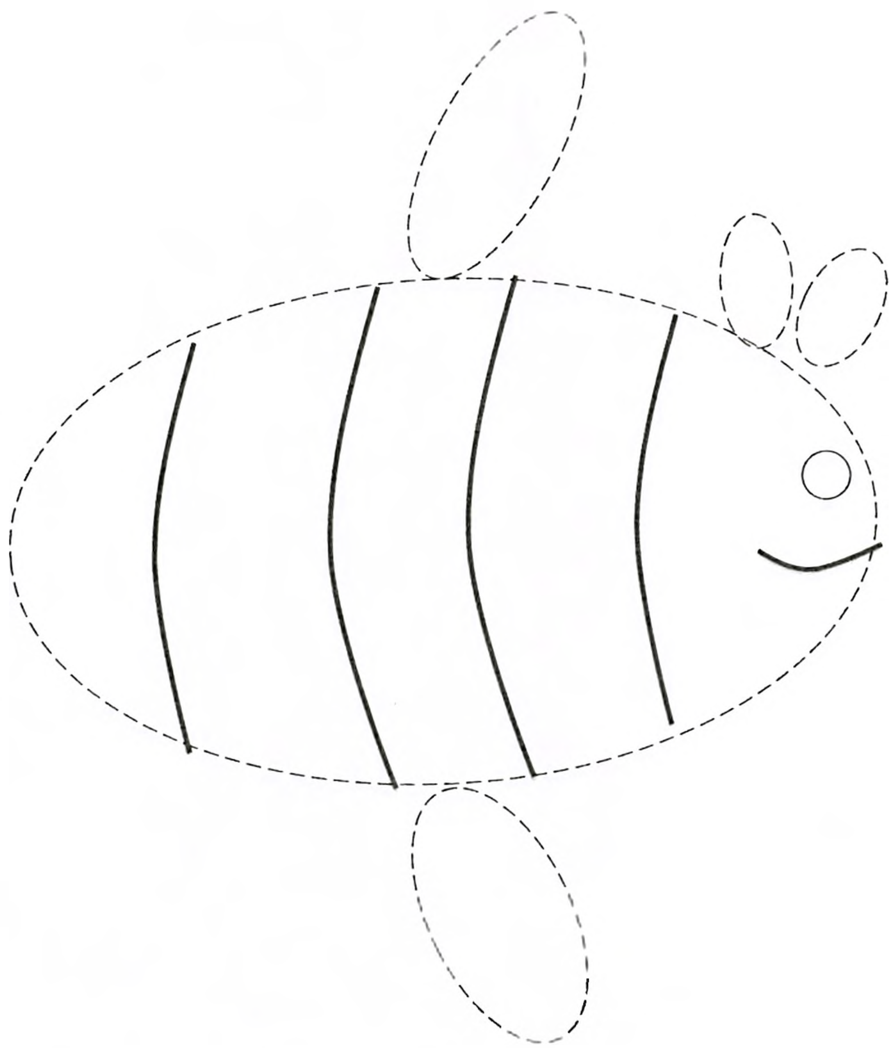
Try again!



Find Thabo's oval and trace it!

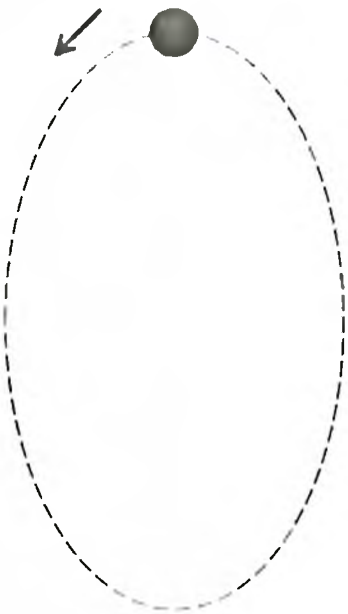


Try and find the oval to trace on Jessica's picture!



SESSION 10

Trace the outline of the oval. Start at the dot!

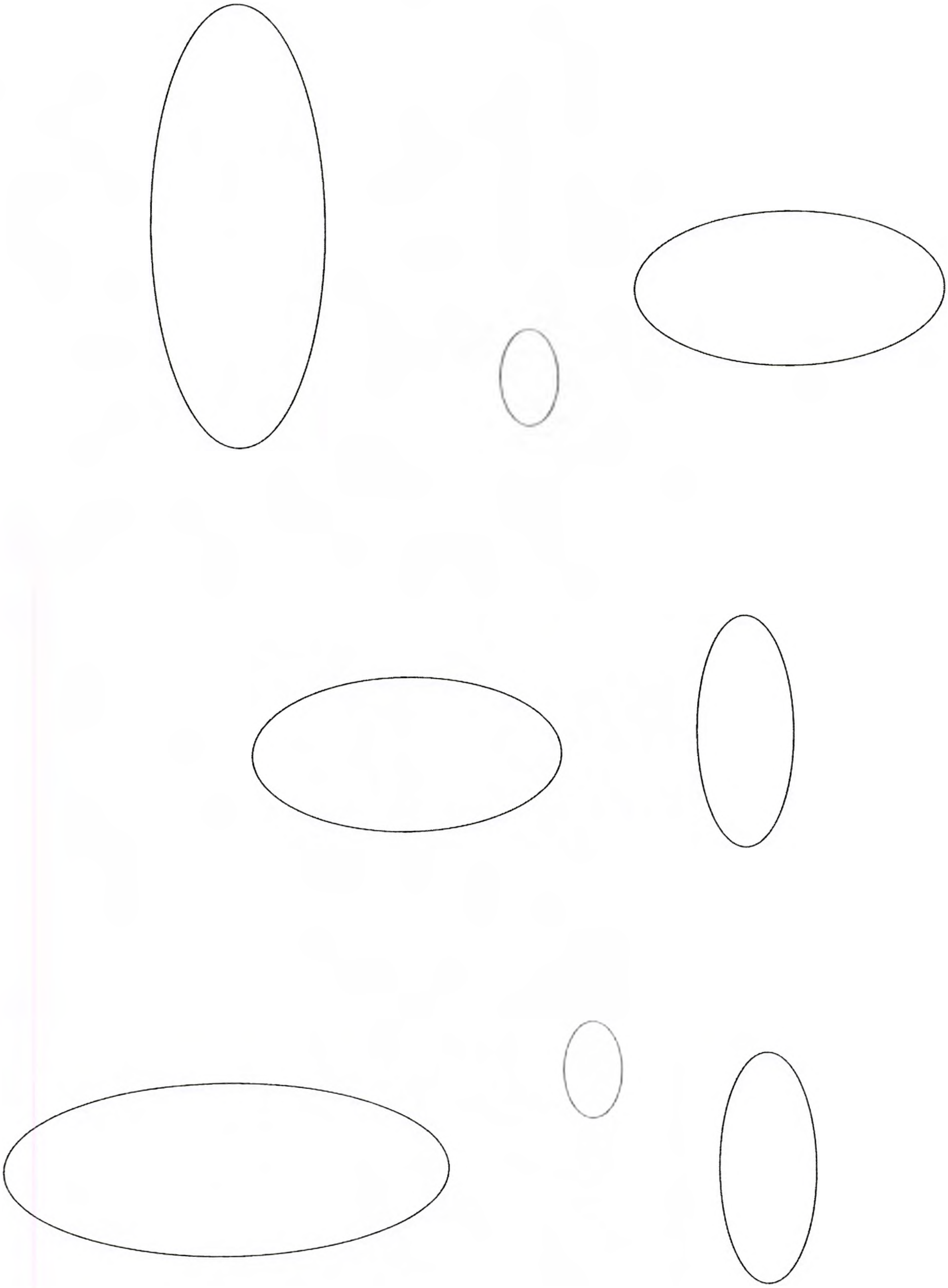


Join the dots to make an oval!

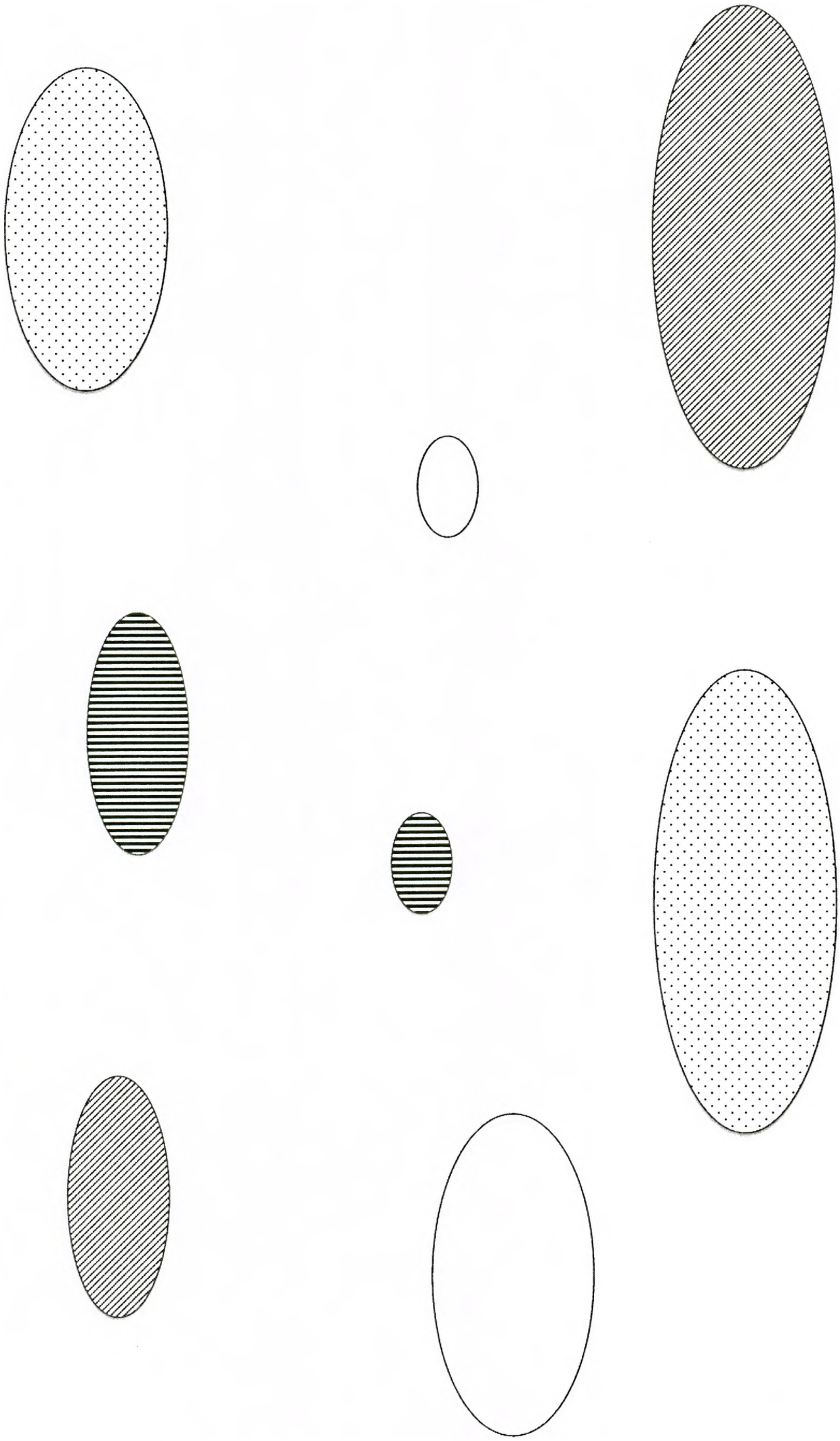
Join the dots again to make an oval!

Now try and draw an oval by yourself. Start at the dot!

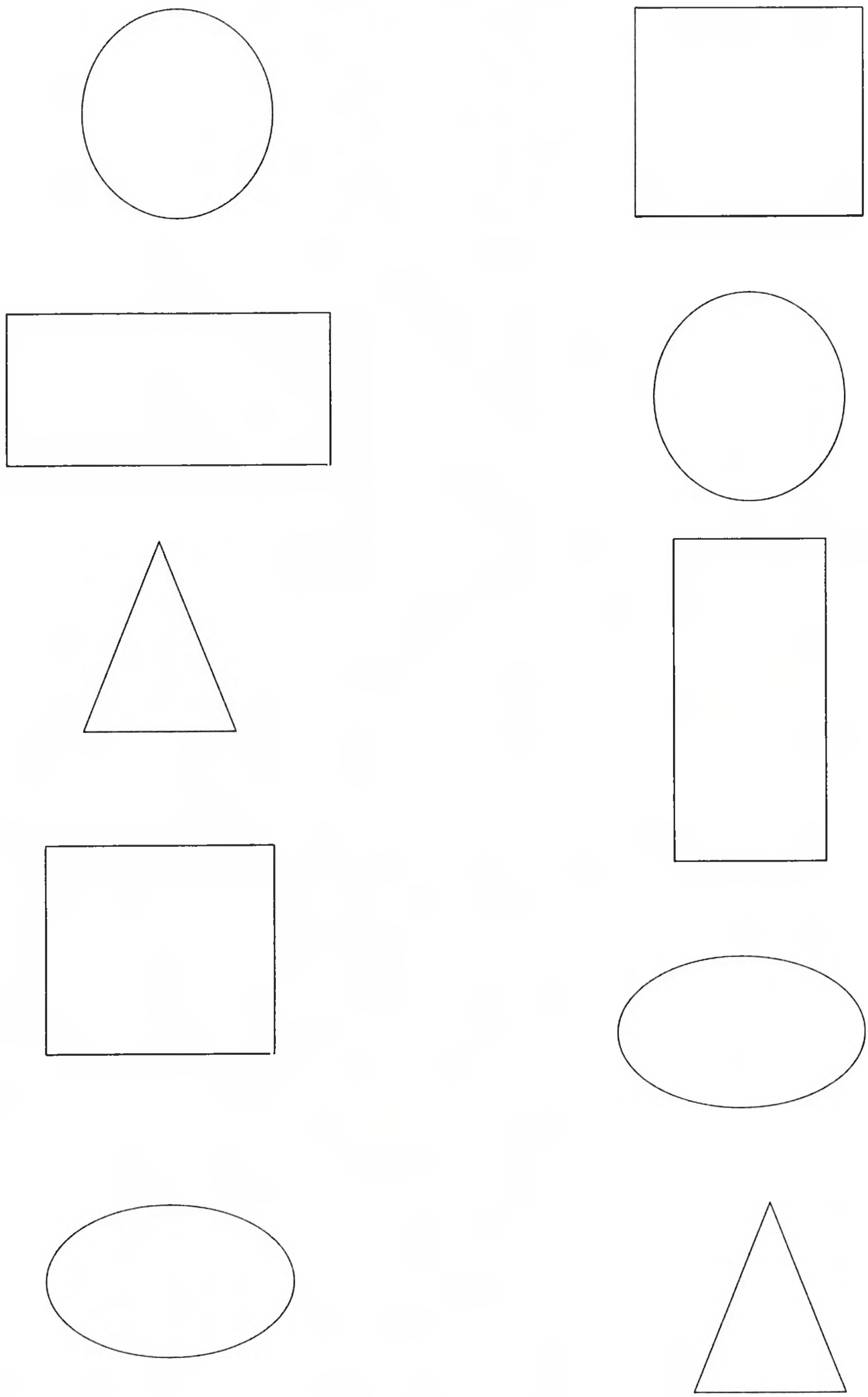
Try and find an oval of the same size!



Now try and find an oval of the same size.



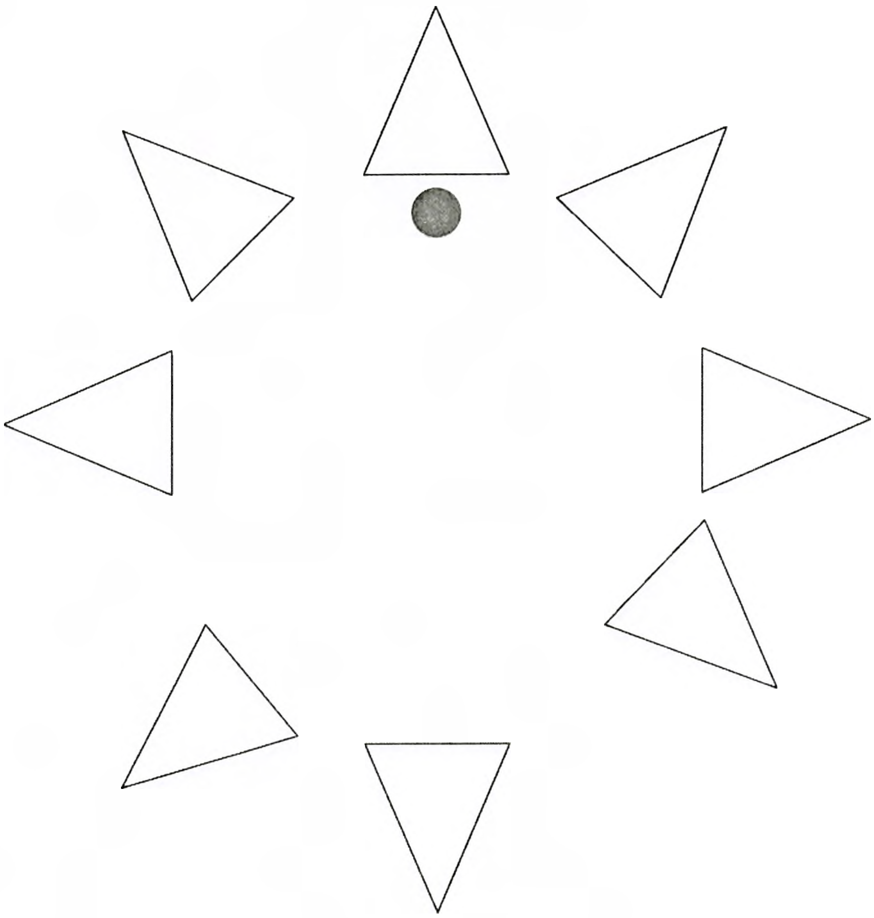
Try and match the same shape!



SESSION 11

Can you draw a circle? Start at the dot!

Now try and draw the circle to complete the sun. Hint: start at the dot and go round!

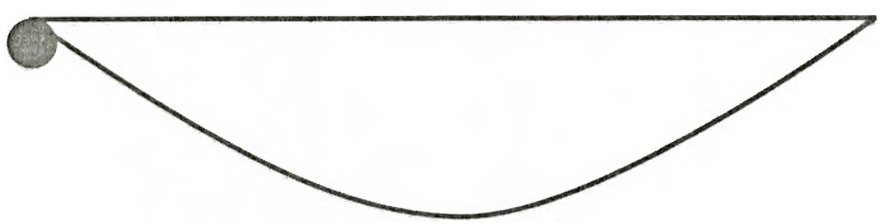


Can you draw a square? Start at the dot.

Now try and draw the square to complete the piece of bread that Thabo is about to eat!

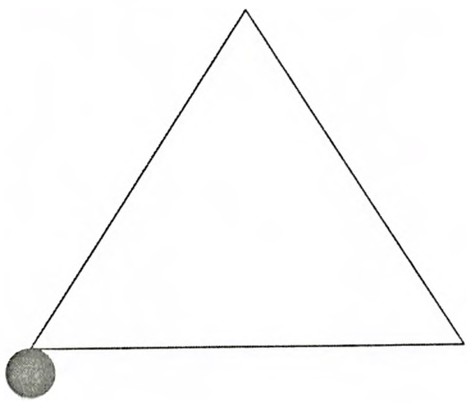
Can you draw a rectangle? Start at the dot!

Now try and draw the rectangle to complete the envelope for Jessica!



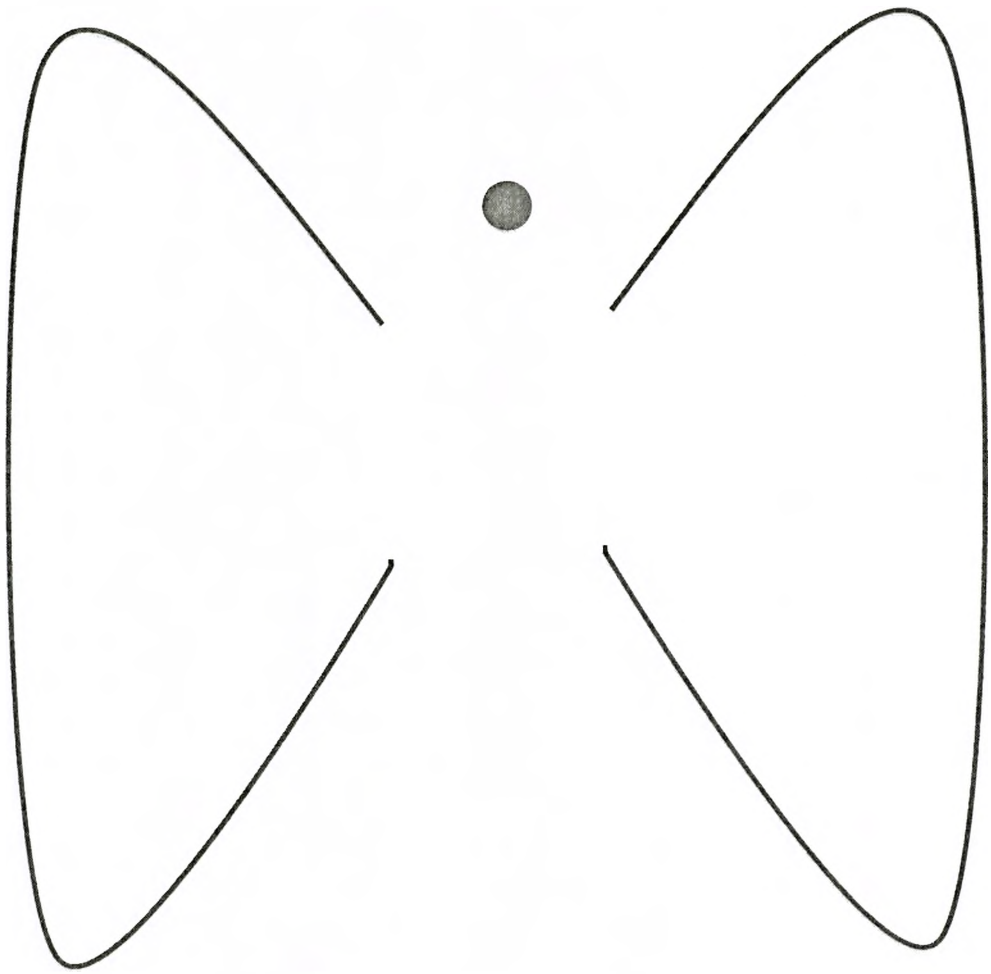
Can you draw a triangle? Start at the dot!

Now try and draw a triangle to complete the kite that Thabo made!



Can you draw an oval? Start at the dot!

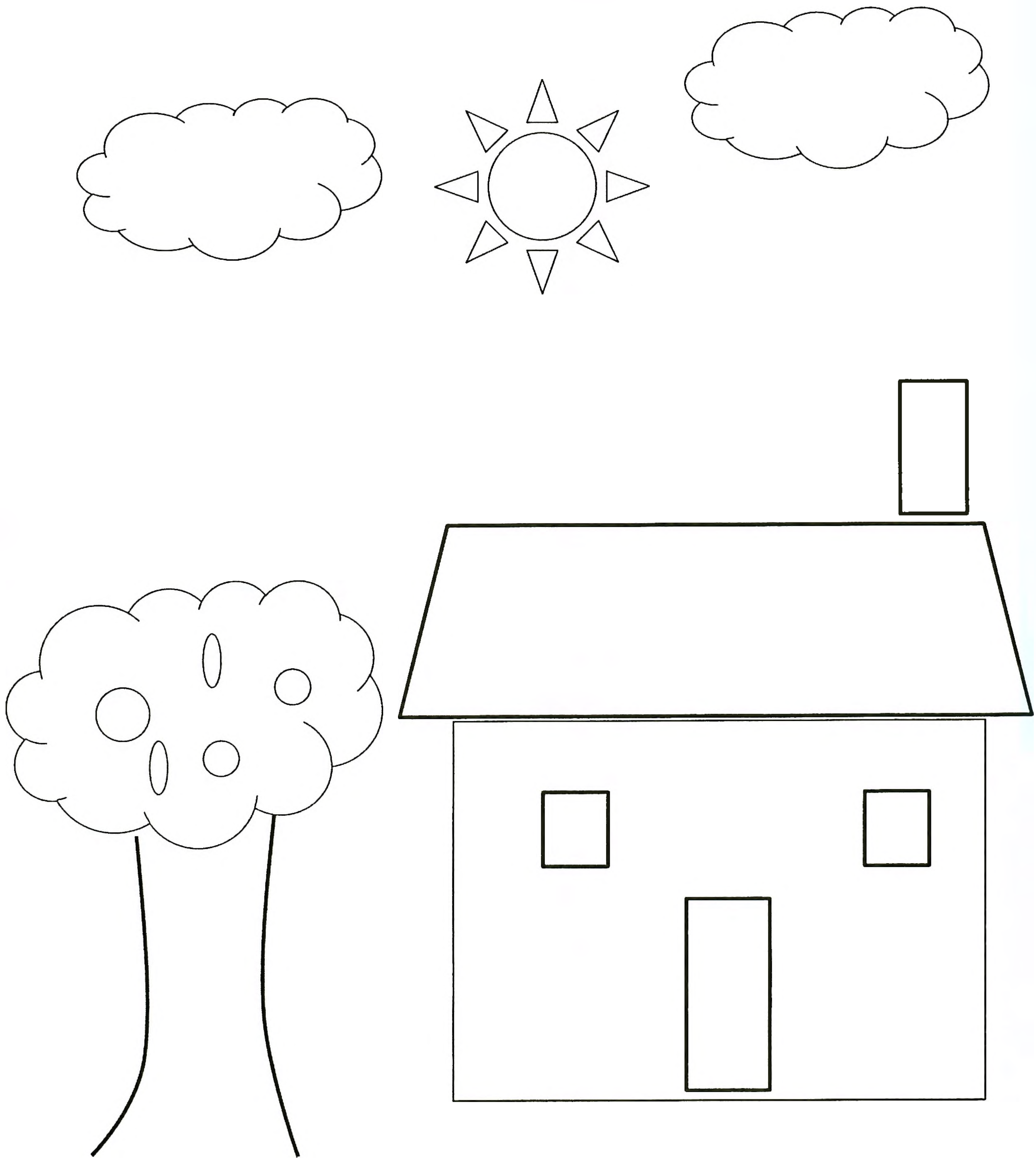
Now try and draw the oval to make Jessica's butterfly!



SESSION 12

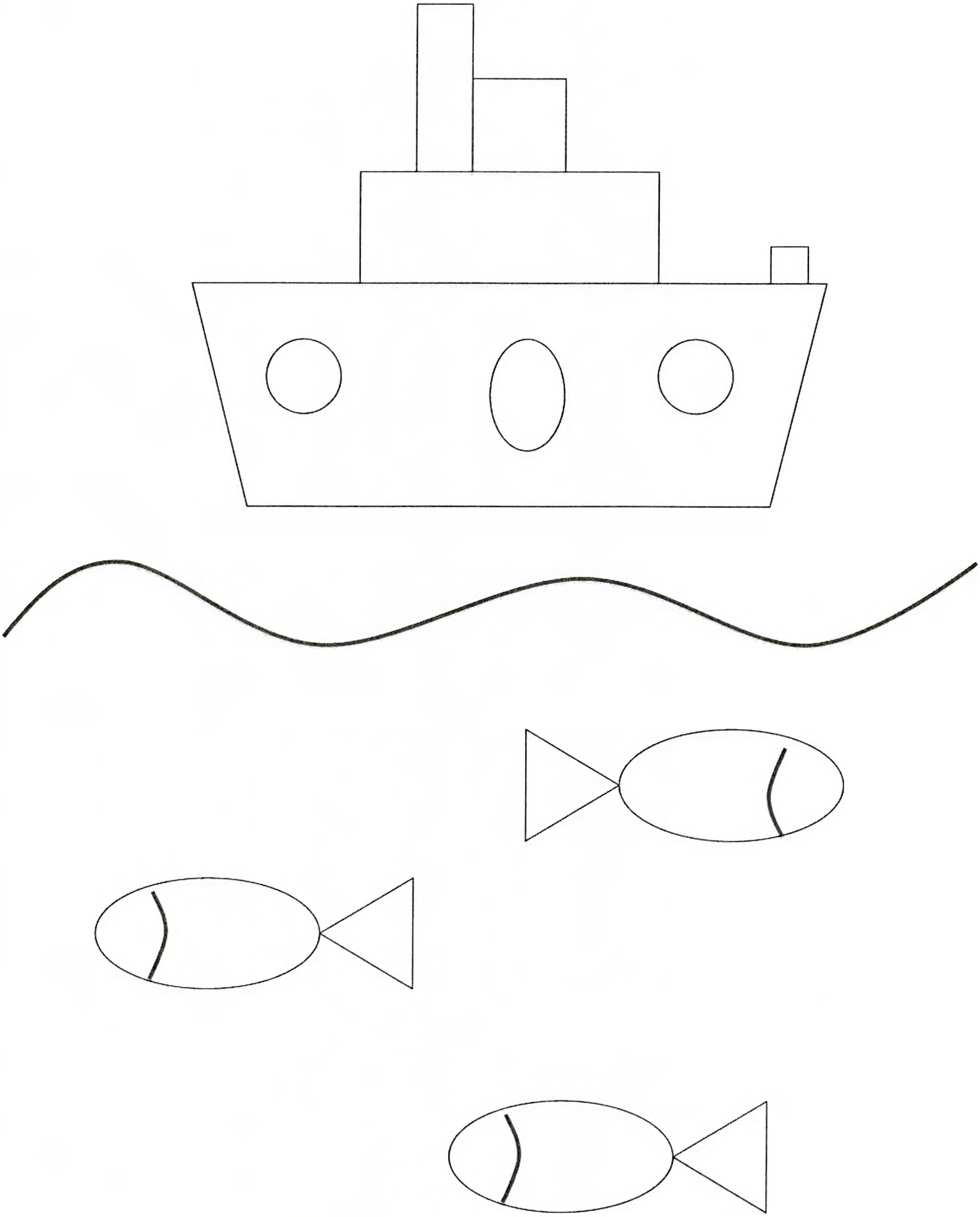
Can you find the following shapes in this picture?

- **2 circles, 2 squares, 2 rectangles, 2 triangles, 2 ovals**



Now can you find the following shapes?

- 2 circles, 2 squares, 2 rectangles, 2 triangles, 2 ovals



Appendix K: informed consent to experts

Dear ....,

I am an Occupational Therapist, currently in my second year of the MSc (Occupational Therapy) by dissertation, part-time program through The University of the Witwatersrand. The title of my research is: *The development of a visual-motor treatment programme for pre-school HIV-infected children with visual motor integration difficulties.*

I would like to request your participation in this study. I am conducting research to develop a treatment programme to address the visual-motor difficulties that pre-school children with HIV face. While the neurodevelopmental delay associated with HIV on children has been documented, there is a gap in the knowledge of the effect of HIV on the visual-motor integration of children and the use of treatment interventions to address these difficulties, particularly in the South African population.

The first phase of this study includes a cross-sectional study of the visual-motor integration, visual perception and motor coordination of 75 pre-school children with HIV. This phase is nearly complete. The second phase consists of the development of a theoretical framework and a treatment programme. The final phase will include a pilot study.

In addition to this a Delphi technique will require your participation to provide comments and ideas on various areas of the treatment programme before the pilot study is implemented. You will be one of 5 experts providing comments. Once comments have been received, the data will be summarised and sent back to the experts for further comment. This process will be repeated for approximately 4 rounds of data collection until data saturation has been reached. The entire process will occur via email or fax. I am currently developing the treatment programme and it should hopefully be ready for comments by the third quarter of this year.

Your input in this programme will be valued and appreciated. If at any time you wish to withdraw from the study, you may do so without any consequences. Your personal information will be kept confidential at all times and will be coded for research purposes. The data will be stored in a safe place for 6 years according to HPCSA regulations.

If you would like to participate in this study, please fill and sign the consent form on the next page and email/fax back to me. If you have further queries regarding the study, please contact me.

Thanking you,

Ramona Odejayi

INFORMED CONSENT OCCUPATIONAL THERAPIST

I ....(name of participant) agree to take part in Ramona Odejayi's study. I understand that I can withdraw from this research at anytime.

Signed...

Dated..

Appendix L: Questionnaire for experts

Comments and Suggestions on the visual-motor treatment programme

Treatment Programme Theories:

1. Please comment on the *appropriateness* of the theories, models and frames of reference to guide the principles of the treatment programme:

   1.1. Model of Creative Ability:

   ____

   ____

   ____

   1.2. Developmental frame of reference:

   ____

   ____

   ____

   1.3. Visual Perception Frame of reference:

   ____

   ____

   ____

   1.4. Feuerstein's Mediated Learning Experience:

   ____

   ____

   ____

   1.5. Piaget's Assimilation and Accommodation:

   ____

   ____

   ____

2. Are there any other theories that can be included in the treatment programme?

   Yes No (Please circle or highlight)

   2.1. If yes please indicate which one/s with a brief explanation of its application to the treatment programme

   ____

   ____

   ____

Forms and shapes

3. The forms addressed in the treatment programme is based on the Beery VMI developmental norms for 5 year 0 month – 5 year 6 months: I, - , O , + , / , , □ X , ○ △ ⋇ U

   3.1. Have *all* forms been used in the treatment programme?

   Yes No (Please circle or highlight)

   3.2. If No, which forms need to be developed more in the treatment programme?

   ____

   ____

   ____

Format of treatment programme

4. Each session is 45 minutes long divided into 3 sections

   4.1. Please comment on the *appropriateness of the length of the session* (45 minutes) in reaching the treatment goal
   (Goal : *To match and copy circle, square, rectangle, triangle and oval of various sizes and orientation)*

   ____

   ____

   ____

5. The treatment programme is divided into 3 sections consisting of an
   - Introduction utilising a story book (narrative) – *15 minutes*
   - Exploration of shape upgrading to activity that results in an end product (3D activity) – *20 minutes*
   - Handbook (Worksheets) – *10 minutes*

   5.1. Please comment on whether the *number of sections* (3 sections) in one session will *assist in reaching the treatment goal* and recommend any changes

   ____

   ____

   ____

   5.2. Please comment on the *content of each section* for the treatment programme and highlight any particular sessions that need further development
   Introduction:____

   ____

Shape exploration and activity:

____

____

Handbook:

____

____

Sessions that need further development:

____

____

Grading

6. The grading between sessions is by increasing the complexity of the developmental forms.
   6.1. Is the grading between sessions *appropriate*?

Yes No (please circle or highlight)

   6.2. If No, please comment on *how* grading between sessions can be achieved:____

____

____

7. The grading within sessions is from 3D to 2D and from exploring shapes to constructive activities with an end product

   7.1. Is this appropriate?
   Yes No (Please circle or highlight)

   7.2. If No, please comment on other ways to grade within the session

____

____

____

Type of activities used

8. The materials utilised are low cost so as to ensure that preschools from various socioeconomic levels can use the programme.

   8.1. Do the *type of activities used in the treatment programme meet the activity requirements* (*See Brief Rationale p. 4*)
   Yes No (Please circle or highlight)

8.2. If No, please comment on what type of activities can be included to meet the activity requirements:

____

____

____

8.3. Will the *type of activities used assist in reaching the treatment goal*? (Goal: *To match and copy circle, square, rectangle, triangle and oval of various sizes and orientation)*

Yes No (Please circle or highlight)

8.4. If No, please recommend different activity types that can assist in reaching the treatment goal

____

____

____

9. Please comment further on the treatment programme if you have further suggestions(optional)

____

____

____

____

Appendix M: Feedback provided by experts

Expert 1

Hi Ramona

I hope my feedback is understandable. It is good work on the planning. I suggested a couple of changes and additions to think about.

1. Medation process- Meaning, feedback and bridging.
2. Task evaluation and directionality of the task, correcting the problem
3. Maybe music and song can be used to enhance the concepts of the characteristics of the shape.
4. Grading – you grade from the total endproduct on 3 D level to 2 D I would perhaps use clay or stick or other material to bring in directionality – start to work from top to bottom, left to right
5. Hand eye coordination and memory is aspects that should be included.
6. Identification of similarities and differences
7. Grading of reproduction on a vertical level to a horizontal level.
8. Tracing around an object is good but difficult.

Comments and Suggestions on the visual-motor treatment programme

Treatment Programme Theories:

10. Please comment on the *appropriateness* of the theories, models and frames of reference to guide the principles of the treatment programme:
    10.1. **Model of Creative Ability:** *Reasonable appropriate if you work with typical developing children. It would be more valuable when you work with children with a psychiatric diagnosis. The child that is 5 years of age is still dependent on a role model to develop the skills needed that is measured in VMI. A Baseline for participation in the activities and to plan for your teaching method to be used can be informed by your use of the model of Creative Ability. I would use the model to inform my clinical reason on the approach that I would use and to establish the child's level of participation to guide me in scaffolding activities to achieve a "just right fit" in participation. It will help me to work on the correct motivational level for the child to encourage creative thinking and self esteem to try and participate in the challenge that the task will present with*
    10.2. **Developmental frame of reference:** *Very appropriate frame of reference. The assumptions of the human development will guide your clinical reasoning and the logical sequence of developing patterns will enable you to grade your activities in treatment and to find a baseline for the program. The adapted frame of reference as referred to in the book of Case Smith on frames of reference in Paeds include the approach to development which could be NDT, SI or just developmental approach. To me it was a valuable frame of reference and theory to use when I developed the visual perceptual program including eye exercises.*_
    10.3. **Visual Perception Frame of reference:** *Most important and appropriate frame of reference. It covers the one part of visio motor integration The Visual Perceptual Frame of Reference: An Information Processing Approach as referred to in P Kramer & J Hinosja (reds.) Frame of Reference for Pediatric Occupational Therapy is very valuable to understand and guide the grading of activities and the level of expectation expected by the task. The assumptions are used in line with the developmental assumptions. The focus is just on how to make meaning of the visual information. I found it a very valuable frame of reference to understand the complexity of the challenge in visual perception. Together with the Hierarchical model of Visual perception as suggested by Warren. The model is used in the evaluation and Treatment of visual perceptual Dysfunction in Adult Acquired Brain Injury. To me this model present the "wall of visual perception"*
    10.4. **Feurstein's Mediated Learning Experience:** _*Ater I did a course to enable me to use Feuerstein's Mediated Learning Experience together with a Cognet course the value that was added to intervention and group program to develop the skills to differentiate, understand, make meaning of and bridging to every day activities I saw a big difference in the outcome of the childrens's ability to use their perceptual skills to focus, analyze and perform. eMissuana et al refined all the cognitive skills to be used in a top down or bottom approach in cognitive treatment. I would say it is a very very very appropriate approach to intervention.*
    10.5. **Piaget's Assimilation and Accommodation:** *Piaget's theory is good to understand and to be used in the grading of the visual perceptual task. To me the theory is to be used in collaboration with the understanding of the natural developmental stages as described*

by Ericson and that what happens in the one stage will influence the next stage. The ages that are indicated to stages of development can be used as a baseline for outcome goal formulation but not seen as the end all. There is many children that will reach tasks of certain ages much earlier or later. The sequence is very valuable. The whole concept of readiness to learn and the appropriate environment to learn should be seen in context with Piaget's theory on cognitive development. This theory will enhance the therapist's understanding of the learning theories and the child.

11. Are there any other theories that can be included in the treatment programme?

    Yes No (Please circle or highlight)

    11.1. If yes please indicate which one/s with a brief explanation of its application to the treatment programme

    _VMI is a learnt skill and has a strong motor performance skill included. I would therefor include the theory on **motor learning** and also **learning theories**. The learning theories include the system theory of learning, self regulation and motivation. Including the way a child learns will enable you to under the approach to the child and the process of learning and evaluation of the task by the child. The theory is been developed from Vygotsky's original work.

    I have looked again at the different theories and depending on the focus of the program then I would include the Gestalt development related to figure ground perception and the theories under the Cognitivest orientation to learning under the Cognitive frame of reference , with the inclusion of how to teach and learn I would include the Social and situation orientation of learning – eg. Bandura's work and the behaviorist orientation – Skinner. You hanve most of the developmental theories. I would include one of the Occupation based modules to reason why and what to plan for – a good one might be the PEO of Law et al or the Peop module (Canadian module) the occupation focused models will be the integration of all the underlying theorists work.

    Research indicated that the outcome through play is much more effective than the 2 D programs that was used in therapy I will include theory on play as an occupation for child development.

Forms and shapes

12. The forms addressed in the treatment programme is based on the Beery VMI developmental norms for 5 year 0 month – 5 year 6 months: I, - , O , + , / , , ☐X , ○ △ ⚹ U

    12.1. Have *all* forms been used in the treatment programme?

    Yes No (Please circle or highlight)

    12.2. If No, which forms need to be developed more in the treatment programme?

    __*The focus is on the shapes and the reproductio*n of shapes. Exploration will be also to experience the shape eg. Ball or rolling or handling round objects discussing why we say they are round. I miss directionality and task concept, evaluation and problem solving together with the cognitive strategies and techniques to be used. Appropriate feedback to enhance learning. I would start with the simple lines and directionality, where to start en to stop, judging of size and distance before I would draw the shape. The shape or constructions of lines that I do not see is the late one that consists of three overlapping lines. As the 5 year will start to copy numbers and alphabetical letters as represented in his/her name I would bridge the use of lines circles and shapes to the exploration of eg clay or different materials letters and numbers

Format of treatment programme

13. Each session is 45 minutes long divided into 3 sections

13.1. Please comment on the *appropriateness of the length of the session* (45 minutes) in reaching the treatment goal

(Goal : *To match and copy circle, square, rectangle, triangle and oval of various sizes and orientation)*

_the time should be adequate- You need to include time for repetition and individual differences. I found with presenting a visual perceptual programme that 45 minutes to an hour is good to achieve the goal and to be able to bridge and get inner meaning of the activity that you work from settling the group to activity participation and to achieve performance and mastery- feedback is very important and the mediation process is more time needed. Depending on the size of the group and their ability to grasp the activity.

14. The treatment programme is divided into 3 sections consisting of an
    - Introduction utilising a story book (narrative) – *15 minutes*
    - Exploration of shape upgrading to activity that results in an end product (3D activity) – *20 minutes*
    - Handbook (Worksheets) – *10 minutes*

14.1. Please comment on whether the *number of sections* (3 sections) in one session will *assist in reaching the treatment goal* and recommend any changes

I would like to see a closure and feedback at the end of the session and a concrete recapture of activity and evaluation of the goal reached. Each section is very important and necessary.

Introduction- to get the attention and understand the context of the ses
sion. Also to introduce the goal of the session for the child the get the big picture.
Section 2 will enhance active learning and a chance to learn from the peers and the role model. I would include some of the stepping stones as specified in Beery (2004, P 22). __
Section 3 will give the child the opportunity to apply learnt knowledge. 10 minutes on a 2 D level might be long for a five year old. They lose interest very quickly as they want to play on a more gross motor level at that age.

It would be good if feedback and feedforward was cognitively planned for to be included in the programme. Use of cognitive strategies also to be planned for.

14.2. Please comment on the *content of each section* for the treatment programme and highlight any particular sessions that need further development

Session 1: Circle

Introduction:_good I would include a song of a circle and encourage the child to form a circle.

Shape exploration and activity:_good_

Handbook : Pasting stickers is easier than trace I would swop the activity and first do this then tracing on a vertical surface

Sessions that need further development: I miss the discussion on why it is called a circle

Session 2 Circle: Introduction:Good – I would bring in the starting point how to make a circle and also perhaps a song

Shape exploration and activity: Good

Handbook Before free drawing I would include copying on a broken line or between lines different size circle shapes.

Same and different size circles should be first as it is on the level of identification and then reproduction

Sessions that need further development: Discussion and feedback_- level of work vertical and horizontal could be graded in

Session 3: Square

Introduction:_Discussion of the characteristics of the square

Shape exploration and activity:

Handbook:

Sessions that need further development: there should be an opportunity to match the same size squares and reproduce and also differentiate between a circle and a square.

Session 4 Square:

Introduction: Discussion on directionality/ repeat the characteristics of the square

Shape exploration and activity: _

Handbook: I think the grading can be refined to the same as indicated in the circle.

Sessions that need further development: the feedback on all the sessions seems to be the same I suggest that you use more variations in how to reproduce the shapes Refine the grading of reproduction.

Grading

15. The grading between sessions is by increasing the complexity of the developmental forms.

15.1. Is the grading between sessions *appropriate*?

Yes ______ No (please circle or highlight)

15.2. If No, please comment on *how* grading between sessions can be achieved:_The shapes yes the teaching method must be refined. The grading of simalarities and difference should be brought in

16. The grading within sessions is from 3D to 2D and from exploring shapes to constructive activities with an end product

    16.1. Is this appropriate?

    Yes ________ No (Please circle or highlight)

    16.2. If No, please comment on other ways to grade within the session

    The construction, experiencing the characteristics could be refined in the grading process.

Type of activities used

17. The materials utilised are low cost so as to ensure that preschools from various socioeconomic levels can use the programme.

    17.1. Do the *type of activities used in the treatment programme meet the activity requirements* (*See Brief Rationale p. 4*)

    Yes No (Please circle or highlight)

    17.2. If No, please comment on what type of activities can be included to meet the activity requirements:

You can include stones and sticks and sand to make the activities more cost effective.

Will the *type of activities used assist in reaching the treatment goal*? (Goal: *To match and copy circle, square, rectangle, triangle and oval of various sizes and orientation)*

Yes ________ No (Please circle or highlight)

    17.3. If No, please recommend different activity types that can assist in reaching the treatment goal

    __the effectiveness in terms of mediation. Feedback and bridging could be included. The concept of Hand eye coordination can be refined in the grading process.

18. Please comment further on the treatment programme if you have further suggestions(optional)

    Music is a very natural why to enhance learning. Musical instruments and song could be included to enhance the concepts of shapes in reference to their characteristic. The inclusion of imitation of posture(using shapes) and memory is an area that more thought can be given to. Children will love to draw a shape and cover it and let their friend draw the shape Sequencing preparing the child for writing can be included.- meaning Built or reproduce the following, memory can also be included at a later stage. See eg.

Expert 2

Comments and Suggestions on the visual-motor treatment programme

Treatment Programme Theories:

19. Please comment on the *appropriateness* of the theories, models and frames of reference to guide the principles of the treatment programme:
    19.1. Model of Creative Ability: _This type of model I would use more in relation to creative activities
    19.2. Developmental frame of reference: _This is appropriate and always used as background for activities done with children
    19.3. Visual Perception Frame of reference:Appropriate for a visual-motor treatment program
    19.4. Feurstein's Mediated Learning Experience: _Also appropriate as I think that a visual-motor treatment program is therapist directed. As long as it is high-level enough at the end of the sessions and not too directed!!
    19.5. Piaget's Assimilation and Accommodation: _Not appropriate for yur program
20. Are there any other theories that can be included in the treatment programme?
    Yes No (Please circle or highlight)

    20.1. If yes please indicate which one/s with a brief explanation of its application to the treatment programme
    Motor development

My time is very limited and I thought I'd give you an overall feeling for your program: 45 minutes is a long time for a task like this and I think a lot of time is used for parts of the task that the children should definitely have integrated at that stage. Matching shapes is really a 3-year old level, so I don't think it will help with the VMI at all.
Also in your program you place the triangle before the rectangle, for instance where I would compare and draw the square with the rectangle rather.
A child that can't draw diagonals is not going to learn this in your task as this is too little time. Generally the breakdown will be the diagonal lines and thus you need to place much more emphasis on this. E.g. drawing diagonal lines from one sticker to another in order to develop the diagonal, before attempting it free-hand.
For integration of diagonals I use body movement, crossing of the midline etc, before attempting to draw. In your program therefore there needs to be much more emphasis on diagonals. (Maybe you need to interpret your results a little?)
I would look at the results in more detail and really zoom in on where the problem is.......maybe not necessarily the circle. Further, I don't think that manipulating a ball with improve drawing a circle. I think that children would benefit more from feeling a shape with vision occluded i.e. forming a mental picture and then drawing it (even with eyes closed).

So all in all, I feel that the program is too easy for this age group and the ultimate goal is to improve VMI. Maybe you could think of including the shapes in free drawings? E.g. draw a horse using an oval, rectangles triangle etc