The suitability of the DTVP-2 as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking children in South Africa

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This dissertation is devoted to

my late mother, Alta,

whom ignited the fire that fuels my thirst

for knowledge, curiosity and wisdom,

and to

my father, Louis,

for without him, this study would not have been possible.

DECLARATION

I, MARISKA SMITH, declare that the master's research dissertation or publishable, interrelated articles that I herewith submit at the University of the Free State, is my independent work and that I have not previously submitted it for a qualification at another institution of higher education.

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MARISKA SMITH

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LIST OF ACRONYMS

Acronym	**Definition**
%LB95CI	Lower bound of the binomial confidence interval
Beery VMI	Developmental Test of Visual-Motor Integration
CO	Copying
COT	City of Tshwane
CTBS	Comprehensive Test of Basic Skills
DAP	Draw-a-person test
DIF	Differential item functioning
DTVP	Developmental Test of Visual Perception
DTVP-2	Developmental Test of Visual Perception – 2nd edition
DTVP-3	Developmental Test of Visual Perception – 3rd edition
ECDC	Early Childhood Developmental Criteria
ELOLT	English language of learning and teaching
EH	Eye-hand coordination
FC	Form constancy
FG	Figure-ground
GCP	Good Clinical Practice
GDE	Gauteng Department of Education
GN	Gauteng North
GVP	General visual perception

GVPQ	General visual perception quotient
HPCSA	Health Professions Council of South Africa
ICH	International Conference of Harmonisation
LOLT	Language of learning and teaching
L1	First language
L2	Second language
L3	Third language
MRC	Medical Research Council
MRPQ	Motor-Reduced Visual Perception Quotient
MTVP-3	Motor Free Visual Perception Test – 3rd edition
MVPT	Motor Free Visual Perception Test
NTARS	National Teacher Assessment and Referral Scale
OT	Occupational therapist
OTx	Occupational therapy
OTASA	Occupational Therapy Association of South Africa
PCA	Principal component analysis
PS	Position in space
PSI	Person separation index
RMSEA	Root mean square error of approximation
RS	Raw score
SA	South Africa(n)
SD	Standard deviation

SES	Socio-economic status
SIPT	Sensory Integration and Praxis Test
SR	Spatial relations
SS	Standard score
StatsSA	Statistics South Africa
TN	Tshwane North
TS	Tshwane South
TVMS-R	Test of Visual-Motor Skills – Revised
TVMS-3	Test of Visual-Motor Skills – 3rd edition
TVPS-R	Test of Visual Perception Skills – Revised
TW	Tshwane West
UFS	University of the Free State
VC	Visual closure
VMI	Visual-motor integration
VMIQ	Visual-motor integration quotient
VMS	Visual-motor speed
VPAT	Visual Perceptual Aspects Test
WISC-R	Wechsler Intelligence Scale for Children – Revised
WRAVMA	Wide Range Assessment of Visual Motor Abilities

CONCEPT CLARIFICATION

Concept clarification entails more than just a dictionary definition. Conceptual definitions present a variable and/or concept with a complete understanding to the meaning of the word.

Ceiling rule

A ceiling rule entails an examiner to stop administration of a measurement instrument at a point where the subtest items are no longer answered correctly and remainder of the subtest items are considered too difficult to answer (Joint Committee on Standards for Educational and Psychological Testing 1999:6)

Copying

Copying refers to the skill to identify facets of a feature by means of a sketch reproduction (Hammill, Pearson & Voress 1993:26).

Eye-hand coordination

Eye-hand coordination refers to the skill to draw straight or coiled lines accurately within set visual margins (Hammill *et al*. 1993:26).

Figure-ground

Figure-ground refers to the skill to distinguish specific features in a concealed background (Hammill *et al*. 1993:26).

Form constancy

Form constancy refers to the skill to link facets of a feature despite differentiated dimensions (Hammill *et al*. 1993:26).

Item

An item is the construct that constitute the subtests of a measurement instrument or questionnaire (Polit & Beck 2010:558).

Item difficulty

Item difficulty refers to an item difficulty index that specifies the percentage of participants that responds correctly to an item. The difficulty index should not exceed 0.9 or fall under 0.1 (Maree 2007:218).

Item linearity

Item linearity refers to the hierarchical order of items from easiest to most difficult in correspondence to the maturational process children endure (Brown, Lyons & Unsworth 2009:396)

Measurement instrument

A measurement instrument is a tool used to assign numerical values to items in accordance with set administration and scoring guidelines in order to describe the extent of a characteristic (Polit & Beck 2010:559).

Position in space

Position in space refers to the skill to correlate two features corresponding to the general facets of the features (Hammill *et al*. 1993:26).

Raw score

The raw score represents the sum of points a child accumulates for each subtest item answered correctly (Hammill *et al*. 1993:23).

Spatial Relations

Spatial relations refer to the skill to replicate a visual example by means of joining dots (Hammill *et al*. 1993:26).

Standard score

Standard scores are converted raw scores derived from normative tables in examiner manuals of measurement instruments (Hammill *et al*. 1993:24).

Visual closure

Visual closure refers to the skill to identify an incomplete drawn feature (Hammill *et al*. 1993:26).

Visual-motor integration

Visual-motor integration refers to the integration of visual- and motor skills (Hammill *et al*. 1993:4).

Visual-motor speed

Visual motor speed refers to the child's swiftness to draw specific symbols in specific geometric shapes (Hammill *et al*. 1993:26).

Visual perceptual skills

For the purpose of this study visual perception is defined as "an intermediate step in information processing between sensation and cognition" (Hammill *et al*. 1993:1-2).

SUMMARY

KEY WORDS

DTVP-2, Visual perceptual skills, suitability, Rasch analysis, cross-cultural evaluations, evidence-based practice, item linearity, item difficulty, construct validity, reliability

SUMMARY

As there is limited comprehensive visual perceptual skills test that has been standardised on a representative South African population, occupational therapists in South Africa make use of measurement instruments standardised in other countries to measure children's visual perceptual skills. A measurement instrument frequently used by SA OTs, the DTVP-2, is a reliable and valid test for the population on which the test was standardised. However, the DTVP-2's suitability is questioned in a cross-cultural setting, specifically the SA population.

The aim of the study was to investigate the suitability of the Developmental Test of Visual Perception – 2nd edition (DTVP-2) as a measurement instrument for 5 years and 6 months to 5 years and 11 month English-speaking boys and girls from the City of Tshwane, South Africa.

A quantitative, descriptive, observational study was conducted. One-hundred and thirty four (134) study participants were recruited by means of stratified random sampling from English Language of Learning and Teaching schools located within the four educational districts in the urban-suburbs of the City of Tshwane. A self-administered screening questionnaire was used as a screening method to establish children's eligibility for inclusion in the study, as well as for parents/caregiver to provide informed consent. Children of parents/caregivers who returned the questionnaires were assessed with the DTVP-2. The DTVP-2's motor-enhanced subtests were administered according to the prescribed method, while each of the motor-reduced subtests of the DTVP-2 was administered with an adapted method of not implementing the ceiling rule.

Results of the study yielded that the SA study sample's scores differed to the American normative sample. The position in space- and visual closure subtests yielded more accurate results when the ceiling rule was not implemented. It was established that the DTVP-2 was unbiased for gender, with the exception of figure-ground, when scored according to the prescribed method. The DTVP-2 displayed overall acceptable reliability, however the individual subtests of visual closure, visual-motor speed and form constancy was found to be unreliable. A Rasch analysis revealed that figure-ground and form constancy of the motor-reduced subtests measured a single construct and the four motor-reduced subtests of the DTVP-2 exhibited distorted item difficulty and –linearity resulting in misapplication of the ceiling rule.

It is concluded that the DTVP-2 should be used with caution to measure 5 years and 6 months to 5 years and 11 months English-speaking children's visual perceptual skills and care must be taken when interpreting and conveying scores to parents and other health care professionals. It is recommended that South African occupational therapists adjust and/or be sensitive in their assessment procedures in order to inform evidence-based practice.

OPSOMMING

SLEUTELWOORDE

DTVP-2, Visuele perseptuele vaardighede, geskiktheid, Rasch analise, kruis-kulturele evaluasie, bewysgebaseerde praktyk, item volgorde en –moeilikheidsgraad, geldigheid, betroubaarheid

OPSOMMING

Aangesien daar beperkte omvattende visuele perseptuele vaardigheidsmeetinstrument, wat op ‛n gestandardiseerde verteenwoordigende Suid-Afrikaanse populasie beskikbaar is, maak arbeidsterapeute in Suid-Afrika van meetinstrumente gebruik wat in ander lande gestandaardiseerd is om kinders se visuele perseptuele vaardighede te meet. ‛n Meetinstrument wat dikwels deur Suid-Afrikaanse arbeidsterapeute gebruik word, die DTVP-2, is ‛n betroubare en geldige meetinstrument vir die populasie waarop die toets gestandardiseerd is. Die geskiktheid van die DTVP-2 word egter in ‛n kruis-kulturele omgewing, spesifiek in die Suid-Afrikaanse populasie, bevraagteken.

Die doel van die studie was om die geskiktheid van die Developmental Test of Visual Perception – 2nd edition (DTVP-2) as meetinstrument vir 5 jaar en 6 maande tot 5 jaar en 11 maande Engels-sprekende seuns en dogters van die stad van Tshwane, Suid-Afrika te ondersoek.

‛n Kwantitatiewe, beskrywende, obserwerende studieontwerp was gevolg. Een honderd vier en dertig (134) studiedeelnemers is deur middel van ‛n gestratifiseerde steekproeftrekking van uit Engelse taal van leer en onderrigskole, geleë in die vier opvoedkundige distrikte in die stedelike-voorstede van die stad van Tshwane, gewerf. ‛n Self-geadministreerde vraelys was as siftingsmetode gebruik om kinders se moontlikheid vir insluiting in die studie te bepaal, asook vir ouers/versorgers om ingeligte toestemming te gee. Kinders van ouers/versorgers wat die vraelyste teruggestuur het, is met die DTVP-2 ge-evalueer. Die DTVP-2 se motories-verhoogde subtoetse was geadministreer volgens die voorgeskrewe metode, terwyl elkeen van die motories-verlaagde subtoetse geadministreer was deur middel van 'n aangepasde metode deur nie die plafon-reël te implementeer nie.

Resultate van die studie dui daarop dat die Suid-Afrikaanse studie steekproef se tellings verskil van die Amerikaanse normatiewe steekproef. Die posisie in ruimte- en visuele sluiting subtoetse lewer meer akkurate resultate wanneer die plafon-reël nie geïmplementeer word nie. Daar is vasgestel dat die DTVP-2 onbevooroordeeld vir geslag was, met die uitsondering van voorgrond-agtergrond, volgens die voorgeskrewe merk metode. Die DTVP-2 vertoon algehele aanvaarbare betroubaarheid, maar visuele sluiting, visuele-motoriese spoed en vormkonstantheid was onbetroubaar bevind. 'n Rasch ontleding het getoon dat voorgrond-agtergrond en vormkonstantheid, van die motories-verlaagde subtoetse, 'n enkel eienskap meet en dat al vier die motories-verlaagde subtoetse van die DTVP-2 verwronge item volgorde en –moeilikheidsgraad het met gevolglike wantoepassing van die stop reël.

Daar is tot die gevolgtrekking gekom dat die DTVP-2 moet met omsigtigheid gebruik word om 5 jaar en 6 maande tot 5 jaar en 11 maande Engels-sprekende Suid-Afrikaanse kinders se visuele perseptuele vaardighede te meet. Interpretasie- en die oordrag van tellings moet met sorg aan ouers en/of gesondheidsorgverskaffers gedoen word. Daar word aanbeveel dat die Suid-Afrikaanse arbeidsterapeut sensitief is en/of evalueringsmetodes moet aan pas deur bewysgebaseerde praktyk te implementeer.

CHAPTER 1

INTRODUCTION AND ORIENTATION

1.1. INTRODUCTION

As there is limited comprehensive visual perceptual skills test that has been standardised on a representative South African (SA) population, occupational therapists (OTs) in SA make use of measurement instruments standardised in other countries to measure children's visual perceptual skills (Clutten 2009:2; Eksteen 2007:1; Rens 2008:4; Visser, Cronje, Kemp, Scholtz, Van Rooyen & Nel 2012:21).

As a result, internationally standardised tests most often used by paediatric SA OTs are in order of popularity/preference (Van der Merwe, Smit & Vlok 2011:7): the Developmental Test of Visual-Motor Integration (Beery VMI) (Beery, Buktenica & Beery 2004); the Developmental Test of Visual Perception – 2nd edition (DTVP-2) (Hammill, Pearson & Voress 1993); the Test of Visual Perceptual Skills (Non-Motor) – Revised (TVPS-R) (Gardner 1996); the Southern California Sensory Integration Tests (SCSIT) / Sensory Integration and Praxis Tests (SIPT) (Ayres 1989) and the Goodenough-Harris Draw-A-Person Test (DAP) (Harris 1963). Accordingly, Van der Merwe *et al*. (2011:8,9) identified that OTs in SA prefer to use the DTVP-2 more frequently as a measurement instrument than OTs in other countries.

The DTVP-2 is regarded as well designed, easy to pursue and administer (Guntayuong, Chinchai, Pongsaksri & Vittayakorn 2013:114) and is considered a valuable measurement instrument (Visser *et al*. 2012:21). The DTVP-2 is furthermore regarded as clinically useful since the DTVP-2 descriptively measures visual perceptual- and visual-motor skills (Burtner, Bordegaray, Moedl, Roe, Savage & Wilhite 1997:43). The DTVP-2 evaluates children's eye-hand coordination (EH)-, position in space (PS)-, copying (CO)-, figure-ground (FG)-, spatial relations (SR)-, visual closure (VC)-, visual-motor speed (VMS)- and form constancy (FC) skills. These skills generate a composite score, i.e. General Visual Perception Quotient (GVPQ), and are furthermore either allocated to a motor-reduced- or motor-enhanced component to provide OTs with a motor-reduced visual perceptual- (MRPQ) and a visual-motor integration quotient (VMIQ) respectively (Hammill *et al*. 1993:5,6). In addition, OTs can make observations regarding children's fine motor skills while they perform the DTVP-2's motor-enhanced subtests, in contrast with other visual perceptual skill tests that consist of motor-reduced items only. During administration of the DTVP-2, motor-reduced- and motor-enhanced subtests are alternated, providing variation for children, which might contribute towards children's needed level of concentration for partaking in standardised testing.

Although the authors (Hammill *et al*. 1993) of the DTVP-2 state that the subtests are unbiased for culture, research indicates that 5-year-old SA children score below average on the VC subtest of the DTVP-2 (Van Romburgh 2006; Visser 2005; Visser *et al*. 2012). Visser and colleagues (2012:13) have established that if the prescribed ceiling rule is not implemented as set out in the DTVP-2 Examiner's Manual, a more accurate score for the VC subtest are obtained. In addition, Richmond and Holland (2011:35-36) queried the item linearity of the VC subtest since the DTVP-2 scores lower in relation to the TVPS-R.

Research (Van Romburgh 2006; Visser 2005; Visser *et al*. 2012) do not only confirm that the VC subtest of the DTVP-2 measures inaccurately; the results of these studies also indicate a discrepancy in the other subtests of the DTVP-2, specifically PS, CO, SR, VMS and FC. Therefore, the entire DTVP-2 needs further investigation in the SA context.

Hammill *et al*. (1993) also state that the DTVP-2 is meant to be unbiased for gender. However, Cheung, Poon, Leung and Wong (2005:38-39) detected a difference in gender performance for Hong Kong children. Richmond and Holland (2011), Van Romburgh (2006), Visser (2005) and Visser *et al*. (2012) did not report a difference in gender performance in SA children and further investigation is needed.

Although a revised version of the DTVP-2, the Developmental Test of Visual Perception – 3rd edition (DTVP-3) (Hammill, Pearson & Voress 2013), was published during the course of this study, the DTVP-3 is beyond the scope of this Magister dissertation. Therefore, the DTVP-2 remains the focus of the study and is discussed further. To purchase the DTVP-3 would have been an extra expense (which was not originally budgeted for in this study); in SA the DTVP-3 was still relatively unknown and/or minimally used at the time the study was conducted. According to the researcher's knowledge, no research have been conducted on the DTVP-3 other than those reported on in the test manual.

It is imperative that OTs make use of current, valid and reliable measurement instruments to evaluate the incidence and impact of visual perceptual skill impairments accurately (Brown & Hockey 2013:427). Under-identification of visual perceptual skill impairments can have consequences such as misdiagnoses or the child not receiving therapy, while over-identification can lead to immoderate recommendations, resulting in misuse of educational and medical resources (Eksteen 2007:3; Rens 2008:2).

As a preferred and frequently used measurement instrument by OTs in SA, the DTVP-2 does not comprise the most current, valid and reliable measurement properties for the SA population and further investigation is inevitable.

1.2. PROBLEM STATEMENT

The use of valid and reliable measurement instruments is internationally emphasised. There is, however, limited comprehensive visual perceptual skills test inclusive of pre-school going age to school going age that has been standardised on a representative SA population. Standardisation of measurement instruments for a specific country can be a very costly and lengthy process, involving many stakeholders. As a result OTs in SA makes use of measurement instruments standardised in other countries to evaluate children's visual perceptual skills. Such a standardised measurement instrument preferred and frequently used in SA is the DTVP-2.

According to research (Van Romburgh 2006, Visser 2005 & Visser *et al*. 2012), SA children score differently on standardised measurement instruments in relation to American children on which measurement instruments are standardised. South African OTs specifically note that the DTVP-2 over-identifies VC problems in SA children and question the item linearity of the VC subtest of the DTVP-2. It is also evident that an inconsistency in test performance exists in 5-year-old SA children in relation to American children, as SA children obtain average and above-average scores in the PS-, CO-, SR-, VMS- and FC subtests of the DTVP-2. For these reasons the norms of the DTVP-2 do not translate well to the SA context and the validity and reliability of the DTVP-2 in SA is questioned.

The main research question for this study was therefore: Is the DTVP-2 a suitable measurement instrument for 5 year and 6 months to 5 year and 11 months SA children?

In order to answer the main research question, a systematic composition of the following sub-questions was set:

1. What are the psychometric properties of the DTVP-2 when tested on a sample of SA children? Specifically:
   a) What is the reliability of the DTVP-2 and how does this compare to previously calculated reliability values?
   b) What is the validity of the DTVP-2 and how does this compare to previously calculated validity values?
2. How does the prescribed scoring method compare to an adapted scoring method for the following:
   a) Motor-reduced subtests
   b) GVPQ
   c) MRPQ

3. Will there be any gender differences in the DTVP-2 scores?
4. How do the norms for a SA sample compare to those calculated for the American sample?

1.3. AIM AND OBJECTIVES OF THE STUDY

The aim and objectives of the study were:

1.3.1. Aim

To investigate the suitability of the Developmental Test of Visual Perception – 2nd edition (DTVP-2) as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the City of Tshwane (COT), SA.

1.3.2. Objectives

1. To investigate the psychometric properties of the DTVP-2 when tested on a sample of 5 years and 6 months to 5 years and 11 months English-speaking SA boys and girls, specifically:

a) The reliability of the DTVP-2

b) The validity of the DTVP-2

2. To compare the obtained results to previously calculated reliability- and validity values of the DTVP-2 respectively.
3. To compare the results of the prescribed scoring method to an adapted scoring method for the following:

a) Motor-reduced subtests

b) GVPQ

c) MRPQ

4. To investigate gender differences in performance on the DTVP-2 on a sample of 5 years and 6 months to 5 years and 11 months English-speaking SA boys and girls.
5. To compare the norms of a sample of 5 years and 6 months to 5 years and 11 months English-speaking SA boys and girls to those calculated for the American sample.

1.4. SCOPE AND IMPORTANCE OF THE STUDY

Occupational Therapists in SA frequently make use of the DTVP-2 in order to establish difficulties in development, to plan treatment intervention and to validate the efficacy of intervention programmes. Since the suitability of the DTVP-2 is questioned in SA, the study investigated the suitability of the DTVP-2 for 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT.

The population was restricted to the COT metropolitan municipality since the researcher resides in the COT. The COT is furthermore the third largest metropolitan municipality in SA. In order to minimise the effect of potential variance variables, age and gender were controlled in the study. The study focused particularly on children aged 5 years 6 months and 0 days to 5 years 11 months and 29 days. A minimum of 10 boys and 10 girls were included for each month interval in the study sample. Since the DTVP-2 was standardised in English and is not available in any other language, the study population focused on children able to understand and speak English, therefore those who attended English Language of Learning and Teaching (ELOLT) schools. Children were assessed with the DTVP-2, which descriptively measured children's EH-, PS-, CO-, FG-, SR-, VC-, VMS- and FC skills.

Results of the study provide OTs in SA with evidence regarding the reliability and validity of the DTVP-2, as well as differences in gender performance for English-speaking 5-year-old children. In this way the results contribute to Occupational Therapy (OTx) evidence-based practice. Occupational Therapists in SA will be able to interpret and convey results of the DTVP-2 more accurately. Conclusions are made as to whether SA OTs currently under-identify or over-identify visual perceptual skill- and visual-motor integration (VMI) difficulties in children.

Pro-Ed. Inc., publishers of the DTVP-2, will be notified of the results and subsequently different item linearity could be proposed for the motor-reduced subtests of the DTVP-2 for the SA population. The Health Professions Council of South Africa (HPCSA) will be notified of the results. Recommendations regarding the performance of boys and girls on the DTVP-2 from the COT might be proposed and possibly implemented.

Results from this study could be used for future criterion/convergent validity and/or equivalent forms reliability studies of the DTVP-2 with the DTVP-3 in SA.

Although researchers (Clutten 2009; Eksteen 2007; Van Jaarsveld, Mailloux & Hertzberg 2012) have attempted to address measurement instruments for the SA population, the need for standardisation of visual perceptual measurement instruments specifically for the SA population is further emphasised.

1.5. METHOD OF RESEARCH

The method of research is briefly summarised in this section and is comprehensively discussed in Chapter 3.

A quantitative, descriptive, observational study was conducted. A minimum of 10 English-speaking boys and 10 girls were selected for each month interval within the age group of 5 years and 6 months to 5 years and 11 months by means of stratified random sampling (Leedy & Ormrod 2014:217). Study participants were recruited from ELOLT schools located within the 4 educational districts in the urban-suburbs of the COT.

A self-administered screening questionnaire was used as a screening method to establish children's eligibility for inclusion in the study, as well as for parents/caregivers to provide informed consent. Children of parents/caregivers who returned the questionnaires were assessed with the DTVP-2.

The DTVP-2 was administered individually by the researcher in English according to the prescribed, as well as an adapted, administration method. The motor-enhanced subtests were administered according to the prescribed method, while each of the motor-reduced subtests of the DTVP-2 was administered entirely by not adhering to the ceiling rule as prescribed in the DTVP-2 Examiner's Manual by Hammill *et al*. (1993:8-17).

The researcher scored and interpreted the motor-enhanced subtests according to the prescribed method, while item responses of the motor-reduced subtests of the DTVP-2 were scored and interpreted in two different ways on a data score sheet: first, by implementing the ceiling as prescribed by Hammill *et al*. (1993:8-17), i.e. the prescribed way; and, secondly, by scoring the motor-reduced subtests in their entirety, i.e. the adapted way.

The data analysis was conducted by the Department of Biostatistics, University of the Free State (UFS).

1.6. ETHICAL CONSIDERATIONS

Ethical considerations relevant to the study are briefly summarised in this section and are comprehensively discussed in Chapter 3.

The research protocol was scrutinised and approved by an Expert- and Evaluation Committee of the Department of Occupational Therapy and the Research Committee of the School of Allied Health Professions respectively, before approval of the research protocol was obtained from the Ethics Committee of the Faculty of Health Sciences, UFS, (ECUFS133/2012).

Permission was obtained from Pro-Ed Inc., publishers of the DTVP-2, the Gauteng Department of Education (GDE) and school principals. Informed consent was obtained from parents/caregivers and assent from children. The benefit of participation included the fact that children's visual perceptual skills were assessed free of charge and no risks were involved for the child. Parents/caregivers of children with deficient visual perceptual skills were informed by means of a short summary of their child's results and referral to an OT was recommended. Strict confidentiality was maintained before, during and after the study.

Results of the study might be published in an accredited academic journal and be presented at congresses and to the GDE.

1.7. OUTLINE OF THE CHAPTERS

Chapter 1, *Introduction and orientation*, contextualises the identified problem, provides a summary of previous studies and introduces the rationale for this study, followed by the problem statement and study aim. Chapter 1 also introduces the scope and importance of the study, briefly outlines the method of research, ethical considerations, and ends off with a chapter overview.

Chapter 2, the *Literature review*, provides a thorough review of literature pertaining to key aspects of the study. The review specifically analyses visual perceptual skills, the DTVP-2 and the multicultural SA population.

Chapter 3 describes the *Method of Research*. The study design, study population, sample selection, sample size and compilation, research procedure, pilot study, measurement instruments, data collection, data analysis, methodological and measurement errors and ethical considerations involved in the study are described.

Chapter 4 presents the *Results* of the study. Results regarding the demographic information of the study sample, validity and reliability of the DTVP-2, prescribed and adapted DVTP-2 administration methods, gender performance and a norm comparison between a selected SA sample and the American normative sample are presented by means of tables and graphs.

Chapter 5 presents an interpretation of the results and provides an in-depth *Discussion*, analysis and comparison with the relevant literature.

Chapter 6 describes the *Conclusions* drawn from the study. *Recommendations* are made for future studies and *Limitations* experienced in the study.

1.8. SUMMARY

Chapter 1 described a phenomenon identified in the literature and observed in clinical practice, which gave rise to the study aim. The researcher outlined the method of research used to answer the set questions and ethical considerations relating to the study. The significance, i.e. the value, of the study was highlighted and a chapter overview orientated the Magister dissertation.

Chapter 2 provides a systematic description of the literature relevant to the study.

CHAPTER 2
LITERATURE REVIEW

2.1. INTRODUCTION

Chapter 1 introduced and presented a general overview of the study and Magister dissertation. Chapter 2, the literature review, explains the theoretical perspectives and research findings relevant to this study. According to Leedy and Ormrod (2014:51), Maree (2007:26) and Mouton (2001:123) a literature review constitutes the theoretical basis of a study, clarifying the key concepts under study. Grove, Burns and Gray (2013:40) elaborate that a literature review enables a researcher to identify what has been investigated and what needs to be investigated in order to address knowledge gaps for evidence-based practice.

This literature review aims to clarify and discuss visual perception and related aspects, the DTVP-2 standardised measurement instrument and the SA population in particular the COT population.

2.2. VISUAL PERCEPTION

Section 2.2 defines visual perception. After which a review of the development of visual perception, outcomes of difficulties in visual perception and assessment of visual perception are discussed.

2.2.1. Defining visual perception

According to the Occupational Therapy Practice Framework (American Occupational Therapy Association 2014:S7-S8) visual perception is an occupational performance skill needed to support engagement and participation in daily life occupations. The American

Optometric Association (2010:19) defines visual perception as an active process where visual information is located, selected, extracted, analysed, recalled and manipulated from the environment. Visual perception is therefore the brain's ability to make sense of, and give meaning to, what is seen by the eyes (Muiños-Durán, Vidal-López, Rodán-González, Rifá-Giribet, Codina-Fossas, García-Montero, Gimeno-Galindo & Javaloyes-Moreno 2009:1). Furthermore, visual perception is described by Hammill and colleagues (1993:1-2) as the transition of information between the senses and cognition; i.e. the process of the brain to organise and understand a visual stimulus. Likewise, Zaba (1984:184) defines "visual perception" as "the total process responsible for the reception and cognition of visual stimuli". Visual perception is defined by Beery and Beery (2010:11) as the transitional step linking visual sensation and cognition that interprets visual stimuli. Schneck (2010b:373) affirms these definitions by stating that visual perception is dependent on a visual-receptive component (i.e. the sensory function) and visual-cognitive component (i.e. the mental function). The visual-receptive component extracts and organises background information, while the visual-cognitive component is the ability to classify, arrange and understand what is observed.

Therefore, in defining "visual perception" authors agree that 2 distinctive constructs – i.e. sensory processing and cognitive processing tasks – are seen comprising visual perception. For the purpose of this study, selected constructs of the visual-cognitive component of visual perception are further discussed. According to Schneck (2010a:359) the visual-cognitive component can be classified into smaller constructs. These constructs are: visual attention, visual memory, visual discrimination, visual imagery and integrated functions. Visual discrimination is differentiated into object perception and spatial perception, where object perception comprises FC, VC, basic concepts and FG components. Similarly, spatial perception is differentiated and comprises PS, SR, depth perception and topographic orientation components (Schneck 2010a:359). The composition of the visual-cognitive function is illustrated in Figure 2.1.

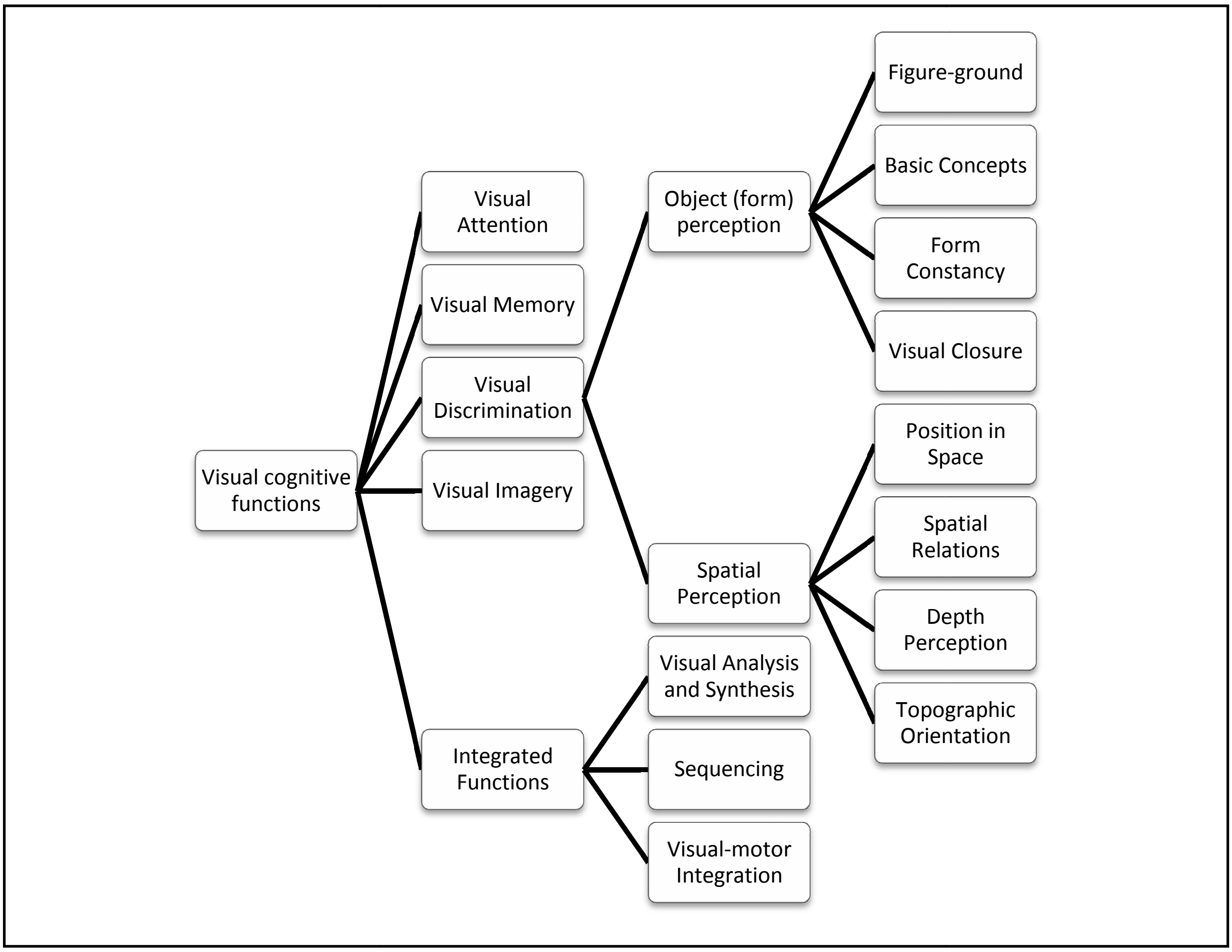


Figure 2.1. Composition of visual cognitive functions (Janse van Rensburg 2012:42)

Visual perceptual components relevant to this study are further theoretically defined as skills. **Form constancy,** is the ability to recognise, sort, or to name the same forms, objects or symbols regardless of its environment, shading, rotation or size and the application thereof in objects (Lambert 2013:16; Schneck 2010a:359). **Visual closure** is the ability to mentally identify and complete an incomplete, broken up or disorganised picture, figure, shape, symbol, word or sentence (Lambert 2013:18-19; Mostert 2000:3). **Figure-ground** is the ability to focus the eyes on specific objects or information in order to distinguish the foreground from the background (Lambert 2013:17; Schneck 2010a:359). **Position in space** is the awareness and understanding of one's body position towards figures or objects; i.e. in or out, up or down, in front, between or behind, left or right (Lambert 2013:17; Schneck 2010a:359). **Spatial**

relations is the ability to apply direction to objects, as well as to see the relation between objects (Schneck 2010a:360).

Hence, visual perception provides meaning to what is visually seen. However, when visual perceptual skills are combined with fine motor movements, reference is made to "VMI" (Brown & Hockey 2013:426). Visual-motor integration, along with visual analysis and synthesis, and sequencing, comprise integrated functions of the visual-cognitive component as illustrated in Figure 2.1 (Janse van Rensburg 2012:42). Beery and Beery (2010:13) define **VMI** as the coordination of visual perception and finger-hand movements. The American Optometric Association (2010:21) furthermore differentiates VMI into visual analysis, EH and visual conceptualisation. Lotz, Loxton and Naidoo (2005:63) affirm that VMI relies on **EH**. According to Schneck (2010a:361), VMS are also dependent on visual perception. Although all these visual perceptual components are theoretically differentiated, they are interrelated (Brown & Hockey 2013:426).

Therefore, visual perceptual skills enable visual functioning in the environment, thus playing an integral part in participation in and execution of all occupations. Adequate visual perceptual development is necessary in order to function optimally and/or to comply with the demands of occupational spheres.

2.2.2. Development of visual perceptual skills

Visual perceptual skills develop according to a specific hierarchy along a continuum (Schneck 2010a:352). However, the tempo at which children develop visual perceptual skills vary (Schneck 2010b:379). Additionally, it is of significance to consider that children from diverse cultural backgrounds develop at different tempos (Guntayuong *et al.* 2013:114) and that cultural diversity influences the interpretation of children's perceptual development (Cheung *et al.* 2005:31). According to Clutten (2009:29), Eksteen (2007:14) and Schneck (2010a:354) visual perceptual development is furthermore influenced by age, gender, roles, frame of mind, values, motives, prejudice, personality, language, cognition, religion, custom, life experiences, environmental circumstances, as well as sensory factors.

Moreover, Schneck (2010a:354) classifies these influences according to an acquisitional, i.e. influential; or developmental, i.e. maturational, theory. The acquisitional theory proposes that visual perceptual skill development is influenced by stimulation through children's surroundings and upbringing such as life experiences, environmental circumstances and cultural background (Schneck 2010a:354). Likewise, Rens (2008:8-9) emphasises that culture and socio-economic status (SES) are important considerations, in view of the fact that these influences constitute part of children's surroundings and upbringing. Schneck's (2010a:352) developmental theory has visual perceptual skills being dependent on age, developing from birth, and maturing with age. This maturational development is supported by Beery and Beery (2010:167-175), who provide a detailed month-to-month description of visual-, as well as visual-motor development from birth to 5 years 11 months in the Manual of the Beery VMI – 6th edition (Beery & Beery 2010).

However, authors differ regarding the age when visual perceptual skills develop (Van Romburgh 2006:25). According to Eksteen (2007:1), visual perceptual skills predominantly develop between the ages of 5 years and 8 years, and are regarded as complete by the age of 10 years to 11 years (Burtner *et al.* 1997:43). Schneck (2010b:379) states that most developmental changes take place at 9 years. Table 2.1 illustrates this development and also differentiates between genders in the acquisition of visual perceptual skills.

Table 2.1: Developmental ages for visual perceptual skills (Adapted from Schneck 2005:419; Schneck 2010a:352)

PERCEPTION	DEVELOPMENTAL AGE		TREND OF DEVELOPMENT
OBJECT (FORM)			
Form constancy		3 years	Sort objects according to dimension
	Girls	5 – 8 years	Improves dramatically
		9 – 10 years	Plateaus
	Boys	5 – 7 years	Gradual improvement
		7 – 9 years	Slight plateau
Visual closure			
		4 months	Able to perceive partial hidden objects
		4 years	Recognise simple incomplete figures
		6 years	Recognise more complex incomplete figures
Figure-ground			
		3 – 5 years	Improves
	Girls	5 – 8 years	Improves steadily
	Boys	5 – 7 years	Great improvement
		7 – 8 years	Slight improvement
	Both	8 years	Stabilisation of growth
SPATIAL			
Position in space		6 – 7 years	Left-right concepts
		8 years	Directionality
	Both	5 – 6 years	Same rate of development
		9 years	Reaching plateau
Spatial relations		4 – 8 months	Reach out accurately
		3 years	Understand basic size
	Girls	7 years	Understand time and space concepts
	Boys	Up to 8 years	Improvement
		5 – 10 years	Linear trend

Table 2.1 outlines the major developmental phases of visual perceptual skills, although visual perception develops continuously from birth until it reaches a plateau at approximately 12 years of age (Guntayuong *et al.* 2013:119). According to Burtner *et al.* (1997:43), little variance is reported in visual perceptual test scores after 12 years, which would imply that little development of visual perceptual skills takes place after 12 years of age.

Visual perceptual skills and VMI develop separately (Brown and Hockey (2013:426), even though visual perception and VMI correlate closely. Witthaus (2002:20) corroborates that VMI development is dependent on sufficient development of visual perceptual skills, alongside adequate motor development. In addition, Lotz *et al.* (2005:64) affirm that VMI matures with age and differences between genders exist.

To summarise, visual perceptual development is subjected to acquisitional and developmental factors. An interplay between these, as well as other biomedical factors, could lead to failure to develop visual perceptual skills at the typical developmental age, resulting in difficulties in visual perceptual skills and hindering, as a result, occupational performance. Possible difficulties that could be experienced in visual perceptual skills are discussed in 2.2.3.

2.2.3. Difficulties in visual perceptual skills

Possible difficulties are described according to the visual perceptual components relevant to this study. These components are described below.

Difficulties in **FC** may result in finding it hard to distinguish similar shapes – for example, circle and oval – or to project a shape onto an everyday object such as a door that is rectangular. With regard to academic performance, a child could confuse similar-looking letters, numbers or words, have a difficulty to read fluently (words are spelled rather than read as a whole), as well as experience difficulty to recognise that a maths sum written vertically is the same as the sum written horizontally (Lambert 2013:16; Mostert 2000:1). Possible **VC** difficulties could present as a child that cannot complete letters, numbers, words or sentences in reading or writing, does not make use of punctuation, only reads half of a comprehension story, does not read the full exam question or struggles with fractions (Lambert 2013:18-19; Mostert 2000:3). Difficulties in **FG** could result in a child finding it difficult to find the correct pencil among other stationery or the correct answers in a reading comprehension, experience difficulty to look up words in a dictionary or find places on a map, inaccurately copy from the blackboard, have difficulty understanding detailed pictures or diagrams, confuse the numbering of a math sum with the sum and/or appear to be distractible and disorganised (Lambert 2013:18; Mostert 2000:2). Difficulties in **PS** and **SR** could result in confusion and/or reversal of letters, numbers and vowels like b/d, 6/9 and ou/uo respectively when reading, writing or spelling. A child could have poor judgement of spacing when writing, reads from the right to the left or have difficulty providing directions (Lambert 2013:17-18; Mostert 2000:4). A child may also have difficulty to position himself or herself and confuse direction when participating in sports games. With regards to **VMI**, a child could perform poorly at sport, present with poor and/or slow handwriting, struggle with reasoning, word sums and copying from the board or a book (Lambert 2013:19).

Evidently, difficulties in visual perceptual component skills could hinder occupations such as manipulating scissors, colouring, pasting, constructing, hitting a ball, and building puzzles. Tying shoelaces, closing fasteners, brushing and styling hair, eating, placing toothpaste on a toothbrush, dressing and undressing, finding objects, and organising and folding clothes are other illustrations of this difficulty (Schneck 2010a:350; Schneck 2010b:384-385). Immature visual perceptual- and visual-motor skills can impact on academic performance such as reading, spelling, writing and mathematical abilities (Schneck 2010a:350; Schneck 2010b:385).

Difficulties in visual perceptual skills may also have an interdependent effect on motor abilities such as posture, mobility, bilateral manipulation and coordination, as well as on cognitive processing skills such as knowledge and organisation (Schneck 2010b:377,384). Therefore, children with diagnosed sensory- and/or motor impairments such as cerebral palsy, learning disabilities, developmental coordination disorder and autism commonly experience difficulties in visual perception (Guntayuong *et al*. 2013:114). As a consequence they perform below average on measurement instruments in relation to their age-related peers.

It is imperative for paediatric OTs to assess the incidence, degree and impact of visual perceptual skill impairments accurately in children (Brown, Davies & Rodger 2008:503) as under-identification of visual perceptual skill difficulties can have consequences such as misdiagnosis or the child not receiving therapy (Eksteen 2007:3; Rens 2008:2). Over-identification can lead to immoderate recommendations, resulting in misuse of educational and medical resources (Rens 2008:2). It is furthermore crucial to make use of culturally suitable measurement instruments when assessing visual perceptual skills (Thorley & Mui Lim 2011:3) since cultural diversity influences the interpretation of children's perceptual development (Cheung *et al*. 2005:31), which could lead to under- or over-identification of visual perceptual difficulties. Assessment practices in paediatric OTx are discussed in 2.2.4.

2.2.4. Assessment of visual perceptual skills

Paediatric OTs make use of non-standardised- and standardised assessment methods to assess visual perceptual- and VMI skills in order to establish eligibility for therapy, to select and plan the most appropriate treatment intervention or to monitor therapeutic progress (Richardson 2010:216,218). Non-standardised assessments are conducted by means of age-related checklists and informal observations during specific activity participation, while standardised measurement instruments assess children's performance according to set administration and scoring guidelines (Richardson 2010:216, 221).

Standardised measurement instruments are either classified as norm-referenced- or criterion-referenced tests (Richardson 2010:221). For the purpose of this study, norm-referenced tests are further defined as measurement instruments that are founded on a normative sample – the sample population from who normative scores are derived from and that subsequent test-takers test performance is measured against (Joint Committee on Standards for Educational and Psychological Testing 1999; Richardson 2010:221). According to Thorley and Mui Lim (2011:3) most measurement instruments are standardised on the American population. This practice implies that all children who are assessed with a standardised measurement instrument have their developmental level most likely compared to the American population. Richardson (2010:239) argues that children from diverse cultures and/or countries perform differently on standardised measurement instruments developed in America. This difference in test performance was illustrated in 5 subtests of the SIPT with a SA sample (n = 775) performing better than the American normative sample (Van Jaarsveld *et al*. 2012:16-17). However, despite identified differences in test performance, standardised measurement instruments are continuously used internationally. The use of standardised measurement instruments in SA is further discussed.

Paediatric OTs in SA make use of measurement instruments standardised in other countries as a result of few locally developed and/or adapted standardised measurement instruments available. In addition, owing to the high costs involved in developing and standardising measurement instruments (Eksteen 2007:1,20), SA OTs frequently make use of, in order of preference (Van der Merwe *et al*. 2011:7): the Beery VMI (Beery *et al*. 2004), DTVP-2 (Hammill *et al*. 1993), TVPS-R (Gardner 1996), the SCSIT / SIPT (Ayres 1989) and the Goodenough-Harris DAP (Harris 1963). Although updated editions of the Beery VMI, DTVP-2 and the TVPS-R have been published, the updated versions of these measurement instruments are not always widely known and/or used in SA.

However, OTs and other health professionals in SA have realised the need for valid and reliable measurement instruments specific to the SA population. A few attempts have been conducted by SA researchers and/or clinicians to develop more suitable measures specifically for the SA population. First, the Early Childhood Development Criteria (ECDC) (Herbst & Huysamen 2000), originally known as the Herbst Test (Herbst, Schoeman & Huysamen 1993), was standardised in SA for 3- to 6-year-old children from diverse cultural backgrounds and living in low socio-economic environments. Second, a component of the Beery VMI – 4th Edition (Beery 1997) – specifically between 7 years 0 months and 7 years 3 months – has been standardised in the Eastern Cape (Rens 2008) particularly for the SA population. Third, Clutten (2009) attempted to construct a visual perceptual measurement instrument; i.e. the Visual perceptual Aspects Test (VPAT), specifically for foundation phase (grade 1 – 3) children for the SA population.

Considering the research outlined immediately above, it can be derived that SA OTs still do not have access to a comprehensive visual perceptual skills measurement instrument, inclusive of pre-school children to those of school going age, that has been standardised on a representative SA population with regard to age, culture, geographic setting, language or SES. For this reason, SA OTs are obliged to rely on internationally available standardised measurement instruments.

From the standardised measurement instruments frequently used in SA to measure children's visual perception- and VMI skills, SA OTs prefer and make use of the DTVP-2 more frequently than OTs in other countries (Van der Merwe *et al*. 2011:8,9). Availability, ease of use, time limits and professional bias motivate the use of the test. It is also argued that the DTVP-2 has well established psychometric properties. Furthermore, when comparing the contents of the DTVP-2 with other visual perceptual measurement instruments, the DTVP-2 is regarded as more comprehensive since it comprises 8 subtests that assess 6 constructs of visual perception (Cheung *et al*. 2005:31). The DTVP-2's contents and psychometric properties are thoroughly analysed under Section 2.3.

2.3. Developmental Test of Visual Perception – second edition

2.3.1. Overview

The DTVP-2 (Hammill *et al*. 1993) was developed as a revision of the Developmental Test of Visual Perception (DTVP) (Frostig, Lefever & Whittlesey 1966) (Hammill *et al*. 1993:vii) for children aged 4 years and 0 months to 10 years and 11 months. Professionals with formal training in evaluations, such as OTs, psychologists, educators and diagnosticians (Hammill *et al*. 1993:5), make use of the DTVP-2 to establish the incidence and extent of children's visual perceptual- or VMI skill difficulties, to refer, to validate the efficacy of intervention programmes and for research (Hammill *et al*. 1993:5-7). The test is individually administrated and it takes test-takers about 30 to 60 minutes to complete.

The DTVP-2 is regarded as well designed, easy to follow and administer (Guntayuong *et al.* 2013:114) and is considered a valuable measurement instrument (Visser *et al.* 2012:21). The DTVP-2 is furthermore regarded as clinically useful since the DTVP-2 descriptively measures visual perceptual- and VMI skills (Burtner *et al.* 1997:43): EH-, PS-, CO-, FG-, SR-, VC-, VMS- and FC skills by means of motor-reduced (motor-free)- and motor-enhanced subtests (Hammill *et al.* 1993:5-6). Table 2.2 illustrates the constructs the DTVP-2 comprises.

Table 2.2. Constructs of the DTVP-2 subtests (Adapted from Hammill *et al.* 1993:6)

DTVP-2	Motor-Reduced	Motor-Enhanced
Subtest 1: Eye-hand Coordination		✓
Subtest 2: Position In Space	✓	
Subtest 3: Coping		✓
Subtest 4: Figure Ground	✓	
Subtest 5: Spatial Relationships		✓
Subtest 6: Visual Closure	✓	
Subtest 7: Visual Motor Speed		✓
Subtest 8: Form Constancy	✓	

Subtest 1 (EH) comprises 4 items (52 segments) in which the skill to draw straight or curved lines accurately (within set perimeters) are assessed. Subtest 2 (PS) comprises 25 items and assesses the skill to find two matching shapes with specific attributes. Subtest 3 (CO) comprises 20 items and assesses the skill to copy a drawing based on certain elements of the drawing. Subtest 4 (FG) comprises 18 items measuring the skill to distinguish specific shapes from perplexing environments. Subtest 5 (SR) comprises 10 items in which the skill to join dots are assessed in order to replicate a given example. Subtest 6 (VC) comprises 20 items and assesses the skill to identify a partially drawn shape. Subtest 7 (VMS) assesses the speed with which a child draws specific markings inside specific shapes. Subtest 8 (FC) comprises 20 items and measures the skill to find two matching shapes with differing dimensions (Hammill *et al.* 1993:26)

Administration of test items commences from item 1 in each subtest since the DTVP-2 has no basals. Different ceiling rules apply for the individual subtests of the DTVP-2: subtest 1 has no ceiling rule and all items are administered; in subtests 3 and 5 testing is continued until a ceiling of 0 correct in 3 consecutive items are reached, while subtest 7 has no ceiling rule, but a 1-minute time constraint applies. The motor-reduced subtests – i.e. subtests 2, 4, 6 and 8 – are administered until the test-taker achieves a ceiling point of 3 missed out of 5 consecutive items (Hammill *et al*. 1993:8-17).

Different scoring criteria apply to the individual subtests of the DTVP-2. For subtest 1, item 1 is scored by awarding 1 point for each segment. For items 2 to 4, the segments are scored by awarding 4, 3, 2 or 1, depending on the line interval in which the pencil mark occurs. A descending number is awarded when "the line is considered in an adjacent interval if you can see white space between the pencil mark and the track line" (Hammill *et al*. 1993:10). For the third subtest, a 2, 1, or 0 score is awarded, depending on the quality of the drawing (Hammill *et al*. 1993:11). Subtest 5 is scored by awarding 1 point per dot that the pencil marks touch for reasonable attempts to copy the design (Hammill *et al*. 1993:11). Subtest 7 is scored by awarding 1 point for the correct marking in each shape that does not extend past the shape's edge (Hammill *et al*. 1993:16-17). The motor-reduced subtests (subtests 2, 4, 6 and 8) are dichotomously scored, meaning that correct items answered are allocated a 1 and incorrect answers a 0. The subtests are individually calculated in order to generate a total raw score (RS) for each subtest.

Raw scores obtained can be converted to an age equivalent, percentile and/or standard score (SS) by means of normative tables in the Examiner's Manual of the DTVP-2. Subtest SSs are either allocated as motor-reduced to constitute part of the MRPQ or as motor-enhanced to comprise the VMIQ. A GVPQ is generated by means of combining the SSs of all the subtests (Hammill *et al*. 1993:21).

The subtest SSs and composite quotients of the DTVP-2 can be compared with one another. All the subtests have a mean of 10 with a standard deviation (SD) of 3 (Hammill *et al*. 1993:24). Table 2.3 illustrate the interpretation of subtest SSs.

Table 2.3. Interpretation of subtest standard scores (Hammill *et al.* 1993:24)

Standard scores	Descriptive ratings	Percentage included
17 – 20	Very Superior	2.34
15 – 16	Superior	6.87
13 – 14	Above Average	16.12 (75th percentile)
8 – 12	Average	49.51 (50th percentile)
6 – 7	Below Average	16.12 (25th percentile)
4 – 5	Poor	6.87
1 – 3	Very Poor	2.34

Composites have a mean of 100 with a SD of 10 (Hammill *et al.* 1993:24). Table 2.4 illustrate the interpretation of composite quotients.

Table 2.4. Interpretation of composite quotients (Hammill *et al.* 1993:24)

Composite quotients	Descriptive ratings	Percentage included
>130	Very Superior	2.34
121 – 130	Superior	6.87
111 – 120	Above Average	16.12 (75th percentile)
90 – 110	Average	49.51 (50th percentile)
80 – 89	Below Average	16.12 (25th percentile)
70 – 79	Poor	6.87
<70	Very Poor	2.34

The subtest SSs and composite quotients of the DTVP-2 can also be compared with other standardised measurement instrument scores using an equivalent score distribution (Hammill *et al.* 1993:29). According to Hammill and colleagues (1993:24-25), the most useful and highly reliable DTVP-2 scores are the composite quotients, which should be emphasised rather than subtest SSs. In contrast, Brown and colleagues (2008:511) state that the composite quotients should not be used to calculate the GVPQ or MRPQ, as the MRPQ is multidimensional. Individual SSs should rather be used to generate a profile of visual perceptual skills, but healthcare professionals should interpret scores with caution (Brown *et al.* 2008:511). As a result of these conflicting viewpoints, the psychometric properties of the DTVP-2 are examined in Section 2.3.2.

2.3.2. Psychometric properties of the DTVP-2

"Psychometric properties" refers to the reliability and validity of standardised measurement instruments, which provide an indication of a test's accuracy (Brown & Hockey 2013:429). The statistical values obtained and described under reliability and validity are based on the normative sample of the DTVP-2. This sample is described in Section 2.3.2.1. Sections 2.3.2.2 and 2.3.2.3 respectively examine the reliability and validity of the DTVP-2.

2.3.2.1 Normative sample of the DTVP-2

The DTVP-2 was developed and standardised in 1992 on a sample of 1972 English-speaking children, residing in 12 American states. Children with disabilities constituted 3% of the sample (Hammill *et al.* 1993:29). The characteristics of the normative sample are reported in Table 2.5 and are stratified according to age, ethnicity, geographic region, gender, race, residence and handedness.

Table 2.5. Demographic characteristics of the normative sample (adapted from Hammill *et al*. 1993:30)

Characteristics	Percentage of sample
Race	
White	84
Black	13
Other	03
Ethnicity	
Native American	01
Hispanic	12
Oriental/Pacific Island	03
African-American	12
Other	72
Gender	
Male	51
Female	49
Residence	
Urban	76
Rural	24
Geographic area	
Northeast	22
North Central	24
South	33
West	21
Handedness	
Right	90
Left	10
Age (Number of cases)	
4 (100)	05
5 (240)	12
6 (244)	12
7 (309)	16
8 (324)	16
9 (467)	24
10 (288)	15

Although it is important to consider and report the SES of the normative sample, no mention is made of the SES of the normative sample in the Examiners Manual of the DTVP-2 (Hammill *et al*. 1993). The normative sample characteristics are summarised as primarily white, comprising English-speaking children from cultures inherent to the American population and residing mainly in urban settings.

"The reliability and validity of a test can be ensured only if the test is administered to the prescribed population, under the prescribed conditions and in the prescribed manner. Once any of these conditions have been changed the test cannot claim to be as reliable" (Eksteen 2007:3). The reliability of the DTVP-2 can be examined once the population on which the DTVP-2 was standardised is known.

2.3.2.2 Reliability

According to Polit and Beck (2010:566), "reliability" refers to the stability and/or constancy of a measurement instrument when a characteristic is measured. Burtner *et al.* (1997:52) state that reliability coefficients provide clinicians with information concerning "how well all items measure the same variable". A large reliability coefficient contains little measurement error and vice versa. Therefore, measurement instruments must demonstrate adequate reliability values in order to interpret results correctly. In order to be considered reliable the following guidelines are accepted:

- >.90 – most desirable reliability
- >.80 – high reliability (acceptable)
- .50 – .80 – moderate reliability (acceptable)
- <.50 – low reliability (unacceptable) (Burtner *et al.* 1997:52; Leedy & Ormrod 2014:93; Maree 2007:215-216).

According to Burtner *et al.* (1997:51) correlation coefficient alphas should exceed .80 when the reliability of measurement instruments is studied.

The DTVP-2 reports 3 types of reliability: (a) internal consistency, (b) test-retest reliability and (c) inter-rater reliability (Hammill *et al.* 1993:33), which are discussed in this order immediately below.

a) Internal consistency

Internal consistency is referred to as "content sampling" in the Examiner Manual of the DTVP-2 (Hammill *et al*. 1993:33) and reflects the level of homogeneousness among test items. In order to establish homogeneousness, internal-consistency reliability of test items is examined. A high level of homogeneousness should exist among test-item correlation (Hammill *et al*. 1993:33; Maree 2007:216). Internal consistency is calculated by means of Cronbach's coefficient alphas. The DTVP-2 subtests demonstrate acceptable, moderate to high reliability mean alphas ranging from .83 to .95, while composite mean coefficient alphas exceed .90 (Hammill *et al*. 1993:33).

b) Test-retest reliability

Test-retest reliability is referred to as "time sampling" in the Examiner Manual of the DTVP-2 (Hammill *et al*. 1993:35) and refers to the degree that the test performance of a child is invariable over a point in time. Hammill and colleagues (1993:35) state "that this form of reliability shows the extent to which scores on a test can be generalized over different occasions; the higher the reliability, the less susceptible the scores are to random daily changes in the conditions of the examinee or the testing environment" (Hammill *et al*. 1993:35). Hammill *et al*. (1993:35) established test-retest reliability by testing 88 students, aged between 4 years and 10 years, twice within 2 weeks. Subtest scores range between .80 to .92 and .93 to .96 for the composite scores, providing adequate evidence of moderate and high test-retest reliability respectively (Hammill *et al*. 1993:35).

c) Inter-rater reliability

Inter-rater reliability is referred to as "interscorer reliability" in the Examiner Manual of the DTVP-2 (Hammill *et al*. 1993:35) and involves the degree to which different scorers draw the same judgments from the same measurement instrument (Hammill 1993:35; Leedy & Ormrod 2014:93). Firstly, clerical errors could cause erroneousness. A second cause of error is the various motor-enhanced subtests of the DTVP-2 that require subjective judgments. Hammill *et al*. (1993:35-36) established inter-rater reliability by scoring the same (as above) 88 completed DTVP-2 protocols by two independent individuals. Subtest correlated coefficient scores range between .87 and .98, and .95 to .98 for the composite scores (Hammill *et al*. 1993:35-36).

The DTVP-2's overall, as well as the 5-year-old age interval reliability (for the purpose of the study), is shown in Table 2.6. According to Hammill and colleagues (1993:36), the average coefficients best represent the DTVP-2's reliability.

Table 2.6. Overview of the DTVP-2's reliability (adapted from Hammill *et al*. 1993:34,36)

DTVP-2 subtests and composites	Sources of test error			Overall average	5-year-age-interval
	Internal consistency	Test-retest reliability	Inter-rater reliability		
Eye-hand coordination	90	87	90	89	93
Position in space	88	87	95	91	92
Coping	91	80	87	87	93
Figure-ground	83	92	96	92	83
Spatial relations	94	92	90	92	97
Visual closure	88	89	97	93	88
Visual-motor speed	95	88	93	92	94
Form constancy	89	89	98	94	91
Motor-reduced visual perception	94	95	98	96	95
Visual-motor integration	96	93	95	95	97
General visual perception	97	96	98	97	98

From Table 2.6 it can be derived that the DTVP-2 has well established reliability. However, a measurement instrument's reliability poses a threat to its validity (Maree 2007:218). Beery & Beery (2010:13) state that "a test can only be as valid as it is reliable". The validity of the DTVP-2 is discussed in Section 2.3.2.3.

2.3.2.3. Validity

"Validity" refers to the degree to which a measurement instrument measures the intended variable (Leedy & Ormrod 2014:91; Maree 2007:216). Content-, criterion-related- and construct validity of the DTVP-2 is established. The different types of validity are described in the paragraphs that follow this one.

a) Content validity

Content validity is the extent to which the items in a test accurately sample a particular behaviour domain. Content validity is established by review of the test content by experts in the field, who reach some agreement that the content is in fact representative of the behavioural domain to be measured. Measurement instruments exhibit significant content validity when diverse elements of the domain are reflected in suitable quantities in test items and if specific behaviour and skills, fundamental to the domain, are required (Leedy & Ormrod 2014:91). Content validity is demonstrated by a detailed rationale (qualitative evidence) for subtest content and format selection, as well as an item analysis (quantitative evidence) of an experimental and the final (current) version of the test (Hammill *et al*. 1993:37-40). According to the experimental version item-discrimination-analysis results, Hammill and colleagues (1993:40-41) discarded the unsatisfactory items and placed the satisfactory items in sequence of easy to difficult to comprise the final DTVP-2 test version. The final test involves analysing items of 100 randomly selected protocols at each age interval. Resulting item discrimination coefficients range from .31 to .75, hence deemed statistically significant (Hammill *et al*. 1993:40-41).

b) Criterion-related validity

Criterion-related validity comprises concurrent validity and predictive validity. Concurrent validity entails a comparison of related characteristics among different measurement instruments, while predictive validity involves the prediction of a child's performance in the future (Hammill *et al*. 1993:40). Concurrent validity of the DTVP-2 is established by correlating the Motor Free Visual Perception Test (MVPT) (Colarusso & Hammill 1972) and the Beery VMI (Beery 1989). The DTVP-2 subtest mean coefficients and the MVPT and Beery VMI total scores yield a high correlation of .65. A higher level of correlation of .89 exists between the Beery VMI and the VMIQ of the DTVP-2, and .73 between the MVPT and MRPQ of the DTVP-2. The GVPQ of the DTVP-2 correlates .78 with the MVPT and .87 with the Beery VMI. Predictive validity has not yet been established and still has to be explored. The DTVP-2's authors anticipate research of the validity of the DTVP-2 in other populations (Hammill *et al*. 1993:40).

c) Construct validity

Construct validity refers to the extent to which different groups of related items measure the constructs of a measurement instrument that assumedly exists, but cannot be directly examined (Leedy & Ormrod 2014:92; Maree 2007:217). Construct validity of the DTVP-2 is examined by means of exploring 6 constructs fundamental to the DTVP-2. These 6 constructs are: age differentiation, interrelationships among DTVP-2 values, relationship of the DTVP-2 to cognitive-ability tests, group differentiation, factor analysis and item validity. Subtest RSs increase, as expected, according to children's age, as set out in Table 2.7. Correlations between subtest scores and children's age range from .43 to .65 and are, therefore, considered as highly significant (p<.01) (Hammill *et al*. 1993:41).

Table 2.7. Mean raw scores for DTVP-2 subtests according to age (adapted from Hammill *et al*. 1993:42)

	Raw score according to age						
DTVP-2 subtests	4	5	6	7	8	9	10
Eye-hand coordination	100	126	140	154	160	164	168
Position in space	9	13	18	19	20	22	23
Copying	7	16	22	24	27	29	31
Figure-ground	8	9	10	12	12	13	14
Spatial relations	8	21	33	38	39	40	41
Visual closure	4	7	10	12	13	15	16
Visual-motor speed	3	6	9	11	14	17	19
Form constancy	4	8	11	12	13	14	16

Inter-correlation of subtests yield significant (p<.01) coefficient scores between .10 and .57. Although a low degree of relation among subtests are indicated, different constructs of visual perception are measured. DTVP-2 scores also compared with achievement and intelligence measurement scores of the National Teacher Assessment and Referral Scales (NTARS) (Hammill & Hresko 1993), the Comprehensive Tests of Basic Skills (CTBS) (CTB/McGraw-Hill 1989) and the Wechsler Intelligence Scale for Children – Revised (WISC-R) (Wechsler 1974). A low degree of correlation exists, as indicated by research, which therefore suggests construct validity (Hammill *et al.* 1993:42-44). Discriminant validity is calculated by examining the scores of 49 neurologically impaired children, a group known to have deficiencies in perceptual-motor abilities. Below-average scores provide evidence of construct validity (Hammill *et al.* 1993:44). Results of 2 factor analysis studies, utilising eigenvalues greater than 1, provide confirmation that the DTVP-2 subtests are valid in measuring visual perception constructs (Hammill *et al.* 1993:44-45). Construct validity is lastly demonstrated by item-test correlation, as discussed under content validity (Hammill *et al.* 1993:45).

Hammill and colleagues (1993:47) investigated bias in the DTVP-2 for gender, race and handedness. Correlated coefficient subtest scores ranged from .97 to .99, .82 to .99 and .97 to .99 respectively, therefore providing evidence of no gender, race or handedness bias (Hammill *et al.* 1993:47).

By thorough examination of the DTVP-2's psychometric properties, it is evident that the DTVP-2 is a valid and reliable measurement instrument to measure visual perceptual- and VMI skills. However, the validity and reliability of the DTVP-2 relate to the American normative population – the reference population against which subsequent test-takers performance is measured. The suitability of the DTVP-2 for the SA population is therefore questioned as the SA population is not represented in the normative sample of the DTVP-2. Since the SA population differs from the American population, the SA population are overviewed in Section 2.4.

2.4. THE SOUTH AFRICAN POPULATION

South Africa, a developing/third world country, differs significantly with regards to ethnicity, culture, language and SES when compared to the population of America (Table 2.5), a developed/first world country, on which most measurement instruments are standardised.

According to Statistics South Africa (StatsSA 2014:2) the SA population comprises an estimated 54-million people of whom 51% are female. The population consists of approximately 80.2% African-, 8.8% Coloured-, 8.4% White- and 2.5% Indian/Asian people (StatsSA 2014:3).

South Africa recognises 11 official languages: Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sesotho sa Leboa, Sesotho, Setswana, siSwati, Tshivenda and Xitsonga (StatsSA 2012:25). IsiZulu is the most common home- or first language (L1), spoken by 22.7% of the population, followed by i6hosa 16.0%, Afrikaans 13.5%, English 9.6% and Sepedi 9.1% (StatsSA 2012:25).

According to Morrow, Jordaan and Fridjhon (2005:164), English is the most common second language (L2). South Africans prefer and consider English as the most important official language because of its widespread use in economics, government departments, institutions and services, the media and politics (Kallenbach 2007:10). This widespread use of English gives rise to parents/caregivers believing that English is paramount for children's language of learning and teaching (LOLT), which enforces English as children's L2 or third language (L3) (Nel & Theron 2008:203). As a result, more English L2 and L3 children attend ELOLT schools than English home language children. Morrow *et al*. (2005:164-165) differentiate and describe SA schools as non-urban or rural, urban-township and urban-suburban, as tabulated in Table 2.8.

Table 2.8. South African schools (Morrow *et al*. 2005:164-165)

Non-urban/rural schools	**Urban-township schools**	**Urban-suburban schools**
Located in rural geographical settings.	Located in townships and informal settlements near major metropolitan areas or cities.	Located in the suburbs of major metropolitan areas or cities. (Also Referred to as former "Model C" schools.)
Attended by English L2 children.	Attended by English L2 children.	Attended by a diversity of English L1 and L2 children.
Utilise children's L1 and nominal English as LOLT.	Utilise children's L1 and English as LOLT.	Only English is utilised as LOLT.
Have poor educational resources.	Schools have limited educational resources.	Well resourced and managed.
Children have limited exposure to English outside the educational environment.	Educational and community support exists for children's L1 and English.	Children are taught by monolingual English teachers, with no to little support for other languages.

English is generally understood across the country, but the provincial distribution varies. South Africa is divided into 9 provinces: Eastern Cape, Free State, Gauteng, Kwa-Zulu Natal, Mpumalanga, Limpopo, North West, Northern Cape and Western Cape. From these provinces, Gauteng hosts the largest number; i.e. 23.9% of the SA population with an estimated 12,91 million people (StatsSA 2014:3) comprising 77.9% African, 3.5% Coloured, 2.9% Indian and 15.7% White people (StatsSA 2012:10).

Gauteng is furthermore sub-divided into 5 district municipalities, which are Johannesburg, the COT, Ekurhuleni, Sedibeng and West Rand (StatsSA 2012:10) of which the Johannesburg, Ekurhuleni and the COT is the province first, second and third largest municipalities respectively. Given that the researcher resides in the COT metropolitan municipality and had limited human resources, funding and time to conduct the study across SA in all 9 provinces and/or the Gauteng districts, this study was confined to the COT metropolitan municipality area. The demographic information of the COT is elaborated on in the remainder of Section 2.4.

The COT constitutes 24.2% of the Gauteng province population, comprising approximately 75.4% African, 2.0% Coloured, 1.8% Indian/Asian, 20.1% White and

0.7% other people (StatsSA online), with 49.8% males and 50.2% females (StatsSA 2012:9). The home language most often spoken in the COT is Sepedi (19.4%), followed by Afrikaans (18.4%), Setswana (14.7%), Xitsonga (8.4%) and English (8.4%) (StatsSA online). According to StatsSA (online), 89.3% of the COT population lives in urban areas. It is of relevance for this study to consider urban living in SA since the incidence, intensity and severity of poverty are the least in urban formal areas, in relation to urban-informal-, rural- and traditional settlement types (Human Sciences Research Council 2014:57-58).

Evidently the SA population and, in particular, the COT, differs significantly with regard to ethnicity, culture, language and SES when compared to the American norm population. Although specific population-group differences exist and SES did not constitute part of this study, it is of significance to consider these influences since SES constitutes part of a child's environment. According to Burtner and colleagues (1997:50-51), if a child's culture is inadequately represented in the normative sample, "test results should be interpreted with caution".

To date, adequate research has not been conducted in SA to investigate the extent of culture, language and SES on the DTVP-2's psychometric properties, or to establish norms specifically for the SA population. Despite the inadequate research, the use of the DTVP-2 in SA as a psychometric instrument was condoned by the HPCSA without the DTVP-2 having been assessed (HPCSA 2010:9).

Research conducted by Richmond and Holland (2011), Van Romburgh (2006), Visser (2005) and Visser *et al*. (2012) provides evidence for questioning the validity of the DTVP-2 in the SA context. Visser and colleagues (2012:23-24) established a statistically significant difference between the DTVP-2's VC and the 7 other subtests in typically developing English-speaking children aged 5 years and 6 months to 5 years and 11 months residing in Bloemfontein. Moreover, half of the typical developing children aged 5 years and 6 years residing in Johannesburg, scored below what is considered normal for their age cohort on the VC subtest of the DTVP-2 (Visser 2005:44). While 97.5% of

40 grade 1 typically developing Afrikaans-speaking Coloured children residing in a low SES community in Bloemfontein, experienced VC as their greatest visual perceptual difficulty (Van Romburgh 2006:75).

Visser *et al*. (2012:24) determined that 40% of 5-year-old English-speaking children scored below the normal score for their age, 57.5% obtained a normal score for their age, and 2.5% scored superior to their age-appropriate score in the VC subtest of the DTVP-2. In addition, Visser *et al*. (2012:24) established that if the prescribed ceiling rule is not adhered to as set out in the DTVP-2 Examiner's Manual, more accurate results for VC were obtained.

Richmond and Holland (2011:35-36) noted that the DTVP-2 and TVPS-R's VC subtest scores did not compare with each other and that the DTVP-2 scored significantly lower in remedial school grade 1 to grade 4 children residing in KwaZulu-Natal. Richmond and Holland (2011:35-36) queried the item linearity of the VC subtest. The researchers proposed that the DTVP-2 might possibly over-identify VC difficulties (Richmond & Holland 2011:35,37). Therefore, not only is the item linearity, but also the use of the ceiling rule for the VC subtest of the DTVP-2 questionable.

Even though VC has been identified as the biggest concern emanating from the DTVP-2, it is also noteworthy that 82.5% and 62.5% of 40 grade 1 children scored below average on the PS- and SR subtests of the DTVP-2 respectively (Van Romburgh 2006:58). Furthermore, 77.5%, 62.5% and 75% of these children scored average and above average on the CO-, FC- and VMS subtests of the DTVP-2 respectively (Van Romburgh 2006:58). Visser *et al*. (2012:23) established that 100% of the 5-year-old English-speaking children her group of researchers tested scored average and above average on the SR- and FC subtests, while 97.5% of the children scored average and above average on the EH-, CO- and FG subtests of the DTVP-2.

The validity of the DTVP-2 is not only questioned in SA. Cheung *et al*. (2005:38-39) reported distorted item difficulty in the DTVP-2's EH-, PS- and SR subtests for Hong Kong children. Additionally, Lai and Leung (2012:437) established that 5-year-old

Chinese children obtained high scores on the CO- and SR subtests of the DTVP-2, while 5-year-old English-speaking Australian children obtained the lowest mean score for the VC subtest of the DTVP-2. Guntayuong *et al*. (2013:113) found that Thai children scored similarly to their American counterparts with the exception of VMS, in which Thai children aged 4- to 5 years and 8- to 11 years scored higher. Guntayuong and colleagues (2013:113) reasoned that a difference in scores was the result of cultural and environmental experiences relating to, amongst other factors, learning the complex Chinese letter formation from an early age (Lai & Leung 2012:440-441).

Research (Cheung *et al*. 2005; Guntayuong *et al*. 2013; Lai & Leung 2012) provides ample evidence about the impact of culture and language on standardised measurement instruments. However, contrasting findings regarding the impact of gender performance on standardised measurement instruments are reported, although literature theoretically differentiates between genders in the development of visual perceptual skills as indicated in Table 2.1.

Richmond and Holland (2011), Van Romburgh (2006), Visser (2005) and Visser *et al*. (2012) did not differentiate and/or report findings on gender performance on the DTVP-2 in SA. Visser *et al*. (2012:25) recommended further investigation in view of the fact that Cheung *et al*. (2005:39) had noticed a difference in gender performance in the CO- and FG subtests of the DTVP-2 in Hong Kong children, with girls performing significantly better than boys. It would therefore be of significance to establish whether a difference in gender performance on the DTVP-2 is prevalent in SA, since differences in gender performance are reported in studies that make use of other standardised measurement instruments.

In a study conducted in the COT, Eksteen (2007:56) established that 8-year-old Afrikaans boys and girls performed differently from each other on the Motor-Free Visual-perceptual Test – 3rd edition (MVPT-3) (Colarusso & Hammill 2003) and that the MVPT-3 yields more reliable results for 8-year-old Afrikaans-speaking girls than boys. In addition, Lotz *et al*. (2005:65) established a statistically significant difference between genders in VMI, with boys obtaining higher scores on the Beery VMI and DAP respectively. Conversely, Rens (2008:48) established no statistical significant difference in the performance of Eastern Cape boys and girls on the Beery VMI.

Even though the psychometric properties of the DTVP-2 require extensive investigation in order to be considered a valid and reliable measurement instrument for the SA population, the DTVP-2 remains a useful measurement instrument. While it would be ideal to standardise the DTVP-2 on the SA population, standardisation will require numerous human- and financial resources across all provinces of SA, which could also be time consuming and possibly not sustainable as each new, updated version of the test would require standardisation. It is therefore argued that it would be more feasible and valuable to inform evidence-based practice by investigating the suitability of the DTVP-2 for the SA population. On the basis of the results of the current study, SA OTs might be able to adjust and/or be sensitive in their assessment procedures, interpretation and use of DTVP-2 test findings.

2.5. SUMMARY

Visual perception is a composite construct comprising various interrelated components enabling engagement and participation in activities of daily living (occupations). The development of visual perception is influenced by, among other factors, age, gender, culture and language. Children with difficulties in visual perceptual skills could experience limited occupational performance and, as a result, need to be assessed with visual perceptual measurement instruments, preferably suitable for the population. A measurement instrument frequently used by SA OTs, i.e. the DTVP-2, is a reliable and valid test for the population on which the test was standardised. However, the DTVP-2's suitability is questioned in a cross-cultural setting, specifically the SA population.

Chapter 3 describes the method of research, specifically the study design, study population, sample selection and size and research procedure. A pilot study, measurement, and ethical principles followed to investigate the suitability of the DTVP-2 for the SA population are also described.

CHAPTER 3

RESEARCH APPROACH AND METHOD OF RESEARCH

3.1 INTRODUCTION

Chapter 2 defined and overviewed visual perception with reference to the development of-, difficulties in- and assessment of visual perceptual skills. The DTVP-2, specifically the reliability and validity properties of the DTVP-2, was analysed. Last, the demographic information of the diverse SA population, in particular the COT, was outlined.

From the literature review it became evident that measurement instruments standardised in 1 country are not equally reliable and valid across countries and across cultures. However, since limited standardised visual perceptual measurement instruments are available specifically for the SA population, OTs in SA continue to make use of internationally available measurement instruments, such as the DTVP-2, despite research indicating a discrepancy in test performance. South African OTs may be unaware of this discrepancy and do not implement evidence-based practice. Visual perceptual difficulties are consequently under- or over-identified in SA children. As a result, the suitability of the DTVP-2 for the SA population is questioned.

The aim of this study was to investigate the suitability of the DTVP-2 as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT, SA.

In this chapter the method of research and ethical considerations applicable to this study are described thoroughly.

3.2 METHOD OF RESEARCH

Section 3.2 describes the study design, study population, sample selection and -size, the research procedure, pilot study and measurement.

3.2.1 Study design

The study design sets the framework of a study and clearly defines the method; i.e. the plan and the execution of the study in order to answer the research questions accurately (Grove *et al*. 2013:195; Polit & Beck 2010:222).

A quantitative research design was followed, which entailed the systematic and objective investigation of numeric quantities of measurable variables obtained from a sample population. The purpose of this method is to apply the findings universally to the broader population under investigation (Leedy & Ormrod 2014:97; Maree 2007:145). Quantitative research therefore contributes to the development of a knowledge structure (framework) and is essential for evidence-based practice (Grove *et al*. 2013:34).

Numeric quantities were obtained from 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT metropolitan municipality by means of: 1) a self-administered screening questionnaire to obtain children's background and/or demographic information; and 2) the DTVP-2 standardised measurement instrument to obtain data regarding the children's visual perceptual- and VMI skills. Quantitative data obtained was statistically analysed by means of various statistical procedures that enabled the researcher to draw conclusions and make recommendations regarding the suitability of the DTVP-2, as well as to evaluate the DTVP-2's generalisability for similar and other populations in SA.

Moreover, a descriptive, observational study was conducted. Descriptive research explores, observes, describes and records characteristics of an occurrence in a natural setting, thereby generating new knowledge about little known or unknown subject matters (Grove *et al*. 2013:49,215; Polit & Beck 2010:236). For this study, the performance of 5 years and 6 months to 5 years and 11 months English-speaking SA boys and girls on the DTVP-2 measurement instrument was observed and described, therefore generating new OTx evidence-based practice knowledge regarding the reliability and validity of the DTVP-2 in SA.

3.2.2 Study population

The study population constitutes the entities that meet the set inclusion criteria in a specified space (Grove *et al*. 2013:44). The researcher attempted to construct a sample from the SA population that was similar and/or comparable to the DTVP-2's normative sample from America.

Considering that the researcher resides in the COT, and for other practical execution reasons, this study was conducted in the COT metropolitan municipality area. The COT is also the third largest metropolitan municipality urban area in SA and comprising of many heterogeneous cultures from different SES backgrounds. The study population was further motivated in view of the fact that the performance of the COT population on the DTVP-2 has previously not been investigated and/or described in the literature, as suggested by Hammill *et al*. (1993:40) and Visser *et al*. (2012:25) who recommend investigating the validity of the DTVP-2 across countries and across cultures.

The study population focused particularly on English-language speakers given that the DTVP-2 was standardised in English and is not available in any other SA language. Josman, Abdallah and Engel-Yeger (2006:2) affirm that literal translation is insufficient when a measurement instrument is standardised for utilisation in another culture. According to Eksteen (2007:79), culture influences language and the interpretation thereof and can lead to misinterpretation of test instructions. Maree (2007:218) concur that cultural differences and language impact on test performance, as the meaning of test items are interpreted differently. It requires approximately 2 years of constantly speaking English on a daily basis to become proficient in basic English interpersonal-communication skills (Du Plessis & Louw 2008:57). In order to control the effect that language could have had on children's test instruction interpretation and performance, the study population focused on English L1, L2 and L3 children who had attended an ELOLT school for at least 2 years.

The GDE divides the COT metropolitan municipality geographical area into 4 educational districts – Gauteng North (GN), Tshwane North (TN), Tshwane South (TS) and Tshwane West (TW). Diverse ethnic-, culture- and language groups from different SES backgrounds reside across the 4 districts, which ensured representation of the SA population in the study sample. Urban-suburban schools located in these 4 districts were included in the study population, as these schools were located in the suburbs of a major metropolitan urban area, attended by a diversity of English L1 and L2 children, made use of ELOLT only, and are well resourced and managed (Table 2.8). Furthermore, the incidence, intensity and severity of poverty, which are indicators of SES, are the least in urban formal settlements (Human Sciences Research Council 2014:57-58), although the SES varies from middle-low to high in the various suburbs.

Ethnicity-, culture-, language- and SES variables were not included and controlled in the study since these variables would necessitate a larger study sample, which was beyond the feasibility of the study and scope of this Magister dissertation. Age and gender were controlled in the study. Firstly, by ensuring equal proportions of both genders in the study sample. Secondly, by including equal numbers of study participants within the 1 month intervals of 5 years and 6 months to 5 years and 11 months. The selection of these variables was motivated by the fact that visual perceptual skills demonstrate an increase in development from 5 years (Table 2.1) and studies conducted by Van Romburgh (2006), Visser (2005) and Visser *et al.* (2012) provide evidence of an inaccuracy in SSs in 5-year-old children. The study particularly focused on children aged from 5 years, 6 months and 0 days to 5 years, 11 months and 29 days. An in-depth analysis was conducted through examination and description of the results. The results were compared to the same age norm of the American data.

Because Cheung *et al.* (2005:40) identified a gender difference in the performance of Hong Kong boys and girls and the literature differentiates gender in the acquisition of visual perceptual skills (Table 2.1), boys and girls were included in this study. Boys and girls were included in equal numbers for each month interval and observed in this study in order to investigate gender performance on the DTVP-2 in the SA population.

From the study population, the study sample was selected that complied with the following inclusion- and exclusion criteria:

a) Inclusion criteria

Children were considered eligible as participants if they:

- Were between 5 years 6 months and 0 days and 5 years 11 months and 29 days on the day the DTVP-2 was administered;
- Could speak and understand English; and
- Had attended an urban-suburban school that used English as LOLT for at least 2 years.

b) Exclusion criteria

Children were not included in the study if they:

- Were children that parents/caregivers/teachers suspected had developmental delays or was an atypical developing child;
- Were children with a diagnosed sensory-, physical-, emotional-, intellectual impairment or any other condition not mentioned below that could influence participation and/or their results on the DTVP-2, such as:
  - Autism Spectrum Disorder

  - Attention Deficit Disorder / Attention Deficit Hyperactivity Disorder
  - Cerebral palsy
  - Down's syndrome
  - Learning disability
  - Psychiatric conditions such as Conduct Disorder or Oppositional Defiance Disorder.
- Had been tested with the DTVP-2 within the previous 6 months;
- Were children who had previously received or were currently receiving OTx or any other kind of therapy, such as paediatric optometry or Bio-Link, that could influence a child's visual perception;
- Had parents or caregivers that had not given informed consent for their child to participate in the study; and/or
- Were children who had not given assent to participate in the study.

3.2.3. Sample selection

The study sample constitutes a fraction of the study population chosen for the study (Grove *et al*. 2013:44) by means of sampling, which describes the procedure used to select a proportion of the study population under investigation (Maree 2007:79).

For this study, 5 years and 6 months and 5 years to 11 months English-speaking boys and girls from the COT metropolitan municipality urban area were selected by means of stratified random sampling. Stratified random sampling entails dividing the study population in more than 2 sections, i.e. strata, from which subjects are randomly selected in order to ensure representation in the study sample (Polit & Beck 2010:314).

The study population was divided into 4 strata according to the 4 educational districts the COT is divided into – GN, TN, TS and TW. The researcher compiled a list of ELOLT government- and independent primary- and nursery/pre-primary urban-suburban schools located across the 4 strata from which the study sample was randomly selected. The researcher made use of the GDE, the Yellow Pages, the Internet, word of mouth and community-information-search results, obtained from the Tshwane Community Library, to identify ELOLT nursery/pre-primary- and primary urban-suburban schools. One-hundred-and-eight (108) nursery/pre-primary- and 43 primary schools were considered eligible to make up the study sample since these schools were located in an urban-suburb, only use ELOLT and had a grade RR and/or a grade R class. Children of 5 years and 6 months to 5 years and 11 months generally attend these grades.

Thirty-nine (39) schools were stratified according to the 4 GDE districts and a number of schools, proportional to the size of the district, were randomly selected from each stratum. However, because of a very poor response and/or inability to get hold of some of these 39 initially selected schools, the researcher contacted schools randomly by selecting a school from the top, middle and bottom from each stratum, not exceeding the set proportional number for each stratum. As a result, the researcher contacted a total of 92 schools telephonically to introduce the study and request permission to conduct the study at the school. From these 92 schools, 23 did not want to participate in the study for one of the following reasons: (1) no interest in participating in the study; (2) an OT was already providing services at the school and the school wished to guard against conflict of interest among OTs; (3) the school was involved with another study; or (4) data collection took place at an inconvenient time for the school. A number of schools had no sample population, while some schools had to be excluded given that they were Afrikaans-English double medium.

The remainder of the schools showed interest in the study by either providing verbal permission telephonically or requesting more information about the study. Copies of the GDE permission letter (Addendum C), a letter addressed to the school principal, school governing body and class teachers (Addendum D), the research information pamphlet (Addendum F), as well as the principal consent form (Addendum E) were emailed to these schools. Of the 69 schools that were emailed, 29 schools returned the signed principal consent form, therefore providing permission to conduct the study in their setting. These 29 schools comprised 2 private schools, 2 primary- and 25 nursery/pre-primary schools. Table 3.1 summarises the sample selection data from which study participants were recruited.

Table 3.1: Summary of school selection (compiled by the researcher)

	GN	TN	TS	TW	TOTAL
Schools in district	4	19	118	10	151
Schools contacted telephonically	1	13	71	7	92
Schools refused participation	-	3	18	2	23
Schools emailed	1	10	53	5	69
Schools providing permission	1	5	22	1	29

Grade RR and/or -R class teachers, school secretaries and/or school principals identified children that were aged from 5 years 6 months and 0 days to 5 years 11 months and 29 days during the data collection period. Research information packs, containing a research information pamphlet, self-administered screening questionnaire and an envelope were prepared and delivered to the school by the researcher, after which the class teachers or school principals distributed the research information packs among 391 identified children. The information pamphlet (Addendum F) served as a means of introducing the study to the parents/caregivers by providing information regarding the study aim, inclusion- and exclusion criteria, parent/caregiver- and child requirements, benefits and risks of participation, ethical principles and the researcher's contact information. The purpose of the self-administered screening questionnaire (Addendum G) was to serve as a screening method to establish children's eligibility for inclusion in the study, as well as for parents/caregivers to provide informed consent.

Class teachers or school principals reminded parents/caregivers and children to return the questionnaires to school. The researcher collected the returned questionnaires from the school no later than 1 week after distribution. Three schools did not have returned questionnaires. One-hundred-and-eighty-three (183) parents/caregivers returned the questionnaire via the class teacher in a sealed envelope (response rate of 46.8%), in this way providing consent for their child to participate in the study. Returned questionnaires were scrutinised and sifted by the researcher in order to establish children’s eligibility for inclusion in the study. In addition, children’s age and gender were validated with class teachers since these variables were controlled in the study. Forty-one (41) children did not meet the set inclusion criteria, as children were either (1) too old or too young to participate at the time of data collection (as a result of incorrect pre-selection by the teachers, secretaries and/or school principals); (2) had not attended an ELOLT school for the previous 2 years; or (3) had received OTx during the data collection period or prior to the study. One-hundred-and-forty-two (142) children complied with the inclusion criteria and were therefore included in the study sample as study participants. Table 3.2 summarises the study sample selection.

Table 3.2: Summary of sample selection (compiled by the researcher)

Number of potential study participants	391
Number of returned questionnaires	183
Number of children not complying with inclusion criteria	41
Number of children included in the final study sample	142

From the study sample, 5 children were unavailable during data collection and 3 did not complete the testing, leaving a final sample of 134 (n = 134).

3.2.4. Sample size

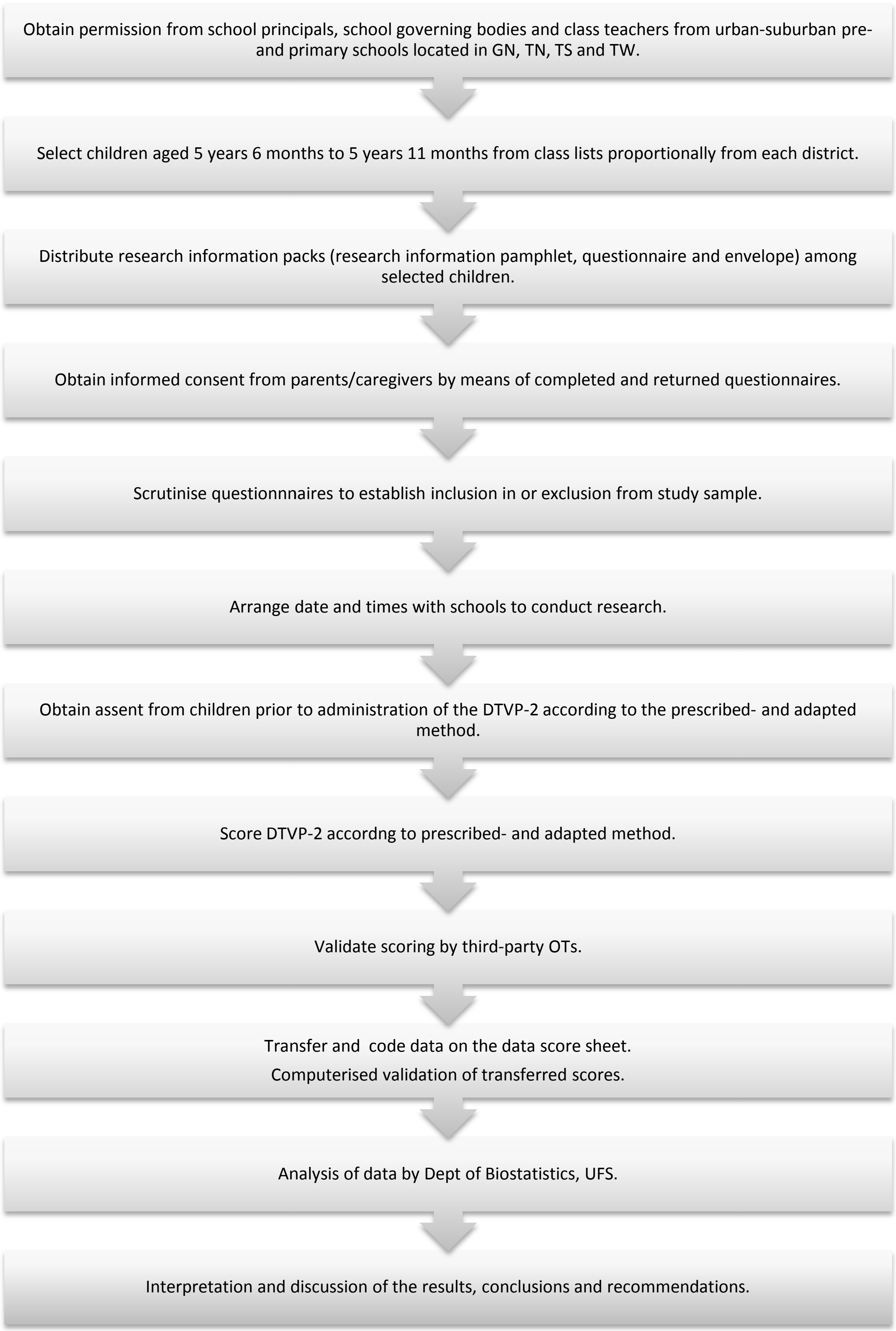
Sample size refers to the sum of study participants partaking in the study (Polit & Beck 2010:509).

Prior to the study being conducted, the study sample size was pre-determined as 125 boys and 125 girls. The sample size was initially determined according to Huysamen (1986:46), who recommends that the measurement instrument be administered to 5 times more participants than the number of items when the construct validity of a test is to be determined. Since the DTVP-2 consists of 8 subtests with a variable number of items per subtest, the subtest with the greatest number of items, i.e. 25, was multiplied by 5, equalling 125. Since Cheung *et al.* (2005:38-39) detected a difference in gender performance and gender performance was investigated in this study, boys and girls participated in equal numbers for each month interval within the study sample of 5 years and 6 months to 5 years and 11 months in order to ensure equal age distribution across gender.

However, the pre-determined sample size differed from the final sample size as a result of limited financial- and human resources, as well as time frameworks available for data collection and completion of this Magister dissertation. A minimum of 10 boys and 10 girls for each month interval, within the age range of 5 years and 6 months to 5 years and 11 months, were selected in order to ensure equal age and gender distribution across the month intervals. A minimum of 20 children for each of the 6 month interval frame equalled close to the minimum number, i.e. 125, according to Huysamen's (1986:46) calculation. The smaller sample size was considered acceptable since Nunnally (1972:194) suggests a minimum of 40, preferably 100, study participants when item difficulty is being investigated. When item linearity is being investigated as few as 15 to 20 participants are considered meaningful (Nunnally 1972:195). Furthermore, the American 5-year-old normative age cluster comprised 240 children; therefore, the sample size correlated with half of the American 5-year-old age range.

3.2.5. Research procedure

The following schematic presentation summarises the research procedure.



Obtain permission from school principals, school governing bodies and class teachers from urban-suburban pre- and primary schools located in GN, TN, TS and TW.

Select children aged 5 years 6 months to 5 years 11 months from class lists proportionally from each district.

Distribute research information packs (research information pamphlet, questionnaire and envelope) among selected children.

Obtain informed consent from parents/caregivers by means of completed and returned questionnaires.

Scrutinise questionnnaires to establish inclusion in or exclusion from study sample.

Arrange date and times with schools to conduct research.

Obtain assent from children prior to administration of the DTVP-2 according to the prescribed- and adapted method.

Score DTVP-2 accordng to prescribed- and adapted method.

Validate scoring by third-party OTs.

Transfer and code data on the data score sheet.

Computerised validation of transferred scores.

Analysis of data by Dept of Biostatistics, UFS.

Interpretation and discussion of the results, conclusions and recommendations.

Figure 3.1: Schematic representation of the research procedure (compiled by the researcher).

3.2.6. Pilot study

A pilot study determines if the methodology, sampling and measurement instruments used for data collection are feasible, adequate, appropriate and suitable for the research procedure (Grove *et al.* 2013:44; Leedy & Ormrod 2014:114). Grove *et al.* (2013:46) state that the pilot study is useful: for problem identification with the design of the study; for establishing if the population is represented in the study sample and/or the effectiveness of the sampling procedure; and for verifying the reliability and validity of the measurement instruments. The pilot study is also useful for altering measurement instruments used for data collection; for providing the researcher with an opportunity to become familiar with the research procedure, study participants, study setting, means of measurement; and for understanding data analysis techniques (Grove *et al.* 2013:46).

The researcher conducted a pilot study in order to determine if the study was viable. The pilot study served as a means of providing the researcher with the opportunity to become familiar with the research procedure, specifically the logistics relating to the collection of data from study participants. The pilot study also helped the researcher to identify influences on the study setting, establish the time needed to complete the DTVP-2 according to the adapted method, and refine the screening questionnaire and the data score sheet.

The pilot study was conducted at the first school that provided the researcher permission to participate in the study. Research information packs, comprising a research information pamphlet and screening questionnaire were distributed among 17 5 years and 6 months to 5 years and 11 months children. Ten of the 17 children's parents/caregivers returned the questionnaires, therefore providing informed consent for their child to participate in the study. The researcher scrutinised the questionnaires and found that 9 children met the inclusion criteria and could be part of the pilot study sample.

The data collection procedure is briefly described in this section and extensively elaborated on in the data collection procedure section.

The DTVP-2 was administered in English to children individually by the researcher across 2 mornings from 07:30 – 12:00. The study setting was prepared prior to collecting a child from his/her classroom by arranging the child information and assent form, DTVP-2 Picture Book, DTVP-2 Examiner/Profile Form, DTVP-2 Response Booklet, 2 pencils and a timer neatly on an age-appropriate table. Assent was obtained from the child prior to administration of the DTVP-2 by reading the child information and assent form to the child, after which the child was required to draw a circle around the tick (✓) if the child provided assent to participate – none of the children denied participation.

The DTVP-2 was administered according to the prescribed- and the adapted method: the motor-enhanced subtests of the DTVP-2 were administered according to the prescribed method set out in the DTVP-2 Examiner's Manual by Hammill *et al.* (1993:8-17). In contrast, the motor-reduced subtests of the DTVP-2 were administered in an adapted way by not adhering to the ceiling as prescribed in the DTVP-2 Examiner's Manual by Hammill *et al.* (1993:8-17). Item responses were recorded on the DTVP-2 Profile/Examiner Record Form and transferred, scored and coded on the data score sheet by the researcher.

The pilot study served as a means to provide the researcher with the opportunity to become familiar with the research procedure, specifically the logistical considerations relating to the collection of data from study participants. During the pilot study the researcher determined that 6 children could be assessed per day, as children took on average 35 minutes to complete the DTVP-2 according to the adapted administration method. However, the researcher was obliged to adhere to and work around children's daily programme activities such as breakfast, snack-time, lunch, formal tuition and/or free play, which limited the number of children that could be assessed per day. Another consideration determined during the pilot study entailed absenteeism of children on the day of the evaluation, which required alternative arrangements for the evaluation to be conducted on another day. Furthermore, the researcher was able to identify influences on the study setting, such as assistants interrupting the evaluation session despite a "do not disturb" notice on the door, as well as curious classmates looking through the windows.

After the pilot study, the coded questionnaires and data score sheets were reviewed by the biostatistician, Department of Biostatistics, UFS. No changes needed to be made to the questionnaire or the data score sheet. Since no changes were made, the results of the pilot study were incorporated into the study.

3.2.7. Measurement

According to Grove *et al*. (2013:44) and Polit and Beck (2010:370), "measurement" refers to the procedure where numbers are assigned to items by means of a measurement instrument. Certain rules have to be followed. Data obtained with a measurement instrument generates nominal-, ordinal-, interval- or ratio levels of measurement, which determine the nature of statistical analysis (Grove *et al*. 2013:45). For this study, nominal scales were used for the screening questionnaire and interval scales for the DTVP-2 measurement instrument. Nominal scales do not have quantitative meaning since numbers are used to classify characteristics such as gender, while interval scales indicate a characteristic's rank level (Polit & Beck 2010:371).

Measurement is described according to measurement instruments used for data collection, the data collection procedure, analysis of data, and methodological and measurement errors.

3.2.7.1. Measurement instruments

A measurement instrument is a tool used to assign numerical values to items according to set administration and scoring guidelines in order to describe the extent of a characteristic (Polit & Beck 2013:502-503). The researcher made use of 2 measurement tools for data collection: a) a self-administered screening questionnaire and b) the DTVP-2 standardised measurement instrument. These measurement instruments are described immediately below.

a) The self-administered screening questionnaire

The researcher drafted a screening questionnaire (Addendum G), which served as a means to obtain children's background and/or demographic information in order to establish children's eligibility for inclusion in the study and to allow parents/caregivers to provide informed consent. Questionnaires were distributed among children that were identified as possible study participants and completed, i.e. self-administered, by children's parents/caregivers.

To ensure ease of completion of the questionnaire, clear, concise and simple instructions were provided at the top of the questionnaire and questions were asked in simple language. Questions regarding children's date of birth, gender, home language, handedness, vision, attendance of therapy and medical diagnoses were posed in English by means of closed- and open-ended questions. The researcher scrutinised the returned questionnaires to establish children's eligibility for inclusion in the study and to validate children's age and gender.

Children of parents/caregivers who provided informed consent by returning the completed questionnaires were assessed with the DTVP-2 standardised measurement instrument.

b) The DTVP-2 standardised measurement instrument

The researcher made use of the DTVP-2 standardised measurement instrument to measure boys' and girls' of 5 years and 6 months to 5 years and 11 months visual perceptual- and VMI skills. See Chapter 2 for a detailed overview and description of the DTVP-2.

Although the DTVP-2 has adequate levels of validity and reliability (Hammill *et al.* 1993: 33-45), the validity and reliability relate to the American normative population, while the research questioned the suitability of the DTVP-2 for the SA population. The aim of this study was to investigate the DTVP-2's suitability as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT.

3.2.7.2. Data collection

Data collection involves the methodical collection of specific statistical information that is in line with a study's questions and objectives (Grove *et al.* 2013:45). For this study, information was gathered relating to: (1) the psychometric properties of the DTVP-2 when tested on a sample of SA children; (2) DTVP-2 scores scored according to the prescribed-, as well as an adapted scoring method; (3) gender differences in test performance; and (4) norms for a SA sample.

Statistical information was collected from study participants intermittently during June 2014 to February 2015 by the researcher independently. The researcher was a competent test administrator since the researcher had 9 years experience in paediatric OTx and was familiar with the DTVP-2. Having only 1 test administrator also addressed concerns about inter-rater reliability, although the DTVP-2 has demonstrated good inter-rater reliability. One-hundred-and-eleven (111) children's data were collected in the morning between 07:30 and 12:00, and 23 children's data in the afternoon after children had wakened from their afternoon nap at certain pre-schools. The researcher observed no difference in children's test performance before and after school break.

Administration of the DTVP-2 occurred in the room or area allocated by the school principals or teachers according to availability. In order to adhere to the necessary requirements for optimal testing conditions prescribed by Hammill *et al.* (1993:7) for obtaining reliable results, allocated rooms had to meet the following conditions: sufficient lighting, comfortable room temperature, low noise levels, as well as limited auditory and visual distractions. Accordingly, administration of the DTVP-2 was conducted in various settings such as churches, storerooms, empty classes, libraries and offices. The researcher placed a "do not disturb" notice on the door of the assessment room. Children were furthermore positioned with their back towards windows and doors in order to minimise distraction of curious classmates.

Prior to collecting a child from his/her classroom, the researcher prepared the research setting by neatly arranging the child information and assent form (Addendum H), the DTVP-2 Picture Book, DTVP-2 Response Booklet, 2 pencils and timer on a table. The researcher collected a child from his/her class, introduced herself and established rapport by asking simple non-threatening questions, while escorting the child to the room where the DTVP-2 was administered.

Children were positioned at an age-appropriate table and chair perpendicular to the researcher. The researcher read the child information and assent form to the child and children were given the opportunity to ask questions prior to administration of the DTVP-2. Children were required to draw a circle around the tick (✓) if they provided assent to participate in the study. Children who did not provide assent to participate in the research study would be escorted back to their classroom, but none of the children refused to participate in the study.

The DTVP-2 was administered in English in the following sequence as prescribed by Hammill *et al*. (1993:8): (1) EH, (2) PS, (3) CO, (4) FG, (5) SR, (6) VC, (7) VMS and (8) FC. The researcher made use of the original DTVP-2 Picture Book and recorded children's item responses on the original DTVP-2 Profile/Examiner Record Form. The motor-enhanced subtests of the DTVP-2 – (1) EH, (3) CO, (5) SR and (7) VMS – were administered in the original DTVP-2 Response Booklets according to the prescribed method set out in the DTVP-2 Examiner's Manual (Hammill *et al*. 1993:8-17). The ceiling rule of 3 0's in a row was implemented for the CO- and SR subtests.

In contrast, the administration of the motor-reduced subtests of the DTVP-2 – (2) PS, (4) FG, (6) VC and (8) FC – was performed in an adapted way by not adhering to the ceiling rule as prescribed in the DTVP-2 Examiner's Manual by Hammill *et al*. (1993:8-17). Instead, each motor-reduced subtest of the DTVP-2 was administered from the first to the last item number, not adhering to the ceiling rule of stopping after 3 out of 5 incorrect responses, in order to obtain an in-depth investigation of the items' properties.

Children were encouraged and praised for their efforts during the administration of the DTVP-2, by statements such as: (1) "wow, you are really working very hard"; and (2) "I can see that you are giving all your best", regardless of right or wrong answers and without indicating the correct item responses as suggested by Hammill *et al*. (1993:7-8).

During the administration of the DTVP-2, the researcher was alert to children showing signs of loss of interest and/or fatigue, as these factors could have influenced children's test performance and ultimately the research results. Children that showed signs of lost of interest and/or fatigue presented with 1 or more of the following behaviours: attention wandering, excessive talking, yawning and/or fidgety behaviour. Children generally showed lost of interest after the first 4 subtests of the DTVP-2. These 4 subtests took on average 20 minutes to complete, which coincides with concentration abilities of 5-year-old children according to Witthaus (2002:92). When the researcher observed any of the mentioned signs, the researcher discontinued administration for a brief period and performed 5 steps of self-regulation (Lombaard 2014:10) with the children in order to enhance/restore their concentration. Self-regulation is based on the principals of deep pressure by means of proprioceptive input in order to influence arousal/alert levels (The South African Institute for Sensory Integration 2014).

After performing the self-regulation sequence, the researcher asked the children whether or not they wanted to continue with administration, stop completely or continue with administration at another time or day, since the DTVP-2 can be conducted in multiple sessions (Hammill *et al.* 1993:7-8). No children wanted to stop completely, while 7 boys' and 3 girls' administration continued on another day. Although the authors of the DTVP-2 do not elaborate on conditions surrounding multiple sessions in the Examiner Manual of the DTVP-2, the researcher completed administration of the DTVP-2 no later than 2 days. Upon completion of the DTVP-2, children were awarded 3 golden stars for their participation and were escorted back to their classroom.

After administration of the DTVP-2, the researcher scored the motor-enhanced subtests of the DTVP-2 according to the prescribed method set out in the DTVP-2 Examiner's Manual by Hammill *et al*. (1993:8-17) and the motor-reduced subtests of the DTVP-2 according to the prescribed method, as well as the adapted method on the original DTVP-2 Profile/Examiner Record Form (Hammill *et al*. 1993). Scoring and interpretation of the motor-enhanced- and motor-reduced subtests of the DTVP-2 were verified by third-party paediatric OTs with at least 10 years' clinical experience. Owing to the subjectivity involved in scoring of the CO subtest of the DTVP-2, as well as limited examples and guidelines provided by the authors of the DTVP-2, no changes were made to the scoring of the CO subtest items as therapists differed regarding the allocation of marks – some therapists would score stringently, while others were less rigid. Minor clerical errors were corrected in the EH- and VMS subtests of the DTVP-2.

In order to quantify and code all the item responses, RSs, SSs and composite scores – i.e. GVPQ, MRPQ and VMIPQ – the researcher drafted a data score sheet (Addendum I) in accordance with the DTVP-2 Profile/Examiner Record Form (Hammill *et al.* 1993). The researcher transferred the scored item responses of each subtest to the data score sheet. The motor-enhanced subtests of the DTVP-2 were transferred once (i.e. the prescribed method), while the motor-reduced subtests of the DTVP-2 were transferred twice to the data score sheet (i.e. the prescribed- and adapted method), consequently yielding 2 GVPQ and MRPQ composite scores. Transferred scores were verified by comparing electronically computed scores on the data score sheet in Microsoft Excel with manually calculated scores on the DTVP-2 Profile/Examiner Record Form (Hammill *et al.* 1993). Data score sheets were submitted electronically to and analysed by the Department of Biostatistics, UFS.

3.2.7.3. Data analysis

Data analysis reduces, organises and provides meaning to obtained statistical information (Grove *et al.* 2013:46). Quantitative research data analysis: (1) describes the study sample and variables by means of descriptive and exploratory methods/formulas; (2) tests anticipated relationships and make predictions through statistical techniques; and (3) examines causality by analysis techniques (Grove *et al.* 2013:44).

For this study, descriptive statistics – means with standard deviations or medians and percentiles for continuous data, and frequencies and percentages for categorical data – were computed. Descriptive statistics are presented for demographic data, such as gender, age, district, school and language, as well as the DTVP-2 RSs, SSs and composite scores.

Relationships between variables (Polit & Beck 2010:400), were examined by means of the appropriate inferential statistics; i.e. statistics allowing the researcher to draw conclusions about the application of the results obtained from the sample population to the larger population (Polit & Beck 2010:405,556). Results were considered statistical significant or nonsignificant (Polit & Beck 2010:437). T-tests test the significance of the difference between group means (Polit & Beck 2010:437). Gender differences were examined by means of Student's t-tests. Paired t-tests were conducted to establish differences in prescribed- and adapted test scores. A significance level of 5% was used with the Student's t-test, the sample size and the expectation of a medium effect size for any differences obtained, as generally recommended.

Cronbach coefficient alphas were calculated in order to determine the internal consistency reliability of the DTVP-2 in SA. Cronbach coefficient alphas normally range from .00 to +1.00. Coefficient alphas closer to +1.00 are more consistent and measure more accurately (Polit & Beck 2010:375). According to Burtner *et al*. (1997:51), correlation coefficient alphas should exceed .80 when the reliability of measurement instruments is studied.

The construct validity of the 4 motor-reduced subtests was examined by means of a Rasch analysis for dichotomous items using RUMM2030. According to Brown, Lyons and Unsworth (2009:394), a Rasch analysis evaluates the psychometric properties of ordinal-level measurement instruments. A Rasch analysis establishes a measurement instrument's scalability, unidimensionality, differential item functioning (DIF) and item difficulty and -linearity (Brown *et al*. 2009:395). Scalability refers to the linearised rise of ordinal items that supports the underlying theoretical trait. Fit statistics validate the theoretical trait that is measured and generally range between .6 to 1.4. Unidimensionality confirms whether a subtest of a measurement instrument measures a single trait the subtest claims to measure. DIF establishes differences among groups (Brown *et al*. 2009:395). Item difficulty and –linearity reveals the hierarchical order of subtest items, ordered from least to most difficult (Brown *et al*. 2009:395-396; PsyLab Group 2015:40)

Principal component analysis (PCA) was conducted to examine the construct validity of the DTVP-2 for the SA population. Principal component analysis statistically examines interrelationships between variables to establish the amount of variance in subtests

(Brown *et al*. 2009:395; Polit & Beck 2010:566-567). According to Brown *et al*. (2009:395), the factor with the largest variance represents the underlying theoretical trait which also serves as confirmation of subtest's unidimensionality.

The data analysis for this study was done using SAS/STAT software, Version 9.4 of the SAS System for Windows. Copyright © 2012 SAS Institute Inc, as well as RUMM2030. Results of the data analysis are presented in Chapter 4. Results obtained and conclusions drawn from the COT sample population could be applied to similar populations in SA.

3.2.7.4. Methodological and measurement errors

"Methodological and measurement errors" refers to the discrepancy among accurate real life and obtained statistical information, measured with a measurement instrument, consequential from influential factors (Grove *et al*. 2013:699; Polit & Beck 2010:372-373). Leedy and Ormrod (2014:223) elaborate by adding that bias refers to situations or circumstances that independently or in conjunction influence the data.

Unreliable measurement instruments, administering a test with bias, inconsistent behaviour of participants and unviable testing conditions are possible sources of measurement error (Stein & Cutler 2002:246). According to Hammill *et al*. (1993:27), any measurement instrument's reliability can be influenced by test content, stability over time, examiner scorer, examinee and the test situation.

Sampling bias may have occurred as a result of the poor initial response rate of schools that did not provide permission to conduct the study in their setting. The researcher attempted to overcome sampling bias by randomly contacting schools from different suburbs within the 4 strata. In addition, a poor response rate from parents/caregivers not returning the self-administrated screening questionnaire could have further resulted in research bias, although the response rate was in line with the general response rate of less than 50%. Teachers conveyed possible reasons for parents/caregivers not returning the questionnaire as parents/caregivers not reading newsletters sent home, a busy life schedule and/or parents/caregivers that do not take interest in their child's school. Furthermore, the researcher hypothesised that parents/caregivers possibly did not provide informed consent since they had difficulty trusting the researcher, an unknown health professional, and the unfamiliar research procedure.

Although the rooms/areas allocated by each school for test administration differed, similar testing conditions were ensured across all evaluations by conducting the administration of the DTVP-2 in quiet, well ventilated and illuminated rooms with minimal/restricted visual and auditory distractions. Evaluations were conducted in the morning, from 07:30 to 12:00 or in the afternoon after children wakened from their afternoon nap, in order to ensure optimal concentration levels of children.

The researcher could not control an inconsistency in behaviour and performance of study participants, specifically children selecting the same response for each test item. However, in an attempt to obtain accurate results, administration of the DTVP-2 was discontinued when children showed signs of fatigue or loss of interest, as prescribed by Hammill and colleagues (1993:7), and resumed on another time or day.

The researcher also cleaned children's hands with waterless hand cleaner prior to administration of the DTVP-2 in order to ensure that children did not leave dirty marks in the DTVP-2 Picture Book and in doing so indicating their item responses.

Since the inter-rater reliability has not been established in SA, the researcher ensured reliability by administering the DTVP-2 independently to all 134 study participants. In order to reduce administration of the DTVP-2 with bias, the researcher strictly adhered to the administration procedure and subtest instructions as set out in the Examiner Manual of the DTVP-2 (Hammill *et al.* 1993) by using instruction cue cards during administration of the DTVP-2. The researcher furthermore did not interpret the RSs to

SSs until after the data collection period – therefore recording children's responses "blindly" without knowing how they performed on the DTVP-2.

The researcher strictly adhered to the scoring criteria set out by the authors of the DTVP-2 (Hammill *et al.* 1993:7-17) when scoring the prescribed method. The researcher furthermore discussed scoring of the motor-enhanced subtests of the DTVP-2 with experienced OTs prior to the study because of a lack of specific examples and guidelines when scoring the CO subtest of the DTVP-2. Scoring of the subtests, as well as the calculation of subtest SSs and composite scores on the DTVP-2 Examiner Profile Form, was verified by third-party OTs with at least 10 years' clinical experience in paediatric OTx before the data were transferred to the data score sheet.

The researcher minimised possible clerical error during transference of scores from the DTVP-2 Profile Examiner Form to the electronic data score sheet, by verifying and correlating all manually calculated scores on the DTVP-2 Profile Examiner Form with automatically computed scores on the data score sheet with the Microsoft Excel programme. Coding of the data score sheets was verified by an independent third-party person.

3.3 ETHICAL CONSIDERATIONS

"Ethical considerations" refers to a set of ethical codes and/or principles, rooted in professional, legal and social responsibility, which is specifically compiled for research procedures in order to protect study participants' human rights (Polit & Beck 2010:553).

The most noteworthy code of ethics, the Declaration of Helsinki, was approved by the World Medical Association General Assembly in 1964, with the final amendment in 2008 (Grove *et al.* 2013:160; Polit & Beck 2010:119). The Declaration of Helsinki differentiates research as therapeutic or non-therapeutic. For the purpose of this study non-therapeutic research is further defined as new knowledge being generated that will probably be beneficiary to future patients and not necessarily the study participants (Grove *et al*. 2013:160). Results of this study provide OTs in SA with new knowledge regarding the reliability and validity of the DTVP-2, as well as gender performance for English-speaking 5 years and 6 months to 5 years and 11 months children. Occupational Therapists in SA will therefore be able to interpret and convey results of the DTVP-2 more accurately.

The researcher adhered to strict ethical conduct during the study, especially since the study sample comprised children – a vulnerable group (Polit & Beck 2010:131). Ethical principles regarding permissions, informed consent, confidentiality and the risk/benefit ratio are respectively discussed.

3.3.1. Permissions

According to the Oxford English Dictionary (online):

Permission:
"the action of officially allowing someone to do a particular thing; consent or authorisation".

Permissions were obtained from the Ethical Committee of the Faculty of Health Sciences, UFS, Pro-Ed Inc. publishers, the GDE and school principals prior to the study being conducted.

a) Ethics committee of the Faculty of Health Sciences, UFS

Approval of the research protocol was obtained from the Ethics Committee of the Faculty of Health Sciences, UFS (ECUFS133/2012) (Addendum A).

The Ethics Committee made use of the following guidance documents as stipulated in the ethical letter: Declaration of Helsinki (World Medical Association 2008), International Conference of Harmonisation (ICH) for Good Clinical Practice (GCP) (ICH 1998) and the Medical Research Council (MRC) Guidelines on Bio-Medical Research (MRC 2003). Use was made also of Ethics in Health Research: Principal Structure and Processes (Department of Health SA 2004); Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in SA – Second Edition (Department of Health SA 2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as laws and regulations with regard to the control of medicines.

b) Pro-Ed Inc. publishers

Permission was requested and obtained from Pro-Ed Inc., publisher of the DTVP-2, to make use of the DTVP-2 as a measurement instrument for the study. Refer to Addendum B for the approval letter received from Pro-Ed Inc. publishers. According to Pro-Ed Inc. publishers, "if completing a Dissertation or Master's Thesis, please note that permission will not include publication of any actual test items, discussion of any actual test items or inclusion of the actual product in the body or appendix of your dissertation". The researcher did and will not provide examples of the DTVP-2 Examiner Profile or the DTVP-2 Response Booklet in the research protocol or Magister dissertation respectively.

c) Gauteng Department of Education

Permission was obtained from the GDE to conduct research at pre- and primary schools within the 4 districts of the GDE (Addendum C).

d) School principals

After approval was granted by the Ethics Committee of the Faculty of Health Sciences, UFS, permission were obtained from 29 school principals to conduct the study in their setting.

3.3.2. Informed consent

Informed consent entails obtaining potential subjects' voluntary participation for a study after providing them with information regarding potential risks and benefits associated with participation (Polit & Beck 2010:557). For this study implied consent was obtained from parents/caregivers and assent from children.

a) Parents/caregivers

Parents/caregivers of potential study participants were thoroughly informed of the study by means of a research information pamphlet (Addendum F) that was distributed. A screening questionnaire was given out to the selected 5 years and 6 months to 5 years and 11 months children at the schools as part of a research information pack.

Parents/caregivers could voluntarily self-determine their child's participation in the study by completing and returning the screening questionnaire, hence implied consent. Parents/caregivers were informed at the beginning of the questionnaire that they could cease to complete the questionnaire at any time without any implications. Participation was therefore completely voluntary. It was furthermore stipulated in the information pamphlet that parents/caregivers and children could withdraw at any time, without any consequences.

The information pamphlet also introduced the background to the study, provided information regarding the study's aim and clarified the inclusion- and exclusion criteria. The information pamphlet further provided information about parents/caregivers- and child requirements, benefits and risks of participation, ethical principles and the researcher's contact information. The information pamphlet was drafted in English since the study included English-language speakers.

b) Children

Although children aged 0 to 6 years are considered incompetent to provide assent (Grove *et al*. 2013:166), the researcher obtained assent from children in the form of an age-appropriate picture story. The story, i.e the child information and assent form (Addendum H) were read to the children prior to administration of the DTVP-2, where after children were required to draw a circle around the tick (✓) if they assented to participate in the study.

The administration procedure and what to expect was explained to the children in simple English language. Children were informed that they could voluntarily discontinue at any point in time their participation in the study without any implications. Children that made 'deliberate objections' would have been precluded from participation (Grove *et al*. 2013:166). However, none of the children denied participation.

3.3.3. Risk/benefit ratio

The risk/benefit ratio is determined prior to conducting a study by determining the health-related- and/or psychosocial benefits from possible harm associated with participation for a study participant or larger population (Grove *et al*. 2013:175; Polit & Beck 2010:567). Grove *et al*. (2013:175) add that a research benefit contributes to the generation of new knowledge for evidence-based practice. Benefits must exceed or be equal to the risks involved.

For this study, a benefit of participation included that children's visual perceptual skills were assessed free of charge, while there were no infinite risks involved for the child. Some children may have experienced slight emotional discomfort prior to administration of the DTVP-2 as a result of the unfamiliar researcher and/or the testing situation. Overall, participation in this study contributed to OTx evidence-based practice and recommendations regarding the use and suitability of the DTVP-2 for the SA population.

In the instance where children scored below their developmental age norm, when scored according to the American norms, parents/caregivers were informed of their child's visual perceptual skill difficulties by means of a short feedback letter (Addendum J). The feedback letter served to inform the parents/caregivers that their child's visual perceptual skills were below their developmental age norm and accordingly recommended OTx. Four boys and 6 girls' parents/caregivers received feedback letters since their children scored below their developmental age norm, when scoring the DTVP-2 according to the American norms.

3.3.4. Confidentiality

Confidentiality is concerned with the safekeeping of study participants' personal information (Grove *et al*. 2013:172). For this study, confidentiality related to schools, school principals, parents/caregivers and children.

Strict confidentiality was maintained before, during and after the study. Names and contact information of schools, school principals, parents/caregivers and children were and will not be made public in any documentation or presentation relating to this study. Schools were assigned an alphabetical letter and children an alpha-numerical identification code in order to ensure confidentiality. Codes were used on all documentation relating to the school or children respectively for tracking and coding purposes. All documents, i.e. completed questionnaires, DTVP-2 Response Booklets, DTVP-2 Assessor/Profile form, data score sheets and parent/caregiver feedback letters, were sent to and from the researcher in sealed envelopes to ensure confidentiality.

Documentation – i.e. questionnaires, child information and assent form as well as the DTVP-2 Examiner/Profile form, DTVP-2 Response Booklets and data score sheets – will be stored in a safe, secure cabinet for a period of 15 years, until study participants are 21 years of age (HPCSA 2008:8), after which the documentation will be shredded and discarded. All electronic documents are password protected and were transferred to an external disk for safekeeping.

3.4 SUMMARY

Chapter 3 thoroughly described the method of research and the ethical principals considered and adhered to for this quantitative, descriptive, observational study. The study sample comprised 134 heterogeneous English-speakers from an urban setting. Participants completed the DTVP-2's motor-enhanced subtests according to the prescribed administration method and the motor-reduced subtests according to the adapted scoring method of not implementing the ceiling rule. Data were analysed, amongst other statistical methods, by means of a Rasch analysis and are presented in the next chapter.

Chapter 4 present data regarding the demographic characteristics of the study sample, gender performance, DTVP-2 scores scored according to the prescribed- and adapted methods, and reliability and validity values by means of tables and graphs.

CHAPTER 4
RESULTS

4.1. INTRODUCTION

Chapter 3 described the method of research and how the suitability of the DTVP-2 for a sample of the SA population (n = 134) was investigated. The research questions set in Section 1.2 guided the content of this chapter. The results are presented by means of tables and figures as follows:

4.2. Demographic information of the study sample;

4.3. Differences in DTVP-2 scores among boys and girls of the SA study sample;

4.4. The DTVP-2 scores of the SA study sample, scored according to the prescribed scoring method and in comparison to the 5 years and 6 months to 5 years and 11 months age interval of the normative sample from America;

4.5. The DTVP-2 scores of the SA study sample, scored according to the adapted scoring method and in comparison to the 5 years and 6 months to 5 years and 11 months age interval of the normative sample from America; and

4.6. Results of the psychometric properties of the DTVP-2 based on a SA study sample.

4.2. DEMOGRAPHIC INFORMATION OF THE STUDY SAMPLE

This section presents descriptive statistics regarding the gender, age, grade and home language, as well as the districts and the type of schools of the SA study sample (n = 134).

Table 4.1: Gender, type of school and grade

	Gender		Schools (n=26)		Grade	
	Boys	**Girls**	**PS**	**P**	**RR**	**R**
n	65	69	22	4	35	99
%	48.51	51.49	84.62	15.38	26.12	73.88

PS = Pre-school, P = Primary, RR = Pre-reception year, R = Reception year

The study sample comprised 134 typically developing children – 48.51% boys and 51.49% girls. Children were recruited from 26 schools, of which 84.62% were pre-schools and 15.38% primary schools. Just over 26% (26.12%) of the children were enrolled in grade RR and 73.88% in grade R. Therefore, the comparatively equal number of boys and girls mostly attended grade R of pre-schools. A further outline of the schools is presented.

Table 4.2 provides a synopsis of the districts in terms of the number of schools per district and the study participants per district.

Table 4.2: Synopsis of districts according to the distribution of schools and study participants

District	Schools (n=26)	% of study sample	Participants (n=134)
Gauteng North	1	6.72	9
Tshwane North	5	16.42	22
Tshwane South	19	68.66	92
Tshwane West	1	8.21	11

Gauteng North constituted the smallest proportion of the study sample (6.72%), with 1 school and 9 study participants. Tshwane North represented 16.42% of the study sample with 5 schools and 22 study participants. Tshwane South constituted the largest proportion (68.66%) of the study sample, which comprised 19 schools and 92 study participants. Tshwane West represented 8.21% of the study sample with 1 school and 11 study participants.

The school-per-district distribution coincided more or less with the number of proportionally selected schools according to the size of the district's eligible schools.

Table 4.3 presents a delineation of the study participants' ages.

Table 4.3: Delineation of study participants' age

	Study sample (n=134)					
Age	**5 y 6 m**	**5 y 7 m**	**5 y 8 m**	**5 y 9 m**	**5 y 10m**	**5 y 11 m**
n	20	22	22	26	23	21
%	14.93	16.42	16.42	19.40	17.17	15.67

The study focused specifically on children aged 5 years 6 months and 0 days through 5 years 11 months and 29 days. The age distribution was relatively equal along the month intervals, although the age interval 5 years and 6 months made up the smallest proportion of the study sample (n = 134) and the age interval 5 years and 9 months the largest.

The delineation of the study sample's (n = 134) home language is presented next in Table 4.4.

Table 4.4: Home language of the study sample

Home language	**Study sample (n=134)**	**%**
English	34	25.37
Setwana	24	17.91
Sepedi	12	8.96
Northen Sotho	9	6.72
Zulu	9	6.72
Afrikaans	8	5.97
Tshivenda	6	4.48
Sotho	5	3.73
Xhosa	4	2.99
Ndebele	2	1.49
Siswati	2	1.49
Tsonga	1	0.75
Other*	18	13.44

* = Foreign languages/not considered an official SA language

The majority of study participants indicated English as their first language (25.37%), followed by Setswana 17.91% and Sepedi 8.96%. Foreign languages accounted for 13.44% of the study sample and included Arabic (1.49%), Cantonese (1.49%), Chinese (0.75%), French (1.49%), Hebrew (0.75%), Italian (1.49%), Portuguese (0.75%), Shona (3.73%), Thamazighth (0.75%) and Tigirinho (0.75%).

The home language of the members of the study sample mainly (86.56%) made up the 11 official languages of SA, therefore indicating a multi-lingual, heterogeneous study sample (n = 134) and representative of the many cultures inherent to SA.

4.3. DIFFERENCES IN DTVP-2 SCORES AMONG BOYS AND GIRLS OF THE SA STUDY SAMPLE

Owing to differential developmental milestones in children, the best gender comparison would be done based on SSs, which would allow for developmental differences. However, SSs calculated during the testing were based on the American norms supplied with the DTVP-2, as these are the only norms currently available. Since the American norms might not be entirely appropriate/suitable for a sample of the SA population, Table 4.5 presents a comparison of both RSs and SSs for the SA boys and girls. Comparisons were calculated by means of Student's t-tests.

Table 4.5: Comparison of gender differences in the DTVP-2's raw- (RS), and standard scores (SS), scored according to the prescribed- and adapted scoring methods

DTVP-2 Subtests and composites	**Score**	**Prescribed**				**Adapted**			
		Means		**Comparison**		**Means**		**Comparison**	
		Boys	**Girls**	***t***	***p***	**Boys**	**Girls**	***t***	***p***
Position in space	RS	12.06	11.33	0.94	0.35	15.96	14.81	1.45	0.15
	SS	9.17	8.94	0.62	0.54	10.91	10.41	1.39	0.17
Figure-ground	RS	10.19	11.36	-2.17	**0.03***	11.59	12.30	-1.70	0.09
	SS	10.19	11.36	-2.17	**0.03***	11.59	12.30	-1.70	0.09
Visual closure	RS	4.92	4.71	0.52	0.60	8.14	7.74	0.96	0.34
	SS	7.79	7.64	0.39	0.69	10.57	10.23	0.96	0.34
Form constancy	RS	11.23	10.80	1.30	0.20	12.39	11.86	1.73	0.09
	SS	12.00	11.70	1.45	0.15	12.74	12.38	1.63	0.10
MRP		*39.14*	*39.64*	*-0.48*	*0.64*	*45.80*	*45.32*	*0.48*	*0.63*
MRPQ		*98.54*	*99.38*	*-0.48*	*0.63*	*109.66*	*108.90*	*0.46*	*0.65*
Eye-hand coordination	RS	138.35	140.32	-0.57	0.57				
	SS	10.43	10.68	-0.66	0.51				
Copying	RS	14.20	15.17	-1.34	0.18				
	SS	9.22	9.51	-1.25	0.21				
Spatial relation	RS	29.55	29.22	0.19	0.85				
	SS	11.69	11.90	-0.38	0.71				
Visual-motor speed	RS	4.94	5.64	-1.06	0.29				
	SS	9.94	10.33	-1.09	0.28				
VMI		*41.28*	*42.42*	*-1.11*	*0.27*				
VMIQ		*102.11*	*103.97*	*-1.09*	*0.28*				
GVP		*80.42*	*82.06*	*-0.92*	*0.36*	*87.08*	*87.74*	*-0.37*	*0.71*
GVPQ		*100.42*	*101.81*	*-0.90*	*0.37*	*106.20*	*106.77*	*-0.36*	*0.72*

MRP = Motor-reduced perception, MRPQ = Motor-reduced perceptual quotient, VMI = Visual-motor integration, VMIQ = Visual-motor integration quotient, GVP = General visual perception, GVPQ = General visual perceptual quotient, t = t-test

* *p* = < .05 statistically significant

Boys and girls obtained similar SSs on all the subtests of the DTVP-2 when using the prescribed scoring method, with the exception of FG where a statistical significant difference (*p* = .03) in SSs were evident, with girls obtaining one mean SS higher than boys.

Boys and girls obtained similar RSs, SSs and composite scores when the ceiling rule was not implemented and therefore showed no statistical significant difference in test scores.

4.4. THE DTVP-2 SCORES OF THE SA STUDY SAMPLE, SCORED ACCORDING TO THE PRESCRIBED SCORING METHOD IN COMPARISON TO THE 5 YEARS AND 6 MONTHS TO 5 YEARS AND 11 MONTHS AGE INTERVAL OF THE AMERICAN NORMATIVE SAMPLE

First this section presents the SA study sample's (n = 134) DTVP-2 subtest RSs in comparison to the mean RSs of the 5 years and 6 months to 5 years and 11 months age interval of the American normative sample, after which the DTVP-2 subtests SS and composite score distribution of the SA sample are presented in line with the American norm distribution (Hammill *et al*. 1993:24). The American norm distribution has a mean of 10 and a SD of 3 for subtest SSs, and a mean of 100 and a SD of 10 for composite scores. Single sample t-tests were conducted to compare the means of the SA study sample (n = 134) to the means of the American normative sample.

4.4.1. The SA study sample's DTVP-2 subtest raw scores in comparison to the 5 years and 6 months to 5 years and 11 months age interval mean raw scores of the American normative sample according to the prescribed scoring method

The RS of each subtest is calculated as the sum of the correct answered items (Hammill *et al*. 1993:23). Accordingly, Table 4.6 presents the DTVP-2 subtests' mean RSs of the SA sample (n = 134) in comparison to the mean RSs of the 5 years and 6 months to 5 years and 11 months American normative sample. The scores are presented in the same sequence in which the DTVP-2 is administered and reported.

Table 4.6: Comparison of the American normative sample and the SA study sample's mean raw scores scored according to the prescribed scoring method

DTVP-2 subtests	American mean raw score	SA sample (n = 134)		
		Mean raw score^a	Comparison	
			t-value	*p*
Eye-hand coordination	126	139	7.71	<.0001*
Position in space	13	12	-3.40	.0009*
Copying	16	15	-3.56	.0005*
Figure-ground	9	11	6.51	<.0001*
Spatial relations	21	29	9.25	<.0001*
Visual closure	7	5	-10.73	<.0001*
Visual-motor speed	6	5	-2.12	.0355*
Form constancy	8	11	18.01	<.0001*

a = Values rounded to the nearest integer since the DTVP-2 reports rounded values, t = t-test
* *p* = <0.05 statistically significant

In comparison to the 5 years and 6 months to 5 years and 11 months American age norms, the SA sample (n = 134) obtained lower mean RSs for PS, CO, VC and VMS, and higher mean RSs for EH, FG, SR and FC.

Raw scores are converted into SSs for clinical value by means of tables in the DTVP-2 Examiner's Manual in order to compare subtest scores (Hammill *et al*. 1993:24). The SSs of the SA sample (n = 134) are presented in the next section.

4.4.2. The SA sample's DTVP-2 subtests' standard score distribution scored according to the prescribed method along with the American norm distribution

The SSs of the SA study sample (n = 134) are presented according to the motor-enhanced subtest cluster and the motor-reduced subtest cluster. Based on the American norm distribution, SSs has a mean of 10 and a SD of 3 (indicated in red) (Hammill *et al*. 1993:24). Therefore a SS of 8 corresponds to the 25th percentile, a SS of

10 to the 50th percentile and a SS of 12 to the 75th percentile. Accordingly, SSs are descriptively rated as average for SSs between 8 and 12, below average for SSs below 8, and above average for SSs above 12 (Hammill *et al.* 1993:24).

4.4.2.1. Motor-enhanced subtests

The motor-enhanced subtest cluster comprises the EH-, CO-, SR- and VMS subtests in order to constitute the VMIQ composite score (Hammill *et al.* 1993:6,21). The distribution of the DTVP-2's motor-enhanced subtest SSs of the SA study sample (n = 134) are presented in Figure 4.1.

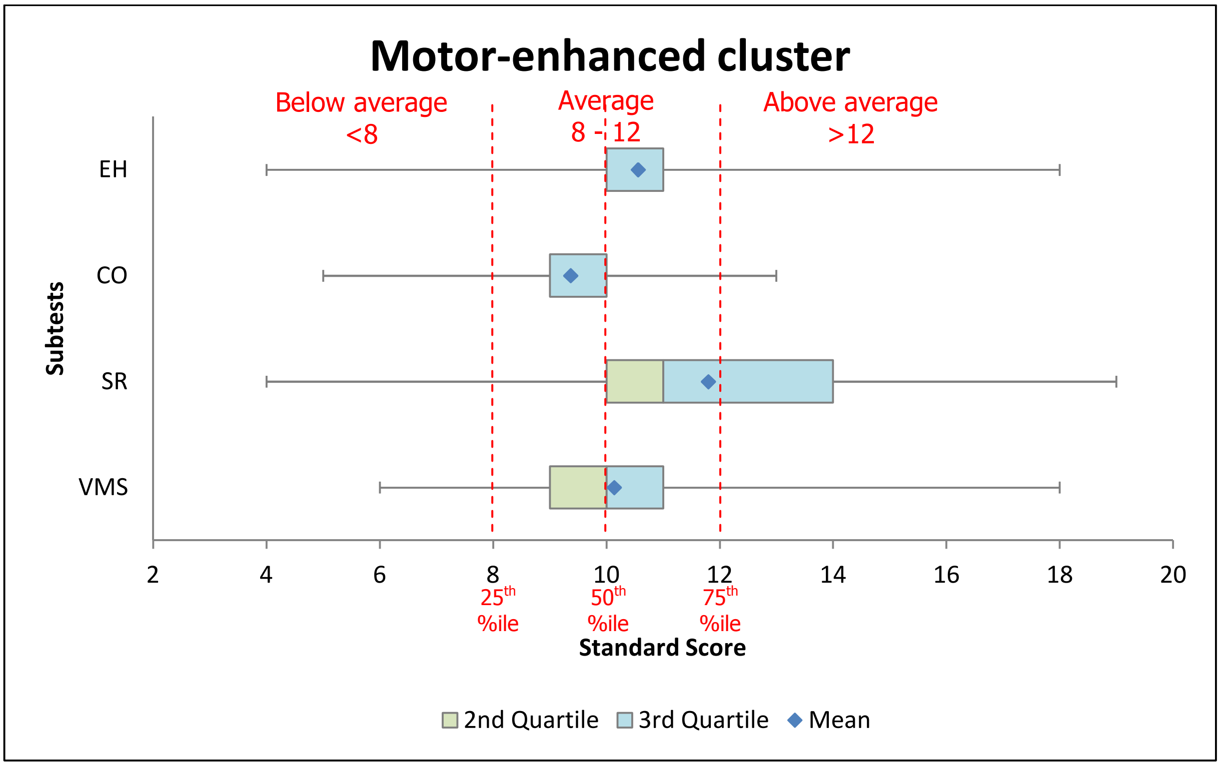


Figure 4.1: Standard scores of the DTVP-2's motor-enhanced subtests scored according to the prescribed method for the SA study sample

Eye-hand coordination had a minimum SS of 4 and a maximum of 18, with a median of 10 (IQR 10 – 11). The mean SS was 10.56 with a SD of 2.19. It is apparent that the mean of the SA sample (n = 134) was superior to the American normative sample but that the SA sample (n = 134) mainly scored in the average range. No score distribution was furthermore apparent in the 2nd quartile, indicating an abnormal distribution of EH SSs.

Copying had a minimum SS of 5 and a maximum of 13, with a median of 9 (IQR 9 – 10). The mean SS was 9.37 with a SD of 1.35. Although the SA sample's (n = 134) CO mean SS was less than the American norm of 10, the SA sample (n = 134) mostly obtained average scores. No score distribution was evident in the 2nd quartile, indicating an abnormal distribution of CO SSs.

Spatial relations had a minimum SS of 4 and a maximum of 19, with a median of 11 (IQR 10 – 14). The mean SS was 11.80 with a SD of 3.17. Evidently the SA sample's (n = 134) SR mean SS was greater than the American normative sample, resulting in the SA sample (n = 134) scoring primarily average and above average in SR. The 3rd quartile possessed a larger distribution of scores in relation to the 2nd quartile, indicating an abnormal distribution of SR SSs.

Visual-motor speed had a minimum SS of 6 and a maximum of 18, with a median of 10.14 (IQR 9 – 11). The mean SS was 10 with a SD of 2.09. The SA sample (n = 134) obtained the same mean SS as the American normative sample, but a smaller SD was evident. It was furthermore apparent that the SA sample (n = 134) obtained average scores according to the American normative distribution.

4.4.2.2. Motor-reduced subtests

The motor-reduced subtest cluster comprises the PS-, FG-, VC- and FC subtests in order to constitute the MRPQ composite score (Hammill *et al*. 1993:6,24). Figure 4.2 indicate the distribution of the DTVP-2's motor-reduced subtest' SSs of the SA study sample (n = 134) scored according to the prescribed scoring method.

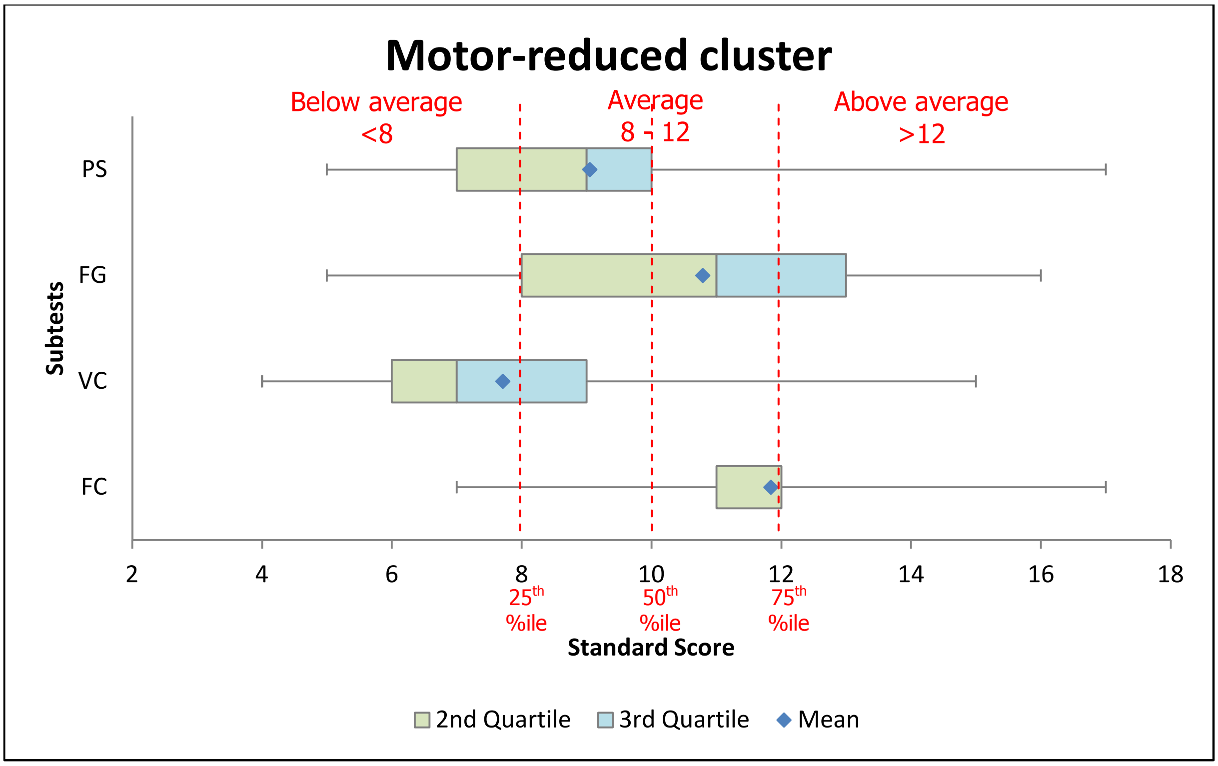


Figure 4.2: Standard scores of the DTVP-2's motor-reduced subtests scored according to the prescribed method for the SA study sample

Position in space had a minimum SS of 5 and a maximum of 17, with a median of 9 (IQR 7 – 10). The mean SS was 9.05 with a SD of 2.11. Noticeably the SA sample's (n = 134) PS mean SS was less than the American norm of 10. The SA study sample (n = 134) SSs was mostly below average and average in PS. Moreover, the 2nd quartile possessed a larger distribution of scores in relation to the 3rd quartile, indicating an abnormal distribution of PS SSs.

Figure-ground had a minimum SS of 5 and a maximum of 16, with a median of 11 (IQR 8 – 13). The mean SS was 10.79 with a SD of 3.18. Evidently the SA sample's (n = 134) FG mean SS was greater than that of the American normative sample, resulting in the SA sample (n = 134) obtaining mainly average and above average FG SSs. The 2nd quartile possessed a larger distribution of scores in relation to the 3rd quartile, indicating an abnormal distribution of FG SSs.

Visual closure had a minimum SS of 4 and a maximum of 15, with a median of 7.71 (IQR 6 – 9). The mean SS was 7.71 with a SD of 2.15. Noticeably the SA sample's (n =

134) VC mean SS was much less than the American norm of 10. Therefore, the SA sample (n = 134) scored largely below average and average. The 3rd quartile possessed a larger distribution of scores in relation to the 2nd quartile, indicating an abnormal distribution of VC SSs.

Form constancy had a minimum SS of 7 and a maximum of 17, with a mean of 12 (IQR 11 – 12). The mean SS was 11.84 with a SD of 1.22. Evidently, the SA sample's (n = 134) FC mean SS was superior to the American normative sample and the SA sample (n = 134) mainly scored in the average range. Furthermore, no SS distribution was evident in the 3rd quartile, indicating an abnormal distribution of FC SSs.

The sum of the relevant subtest' SSs is computed to obtain the composite quotients (Hammill *et al*. 1993:24). Accordingly, the composite quotients of the SA sample (n = 134) are presented in the next section.

4.4.3. The SA sample's prescribed DTVP-2 composite quotient score distribution in comparison with the American norm distribution

Three composite quotient scores are yielded – GVPQ, MRPQ and VMIQ. The GVPQ is computed by the sum of all 8 subtests, while MRPQ comprises the motor-reduced subtests and VMIQ of the motor-enhanced subtests (Hammill *et al*. 1993:6,24-25). Based on the American norm distribution, composite quotient scores have a mean of 100 and a SD of 10. Therefore, a quotient score of less than 90 corresponds to the 25th percentile; a quotient score of 100 to the 50th percentile; and a quotient score of 110 to the 75th percentile. Accordingly, the quotient scores are descriptively rated as average between 90 and 110, below average for scores below 90, and above average for scores above 110 (Hammill *et al*. 1993:24).

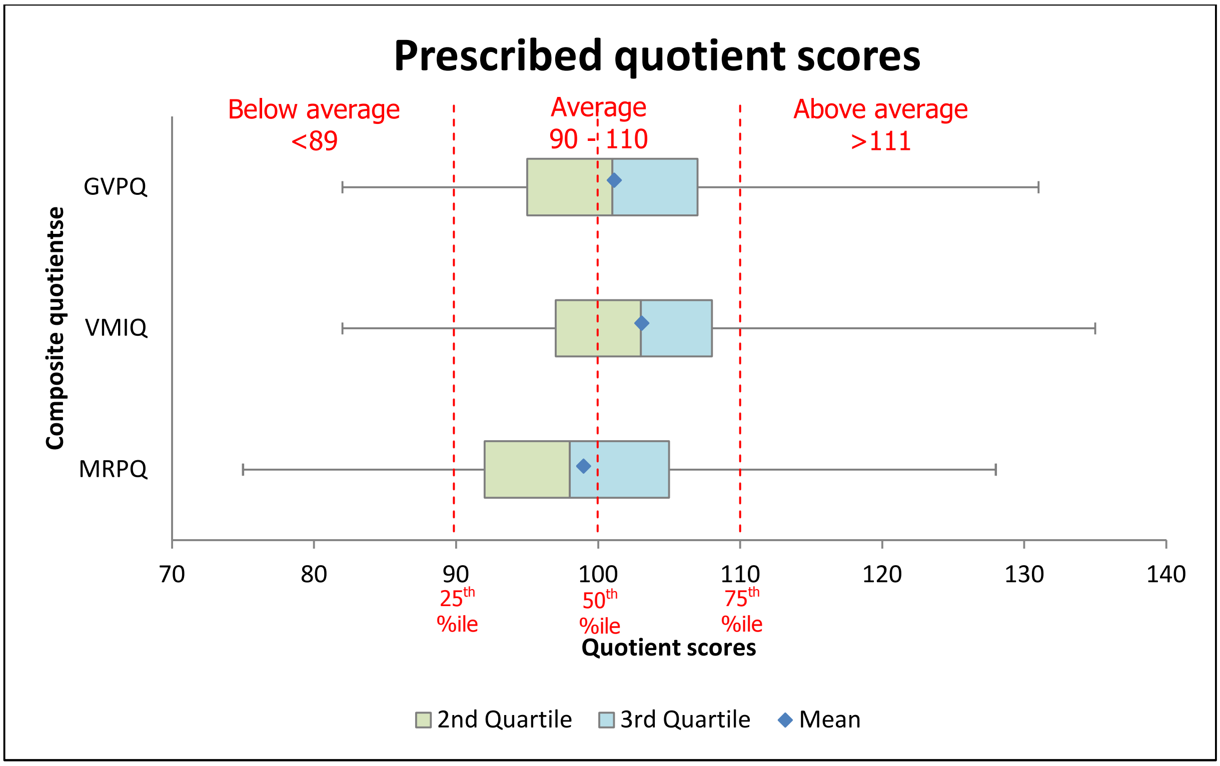


Figure 4.3: Composite quotients computed from DTVP-2 subtest standard scores, scored according to the prescribed scoring method for the SA study sample

The GVPQ had a minimum quotient score of 82 and a maximum of 131, with a median of 101 (IQR 95 – 107). The GVPQ had a mean of 101.13 and a SD of 8.95. Evidently the SA sample's (n = 134) GVPQ mean score was slightly higher than the American normative sample and the SA sample (n = 134), therefore, mainly obtained average GVPQ scores.

The VMIQ had a minimum quotient score of 82 and a maximum of 135, with a median of 103 (IQR 97 – 108). The VMIQ had a mean of 103.07 and a SD of 9.92. Noticeably the SA sample's (n = 134) VMIQ mean score was superior to the American normative sample, with the SA sample (n = 134) obtaining largely average VMIQ scores.

The MRPQ had a minimum quotient score of 75 and a maximum of 128, with a median of 98 (IQR 92 – 105). The MRPQ had a mean of 98.97 and n SD of 10.08. Although it was apparent that the SA sample's (n = 134) MRPQ mean score was slightly less than the American norm of 100, the SA sample (n = 134) mostly scored in the average range. Significantly, the SA sample's (n = 134) MRPQ was less than the VMIQ score.

Hitherto the performance of the SA sample (n = 134) on the DTVP-2 has been described and scored according to the prescribed scoring method. The motor-reduced subtests were also administered and scored according to an adapted method of not implementing the ceiling rule. The results of the adapted motor-reduced subtests are presented in Section 4.5.

4.5. THE DTVP-2 SCORES OF THE SA STUDY SAMPLE, SCORED ACCORDING TO THE ADAPTED SCORING METHOD IN COMPARISON TO THE 5 YEARS AND 6 MONTHS TO 5 YEARS AND 11 MONTHS AGE INTERVAL OF THE AMERICAN NORMATIVE SAMPLE

First, this section presents the RSs of the motor-reduced subtests of the SA sample (n = 134), after which the SS distribution of the motor-reduced subtests, scored according to the adapted scoring method, are presented. Lastly, the adapted GVPQ and MRPQ are presented.

4.5.1. The SA study sample's DTVP-2 subtest raw scores in comparison to the 5 years and 6 months to 5 years and 11 months age interval mean raw scores of the American normative sample scored according to the adapted scoring method

Table 4.7 presents the DTVP-2's motor-reduced subtests' mean prescribed- and adapted RSs of the SA sample (n = 134) in comparison to the mean RSs of the 5-year-old American normative sample.

Table 4.7: Comparison of the American normative sample and the SA study sample's DTVP-2 motor-reduced subtests' mean raw scores, scored according to the prescribed and adapted scoring methods

	USA	SA prescribed			SA adapted			*Prescribed-adapted difference*		
	$\bar{X}$	$\bar{X}$	t-value[a]	*p*	$\bar{X}$	t-value[a]	*p*	$\bar{X}_{diff}$	t-value[b]	*p*
PS	13	12	-3.40	0.0009*	15	7.35	<.0001*	3.55	20.89	<.0001*
FG	9	11	6.51	<.0001*	12	13.88	<.0001*	1.16	10.20	<.0001*
VC	7	5	-10.73	<.0001*	8	4.48	<.0001*	3.12	22.99	<.0001*
FC	8	11	18.01	<.0001*	12	26.68	<.0001*	1.10	11.94	<.0001*
MRPQ								10.30	30.80	<.0001*
GVPQ								5.36	30.87	<.0001*

X = Mean score, p = <.05 statistical significant, t = t-test

a: Single sample t-test on deviation of SA mean value from American mean.

b: Paired t-test between prescribed and adapted SA scores.

When scored according to the adapted scoring method of allowing the children to complete all the items, the SA sample (n = 134) obtained higher mean RSs in all 4 motor-reduced subtests of the DTVP-2. The mean RSs for PS and VC increased significantly with the adapted scoring method, indicating that the SA sample (n = 134) was able to complete numerous additional items as the subtests progressed to the last item.

Table 4.8 tabulates the correlation between the prescribed- and adapted RSs of the motor-reduced subtests of the DTVP-2.

Table 4.8: Correlation of the DTVP-2's motor-reduced subtests raw scores when scored according to the prescribed- and adapted scoring methods

MR	**Raw scores**								**Correlation**	
	Prescribed				**Adapted**				***P'r***	***p***
	Min	**Max**	**M**	**SD**	**Min**	**Max**	**M**	**SD**		
PS	4	23	11.69	4.47	9	23	15.24	3.53	0.91	<.0001*
FG	5	16	10.79	3.18	6	16	11.96	2.46	0.92	<.0001*
VC	1	13	4.81	2.36	3	15	7.93	2.41	0.78	<.0001*
FC	2	17	11.01	1.93	5	17	12.11	1.78	0.84	<.0001*

MR = Motor-reduced subtests, Min = minimum score, Max = maximum score, M = Mean

SD = Standard deviation, P'r = Pearson correlation coefficient, * *p* = <.05 statistically significant

High positive Pearson correlations were evident in all the motor-reduced subtests of the DTVP-2, of which FG showed the greatest correlation and VC correlated the least.

4.5.2. The SA sample's DTVP-2 subtests' standard score distribution scored according to the adapted method along with the American norm distribution

Figure 4.4 indicates the distribution of the DTVP-2's motor-reduced subtest' SSs when scored according to the adapted scoring method. Based on the American norm distribution, SSs had a mean of 10 and n SD of 3 (indicated in red) (Hammill *et al.* 1993:24). Therefore, a SS of 8 corresponds to the 25th percentile, a SS of 10 to the 50th percentile and a SS of 12 to the 75th percentile. Accordingly, SSs are descriptively rated as average for SSs between 8 and 12, below average for SSs below 8 and above average for SSs above 12 (Hammill *et al.* 1993:24).

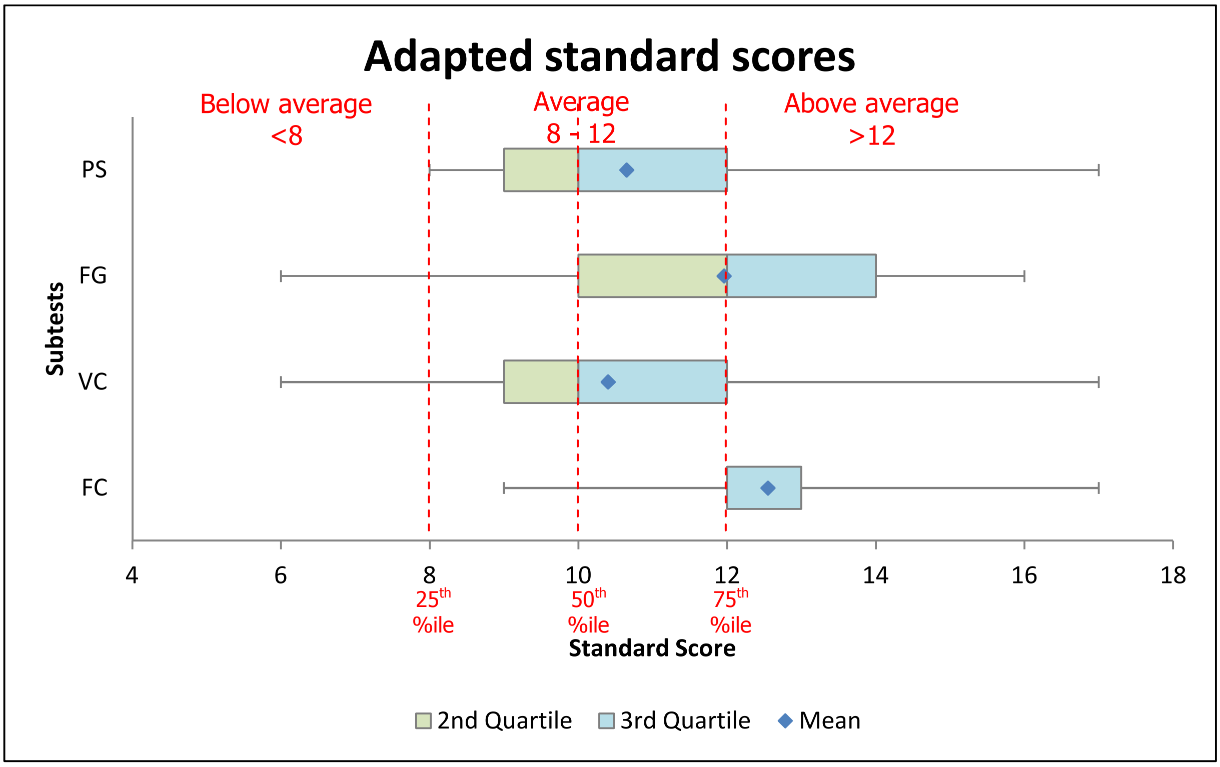


Figure 4.4: Standard scores of the DTVP-2's motor-reduced subtests scored according to the adapted method for the SA study sample

Adapted PS had a minimum SS of 8 and a maximum of 17, with a median of 10 (IQR 9 – 12). The mean SS was 10.65 with a SD of 2.09. The 3rd quartile possessed a larger distribution of scores in relation to the 2nd quartile, indicating an abnormal distribution in adapted PS SSs, resulting in the SA sample (n = 134) obtaining mainly average, but no below average, SSs.

Adapted FG had a minimum SS of 6 and a maximum of 16, with a median of 12 (IQR 10-14). The mean SS was 11.96 with a SD of 2.46. Although the 2nd and 3rd quartiles were evenly distributed, the mean SS was greater than the American norm of 10. As a consequence, the SA sample (n = 134) obtained primarily average and above average and no below average SSs.

Adapted VC had a minimum SS of 6 and a maximum of 17, with a median of 10 (IQR 9 – 12). The mean SS was 10.40 with a SD of 2.03. The 3rd quartile possessed a larger distribution of SSs in relation to the 2nd quartile, indicating an abnormal distribution in adapted VC SSs. The SA sample (n = 134) obtained primarily average, and no below average, SSs.

Adapted FC had a minimum SS of 9 and a maximum of 17, with a median of 12 (IQR 12 – 13). The mean SS was 12.55 with a SD of 1.29. The SA sample (n = 134) obtained largely above average SSs. Furthermore, no SS distribution was evident in the 2nd quartile, indicating an abnormal distribution of adapted FC SSs.

Figure 4.5 indicates the score difference between prescribed- and adapted SSs of the motor-reduced subtests of the DTVP-2.

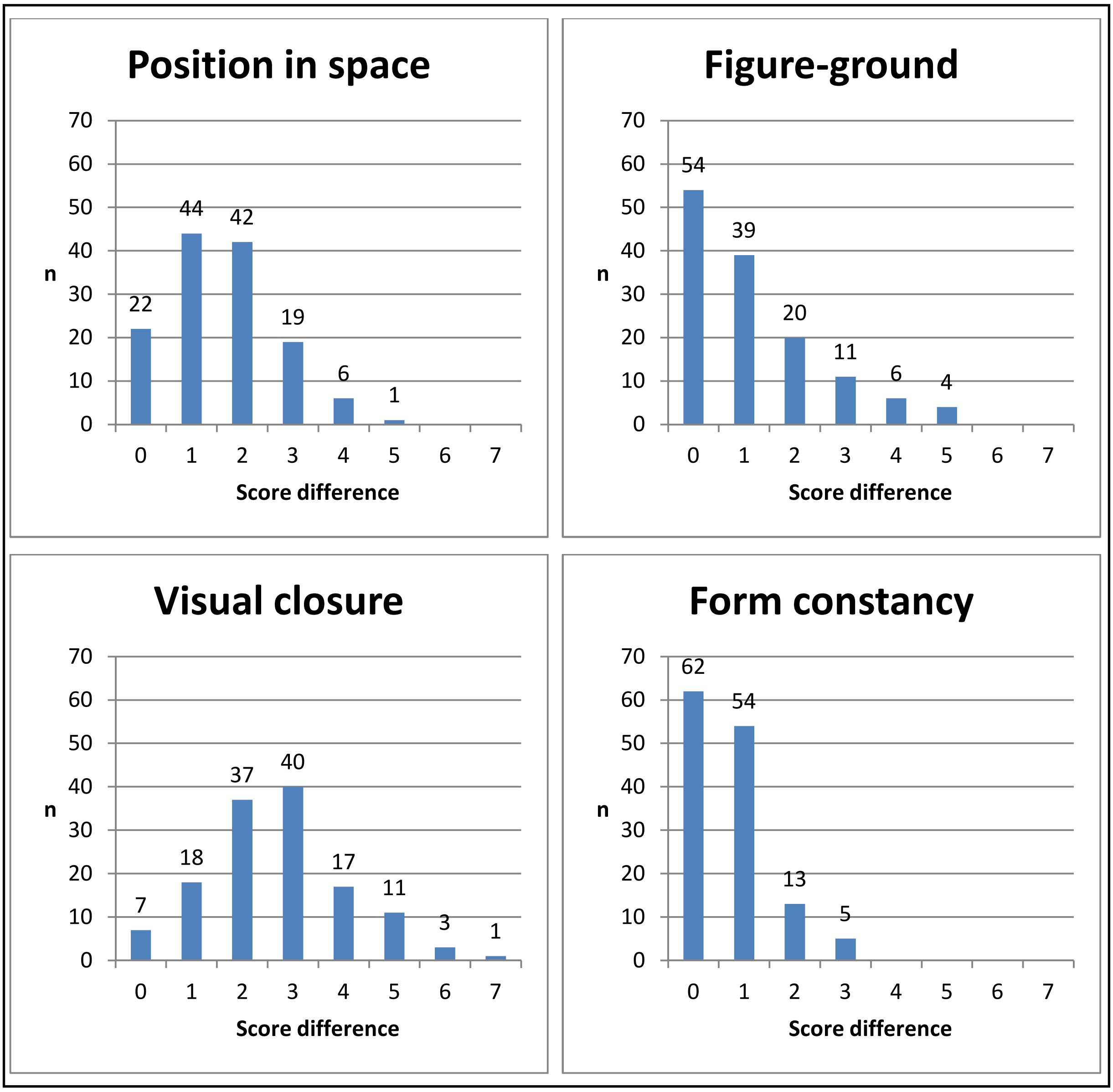


Figure 4.5: Standard score by which adapted score exceeds the prescribed score for the SA study sample

A 1 SS difference between prescribed- and adapted scores was evident for 44 children in PS, a 0 SS difference for 54 and 62 children in FG and FC respectively and a 3 SS difference for 40 children in VC.

The difference in SSs largely impacted on PS and VC, indicating that the ceiling rule should be adapted for the SA population. Figure-ground and FC showed very few children who scored more than 1 SS higher when the ceiling rule was removed.

4.5.3. The SA sample's adapted DTVP-2 composite score distribution in comparison with the American norm distribution

Figure 4.6 indicates the score distribution of the GVPQ and MRPQ when scored according to the adapted scoring method.

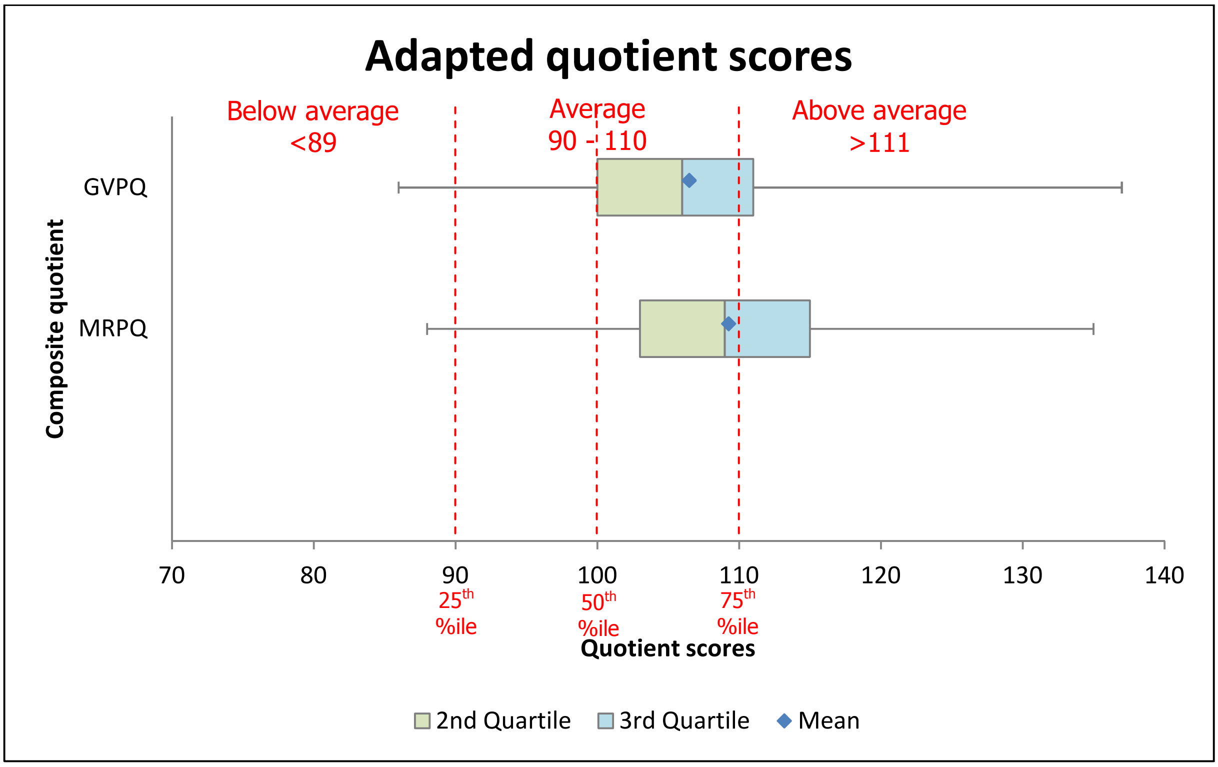


Figure 4.6: Composite quotients comprising DTVP-2 subtest standard scores scored according to the adapted scoring method for the SA study sample

The adapted GVPQ had a minimum quotient score of 86 and a maximum of 137, with a median of 106 (IQR 100-111). The adapted GVPQ had a mean of 106.49 and a SD of 9.04. Evidently the SA sample's (n = 134) GVPQ mean score was slightly greater than the American normative sample and the SA sample (n = 134), therefore, mainly obtained average GVPQ scores.

The adapted MRPQ had a minimum quotient score of 88 and a maximum of 135, with a median of 109 (IQR 103-115). The adapted MRPQ had a mean of 109.29 and a SD of 9.59. Evidently the SA sample's (n = 134) GVPQ mean score was slightly higher than the American normative sample and the SA sample (n = 134), therefore, mainly obtained average and above average MRPQ scores when the ceiling rule was removed.

Figure 4.7 indicates the difference in scores between the prescribed- and adapted quotient scores.

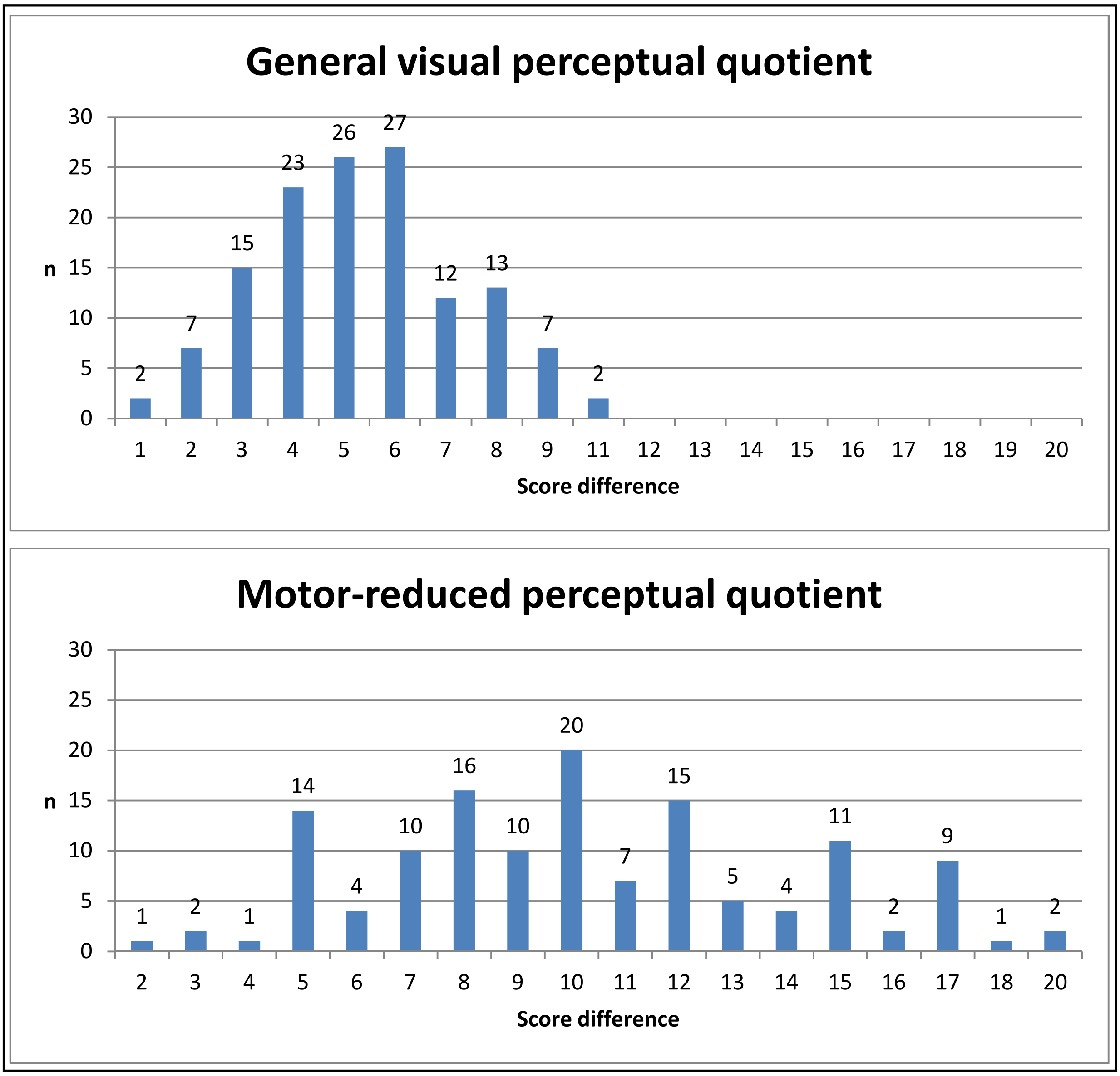


Figure 4.7: Quotient score by which adapted score exceeds the prescribed score for the SA study sample

A 6 quotient score difference was evident for 27 children in their GVPQ and a 10 quotient score difference for 20 children for MRPQ. These differences possibly could influence the descriptive ratings of quotient scores and ultimately the under- or over diagnoses of visual perceptual skill difficulties.

4.6. RESULTS OF THE PSYCHOMETRIC PROPERTIES OF THE DTVP-2 BASED ON A SA STUDY SAMPLE

When investigating the psychometric properties of a measurement instrument, 2 distinct features are examined: reliability and validity. Accordingly, the results of the reliability and validity of the DTVP-2 are presented in 4.6.1 and 4.6.2.

4.6.1. The reliability of the DTVP-2.

When investigating a measurement instrument's reliability properties, a closer look is taken into the internal consistency, test-retest reliability and inter-rater reliability of the measurement instrument. However, for this study only the internal consistency was investigated and thus reported in Table 4.9. Scores were computed by means of Cronbach coefficient alphas. Raw alpha coefficients are reported because standardised alpha coefficients could not be computed for some of the subtests, as some of their items distributed no variation since all the study participants got the items correct. These were typically the first few items, and would generally be items intended for children younger than 5 years and 6 months, who were not included in this study sample.

Table 4.9: Internal consistency alphas of the SA study sample in comparison to the 5-year-old American normative sample

DTVP-2 subtests and composites	**American sample**	**SA sample (n = 134)**	
		Prescribed	**Adapted**
		Raw alpha	**Raw alpha**
Eye-hand coordination	0.93	0.88	
Position in space	0.92	0.89	0.72
Copying	0.93	0.82	
Figure-ground	0.83	0.82	0.64
Spatial relations	0.97	0.81	
Visual closure	0.88	0.70	0.37
Visual-motor speed	0.94	0.54	
Form constancy	0.91	0.67	0.37
Visual-motor integration	**0.95**	**0.89**	
Motor-reduced visual perception	**0.97**	**0.89**	**0.79**
General visual perception	**0.98**	**0.91**	**0.80**

For the SA sample (n = 134), raw Cronbach coefficient alphas, calculated according to the prescribed method, ranged from .54 to .89. Moderate to high reliability was indicated and considered acceptable. However, correlation coefficient alphas should exceed .80 when the reliability of measurement instruments is studied (Burtner *et al*. 1997:51). According here to, EH, PS, CO, FG and SR reliability alphas were considered acceptable, whereas VC, VMS and FC reliability alphas were deemed unacceptable.

Raw Cronbach coefficient alphas calculated for the motor-reduced subtests, according to the adapted scoring method, yielded reliability alphas ranging from .37 to .72, indicating unacceptable reliability.

Overall, the DTVP-2 possessed desirable reliability, .91 and .90 respectively, for the prescribed- and the adapted scoring method.

When comparing the SA study samples (n =134) Cronbach coefficient alphas' to the 5-year-old age interval of the American sample, lower levels of reliability were evident across all the subtests of the DTVP-2. Vast disparities were especially apparent in the VC and FC subtests of the DTVP-2.

4.6.2. The validity of the DTVP-2

Although validity comprises content-, criterion-related- and construct validity, for the purpose of this study only the construct validity of the DTVP-2 was investigated; more specifically item validity by means of item analysis and the factor structure by means of factor analysis. Since the 4 motor-reduced subtests of the DTVP-2 make use of the same ceiling rule – i.e. stopping after 3 of 5 incorrect responses (Hammill *et al*. 1993:8) – the item- and factor analysis were limited to the motor-reduced subtests.

4.6.2.1. Item validity

The items from the 4 motor-reduced subtests, which were administrated with an adapted method by not implementing the ceiling rule, were tested with a Rasch analysis for dichotomous items using RUMM2030. Since Rasch analysis rests on the assumption of unidimensionality, each motor-reduced subtest was tested individually. On each subtest, one or more initial items were answered correctly by all the respondents. Bearing in mind that this study focused, for practical reasons, on children aged 5 years and 6 months and 5 years and 11 months and the DTVP-2 tests children aged 4- to 10 years, these initial items would present challenges to younger children. However, since there is no variation on these items, they could not be included in the analysis. None of the motor-reduced subtests showed any items with signs of DIF for either gender or grade. Accordingly, the basic fit data of the SA study sample (n =134) for the motor-reduced subtests are shown in Table 4.10.

Table 4.10: The basic fit data for the DTVP-2’s motor-reduced subtests based on the SA study sample

		SUBTEST	PS	FG	VC	FC
Location	**Item**	Mean	0.000	0.000	0.000	0.000
		SD	1.525	2.401	1.001	2.693
	Persons	Mean	0.213	0.938	-0.659	0.807
		SD	0.999	1.169	0.657	0.916
Fit Residual	**Item**	Mean	-0.146	-0.198	0.380	-0.282
		SD	1.730	0.979	0.856	0.850
	Persons	Mean	-0.236	-0.244	-0.054	-0.330
		SD	0.885	0.426	0.769	0.560
Item-trait interaction	**Chi square**	Value	133.9	32.5	55.1	34.0
		df	42	32	38	36
		p	<.001	0.444	0.036	0.566
		Bonferroni's alpha				
	RMSEA	N	134	134	134	134
		Value	0.128	0.010	0.058	0
		Interpretation	Inadequate fit	Good fit	Inadequate fit	
Reliability	**PSI**	WITH extrems	0.696	0.613	0.317	0.390
		NO extrems	0.696	0.613	0.317	0.390
	Alpha	WITH extrems	0.725	0.643	0.376	0.375
		NO extrems	0.725	0.643	0.376	0.375
		Interpretation	Unreliable for any measure-ment	Unreliable for any measure-ment	Unreliable for any measure-ment	Unreliable for any measure-ment
Unidimensionality	**Paired t-tests**	N significant tests	18	10	13	9
		Sample	134	134	134	134
		% PST	13.4%	7.5%	9.7%	6.7%
		%LB95CI	9.7%	3.8%	6.0%	3.0%
		Interpretation	not acceptable	acceptable	not acceptable	acceptable

SD = Standard deviation, df= degrees of freedom, RMSEA = Root Mean Square Error of Approximation, PSI = Person Separation Index, %PST = Proportion of significant t-tests, %LB95CI = Lower bound of the binomial confidence interval

The PS subtest demonstrated a large SD of 1.73 [greater than the recommended 1.4 (PsyLab group 2015:40)]. It was apparent that there were problems with the item fit. The problematic fit was confirmed by a very large Root Mean Square Error of Approximation (RMSEA) value of 0.128 [greater than the recommended 0.3 (PsyLab group 2015:43)] and a highly significant chi-square value of 133.9 (with $p < .05$). The

Person Separation Index (PSI) and alpha values (.70 and .73 respectively) indicate fair, but not good, reliability for the position in space items. Furthermore, the lower bound of the binomial confidence interval (%LB95CI) is 9.7% [and should be less than 5% for a unidimensional scale (PsyLab group 2015:47)], indicating that the PS items do not appear to measure a single factor.

The FG subtest presents a SD of .98 (less than the recommended 1.4), being indicative, therefore, of a good item fit. The good item fit was confirmed by the RMSEA value of .01. The PSI and alpha values (.61 and .64 respectively) indicated fair, but not good, reliability for the FG items. The %LB95CI was 3.8%, indicating that the FG items appeared to measure a single factor.

Although the VC subtest showed a SD of .86, there are problems with the item fit. The problematic fit was confirmed by a RMSEA value of .058 and a highly significant chi-square value of 55.1 (with $p < .05$). The PSI and alpha values (.32 and .38 respectively) indicated poor reliability for the VC items. The %LB95CI was 6.0%, suggesting that the VC items did not appear to measure a single factor.

The FC subtest possessed a SD of .85 and although less than the recommended 1.4, it was apparent that the item fit is problematic. The problematic item fit was confirmed by a RMSEA value that could not be calculated. The PSI and alpha values (.39 and .38 respectively) indicated poor reliability for the FC items. The %LB95CI was 3.0%, indicating that the FC items appeared to measure a single factor.

Each of the motor-reduced subtests item properties are now individually further delineated and presented.

4.6.2.1.1. Position in space

The individual item fit residuals of PS are presented in Table 4.11.

Table 4.11: Individual item fit of position in space

Individual Item Fit panel							**Local dependency**	**PC Loading panel Unidimensionality**
Item	**Difficulty**		**Item fit**					
Seq	**Location**	**SE**	**FitResid**	**ChiSquare**	**DF**	**Prob**		**PC1**
5	**-3.104**	0.399	-0.533	1.056	2	0.5898		-0.075
6	**-2.660**	0.335	-0.795	0.975	2	0.6143	7	-0.318
7	**-0.602**	0.200	-2.854	10.768	2	0.0046	6,12	-0.182
8	**0.102**	0.191	-1.091	2.602	2	0.2722	9	0.377
9	**-1.141**	0.216	-0.604	1.738	2	0.4193	8,10	0.523
10	**-0.687**	0.202	-1.636	3.148	2	0.2073	9,19	0.656
11	**-1.149**	0.217	-2.070	6.113	2	0.0470		0.089
12	**-1.031**	0.212	-2.097	7.978	2	0.0185	6	0.044
13	**-0.999**	0.211	-0.463	1.368	2	0.5046	18	-0.462
14	**0.502**	0.192	-0.326	1.301	2	0.5217		-0.063
15	**-0.056**	0.192	-0.933	8.733	2	0.0127		-0.027
16	**1.199**	0.205	-0.963	2.451	2	0.2935		-0.115
17	**2.270**	0.257	0.665	1.021	2	0.6001	18	-0.387
18	**1.394**	0.211	3.506	43.936	2	0.0000	13,17,20	-0.483
19	**-0.455**	0.197	1.823	4.586	2	0.1010	10,22	0.592
20	**0.632**	0.194	2.306	4.156	2	0.1252	18	-0.362
21	**-0.260**	0.194	-1.910	6.97	2	0.0307		0.004
22	**-0.307**	0.194	3.055	7.804	2	0.0202	19	0.545
23	**2.486**	0.274	1.281	11.343	2	0.0034	24	-0.481
24	**1.218**	0.206	0.480	3.895	2	0.1426	23	-0.440
25	**2.649**	0.289	0.093	2	2	0.3679		0.154

Seq = Sequence, SE = Standard error, FitResid =Fit residuals, DF = degrees of freedom

When looking at the item fit of the position in space items, it should be remembered that items 1 to 4 were answered correctly by all the respondents. The item fit of items 5 to 25 are shown in Table 4.11. Three items show problematic fit residuals [values outside of ±2.5 (PsyLab group 201:48)]: 7, 18, and 22. There is also a large degree of local dependency between the items, although the dependencies tend to function in pairs, not in multi-item clusters.

Of importance for the interpretation of the ceiling rule is the set of difficulty location values. From the difficulty location values can be seen that while the easier items tended to be placed early (and the first 4 items answered correctly by all respondents but not shown in the fit table because of their obviously being the easiest). The harder items tended to come later. There were some significant variations from this pattern, which are clearly problematic in terms of the ceiling rule. Notably, item 8 was harder than items 9 to 13, 15, and 19 through 22; and also the 3-item cluster 16 to 18, which also contained the third hardest of all the items (item 17), indicating that the ceiling rule should be adapted for the SA population.

4.6.2.1.2. Figure-ground

The individual item fit residuals of FG are presented in Table 4.12.

Table 4.12: Individual item fit of figure-ground

Individual Item Fit panel							**Local dependency**	**PC Loading panel**
Item	**Difficulty**		**Item fit**					**Unidimensionality**
Seq	**Location**	**SE**	**FitResid**	**ChiSquare**	**DF**	**Prob**		**PC1**
2	**-3.971**	0.754	-0.787	0.618	2	0.7341		0.085
4	**-2.859**	0.461	-0.243	2.771	2	0.2502		0.379
5	**-3.617**	0.641	-0.163	1.436	2	0.4877		0.076
6	**-1.711**	0.303	-0.898	2.373	2	0.3052	7	-0.139
7	**-1.971**	0.330	-0.833	1.312	2	0.5190	6	-0.091
8	**0.750**	0.196	-0.073	0.712	2	0.7004	9	0.730
9	**0.504**	0.198	-1.560	2.602	2	0.2722	8	0.787
10	**-0.008**	0.207	-0.469	1.142	2	0.5649		-0.282
11	**1.015**	0.196	1.775	1.058	2	0.5892		0.092
12	**-0.074**	0.209	-0.349	0.851	2	0.6535	13	-0.298
13	**0.120**	0.204	-1.692	4.944	2	0.0844	12	-0.100
14	**1.756**	0.204	0.406	1.091	2	0.5796		-0.350
15	**1.244**	0.197	0.969	1.406	2	0.4951	16	-0.506
16	**4.638**	0.443	1.520	3.269	2	0.1951	15	-0.254
17	**0.377**	0.200	0.011	5.761	2	0.0561		0.091
18	**3.808**	0.325	-0.773	1.118	2	0.5718		-0.351

Seq = Sequence, SE = Standard error, FitResid =Fit residuals, DF = degrees of freedom

When looking at the item fit of the FG items, items 1 and 3 were answered correctly by all the respondents. The item fit of items 2 and 4 to 18 are shown in Table 4.12. No items show problematic fit residuals. There is also some degree of local dependency between 8 items, although the dependencies function singularly.

From the set of difficulty location values, it can be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which are clearly problematic in terms of the ceiling rule. Notably, items 10 and 12 were easier than 8, 9 and 11. Thirteen and 17 were easier than items 11 and 14 to 16 which could have had a definite influence on the subtest RS.

4.6.2.1.3. Visual closure

The individual item fit residuals of VC are presented in Table 4.13.

Table 4.13: Individual item fit of visual closure

Individual Item Fit panel							**Local dependency**	**PC Loading panel**
Item	**Difficulty**		**Item fit**					**Unidimensionality**
Seq	**Location**	**SE**	**FitResid**	**ChiSquare**	**DF**	**Prob**		**PC1**
2	**-2.402**	0.238	-0.768	6.885	2	0.0320	5	0.442
3	**-0.696**	0.181	0.748	0.085	2	0.9582		-0.318
4	**-1.283**	0.188	0.632	1.278	2	0.5279		-0.145
5	**-0.680**	0.181	0.305	4.863	2	0.0879	2,11	0.708
6	**-0.965**	0.183	-0.852	4.1	2	0.1287		-0.517
7	**-0.361**	0.183	2.969	12.909	2	0.0016		-0.194
8	**1.109**	0.240	-0.533	0.331	2	0.8475		0.300
9	**-0.257**	0.184	-0.274	1.179	2	0.5545		-0.475
10	**0.303**	0.198	0.732	0.643	2	0.7249		0.060
11	**0.527**	0.207	0.114	0.967	2	0.6168	5	0.545
12	**-0.462**	0.182	0.996	7.66	2	0.0217		-0.454
13	**0.246**	0.196	-0.113	4.197	2	0.1226		0.011
14	**1.594**	0.282	0.307	1.511	2	0.4697		0.211
15	**-0.330**	0.183	0.697	1.488	2	0.4751		-0.237
16	**0.944**	0.229	0.219	0.291	2	0.8645		0.028
17	**0.652**	0.213	-0.077	0.774	2	0.6790	20	0.396
18	**1.299**	0.255	0.797	3.749	2	0.1534		0.249
19	**-0.223**	0.185	1.249	0.352	2	0.8385		-0.246
20	**0.988**	0.232	0.066	1.842	2	0.3981	17	0.226

Seq = Sequence, SE = Standard error, FitResid =Fit residuals, DF = degrees of freedom

When looking at the item fit of the VC items, it should be remembered that item 1 was answered correctly by all the respondents. The item fit of items 2 to 20 are shown in Table 4.13. Item 7 shows a problematic fit residual value outside of ±2.5. There is some degree of local dependency between 5 items.

From the set of difficulty location values, it can be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which are clearly problematic in terms of the ceiling rule. Markedly, item 8, was harder than items 9 to 13, the 3-item cluster 15 to 17, 19 and 20. Item 14 was the hardest of all the items, indicating that the ceiling rule should be adapted for the SA population.

4.6.2.1.4. Form constancy

The individual item fit residuals of FC are presented in Table 4.14.

Table 4.14: Individual item fit of form constancy

Individual Item Fit panel							Local dependency	PC Loading panel
Item	Difficulty		Item fit					Unidimensionality
Seq	Location	SE	FitResid	ChiSq	DF	Prob		PC1
2	**-5.197**	1.334	-1.264	0.856	2	0.6519		-0.007
3	**-3.623**	0.657	0.117	0.971	2	0.6155		0.160
5	**-0.932**	0.240	-0.342	1.703	2	0.4267		0.396
6	**-1.839**	0.321	-1.068	1.037	2	0.5953	7	0.551
7	**-3.119**	0.531	-1.779	1.533	2	0.4647	6	0.665
8	**-1.389**	0.275	0.246	1.615	2	0.4459		-0.030
9	**-3.379**	0.592	0.196	1.168	2	0.5578		0.014
10	**-0.563**	0.219	-0.830	2.495	2	0.2872		0.017
11	**-1.152**	0.256	-0.879	2.123	2	0.3459		-0.326
12	**1.901**	0.204	0.120	1.461	2	0.4815		0.290
13	**3.639**	0.339	-1.194	2.187	2	0.3350		-0.208
14	**1.633**	0.196	-1.170	5.565	2	0.0619		-0.228
15	**2.016**	0.209	1.208	2.335	2	0.3111		-0.017
16	**2.206**	0.217	0.574	1.144	2	0.5645	17	-0.454
17	**2.437**	0.229	0.431	1.623	2	0.4443	16	0.253
18	**2.239**	0.219	1.006	1.339	2	0.5120		-0.458
19	**1.663**	0.197	0.099	0.718	2	0.6982		-0.200
20	**3.459**	0.317	-0.548	4.136	2	0.1264		-0.164

Seq = Sequence, SE = Standard error, FitResid =Fit residuals, DF = degrees of freedom

When looking at the item fit of the FC items, it should be remembered that items 1 and 4 were answered correctly by all the respondents. The item fit of items 2, 3 and 5 to 20 are shown in Table 4.14. There is also some degree of local dependency between 4 of the items, although the dependencies tend to function singularly.

From the set of difficulty location values, it can be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which are clearly problematic in terms of the ceiling rule. Item 13 (the hardest of all the items), along with items 15 to 18, was much harder than items 14 and 19, indicating that the ceiling rule should be adapted for the SA population.

4.6.2.2. Factor analysis

The small sample size made it difficult to compute full factor analyses on the subtests. Therefore a PCA was conducted for each of the DTVP-2's motor-reduced subtests individually and presented first. Factors were rotated using the Varimax rotation method. The cut off for significant loadings on a factor was set at below -0.4 or above 0.4 and **indicated in bold**. The factor with the largest variance represents the underlying theoretical trait. The PCA serves as further confirmation of the motor-reduced subtest's dimensionality (Brown *et al*. 2009:395). Secondly, the factor structure of the DTVP-2 measurement instrument as a whole (scored according to the adapted scoring method) is presented in comparison with the American normative sample.

4.6.2.2.1. Position in space

It should be remembered that the lack of variation on the first 4 PS items implies that it is impossible to determine their factor loadings. Figure 4.8 presents a scree plot of eigenvalues for PS.

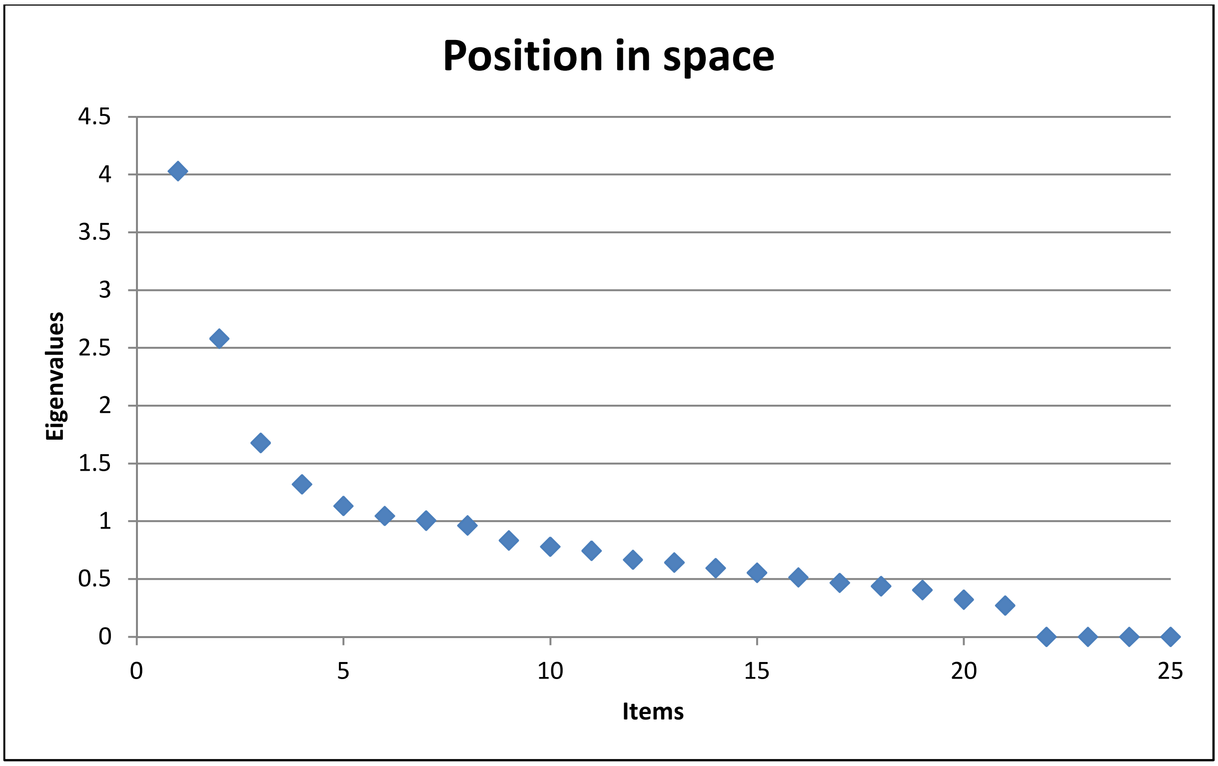


Figure 4.8: Scree plot of eigenvalues calculated for position in space

The PS items measured 3 or possibly 4 factors. Accordingly, the 3- and 4 rotated factor patterns are presented in Table 4.15.

Table 4.15: Three- and four rotated factor patterns for position in space

	Rotated Factor Pattern			**Rotated Factor Pattern**			
Itm	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.36	-0.13	-0.21	0.08	-0.05	**0.42**	-0.13
6	**0.41**	-0.18	0.13	-0.05	-0.08	**0.58**	0.30
7	**0.76**	0.00	0.00	0.37	0.06	**0.69**	0.13
8	0.37	**0.49**	-0.08	0.32	**0.48**	0.20	0.00
9	0.02	**0.76**	-0.03	0.23	**0.70**	-0.20	0.01
10	0.28	**0.69**	-0.21	0.30	**0.69**	0.11	-0.11
11	**0.61**	0.19	-0.06	0.35	0.23	**0.50**	0.05
12	**0.72**	0.06	-0.16	**0.43**	0.11	**0.58**	-0.09
13	0.36	0.00	**0.44**	0.13	-0.01	0.33	**0.54**
14	**0.51**	0.10	-0.04	**0.48**	0.07	0.26	-0.06
15	**0.47**	0.18	0.05	**0.61**	0.08	0.08	-0.04
16	**0.50**	0.13	0.15	**0.56**	0.04	0.16	0.09
17	0.21	-0.02	**0.39**	0.21	-0.10	0.06	0.38
18	-0.25	-0.03	**0.71**	-0.12	-0.14	-0.28	**0.69**
19	0.14	**0.41**	**-0.57**	-0.10	**0.57**	0.31	-0.39
20	0.08	0.22	**0.60**	-0.06	0.19	0.11	**0.73**
21	**0.63**	0.18	0.04	**0.53**	0.15	0.37	0.06
22	0.14	0.35	**-0.63**	-0.06	**0.49**	0.28	**-0.48**
23	0.18	**-0.63**	0.02	0.17	**-0.66**	0.11	-0.13
24	**0.47**	-0.22	0.25	**0.53**	-0.33	0.14	0.13
25	0.17	**0.39**	0.25	**0.59**	0.19	-0.33	0.09
V	*3.67*	*2.39*	*2.23*	*2.64*	*2.53*	*2.42*	*2.02*

Itm = Subtest item, V = Variance explained by each factor

Looking at both 3-and 4 rotated factor patterns, both accounted for a fair amount of variance (8.3% and 9.6% respectively), although the accounted variance for the first factor of the 3-factor solution was much higher (3.7% vs 2.6%). Also, the 3-factor solution showed – in terms of concurrent discriminant- and convergent validity (i.e. a high item loading on only 1 factor, and low loadings on the remaining factors, and all items loading on 1 of the factors) – a slightly better fit.

Items 6, 7, 11, 12, 14, 15, 16, 21 and 24 loaded well on factor 1; items 8 to 10, 19, 23 and 25 on factor 2, and items 13, 17 – 20 and 22 on factor 3. Factor 1 accounted for 3.67% of variance, factor 2 accounted for 2.39% and factor 3 for 2.23%.

4.6.2.2.2. Figure-ground

The lack of variation on the first and third FG items implies that it is impossible to determine their factor loadings. Figure 4.9 presents a scree plot of eigenvalues for FG.

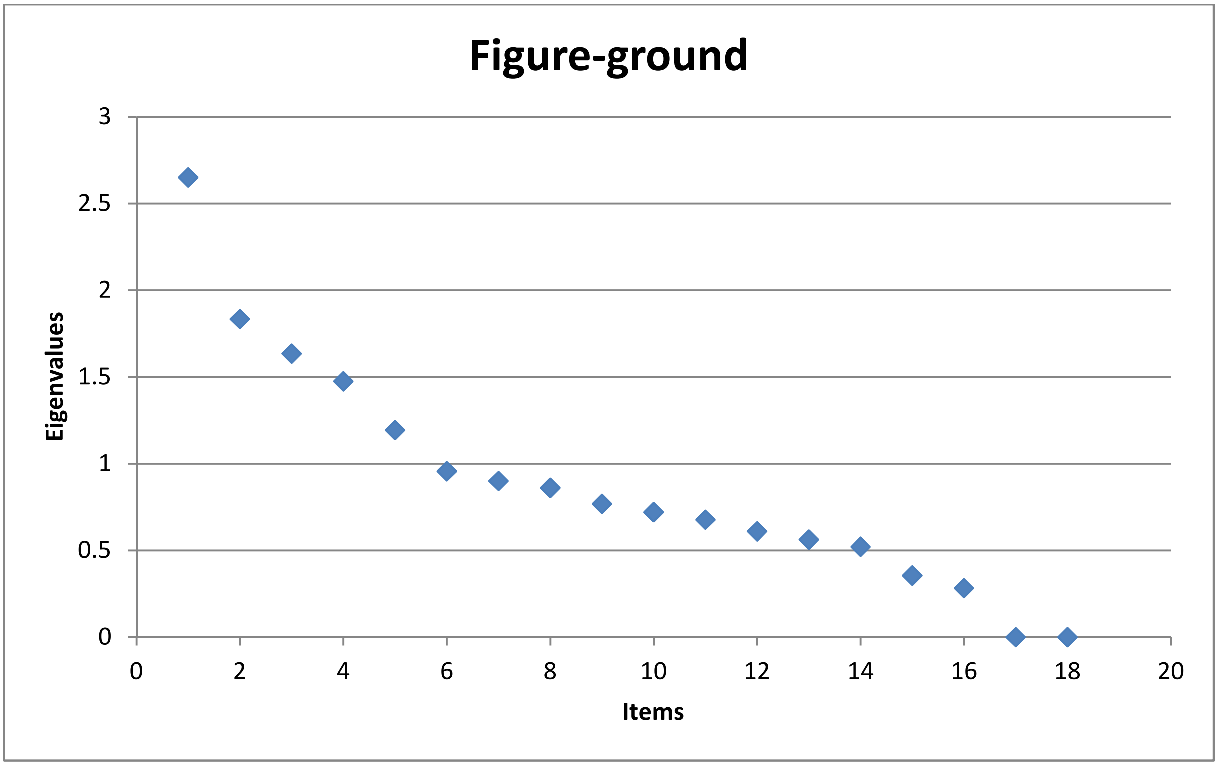


Figure 4.9: Scree plot of eigenvalues calculated for figure-ground

One factor was extracted at best. The factor accounted for 2.7% of the item variance, and the factor pattern is shown in Table 4.16. It should be remembered that rotation of the factor pattern is not possible with 1 factor.

Table 4.16: Factor pattern for figure-ground

	Factor Pattern
Item	**Factor 1**
1	0.00
2	0.31
3	0.00
4	0.19
5	0.18
6	**0.42**
7	0.27
8	**0.49**
9	**0.61**
10	**0.54**
11	0.27
12	**0.47**
13	**0.63**
14	**0.44**
15	0.38
16	-0.08
17	**0.47**
18	0.29
V	*2.65*

V = Variance explained by each factor

Items 6, 8 to 10, and 12 to 14 and 17 loaded well on the factor. This may, though, be related to the slightly low reliability of the items.

4.6.2.2.3. Visual closure

The lack of variation on the first VC item implies that it was impossible to determine its factor loadings. Figure 4.10 presents a scree plot of eigenvalues for visual closure.

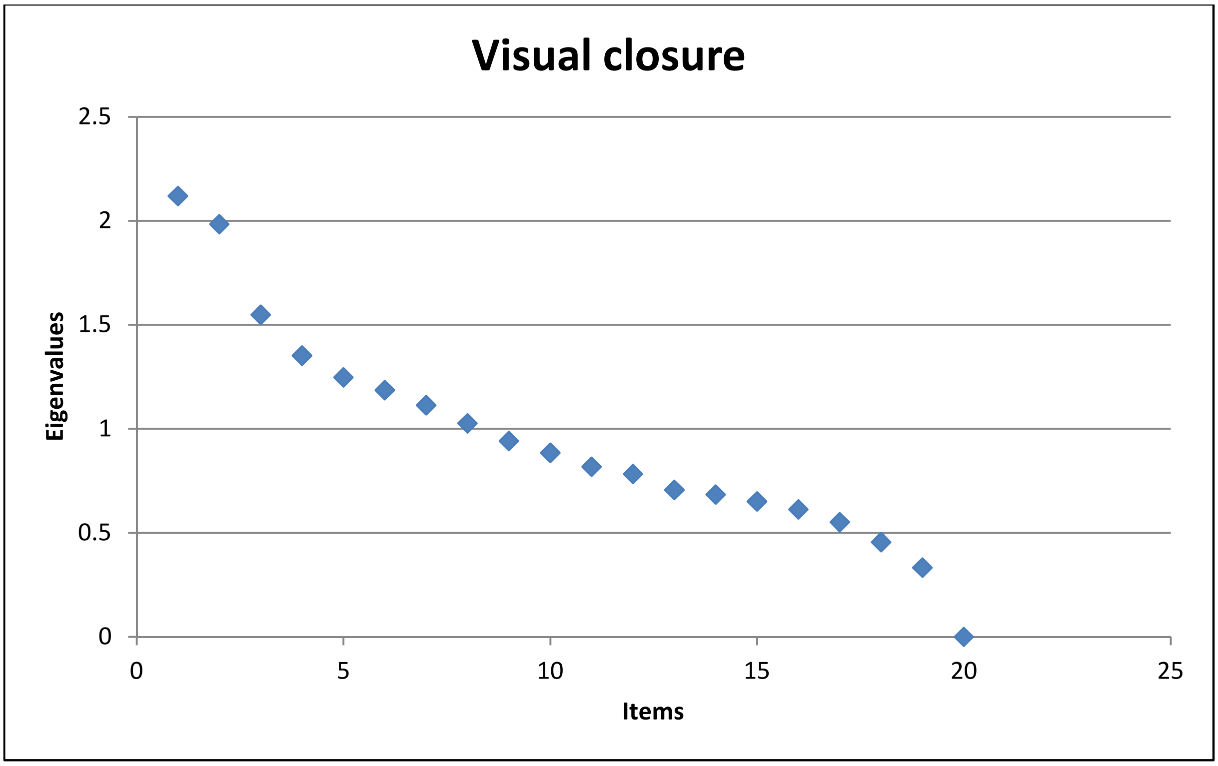


Figure 4.10: Scree plot of eigenvalues calculated for visual closure

The VC items measured 2 factors. Accordingly, the 2-rotated factor pattern is presented in Table 4.17.

Table 4.17: Rotated factor pattern for visual closure

	Rotated Factor Pattern	
Item	**Factor 1**	**Factor 2**
1	0.00	0.00
2	**0.50**	-0.07
3	0.11	**0.52**
4	-0.05	0.17
5	**0.62**	-0.32
6	0.05	**0.68**
7	-0.31	-0.03
8	**0.51**	0.04
9	0.05	**0.60**
10	0.08	-0.04
11	**0.60**	-0.14
12	-0.13	**0.49**
13	0.33	0.17
14	0.13	-0.23
15	0.10	0.35
16	0.18	0.15
17	**0.55**	0.00
18	-0.01	**-0.40**
19	0.00	0.33
20	**0.45**	0.20
V	*2.08*	*2.03*

V = Variance explained by each factor

Looking at the factor solution, both factors accounted for a low amount of variance (2.1% and 2.0% respectively). Items 2, 5, 8, 11, 17 and 20 loaded well on the first factor, whereas item 3, 6, 9, 12 and 18 loaded well on the second factor. Numerous items, however, failed to load on either of the factors.

4.6.2.2.4. Form constancy

The lack of variation on the first and fourth FC items means that it is impossible to determine their factor loadings. Figure 4.11 presents a scree plot of eigenvalues for FC.

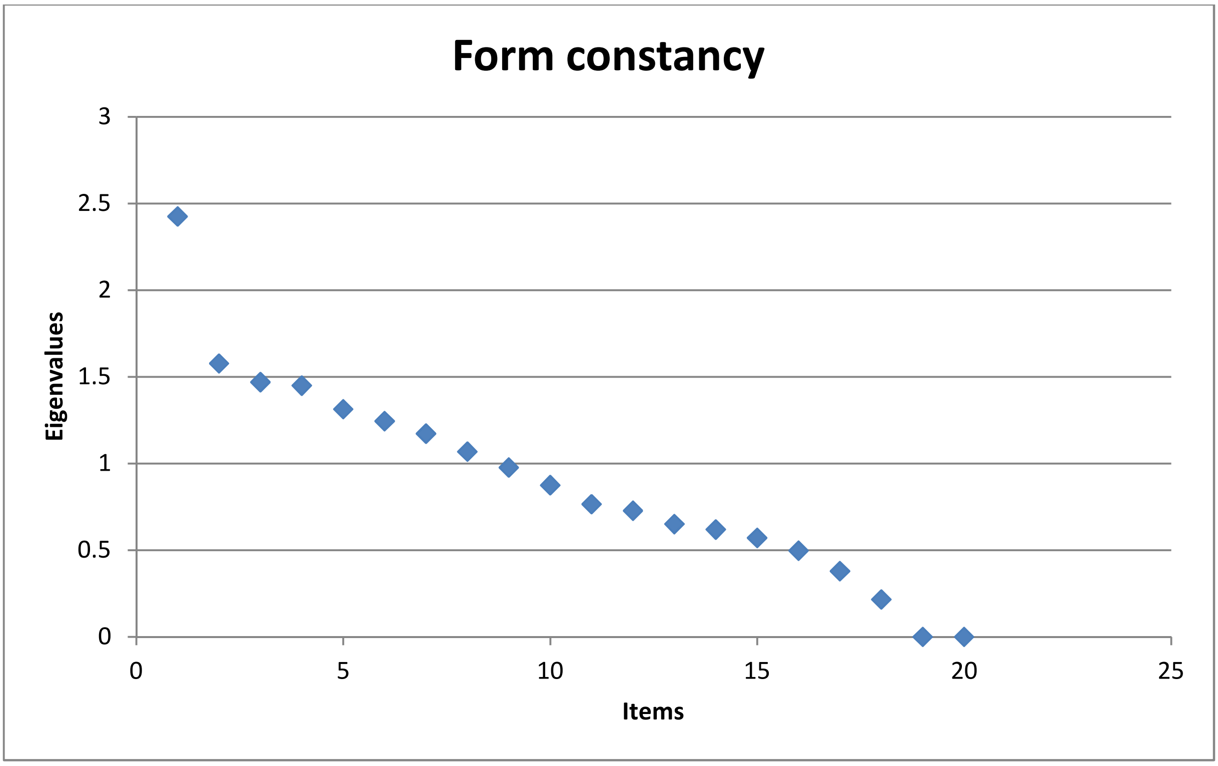


Figure 4.11: Scree plot of eigenvalues calculated for form constancy

One factor could be extracted at best. The factor accounted for 2.4% of the item variance, and the factor pattern is shown in Table 4.18. It should be remembered that rotation of the factor pattern was not possible with 1 factor.

Table 4.18: Factor pattern for form constancy

	Factor Pattern
Item	**Factor 1**
1	0.00
2	**0.79**
3	**0.69**
4	0.00
5	**0.42**
6	0.31
7	**0.77**
8	0.04
9	-0.09
10	0.34
11	0.36
12	0.21
13	0.16
14	0.19
15	0.09
16	-0.01
17	0.12
18	-0.01
19	0.20
20	0.14
V	*2.43*

V = Variance explained by each factor

Items 2, 3, 5 and 7 loaded on factor 1, which accounted for 2.43% of variance. Evidently many items did not load well on the factor. The poor loading of items may, though, be related to the slightly low reliability of the items.

Table 4.19 presents the 2-rotated factor pattern of the DTVP-2 for the SA study sample (n = 134) scored according to the adapted scoring method and in comparison to the American normative sample.

Table 4.22: The rotated factor structure of the DTVP-2 for the SA study sample scored according to the adapted scoring method and in comparison to the American normative sample

DTVP-2 Subtests	**American normative sample**		**SA study sample (n = 134)**	
	Factor 1	**Factor 2**	**Factor 1**	**Factor 2**
Eigenvalues	*3.92*	*3.52*	*2.90*	*1.34*
Factor loadings				
1: Eye-hand coordination	0.59	0.66	0.31	**0.47**
2: Position in space	0.80	0.69	**0.71**	0.17
3: Copying	0.74	0.76	**0.62**	**0.44**
4: Figure ground	0.59	0.60	**0.71**	-0.04
5: Spatial relations	0.84	0.79	**0.76**	0.26
6: Visual closure	0.76	0.65	**0.68**	0.25
7: Visual-motor speed	0.44	0.51	-0.06	**0.82**
8: Form constancy	0.74	0.60	**0.60**	-0.33

It is apparent from the rotated factor pattern for the SA study sample that subtests 2 to 6 and 8 loaded well on factor 1. Subtests 2, 4, 6 and 8 constitute the motor-reduced subtests of the DTVP-2. Although subtests 3 and 5 also loaded on factor 1, factor 1 could possibly support the underlying theoretical trait of motor-reduced visual perception.

Subtest 1, 3 and 7 (constituting part of the motor-enhanced subtests) loaded well on factor 2. In this way there is a possible indication that factor 2 supports the underlying theoretical trait of VMI.

Disparities were evident between the factor loadings and eigenvalues of the American normative sample and the SA study sample (n = 134).

4.6. SUMMARY

Chapter 4 presented the research results by means of tables and figures. Norms were established for a sample of the SA population and compared to the American normative sample. An abnormal distribution of scores became evident. Furthermore, results of the prescribed- and the adapted scoring methods, as well as gender differences in test performance, were compared among the SA sample (n =134). An investigation into the reliability of the DTVP-2 subtests displayed unacceptable reliability for VC, VMS and FC. An item analysis revealed a problematic item fit for PS, VC and FC. The factor structure of the whole DTVP-2 supports the DTVP-2 measuring visual perception through 2 ways; i.e. motor-enhanced and motor-reduced.

In Chapter 5 these results will be correlated and argued in accordance with the relevant literature.

CHAPTER 5
DISCUSSION

5.1. INTRODUCTION

Chapter 4 presented the results of the study that investigated the suitability of the DTVP-2 as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT, SA.

Chapter 5 interprets and discusses the findings of the study in relationship to the relevant literature. International and national research regarding the DTVP-2 is discussed in order to describe similarities and differences. The discussion allows conclusions to be drawn and argues possible recommendations regarding the suitability of the DTVP-2 for the SA population.

First, the demographic characteristics of the study sample are discussed in Section 5.2. Second, gender differences in the DTVP-2 test performance of the SA study sample are discussed in Section 5.3. Third, the scores obtained from the SA sample, scored according to the prescribed method and in comparison with the American normative sample, are discussed. The adapted scores of the DTVP-2's motor-reduced subtests, along with differences and comparisons between the prescribed- and adapted scores are discussed in Section 5.4. Last the measurement properties of the DTVP-2 are discussed in Section 5.5.

5.2. DEMOGRAPHIC CHARACTERISTICS OF THE SA STUDY SAMPLE

The study sample comprised of 134 typically developing children of whom 48.51% were boys and 51.49% girls. Even though the gender distribution differed from the 5-year-age cluster of the American normative sample, it correlated closely with the gender distribution of the COT where 49.8% of the population was males and 50.2% females (StatsSA 2012:9). These boys and girls were enrolled in grade RR (26.12%) and grade R (73.88%) of urban-suburban pre- (84.62%) and primary schools (15.38%) located in the 4 educational districts of the GDE, covering the geographical area of the COT metropolitan municipality. A greater number of grade R children made up the study sample because of the time of the year the data was collected.

Tshwane South presented the largest proportion of the study sample with 68.66% and GN the smallest with 6.72%, while TN and TW constituted 16.42% and 8.21% of the SA study sample respectively. This distribution coincided more or less with the number of proportionally selected schools according to the size of the district's eligible schools. Table 4.3 presented the age distribution of the SA study sample, which consisted of: 14.93% children of 5 years and 6 months; 16.41% children of 5 years and 7 months; 16.42% children of 5 years and 8 months; 19.40% at 5 years 9 months; 17.17% at 5 years and 10 months and 15.67% children of 5 years and 11 months. These percentages indicate a relatively equal age distribution along the month intervals.

The home languages most spoken by the SA study sample were indicated by Table 4.4 as English (25.37%), Setswana (17.91%), Sepedi (8.96%), Northern Sotho (6.72%) and Zulu (6.72%). The home language of the SA study sample (n = 134) differed from the language distribution typically spoken in the COT. However, the distribution was indicative of a multi-lingual, heterogeneous study sample and therefore representative of the many cultures inherent to SA. The large percentage of English speakers could be reasoned by the increase in English-home-language speakers (8.2% to 9.6%) and the simultaneous decrease in African home languages that was noted in the 2011 SA census (Evans & Cleghorn 2014:14-15). The sample also included a total of 13.44% foreign languages, which could be explained by the number of foreign embassies located in the COT (StatsSA online), as well as inter-continental migration and globalisation, altering the demographics of developed urban areas (Evans & Cleghorn 2014:14-15).

In contrast, the American normative sample was primarily white, comprising English-speaking children from cultures inherent to the American and residing mainly in urban settings. Evidently, the SA study sample (n = 134) and American normative sample characteristics differ significantly with regard to ethnicity and language. Although both samples were from urban settings, differences can be anticipated, as SA is a third world/developing country while the American is a first world/developed country.

The demographic characteristics of the SA study sample (n = 134) served as reference on which the results of this study were based. Since the study sample was randomly selected and representative of the COT population, results cannot be generalised to the entire SA population. However, in view of the fact that the population was selected from an urban area which was geographically restricted to the COT, consisting of children attending formal educational settings and proficient in English, the results may be generalised to similar SA populations. Accordingly, the results of the DTVP-2 are interpreted and discussed.

5.3. DIFFERENCES IN DTVP-2 SCORES AMONG BOYS AND GIRLS OF THE SA STUDY SAMPLE

One of the subset questions that guided this research questioned gender differences in DTVP-2 scores among boys and girls of a SA study sample (n = 134). Results of this study indicated that there were no statistically significant differences in test performance among 5 years and 6 months to 5 years and 11 months English-speaking SA boys and girls, with the exception of FG when scored according to the prescribed method (*p* = .03). According to Table 4.5, girls scored 1 RS and/or SS higher than the boys for this subtest. It is a coincidence that the RS equalled the SS. No statistically significant differences were detected when the motor-reduced subtests of the DTVP-2 were administrated and scored according to the adapted method of not implementing the ceiling rule. This finding was substantiated by the DIF for gender, which established no differences for boys and girls.

Although literature is available to describe the DTVP-2 test performance for SA children, gender differences have previously not been reported that could be compared with results from this study. However, consistent with findings from this study, Hong Kong girls perform significantly better than boys in the FG subtest of the DTVP-2 (Cheung *et al.* 2005:39).

Literature (Clutten 2009:31) exist that present the opposite view regarding gender performance in standardised measurement instruments. Clutten (2009:31) states that boys perform better on (sub)tests measuring FC, CO and SR, whereas girls perform better on (sub)tests measuring FG. In light of the contrasting findings regarding the development of visual perceptual skills between genders (Van Romburgh 2006:25), as well as the influence of gender on performance in standardised measurement instruments (Clutten 2009:31), it is necessary to consider research on the specific measurement instrument and the population and context being applied to. Cheung *et al*. (2005:40) recommend that further investigation is warranted as the literature fails to distinguish performance differences between genders.

It is therefore summarised that the DTVP-2 is unbiased for gender in SA children aged 5 years and 6 months to 5 years and 11 months. With the exception of FG, when administrating the DTVP-2 according to the prescribed scoring method. Clinicians should therefore bear in mind that girls, aged 5 years and 6 months to 5 years and 11 months, score 1 SS higher to boys of the same age when interpreting and conveying the FG's subtest results.

5.4. THE DTVP-2 RESULTS OF THE SA STUDY SAMPLE

Sub questions relating to: 1) how the norms of a SA study sample (n = 134) compared to those calculated for the American normative sample; and 2) how the prescribed scoring method compared to an adapted scoring method for the motor-reduced subtests, GVPQ and MRPQ, are answered in this section. Each of the 8 subtests of the DTVP-2 are considered and discussed. The discussion is set out according to the motor-enhanced- and the motor-reduced subtest clusters. The motor-reduced subtest is discussed in accordance with the prescribed- as well as the adapted administration and scoring methods. Last, the composite scores are discussed.

The DTVP-2 yields, among other scores, RSs, SSs and composite quotients, which are translated to descriptive ratings for interpretation (Hammill *et al.* 1993:23,24). In the literature, results are not always reported in a uniform manner, as researchers make use of either RSs, SSs or descriptive ratings to convey their findings. Therefore, the RSs, SSs and descriptive ratings are reported for each of the DTVP-2 subtests. The results of this study are accordingly compared with the relevant literature.

5.4.1. Motor-enhanced subtests

The motor-enhanced subtests of the DTVP-2 provide clinicians with information regarding children's VMI ability (Hammill *et al.* 1993:6), although the motor-enhanced subtests of the DTVP-2 comprise more than the theoretical definition of VMI implies.

5.4.1.1. Eye-hand coordination

According to Table 4.6, the SA sample (n = 134) scored 13 mean RSs higher (139) for EH in relation to the American normative sample (126). The SA sample (n = 134) primarily scored average on EH (Figure 4.1), with a mean SS of 10.56 and a SD of 2.19 in comparison to the American norm distribution of a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

The SA sample (n = 134) scored higher than the American normative sample. This finding is consistent with Visser (2005:44), who established a mean SS of 9.20 and a SD of 0.89 in SA children aged 5 years and 6 years. Similarly Visser *et al*. (2012:23) found that 82.5% of 5-year-old SA children score average, while Van Romburgh (2006:58) established that 40% of 40 grade 1 SA children score below average and 60% average. Evidently the SA sample (n = 134) scores differently from their American peers. Table 4.6 indicated a statistically significant difference (p = <.0001) in mean RSs for EH when the SA sample (n = 134) was compared to the American normative sample. Clinically, this could imply a 1 SS difference between the American normative sample and the SA sample (n = 134) impeding on the interpretation of test results.

Comparable to results of this study, 5-year-old English-speaking Australian children obtain a mean SS of 10.46 with a SD of 1.52 in comparison to 5-year-old Chinese-speaking children, who obtained a mean SS of 13.16 with a SD of 1.95 (Lai & Leung 2012:437). Conversely, Cheung *et al*. (2005:38) detected a discrepancy in mean RSs since 6- and 7-year-old Hong Kong children scored 100% correctly on the EH subtest. The superior scoring of Hong Kong children could be attributed to their culture. In addition the EH subtest items are deemed too easy by an expert panel of 12 Hong Kong paediatric OTs (Cheung *et al*. 2005:33-34).

Reasons for the difference in mean RSs between the SA study sample (n = 134) and the American normative sample are proposed by Visser *et al.* (2012:23) in a previous study, as subtest items being too easy and/or children that are familiar with the task as children participated in similar activities in pre-school. Seeing that the study sample (n = 134) was required to be in an ELOLT pre-school for at least 2 years as part of the inclusion criteria for the study, could explain the high EH scores. Children generally engage in activities at pre-school requiring EH, such as cutting, colouring, pasting, constructing, ball games and building puzzles.

Evidently specific evidence-based guidelines or adaptations are needed in order to obtain more accurate results and to ensure a more normal distribution of scores. Perhaps more advanced EH tasks must be considered for the SA population. A more stringent scoring method could also be applied to the SA population in order to obtain more accurate results. Currently the EH subtest is scored per segment by awarding 4, 3, 2 or 1 depending on the line interval in which the pencil mark occurs. A descending number is awarded when "the line is considered in an adjacent interval if you can see white space between the pencil mark and the track line" (Hammill *et al.* 1993:10). Maybe it should be considered to award one less score as soon as the pencil mark crosses (touches) the adjacent line. Advanced EH test tasks and a more stringent scoring method would however require further investigation.

5.4.1.2. Copying

According to Table 4.6, the SA sample (n = 134) obtained 1 less mean RS (15) for CO in relation to the American normative sample (16). This result translates to the SA sample (n = 134) scoring primarily average on CO (Figure 4.1), with a mean SS of 10.56 and a SD of 2.19 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al.* 1993:24). Figure 4.2 furthermore indicates an abnormal distribution of scores, as there are no scores in the 2nd quartile.

This finding is supported by Visser (2005:44), who noted that no 5- and 6-year-old SA children score below average in CO, with a mean SS of 11.30 and a SD of 2.32. Likewise, Visser *et al*. (2012:23) note that 50% 5-year-old SA children obtain average- and 47.5% above average scores. Van Romburgh (2006:58) also established similar results with 77.5% of 40 grade 1 SA children scoring average on CO.

Moreover, Cheung *et al*. (2005:38) report average and above average scores for Hong Kong children, aged 6 years and 7 years. Lai and Leung (2012:442) observed a ceiling effect in 5-year-old Chinese children obtaining a mean SS of 16.51 with a SD of 2.15, while 5-year-old English-speaking children obtained a mean SS of 11.14 with a SD of 2.50. The difference in performance of Chinese children could possibly be explained by their superior VMI ability, which results from, amongst other factors, learning the complex Chinese letter formation from an early age (Lai & Leung 2012:440-441).

Reasons for the SA sample (n = 134) scoring differently could possibly be attributed to a number of factors. First, the relatively small sample size (n = 134) may have influenced the results. Second, the observed differences in scores can also be attributed to the unique characteristics of the SA population such as SA children interpreting visual stimuli in a different manner in relation to their American peers (Eksteen 2007:78). Third, SA children enroll in formal education at a later age in comparison to their international counterparts (Clutten 2009:8), which may delay the development of CO ability, as the SA curriculum requires children to copy letters and numbers from 6 years of age only.

It could also be argued that the subjectivity involved when scoring the CO subtest could cause the difference in scores as a lack of comprehensive guidelines and examples are provided by the authors. Hammill and colleagues (1993:35) acknowledge subjective opinion that is evoked by some of the DTVP-2 subtests. These authors furthermore elaborate that inaccuracy could be reduced by stipulating specific administration instructions, detailed scoring guidelines and detailed scoring practice. Currently a 2, 1, or 0 score is awarded depending on the quality of the drawing (Hammill *et al*. 1993:11).

Looking at the quality of examples provided by the authors, there seems to be a slight difference between awarding a 2 and a 1, but a larger difference between awarding a 1 and a 0. As a result clinicians in practice could easily award a 2 score for a 1-score-quality drawing. This tendency was observed when the scores of the CO subtest items were verified by third-party OTs, as therapists differed regarding the allocation of marks – some therapists would score more stringently, while others less.

It is therefore recommended that detailed scoring guidelines and examples be provided in order that scoring can be more accurate. The authors of the DTVP-2, however, did improve this shortcoming with the updated version of the test, the DTVP-3, by publishing the CO scoring template (Hammill *et al*. 2013).

5.4.1.3. Spatial relations

According to Table 4.6, the SA sample (n = 134) scored 8 mean RSs higher (29) in SR in relation to the American normative sample (21). This translates to the SA sample (n = 134) scoring primarily average and above average on SR (Figure 4.1), with a mean SS of 11.80 and a SD of 3.17 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

Results are ascertained by Visser (2005:44), who determined that 5-year-old SA children achieve a mean SS of 11.83 with a SD of 3.07. Likewise, Visser *et al*. (2012:23) note that no 5-year-old SA children obtain below average scores, while 50% score average and 50% above average. In contrast, Van Romburgh (2006:58) established that 62.5% of 40 grade 1 SA children scored below average, 32.5% average and 5% above average on SR. The latter results were explained by Van Romburgh (2006:73-74) as the influence of SES and the children's environment, as nearly half of the study sample did not receive any pre-school stimulation prior to formal education. Rens (2008:8-9) affirms that culture and SES are important considerations in visual perceptual development, in view of the fact that these influences constitute part of children's surroundings and upbringing. Therefore, the observed differences in scores could also be attributed to the unique characteristics of the study population, i.e. typically developed Afrikaans-speaking Coloured children residing in a low SES community in Bloemfontein, in which Van Romburgh conducted her study.

The SR subtest scores of the DTVP-2 and the TVPS-R obtained on a sample aged 6- to 11-year-old children in KwaZulu-Natal, correlated significantly (Richmond & Holland 2011:35). The TVPS-R SR subtest requires no motor response, while the DTVP-2 SR subtest requires a motor response. This correlation confirms that the SA population performs differently on these measurement instruments in relation to the American population on which both these tests are standardised. In addition, in view of the superior scores obtained by the DTVP-2, the accuracy of the TVPS-R measurement instrument for the SA population is questioned.

It is apparent that the SA sample (n = 134) score was higher to that of the children's American peers. Reasons for the difference in test scores between the SA study sample (n = 134) and the American normative sample are again proposed by Visser *et al*. (2012:23) (as part of a previous study) as subtest items being too easy and/or children that are familiar with the task since children participate in similar activities in pre-school. The researcher also hypothesises that the test items are possibly too easy.

A second cause of difference between the SA study sample (n = 134) and the American normative sample could be attributed to the tricky SR test instructions, as a number of the current study participants' required additional instruction before commencing the subtest. Although additional instruction is permissible by Hammill and colleagues (1993:8), altering instructions could impinge on the reliability of the subtest. Additional instruction illustrates the effect that language could have on test administration.

Cheung *et al*. (2005:38) detected a discrepancy in mean RSs, given that 6- and 7-year-old Hong Kong children scored above average with 100% correct scores on the subtest. Similarly Lai and Leung (2012:442) observed a ceiling effect in 5-year-old Chinese children's scores since they obtained a mean SS of 17.39 with a SD of 2.45, while 5-year-old English-speaking children scored a mean SS of 11.11 with a SD of 2.78. The difference in performance of Chinese children could again possibly be assigned to their superior VMI ability, as a result of, amongst other factors, learning the complex Chinese letter formation from an early age (Lai & Leung 2012:440-441). Conversely, these results could display the impact of culture on test performance. Hence, the exact reasons for difference in test performance should be established in order in order that results can be interpreted accurately.

From these results it is evident that specific evidence-based guidelines or adaptations are needed in order to obtain more accurate results and to ensure a more normal distribution of scores. The scoring criteria are also a point of concern. The subtest is scored by awarding one point per dot that the pencil marks touches for reasonable attempts to copy the design. No points are subtracted for incorrect dots touched. It is therefore recommended that points should be deducted for incorrect dots touched, since spatial relations are defined as the ability to apply direction to objects, as well as to see the relation between objects. Therefore, touching an incorrect dot influences the direction of the line. An adapted scoring criterion would necessitate further investigation.

5.4.1.4. Visual-motor speed

According to Table 4.6, the SA sample (n = 134) obtained one less mean RS (5) for VMS in relation to the American normative sample (6). This translates to the SA sample (n = 134) scoring mainly average on VMS (Figure 4.1), with a mean SS of 10.14 and a SD of 2.09 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

Similar to the results of this study, Visser (2005:44) found that 5- and 6-year-old SA children obtained a mean SS of 11.10 and a SD of 2.22. Visser *et al*. (2012:23) noted that 60% of 5-year-old SA children obtained average SSs. Likewise Van Romburgh (2006:66) established that 60% of 40 grade 1 SA children scored average on VMS, although 37.5% scored below average.

Cheung *et al*. (2005:38) reported superior scores observed in Hong Kong children aged 6 years and 7 years. Lai and Leung (2012:437) established that 5-year-old Chinese children obtained superior scores with a mean SS of 13.37 with a SD of 2.23, while 5-year-old English-speaking Australian children obtained a mean SS of 10.09 with a SD of 3.30, therefore scoring similarly to the American norms of a mean 10 and SD of 3. In addition, Guntayuong *et al*. (2013:113) found that Thai children score similarly on the subtests of the DTVP-2 in relation to their American counterparts, with the exception of VMS, in which Thai children aged 4- to 5 years and 8- to 11 years scored higher than American children. Guntayuong and colleagues (2013:113) explain that a difference in scores is due to cultural and environmental experiences.

The researcher concurs with Cheung *et al*. (2005:40) who questioned the scoring instructions for VMS, as she observed an equivalent phenomenon when administrating and scoring the VMS subtest: some children achieved high scores since they rapidly completed the task and as a result refrained from touching the inside edge of the shapes. Currently the subtest is specifically instructed as "*keep your marks inside the shapes*" and "*do not let your marks go outside of the shapes*". The sub-test is scored by awarding one point for the correct marking in each shape that does not extend past the shape's edge (Hammill *et al*. 1993:16). Accordingly, Cheung *et al*. (2005:40) recommends that the administration instruction should also include that the markings inside the shapes must touch the shape's edge. Perhaps if this additional instruction were applied, more accurate results would be obtained. Additional instructions for VMS would, however, require further investigation.

Another reason for differences in scores among the populations could be attributed to younger children experiencing difficulty in drawing an oblique cross as required by the subtest. The age norm considered to be able to draw an oblique cross is 4 years and 11 months (Beery & Beery 2010:44-45). As a consequence, the inability to draw an oblique cross could influence VMS scores. Furthermore, children experiencing difficulty to cross their midline could also perform poorly on the VMS subtest (Beery & Beery 2010:45). Since the study sample comprised children of 5 years and 6 months to 5 years and 11 months, the inability to draw an oblique cross was considered irrelevant, although this phenomenon was observed in a few study participants.

In summary, the DTVP-2's motor-enhanced subtest scores of the SA study sample (n = 134) differ from the American normative sample. Results of this study are supported by numerous studies conducted previously in SA involving the DTVP-2 and also correlated with studies in Hong Kong, Thailand and Australia. Moreover, it became evident that administration instructions and scoring criteria should be reviewed in order to obtain more accurate results for the SA population. As standardisation would necessitate numerous resources, beyond the feasibility of a third world country, further investigation is warranted in order to implement evidence-based practice.

5.4.2. Motor-reduced subtests

The motor-reduced subtests of the DTVP-2 were administrated and scored according to the prescribed-, as well as the adapted method. The adapted method entailed that the ceiling rule of 3 of 5 incorrect responses was not implemented.

5.4.2.1. Position in space

According to Table 4.6, the SA sample (n = 134) obtained one less mean RS (12) for PS in relation to the American normative sample (13) when scored according to the prescribed method. This result translates to the SA sample (n = 134) scoring being mainly below average and average on PS (Figure 4.2), with a mean prescribed SS of

9.05 and a SD of 2.11 in comparison to the American norm distribution of having a mean of 10 and SD of 3 (Hammill *et al*. 1993:24).

In congruence with results of this study, Visser (2005:44) detected a mean SS of 9.83 and SD of 1.93 in 5- and 6-year-old SA children. Visser *et al*. (2012:23) established conflicting results, with 17.5% of 5-year-old SA children scoring below average and 75% average, although 7.5% of the children scored above average on position in space. Inconsistent with the results of this study, Van Romburgh (2006:61) noted that 82.5% of 40 grade 1 SA children obtained below average scores, while 17.5% obtained average scores. The latter results were explained by Van Romburgh (2006:74) as the influence of SES and the effect of the children's environment on the development of children's visual perceptual skills.

Cheung *et al*. (2005:38) detected a ceiling effect with 6- and 7-year-old Hong Kong children obtaining superior RSs in PS. Likewise, Lai and Leung (2012:437) established that 5-year-old Chinese children obtained a mean SS of 13.02 with a SD of 2.78, while 5-year-old English-speaking Australian children obtained a mean SS of 10.20 with a SD of 3.23, scoring more equally to the American norms. Brown *et al*. (2008:506) established that Canadian children aged 5 years obtain a mean RS of 16.93, which is greater than the American mean RS of 13. These results display cross-country differences and highlight the importance of suitable and accurate measurement instruments for the country and/or culture that the instruments are applied to.

When scored according to the adapted method, the SA sample (n = 134) obtained two more mean RSs (15) for PS in relation to the American normative sample (13). Results yielded a mean adapted SS of 10.14 and a SD of 2.09 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24). A significant difference (p = <.0001) was therefore found between the prescribed- and adapted PS scores. Hence it can be derived that the adapted score yields more accurate results as it corresponds more closely with the American norms.

These results serve as a foundation to question the item difficulty and subsequent item linearity of the PS subtest. Figure 4.5 indicates that a 2 SS difference was apparent for 42 children in PS, which could constitute a different descriptive rating (i.e. scoring below average, average or above average) and therefore results in under- or over diagnoses of visual perceptual difficulties. Furthermore, if children are eligible for therapy, these scores guide OTs in clinical decision making, intervention planning and progress tracking. The item difficulty and –linearity of PS are further discussed under item analysis in Section 5.5.2.1.1.

5.4.2.2. Figure-ground

According to Table 4.6, a statistically significant difference (p = <.0001) in RSs were prevalent with the SA sample (n = 134) obtaining a higher mean prescribed RS (11) on FG than the American normative sample (9). This translates to the SA sample (n = 134) mainly scoring average and above average on FG (Figure 4.2), with a mean prescribed SS of 10.79 and a SD of 3.18 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

This finding is congruent with that of Visser (2005:44), who established a mean SS of 10.73 with a SD of 2.09, as well as Visser *et al*. (2012:23) who noted that 2.5% of 5-year-old English-speaking SA children obtain below average-, 60% average- and 37.5% above-average scores. Once again Van Romburgh (2006:63) found inconsistent results with 52.5% of 40 grade 1 children scoring below average, 45% average and 2.5% above average. The latter results were ascribed by Van Romburgh (2006:73-74) to the influence of SES and the children's environment, as nearly half of the study sample did not receive any pre-school stimulation prior to formal education.

The FG subtest scores of the DTVP-2 and the TVPS-R correlated significantly in SA (Richmond & Holland 2011:35), as well as in Australia (Brown & Hockey 2013:432). In view of the greater performance on FG and the correlation between these two tests in SA children, the accuracy/suitability of the TVPS-R measurement instrument for the SA population is questioned. However, the correlation also confirms the need to obtain valid and reliable measurement instruments for the SA population.

Reasons for the significant difference (*p* = .0001) in RSs are again proposed by Visser *et al*. (2012:23) as subtest items being too easy and/or children being familiar with the task since they participates in similar activities in pre-school. Cheung *et al*. (2005:33-34) also consider the FG test items as possibly too easy. An expert panel of 12 Hong Kong paediatric OTs reviewed the content validity of the FG test items. They adjusted the difficulty level by replacing 3 items with unfamiliar, overlapping figures (against a complex background) as part of their normative study (Cheung *et al*. 2005:33-34). Results, with their adapted FG subtest, indicated that the 6- and 7-year-old Hong Kong children obtained average scores (Cheung *et al*. 2005:38).

In contrast, a statistically significant difference was established between 5-year-old Chinese children and 5-year-old English-Australian children, with Chinese children obtaining a mean SS of 10.95 with a SD of 2.58 and English-Australian children a mean SS of 12.49 with a SD of 3.67 (Lai & Leung 2012:437). Brown *et al*. (2008:506) established that Canadian children aged 5 obtained a mean RS of 13.40, which is higher than the American norm of 9. It is therefore apparent that these results illustrate cross-country differences and the establishment and application of population- and/or culture-specific norms is once again highlighted.

When scored according to the adapted method, the SA sample (n = 134) obtained an even higher mean RS (11) on FG in comparison to the American normative sample (9) (Table 4.8). This translates to the SA sample (n = 134) scoring mainly average and above average on FG (Figure 4.4), with a mean adapted SS of 11.96 and a SD of 3.18 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

A statistically significant difference (*p* = <.0001) was therefore established between the prescribed- and adapted scoring methods. Figure 4.5 indicated that a 0 SS difference was apparent for 54 children in FG, therefore serving as evidence that the test items are possibly too easy. In view of the fact that the SA sample already obtained high scores in comparison to the American normative sample, when scored according to the prescribed method, implementing the adapted scoring method would be irrelevant.

Results therefore provide evidence that the SA sample (n = 134) outperformed the American normative sample on FG. The test items are deemed too easy. For this reason the content, as well as item difficulty of the FG subtest is questioned. The item difficulty and -linearity of FG are further discussed under item analysis in Section 5.5.2.1.2 of this chapter.

5.4.2.3. Visual closure

The results of the study indicated that the greatest difference in the SA and American children's results were seen in the VC subtest. According to Table 4.6, a statistically significant difference (*p* = <.0001) in prescribed RSs were prevalent with the SA sample (n = 134) obtaining a lower mean prescribed RS (5) on VC in comparison to the American normative sample (7). This translates to the SA sample (n = 134) scoring mainly below average and average on VC (Figure 4.2), with a mean prescribed SS of 7.71 and a SD of 2.15 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

Visser (2005:44) established similar results in SA children aged 5 years and 6 years obtaining a mean SS of 8.07 and a SD of 2.24. Similarly, Visser *et al*. (2012:23) found that 40% of 5-year-old SA children obtained below average-, 57.5% average- and 2.5% above average scores. Results are further supported by Van Romburgh (2006:65) who noted that 97.5% of 40 grade 1 SA children scored below average and 2.5% average. Moreover, Richmond and Holland (2011:35-36) emphasise that there is no correlation between the DTVP-2 and TVPS-R's VC subtest scores, since the DTVP-2 scores significantly lower.

However, in contrast to Richmond and Holland (2011:35-36), Brown and Hockey (2013:432) established a statistically significant correlation between the VC subtests of the DTVP-2 and TVPS-R in Australia. These highlighted cross-country differences therefore raise questions regarding the predictive validity of the DTVP-2. Lai and Leung (2012:437) found 5-year-old English-speaking Australian- and Chinese children also experienced VC as their greatest visual perceptual deficit, obtaining a mean SS of 8.51 with a SD of 3.33 and a mean SS of 10.44 with a SD of 3.61 respectively. Brown *et al.* (2008:506) established that Canadian children aged 5 obtain a mean RS of 9.02, which is greater than the American norm of 7.

Richmond and Holland (2011:35-36) propose that the DTVP-2 might possibly over-identify VC difficulties and query the item linearity of the VC subtest. Visser *et al.* (2012:24) concurs and recommends not implementing the prescribed ceiling rule in order to obtain more accurate results. When scored according to the adapted method, the SA sample (n = 134) scored 1 mean RS (8) higher on VC in comparison to the American normative sample (7) (Table 4.8). This translates to the SA sample (n = 134) scoring mainly average on VC (Figure 4.4), with a mean adapted SS of 10.40 and a SD of 2.03 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al.* 1993:24).

A significant difference (*p* = <.0001) was prevalent between the prescribed- and adapted scores. Figure 4.6 furthermore indicated a 3 SS difference was apparent for 40 children in VC, which could result in a different descriptive rating (i.e. scoring below average, average or above average). Results therefore indicate that more accurate results for the SA population are obtained by using the adapted administration and scoring method, since it correlates more with the American norms.

Evidently these results suggest that the item linearity of the VC subtest is distorted and VC difficulties are possibly over diagnosed in SA. It is recommended that SA OTs consider administrating the VC subtest in its entirety. The item difficulty and -linearity of VC are further discussed under item analysis in Section 5.5.2.1.3 of this chapter.

5.4.2.4. Form constancy

The SA sample (n = 134) experienced FC as their greatest perceptual strength. According to Table 4.6, a statistically significant difference (*p* = <.0001) in RSs were prevalent with the SA sample (n = 134) obtaining a higher mean prescribed RS (11) on FC than the American normative sample (8). This translates to the SA sample (n = 134) mainly scoring average on FC (Figure 4.2), with a mean prescribed SS of 11.84 and a SD of 1.22 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

Similar to these findings, Visser (2005:44) established a mean SS of 11.93 with a SD of 1.44 in 5- and 6-year-old children. The findings are furthermore consistent with Visser *et al*. (2012:23), who found that 100% of the children score average and above average on the FC subtest. Once again Van Romburgh (2006:67) obtained somewhat different results with 25% of grade 1 children scoring below average and 75% average. The latter results were reasoned by Van Romburgh (2006:74) as the influence of SES and the effect of the children's environment on the development of children's visual-perceptual skills. In view of the results, the content and item difficulty of the subtest is queried. The researcher concurs with Visser *et al*. (2012:23), who proposed that the test items are possibly too easy.

Similar to the findings in SA, 5-year-old Australian children achieved a mean SS of 12.83 with a SD of 1.87 and 5-year-old Chinese children a mean SS of 12.27 with a SD of 1.82 (Lai & Leung 2012:437). Brown *et al*. (2008:506) established that Canadian children aged 5 obtained a mean RS of 13.70, which is superior to the American norm of 8. In contrast, an expert panel of 12 Hong Kong paediatric OTs rated FC as having an adequate level of difficulty (Cheung *et al*. 2005:33-34), since Hong Kong children, aged 6 years and 7 years, obtained a mean RS ranging between 10 and 12.98 (Cheung *et al*. 2005:38).

Brown and Hockey (2013:432) and Richmond & Holland (2011:35) noted a significant correlation between the FC subtests of the DTVP-2 and TVPS-R in Australia and SA. Accordingly, it is confirmed that the SA population performs differently on these measurement instruments in relation to the American population on which both these tests are standardised. In addition, in view of the superior scores obtained by the DTVP-2, the accuracy of the TVPS-R measurement instrument for the SA population is questioned.

When scored according to the adapted method, the SA sample (n = 134) obtained a higher mean adapted RS (12) on FC in comparison to the American normative sample (8) (Table 4.8). This translates to the SA sample (n = 134) scoring mainly above average on FC (Figure 4.4), with a mean adapted SS of 12.55 and a SD of 1.29 in comparison to the American norm distribution of having a mean of 10 and a SD of 3 (Hammill *et al*. 1993:24).

A statistically significant difference ($p = <.0001$) was therefore established between the prescribed- and adapted scoring methods. Figure 4.6 indicated that a 0 SS difference was apparent for 62 children in FC, therefore indicating that the test items are possibly too easy. In view of the fact that the SA sample (n = 134) already obtained high scores in comparison to the American normative sample, when scored according to the prescribed method, implementing the adapted scoring method would be irrelevant.

Results therefore provide evidence that the SA sample (n = 134) outperformed the American normative sample on FC. The test items are deemed too easy and, as a result, FC difficulties are possibly under-identified in SA. Moreover, an abnormal distribution of scores was detected for both scoring methods. For this reason the content and the item difficulty of the FC subtest are questioned. The item difficulty and -linearity are further discussed under item analysis in Section 5.5.2.1.4 of this chapter.

In summary, the DTVP-2's motor-reduced subtest scores of the SA study sample (n = 134) vary significantly from the norms reported in the DTVP-2 Examiner Manual. Results of this study are supported by numerous studies conducted previously in SA involving the DTVP-2. Similarities, differences and correlations are apparent in studies in Thailand, Canada, Hong Kong and Australia. Furthermore, the scores exhibit an abnormal distribution of scores. It also became evident that the FG, VC and FC test items appeared to have distorted difficulty levels. The results of the item analysis are discussed in Section 5.5.2.

5.4.3. Composite Quotients

Three composite quotients were calculated; these were GVPQ, MRPQ and VMIQ (Hammill *et al.* 1993:24). The GVPQ and MRPQ were calculated according to prescribed-, as well as the adapted SSs and accordingly discussed in each of the relevant sections.

5.4.3.1. General visual perception quotient

The GVPQ is calculated by the sum of the 8 subtest SSs (Hammill *et al.* 1993:25). When scored according to the prescribed method, the SA sample (n = 134) mainly obtained average GVPQ scores (Figure 4.3), with a mean prescribed GVPQ of 101.13 and a SD of 8.95 in comparison to the American norm distribution of a mean of 100 and a SD of 10 (Hammill *et al.* 1993:24).

The mean GVPQ of this study correlated closely with the American normative sample. This finding is supported by Visser (2005:45), who established a GVPQ of 103.60 and a SD of 8.43 in 5- and 6-year-old SA children. In contrast, 87.5% of grade 1 SA children from a low SES community scored a GVPQ of less than 90 (below average) and 12.5% score a GVPQ of 90 – 110 (average) (Van Romburgh 2006:68). The latter results have been attributed the influence of SES and the effect of the children's environment on the development of children's visual perceptual skills.

Five-year-old Australian children achieved a mean GVPQ of 105.97 with a SD of 14.22, while 5-year-old Chinese children scored a mean GVPQ of 124.05 with a SD of 8.45 (Lai & Leung 2012:437).

When calculating the GVPQ with the adapted SSs, the SA sample (n = 134) mainly obtained average GVPQ scores (Figure 4.6), with a mean adapted GVPQ of 106.49 and a SD of 9.04 in comparison to the American norm distribution of having a mean of 100 and an SD of 10 (Hammill *et al*. 1993:24).

The prescribed GVPQ of the SA sample (n = 134) correlates more with the American norm of 100. However, the prescribed GVPQ score comprises lower subtest scores (such as PS and VC) and higher subtest scores (such as EH, FG, SR and FC) that are summed in order to produce a correlating GVPQ score. Since clinicians make use of the GVPQ in diagnoses, it is recommended that the GVPQ should be interpreted and conveyed with care when making a diagnosis based on children's visual perceptual strengths and -weaknesses.

5.4.3.2. Visual-motor integration quotient

The VMIQ is calculated by the sum of the motor-enhanced subtest SSs (Hammill *et al.* 1993:25). The SA sample (n = 134) mainly obtained average VMIQ scores (Figure 4.4), with a mean VMIQ of 103.07 and a SD of 9.92 in comparison to the American norm distribution of a mean of 100 and a SD of 10 (Hammill *et al.* 1993:24).

This result compares closely with Visser (2005:45), who established that children aged 5 years and 6 years obtained a mean VMIQ score of 105.7 with a SD of 9.77. Similarly Lai and Leung (2012:437) found that English-speaking 5-year-old children obtain a mean VMIQ of 104.71 with a SD of 12.78, while Chinese children obtain a mean VMIQ of 134.71 with a SD of 9.28. The superior performance of Chinese children on VMIQ has been documented by many researchers (Lai & Leung 2012:441) in view of the fact that Chinese children show over advanced VMI skills as a result of their cultural environment and upbringing.

Evidently the SA sample (n = 134) obtained higher VMIQ scores in relation to their American peers, which could be explained by the superior performance of the SA study sample (n = 134) on the EH- and SR subtests. Further investigation is warranted as clinicians make use of the VMIQ to describe and draw conclusions regarding children's VMI and fine motor skills.

5.4.3.3. Motor-reduced perception quotient

The MRPQ is calculated by the sum of the motor-reduced subtest SSs (Hammill *et al.* 1993:25). When scored according to the prescribed method, the SA sample (n = 134) mainly obtained average MRPQ scores (Figure 4.4), with a mean prescribed MRPQ of 98.97 and a SD of 10.08 in comparison to the American norm distribution of a mean of 100 and a SD of 10 (Hammill *et al.* 1993:24). Although these values actually correlate quite closely with the American sample, it should be remembered that the MRPQ was calculated by lower VC score and higher FG- and FC scores.

The MRPQ furthermore compares well with Visser (2005:45) who detected that 5- and 6-year old children obtain a mean MRPQ score of 100.9 and a SD of 8.33. However, 5-year-old Australian children achieve a mean MRPQ of 106.71, with a SD of 16.41 and 5-year-old Chinese children a mean of 111.15 with a SD of 10.99 (Lai & Leung 2012:437).

When the MRPQ was calculated with the adapted SS, the SA sample (n = 134) mainly obtained average MRPQ scores (Figure 4.6), with a mean adapted MRPQ of 109.27 and a SD of 9.93 in comparison to the American norm distribution of a mean of 100 and a SD of 10 (Hammill *et al.* 1993:24). A statistical significant difference ($p = <.0001$) was prevalent between the prescribed- and adapted scores. Figure 4.8 indicates a score difference of 10 in MRPQ for 20 children. These differences could possibly have influenced the interpretation (descriptive ratings) of quotient scores and ultimately the under- or over diagnosis of visual perceptual skill difficulties.

Evidently the prescribed MRPQ scores are lower than the VMIQ scores. This finding was also evident in Visser (2005:45), who found that the VMIQ score was higher than the MRPQ score. Similarly, Lai and Leung (2012:437) noted a marked difference between 5-year-old Chinese children's VMIQ score of 134.71 and their MRPQ score of 111.15. According to the authors of the DTVP-2, the difference between the VMIQ score and the MRPQ score can be attributed to test-, situational- or subject error (Hammill *et al.* 1993:25). Test error is referred to as internal consistency, inter-rater reliability and test-retest reliability. Situational error refers to visual- and/or auditory distractions, uncomfortable room temperature and insufficient lighting, while subject error refers to the test-takers' attention level, attitude and level of motivation. It is highly unlikely that situational- or subject error could have distorted the results, since the researcher strictly adhered to testing conditions specified by Hammill *et al.* (1993:7-8): sufficient lighting, comfortable room temperature, low noise levels, as well as limited auditory and visual distractions. With regard to subject error, the researcher was alert to children showing signs of loss of interest and/or fatigue such as attention wandering, excessive talking, yawning and/or fidgety behaviour. When the researcher observed any of these signs, the researcher discontinued administration for a brief period and performed 5 steps of self-regulation (Lombaard 2014:10) with the child in order to enhance/restore their concentration.

The difference between the SA study sample's (n = 134) VMIQ and MRPQ could possibly be attributed to the unique skills of the SA sample (n = 134) or to test error. Since the researcher conducted all the evaluations independently (and in so doing excluded inter-rater reliability) and test-retest did not constitute part of this research, the difference could possibly be attributed to distorted internal consistency. Lai and Leung (2012:442) attributed the difference between MRPQ and VMIQ to culture, but also questioned the validity of the DTVP-2.

Internal consistency coefficient alphas of the SA sample (n = 134) are further discussed in the next section under reliability.

5.5. DISCUSSION OF THE PSYCHOMETRIC PROPERTIES OF THE DTVP-2 BASED ON A SA STUDY SAMPLE

This study questioned the psychometric properties of the DTVP-2 when tested on a sample of SA children (n = 134). This section discusses the reliability and validity of the DTVP-2 based on a SA sample (n = 134).

5.5.1. Reliability

Reliability of a measurement instrument is a major consideration since subsequent test-takers' scores are compared to the scores derived from the normative sample (Burtner *et al*. 1997:51). The American population served as the normative sample of the DTVP-2.

Internal consistency values were computed by means of Cronbach coefficient alphas for the 8 DTVP-2 subtests and also a Rasch analysis, in particular the PSI, of the 4 motor-reduced subtests of the DTVP-2. According to Burtner *et al*. (1997:51), correlation coefficient alphas should exceed .80 when the reliability of measurement instruments is studied.

According to the results of this study, the GVPQ of the DTVP-2 illustrated acceptable internal consistency with an alpha value of .91. The VMIQ and MRPQ yielded mutually acceptable alphas of .89. However, considering each of the DTVP-2 subtests individually revealed that the SA sample's (n = 134) Cronbach coefficient alphas ranged from .54 to .88 for the motor-enhanced subtests (EH .88, CO .82, SR .81 and VMS .54). Only VMS did not meet the set >.80 criterion, demonstrating a large degree of measurement error in the subtest.

The motor-reduced subtests, when scored according to the prescribed method, yielded moderate reliability for VC (.70) and FC (.67); and high reliability for PS (.89) and FG (.82). With all the items administered, i.e. the adapted method, the Cronbach coefficient alphas decreased to low, unacceptable reliability levels for VC (.37) and FC (.37), and moderate reliability for PS (.72) and FG (.64). These Cronbach coefficient alphas correlated strongly with the PSI values obtained by means of the Rasch analysis (PS .73, FG .64, VC .38 and FC .38), demonstrating large measurement errors among the individual motor-reduced subtest items.

When comparing the SA sample's (n = 134) prescribed Cronbach coefficient alphas with the American normative alpha values, lower levels of reliability were evident in DTVP-2 overall, as well as across the individual subtests. Figure-ground correlated the closest (SA .82 vs. America .83), whereas the largest difference in values were observed in VMS (SA .54 vs. America .94).

The researcher concurs with Brown and Hockey (2013:436), who ascribe possible reasons for differences in reliability values to sample size, geographic location and ethnicity. Differences could indeed be attributed to sample size, as the SA sample (n=134) was smaller than the 5-year-old cohort in the American normative sample. The SA sample (n = 134) also consisted of children aged 5 years and 6 months to 5 years and 11 months, whereas the DTVP-2's 5-year-old cohort extended from 5 years and 0 months to 5 years and 11 months. The geographical location differed in view of the fact that this study was conducted in the COT, SA while the DTVP-2 was normed in America. As discussed in Section 2.5, the population distribution of the SA study sample (n = 134) differs significantly from the American normative sample with regard to ethnicity and language. The American normative sample was considered primarily white, comprising English-speaking children from cultures inherent to the America. The SA study sample (n = 134) comprised English L2 speakers from diverse cultures inherent to SA. Although both samples were from urban settings, differences can be anticipated, as SA is a third world/developing country, while the American is a first world/developed country. Observed differences in internal consistency scores once more illustrate the importance of establishing norms for the population the measurement instrument is applied to.

Reliability of the DTVP-2 has, to date, not been investigated and/or reported in SA and findings of this study can therefore not be compared with SA literature. Moreover, Brown and Hockey (2013:429) affirm that insufficient research has been conducted regarding the internal consistency reliability of the DTVP-2.

Brown and Hockey (2013:435) investigated the internal consistency of the DTVP-2 in Australia. They determined that the DTVP-2 comprises of highly desirable levels of internal consistency with a score of .96 for the overall DTVP-2. Cronbach coefficient alphas for the individual DTVP-2 subtests ranged from .66 to .94 (EH .81, PS .87, CO .82, FG .72, SR .70, VC .94, VMS .66 and FC .86). Similarly the SA sample (n = 134) and Australian sample obtained the lowest alpha value for VMS (SA .54 vs Australia .66). Copying presented the same alpha value for both the SA sample (n = 134) and the Australian sample (.82), whereas the largest difference in alpha values was detected amongst VC (SA .70 and Australia .94) and FC (SA .67 and Australia .86). Accordingly, vast disparities in the overall DTVP-2 and individual subtest alpha values, among the SA sample (n = 134) and the sample of 6-to-12-year-old Australian children, exist.

Differences in alpha values could be attributed to sample size as the SA sample (n=134) was larger than the Australian sample (n=45) and the respective studies were conducted in two different countries (geographic locations) comprising their unique population distribution (ethnicity). These differences once more illustrate the importance of establishing norms for the country and/or culture the measurement instrument is used on.

Results of this study therefore indicate that 5 of the 8 DTVP-2 subtests (EH, PS, CO, FG and SR) comprise of acceptable internal consistency reliability, while VC, VMS and FC are considered unreliable for any measurement. Confidence should not be placed in the latter subtests' results as these subtests contain a high level of measurement error. Further research is warranted to measure children's visual perceptual skills more accurately in SA.

5.5.2. Validity

Although validity of a measurement instrument relates to content-, criterion-related- and construct validity, only the construct validity of the DTVP-2 was investigated. Construct validity refers to the extent that different groups of related items measure the constructs of a measurement instrument that assumedly exist, but cannot be directly examined (Leedy & Ormrod 2014:92; Maree 2007:217). Construct validity of the DTVP-2 was examined by means of exploring 6 constructs fundamental to the DTVP-2. These constructs are: age differentiation, interrelationships among DTVP-2 values, relationship of the DTVP-2 to cognitive ability tests, group differentiation, item validity and factor analysis (Hammill *et al*. 1993:41). However, the study focused in particular on item validity and factor analysis, as these techniques specifically examine the items subtests comprise.

Item validity was investigated by means of an item analysis, while the factor analysis investigated the factor structure of the 4 motor-reduced subtests of the DTVP-2. Furthermore, the motor-reduced subtests' item properties were investigated by means of a Racsh analysis using RUMM2030 to determine the item fit, dimensionality and relative difficulty of each item.

5.5.2.1. Item analysis

On each subtest, 1 or more initial items were answered correctly by all the respondents. Bearing in mind that this study focused, for practical reasons, on children aged 5 years and 6 months to 5 years and 11 months and the DTVP-2 tests children aged 4 to 10 years, these initial items, while "easy" for a 5-year-old, could present challenges to younger children. However, since there was no variation on these items, the items could not be included in the analysis.

Analysis of the DTVP-2 items, including a Rasch analysis, has to date, not been conducted and/or reported in SA and findings of this study can therefore not be compared with the SA literature. Moreover, the researcher could find only 1 international study of relevance to contrast the results with. Each of the motor-reduced subtests is compared with the relevant literature.

5.5.2.1.1. Position in space

One-hundred percent (100%) of the study participants were correct on items 1 to 4. Results of the Rasch analysis revealed that PS yielded a problematic item fit with a SD of 1.73. The problematic item fit was further confirmed by the large RMSEA value of 0.128 and the highly significant chi-square value of 133.9 ($p < .05$). More specifically, 3 items, i.e. item 7, 18 and 22 showed problematic fit residuals of more than ±2.5 (PsyLab group 2015:40). Therefore these 3 items did not support the underlying theoretical construct of PS and, as a result, influenced the content validity of the subtest. Furthermore, there was a large degree of local dependency between the subtest items, although the dependencies tended to function in pairs, not in multi-item clusters. This finding relates to the number of items in a subtest contributing to the subtest and the underlying theoretical construct being measured.

Position in space is defined as the awareness and understanding of one's body position towards figures or objects – i.e. in or out, up or down, above or under, in front, between or behind, left or right (Schneck 2010a:359). In theory PS cannot be purely assessed on a 2D (paper) level. Critically examining the 3 items with problematic fit residuals revealed that these items could also depend on visual discrimination-, SR- and FC perceptual skills.

From the PS difficulty location values (Table 4.11) it could be derived that, while the easier items tended to be placed early (and the first 4 items were answered correctly by all respondents but are not shown in the fit table as they were the easiest), and the harder items tended to come later, there were significant variations from this pattern, which were clearly problematic in terms of the ceiling rule. Notably, item 8, was harder than items 9 to 13, 15, and 19 through 22, and also the 3-item cluster 16 to 18, which contained the third hardest of all the items (item 17), indicating that the ceiling rule should be adapted for the SA population.

Similarly Brown *et al*. (2008:510) established that Canadian children aged between 5 years and 11 years scored 100% on items 1, 2 and 4 in PS. Unfortunately the item difficulty values of PS, based on the Canadian sample, were unavailable to the researcher and could therefore not be compared with the current results.

In practice, this distorted PS item linearity impacts significantly on the subtest RSs, calculation of SSs and ultimately the under- and over diagnosis of PS strengths and weaknesses. Therapists should therefore apply evidence-based practice by not implementing the ceiling rule, as more accurate results are obtained.

5.5.2.1.2. Figure-ground

All of the study participants scored 100% correct on items 1 and 3. Results of the FG Rasch analysis demonstrated good item fit as the SD of .98 was less than the recommended 1.4 (PsyLab group 2015:40). The good item fit was furthermore confirmed by the RMSEA value of 0.01. Accordingly, no FG items showed problematic fit residuals. There was some degree of local dependency between 8 of the subtest items, although no multi-cluster item dependencies were discerned.

From the set of FG difficulty location values (Table 4.12) it could be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which were clearly problematic in terms of the ceiling rule. Evidently, items 10 and 12 were easier than 8, 9 and 11. Seventeen (17) was easier than items 14 to 16, which could have had a definite influence on the subtest RS.

Similarly Brown *et al*. (2008:510) established that Canadian children aged 5 through 11 years scored 100% on items 1, 2 and 5 in FG. Once again the item difficulty values of FG, based on the Canadian sample, were unavailable to the researcher and could therefore not be compared with the current results.

In practice, this distorted FG item linearity impacts significantly on the subtest RSs, calculation of SSs and ultimately the under- and over diagnosis of FG strengths and weaknesses.

5.5.2.1.3. Visual closure

All of the study participants scored 100% correct on item 1. Results of the VC Rasch analysis indicated a problematic item fit. The problematic item fit was confirmed by the RMSEA value of 0.058 and the highly significant chi-square value of 55.1 (p<0.05). In particular, item 7 exhibited a problematic fit residual value outside of ±2.5 (PsyLab group 2015:40), implying that item 7 items did not support the underlying theoretical construct of VC and as a result influences the content validity of the subtest. There was some degree of local dependency between 5 items, although no multi-cluster item dependencies were discerned.

Visual closure is defined as the ability to mentally identify and complete an incomplete, broken up or disorganised picture, figure, shape, symbol, word or sentence (Lambert 2013:18-19; Mostert 2000:3). Critically examining item 7 discloses that item 7 could also be dependable on visual discrimination perceptual skills.

From the set of VC difficulty location values, it could be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which were clearly problematic in terms of the ceiling rule. Markedly, item 8 was harder than items 9 to 13, and the 3-item cluster 15 to 17, 19 and 20. Item 14 was the hardest of all the items, indicating that the ceiling rule should be adapted for the SA population.

Results of this study are supported by Visser *et al*. (2012:24), who conducted an item analysis on the 20 VC subtest items. A decline in scores was not evident in children aged 5 years with progression of the subtest. As a result, Visser *et al*. (2012:24) questions the content, the item difficulty and item linearity of the VC subtest. Moreover, the results correlated with Richmond and Holland (2011:35), who propose that the VC subtest items possibly lack linearity. The item linearity, based on the item difficulty values detected and proposed by Visser *et al*. (2012:24) differed from the item linearity established according to the item difficulty values detected in this study. More research must be conducted in order to suggest a linearity that will generate accurate results.

Similarly Brown *et al*. (2008:510) established that Canadian children aged 5 years to 11 years scored 100% on item 1 in VC. Unfortunately the item difficulty values of VC, based on the Canadian sample, were unavailable to the researcher and could therefore not be compared with the current results.

In practice, this distorted VC item linearity impact significantly on the subtest RSs, calculation of SSs and ultimately the under- and over diagnosis of VC strengths and weaknesses. Therapists should therefore apply evidence-based practice by not implementing the ceiling rule as more accurate results will be obtained.

5.5.2.1.4. Form constancy

All of the study participants scored 100% correct on items 1 and 4. Results of the FC Rasch item analysis yielded a problematic item fit. The problematic item fit was confirmed by the RMSEA value, which could not be calculated. There was some degree of local dependency between 4 of the items with no multi-cluster item dependencies discerned.

From the set of FC difficulty location values in Table 4.14 it could be seen that there were some significant variations from the supposedly easy-to-difficult item pattern, which were clearly problematic in terms of the ceiling rule. Particularly, item 13 (the hardest of all the items) along with items 15 to 18 was much harder than items 14 and 19, indicating that the ceiling rule should be adapted for the SA population.

Similarly Brown *et al*. (2008:510) established that Canadian children aged 5 years to 11 years scored 100% on items 1 to 4 in FC. Unfortunately the item difficulty values of FC, based on the Canadian sample, were unavailable to the researcher and could therefore not be compared with the current results.

In practice, this distorted FC item linearity impacts significantly on the subtest RSs, calculation of SSs and ultimately the under- and over diagnosis of FC strengths and weaknesses.

In summary, PS, VC and FC displayed problematic item fit residuals. Furthermore, all 4 motor-reduced subtests of the DTVP-2 exhibited distorted item difficulty and -linearity. Burtner *et al*. (1997:53) argues that the content of a measurement instrument be reviewed by a panel of experts along with a literature review, rather than just using statistical techniques to determine subtest items. It is recommended that the content of the motor-reduced subtests of the DTVP-2 be reviewed for the SA population.

5.5.2.2. Factor analysis

First, this section discusses the factor structure of the overall DTVP-2, after which each of the motor-reduced subtests' factor structure is discussed individually. The factor structure of the DTVP-2 was investigated by means of PCA, whereas the motor-reduced subtests were also investigated with a Rasch analysis. The factor loading cut-off of was set between -0.4 and 0.4, which implies that values between -0.4 and 0.4 did not support the theoretical trait underlying the subtest.

The PCA revealed that the DTVP-2 measured 2 factors for the adapted scoring method. It is apparent from the rotated factor pattern for the SA study sample that subtests 2 to 6 and 8 loaded well on factor 1. Subtests 2, 4, 6 and 8 constitute the motor-reduced subtests of the DTVP-2. Although subtests 3 and 5 also loaded on factor 1, factor 1 could possibly support the underlying theoretical trait of motor-reduced visual perception.

Subtest 1, 3 and 7 (constituting part of the motor-enhanced subtests) loaded well on factor 2, therefore possibly indicating that factor 2 supports the underlying theoretical trait of VMI.

The factor structure differs from the values reported in the Examiners Manual of the DTVP-2, which extracted 1 factor with an eigenvalue larger than 1 and 2 factors by means of the Promax rotation method (Hammill *et al*. 1993:45). The authors labelled the 1 factor "overall visual perception" and the 2 factors VMI and motor-reduced visual perception respectively (Hammill *et al*. 1993:45).

The factor structure of the DTVP-2 has, to date, not been investigated and/or reported in SA and findings of this study can therefore not be compared with SA literature. Moreover, the researcher could only attain two studies that examined the factor structure of the DTVP-2 internationally. Firstly, Chan and Brown (2002) examined the reliability and construct validity of 3 FC subtests from 3 different measurement instruments in Canada. Unfortunately the researcher could not obtain the results of this study and these results cannot be contrasted against the results of the current study. Secondly, Brown *et al*. (2008:510) investigated the factor structure of the DTVP-2's 4 motor-reduced subtests in Canada. Accordingly, they established that all 4 of the subtests were multidimensional. The multidimensionality implies that each of the 4 motor-reduced subtests measure more than 1 theoretical trait.

In SA, examining each of the motor-reduced subtests individually by means of the Rasch analysis revealed that PS and VC loaded on more than 1 factor (indicating multidimensionality), whereas FG and FC appeared to measure a single construct. These findings are both in congruence and in contrast with Brown *et al*. (2008). For this reason each of the motor-reduced subtests is further compared individually.

5.5.2.2.1. Position in space

The PS subtest comprised 25 dichotomously scored items. Since all of the study participants scored 100% correct on items 1 through 4, these items were excluded from the factor analysis because of the lack of variance.

According to the Rasch analysis, the %LB95CI was 9.7%, indicating that the PS items did not appear to measure a single factor. This was furthermore confirmed by the PCA with Varimax rotation, which retracted 3 factors. Items 6, 7, 11, 12, 14, 15, 16, 21 and 24 loaded on factor 1 and accounted for 3.67% of variance. Items 8, 9, 10, 19, 23 and 25 loaded on factor 2 and accounted for 2.39% of variance, and items 13 and 17 to 20 and 22 loaded on factor 3 and accounted for 2.23% of variance. These results imply that the PS subtest measures more than 1 underlying theoretical construct.

In contrast to these findings, Brown *et al*. (2008:507) found that 6 factors were extracted by means of PCA with Varimax rotation and accounted for a total of 56.50% of variance. Seven items loaded on factor 1 (6, 7, 11, 12, 13, 14, and 21), 6 items loaded on factor 2 (17, 18, 20, 23, 24 and 25), 3 items loaded on factor 3 (19, 21 and 22), 3 items loaded on factor 4 (8, 14 and 16), 2 items on factor 5 (9 and 10) and 2 items on factor 6 (3 and 5) (Brown *et al*. 2008:507). Evidently factor 1 of the SA sample (n = 134) correlates relatively close with factor 1 of the Canadian sample, which could be labelled PS. It is apparent that these results illustrate cross-country differences.

Therapists in practice should therefore interpret and convey results cautiously as the PS subtest does not purely measure PS perceptual ability. It was previously mentioned that, in essence, PS cannot be solely assessed on a 2D (paper) level, as it is deemed impossible to place oneself between objects on a paper.

5.5.2.2.2. Figure-ground

The FG subtest comprises 18 dichotomously scored items. Since all of the study participants scored 100% correct on items 1 and 3, these items were excluded from the factor analysis because of the lack of variance.

According to the Rasch analysis, the %LB95CI was 3.8%, indicating that the FG items appeared to measure a single factor. FG's unidimensionality was furthermore confirmed by the PCA, which yielded 1 factor.

In contrast, Brown *et al*. (2008:508) found that 5 factors were extracted, which accounted for a total of 53.128% of variance. Four items loaded on factor 1 (14, 15, 16 and 17), 4 items on factor 2 (8 to 10 and 17), 3 items on factor 3 (12, 13 and 18), 2 items on factor 4 (3 and 4) and 3 items on factor 5 (6, 7 and 11). It is therefore apparent that these results illustrate cross-country differences.

According to the results, clinicians in SA can interpret and convey FG results with confidence as the subtest purely measures FG perceptual ability.

5.5.2.2.3. Visual closure

The VC subtest comprised 20 dichotomously scored items. Since all of the study participants scored 100% correct on item 1, this item was excluded from the factor analysis because of the lack of variance.

According to the Rasch analysis, the %LB95CI was 6.0%, suggesting that the VC items did not appear to measure a single factor. This was furthermore confirmed by the PCA with Varimax rotation, which yielded 2 factors. Items 2, 5, 8, 11, 17 and 20 (6 in total) loaded on the first factor and accounted for 2.08% of variance. Item 3, 6, 9, 12 and 18 (5 in total) loaded on the second factor and accounted for 2.03% of variance. This result implies that the VC subtest measures 2 underlying theoretical constructs.

In contrast, Brown *et al*. (2008:509) found that 4 factors were extracted, which accounted for a total of 47.25% of variance. Eight items loaded on factor 1 (8, 10, 14, 16-20), 7 items on factor 2 (2, 3, 5, 11, 13, 15 and 17), 4 items on factor 3 (6, 9, 12 and 19) and 1 item (4) on factor 4. It is therefore apparent that these results illustrate cross-country differences. Evidently factor 1 of the SA sample (n = 134) correlates closely with factor 2 of the Canadian sample and factor 2 more or less with factor 3 correspondingly.

Clinicians should therefore interpret and convey results of the VC subtest with caution as the subtest does not purely measure VC perceptual ability.

5.5.2.2.4. Form constancy

The FC subtest comprised 20 dichotomously scored items. Since all of the study participants scored 100% correct on items 1 and 4, these items were excluded from the factor analysis because of the lack of variance.

According to the Rasch analysis, the %LB95CI was 3.0%, indicating that the FC items appeared to measure a single factor. Form constancy's unidimensionality was furthermore confirmed by the PCA, which yielded 1 factor.

In contrast, Brown *et al*. (2008:509) found that 4 factors were extracted, which accounted for a total of 48.47% of variance. Eight items loaded on factor 1 (12 to 18 and 20), 2 items on factor 2 (6 and 7), 3 items on factor 3 (8, 10 and 11) and 2 items on factor 4 (5 and 9). It is therefore apparent that these results illustrate cross-country differences and the establishment.

Since FC measures a single construct (unidimensional), SA OTs can interpret and convey FC results with confidence, as the subtest truly measures FC perceptual ability.

In summary, SA OTs must take care when interpreting and/or conveying the multidimensional PS- and VC subtests. As it is deemed unfeasible to construct a measurement instrument specifically for the SA population, further investigation into the content validity is recommended in order to implement evidence-based practice.

5.6. SUMMARY

Chapter 5 presented an interpretation of the results and provided an in-depth discussion, analysis and comparison with the relevant literature. It became apparent that the norms of the SA sample (n = 134) differ significantly in relation to the American normative sample. Visual closure, VMS and FC were found to be unreliable, although the overall DTVP-2 exhibits acceptable reliability. In addition, the Rasch analysis revealed that PS, VC and FC displayed problematic item fit residuals and that PS and VC was multidimensional. Furthermore, all 4 motor-reduced subtests of the DTVP-2 exhibited distorted item difficulty and -linearity, indicating that the ceiling rule should be adapted for the SA population.

Chapter 6 draws conclusions of the study, describes the limitations and influences experienced in the study and recommendations are made for future studies.

CHAPTER 6

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

6.1. INTRODUCTION

Chapter 5 interpreted the results of the study and provided an in-depth discussion and analysis of the results and compared them with relevant SA and international literature. Quantitative, descriptive results were obtained from 5 years and 6 months to 5 years and 11 months English-speaking boys and girls from the COT in order to answer the main research question: Is the DTVP-2 a suitable measurement instrument for 5 years and 6 months to 5 years and 11 months SA children?

This study investigated the suitability of the DTVP-2 as a measurement instrument for 5 years and 6 months to 5 years and 11 months English-speaking SA children as it has become evident that SA children score differently on standardised measurement instruments in relation to American children on which the measurement instruments are standardised. SA clinicians and researchers (Richmond & Holland 2011; Van Romburgh 2006; Visser 2005 and Visser *et al*. 2012) noted specifically that the DTVP-2 over-identifies VC problems in SA children and, as a result, questioned the item linearity of the VC subtest of the DTVP-2. These clinicians and researchers also noted an inconsistency in test performance among 5-year-old SA children in relation to American children since SA children performs average and above average in the PS-, CO-, SR-, VMS- and FC subtests of the DTVP-2 (Van Romburgh 2006; Visser 2005; Visser *et al*. 2012). Evidently the norms of the DTVP-2 do not translate well to the SA context and the validity and reliability of the DTVP-2 in SA is questioned. Accordingly, the following sub-questions were set:

1. What are the psychometric properties of the DTVP-2 when tested on a sample of SA children? Specifically:

   a) What is the reliability of the DTVP-2 and how does this compare to previously calculated reliability values?
   b) What is the validity of the DTVP-2 and how does this compare to previously calculated validity values?
2. How does the prescribed scoring method compare to an adapted scoring method for the following:
   a) Motor-reduced subtests
   b) GVPQ
   c) MRPQ
3. Will there be any gender differences in the DTVP-2 scores?
4. How do the norms for a SA sample compare to those calculated for the American sample?

Chapter 6 provides answers to the above set questions by drawing conclusions from the study results, offers recommendations for each of the conclusions, as well as for possible future studies, and ends off with the limitations experienced while this study was being conducted.

6.2. CONCLUSIONS

For each of the research sub-questions the following conclusions were made:

6.2.1. The psychometric properties of the DTVP-2 based on a SA study sample

a) Reliability

The psychometric properties of the DTVP-2 based on a SA sample (n = 134) differed significantly from the American normative sample. The overall DTVP-2 displayed acceptable reliability. When administrated and scored according to the prescribed method, 5 of the 8 DTVP-2 subtests (EH, PS, CO, FG and RS) demonstrated acceptable internal consistency reliability. The other 3 subtests – VC, VMS and FC – were found to be unreliable. With the adapted administration- and scoring method, the motor-reduced subtests displayed large measurement error among the individual motor-reduced subtest items. Therefore, confidence should not be placed in the latter subtests' test results as these 3 subtests lack accuracy in SA and further research is warranted.

Since reliability of the DTVP-2 has, to date, not been investigated and/or reported in SA, findings of this study could not be compared with the SA literature and, accordingly, results of this study present new knowledge regarding the reliability of the DTVP-2 for paediatric SA OTs. A comparison with an international reliability study revealed vast disparities in the overall DTVP-2 and individual subtest values. The study sample size, geographical location and ethnicity were reasoned as possible sources for the observed differences. These differences illustrated the importance of establishing psychometric property values specifically for the country and/or culture the measurement instrument is being used on.

b) Validity

Position in space, VC and FC displayed problematic item fit residuals. All 4 motor-reduced subtests of the DTVP-2 exhibited distorted item difficulty and –linearity, indicating that the ceiling rule should be adapted for the SA population. The item difficulty and -linearity of the VC subtest of the DTVP-2 has previously been researched in SA and compares with the results. The remainder of the DTVP-2's motor-reduced subtests' (PS, FG and FC) item difficulty and -linearity has, to date, not been investigated and/or reported in SA. Accordingly, results of this study present new knowledge regarding the motor-reduced subtests' item difficulty and -linearity for paediatric OTs in SA.

Paediatric SA OTs in practice should take note of the distorted item linearity, as this could significantly influence the subtest RSs, calculation of SSs and ultimately the under- and over diagnosis of visual perceptual strengths and weaknesses.

Furthermore, it also became evident that the PS and VC subtests of the DTVP-2 loaded on more than 1 factor, indicating multidimensionality, which means that these 2 subtests measured more than 1 theoretical construct underlying the individual subtests, while FG and FC appeared to measure a single construct. Studies regarding the multidimensionality of the motor-reduced subtests have to date, not been conducted and/or reported in SA and results of this study can therefore not be compared with SA literature. Accordingly, results of this study present new knowledge regarding the multidimensionality of the motor-reduced subtests for paediatric SA OTs.

Since FG and FC measured a single construct and were therefore regarded as 1 dimensional, paediatric SA OTs can interpret and convey FG- and FC results with confidence, as these 2 subtests truly measure FG- and FC perceptual ability respectively. However, paediatric SA OTs must take care when interpreting and conveying the multidimensional PS- and VC subtests as these 2 subtests do not purely measure perceptual ability as they are intended to, but also possibly measure visual discrimination- and FG ability.

6.2.2. Prescribed scoring method compared to an adapted scoring method

a) Motor-reduced subtests

When scored according to the adapted scoring method of allowing the children to complete all the items, the SA sample (n = 134) obtained higher mean RSs in all 4 motor-reduced subtests of the DTVP-2. Moreover, the PS- and VC subtests mean RSs increased significantly with the adapted scoring method, indicating that the SA sample (n = 134) was able to complete numerous additional items with progression to the last item in each of these 2 subtests. Accordingly, more accurate PS- and VC scores were obtained when the ceiling rule was not implemented. The results of the VC subtest correlated with research in SA questioning the content, item difficulty and -linearity of the VC subtest, as well as international studies that also indicated VC as children's greatest visual perceptual difficulty.

Paediatric OTs in SA should therefore administer and score all the subtest items of the PS- and VC subtests of the DTVP-2 in order to obtain more accurate scores.

b) General visual perceptual quotient

A statistically significant difference was prevalent between the prescribed- and adapted GVPQ mean scores. The SA sample's (n = 134) prescribed GVPQ mean score displayed a superior correlation with the American norm than the adapted GVPQ mean score. It is, however, argued that the prescribed GVPQ score comprises lower subtest scores (such as PS and VC) and higher subtest scores (such as EH, FG, SR and FC) that are summed in order to present an overall relatively equal GVPQ score. The GVPQ should be interpreted and conveyed with vigilance when making diagnoses based on children's visual perceptual strengths and weaknesses.

c) Motor-reduced perceptual quotient

A statistically significant difference was prevalent between the prescribed- and adapted MRPQ mean scores. The SA sample's (n = 134) prescribed MRPQ mean score compared better with the American norm than the adapted MRPQ mean score. Although the prescribed MRPQ was preferable to the adapted MRPQ, the prescribed MRPQ comprised the lower VC score and the higher FG- and FC scores. As a result, clinicians are urged to interpret the prescribed MRPQ cautiously and should rather consider each of the motor-reduced subtest scores individually.

6.2.3. Gender differences in test performance on the DTVP-2

It was established that the DTVP-2 was unbiased for gender in the SA population with the exception of FG when using the DTVP-2 according to the prescribed scoring method. No gender differences were evident with the adapted administration- and scoring method. Since gender differences in test performance on the DTVP-2 have, to date, not been investigated and/or reported in SA, findings of this study could not be compared with SA literature. Accordingly, results of this study contribute to the body of OTx knowledge in SA. A comparison with an international study revealed similar results, with girls scoring better than boys on the FG subtest of the DTVP-2.

It is therefore imperative to consider the country and culture the measurement instrument is being used on, as the suitability of the measurement instrument cannot be assumed. Clinicians should bear in mind that girls score better than boys when interpreting and conveying FG results.

6.2.4. Norms of the SA study sample

The mean scores for the DTVP's motor-enhanced subtests of the SA study sample (n = 134) differed substantially from the American norms reported in the DTVP-2 Examiner Manual. Results of this study were supported by numerous studies conducted previously in SA involving the DTVP-2, as well as studies in Hong Kong, Thailand and Australia.

The mean scores for the DTVP-2's motor-reduced subtests of the SA study sample (n = 134) varied significantly from the American norms reported in the DTVP-2 Examiner

Manual. Results of this study were supported by numerous studies conducted previously in SA involving the DTVP-2. Similarities, differences and correlations were also apparent with studies in Thailand, Canada, Hong Kong and Australia.

Accordingly, comparisons with this study affirmed the influence of culture, language and SES on visual perceptual skill development and emphasise that norms should be established specifically for the country and/or culture the measuring instrument is used on.

In summary it is concluded that although the DTVP-2 is a comprehensive measurement instrument, the DTVP-2 should be used with caution to measure 5 years and 6 months to 5 years and 11 months English-speaking SA children's visual perceptual skills, as the DTVP-2 displayed distorted reliability and validity in SA. Care must be taken when interpreting and conveying scores to parents/caregivers and other health care professionals. Since the population was selected from an urban area, geographically restricted to COT, consisting of children attending formal educational settings and proficient in English, results may only be generalised to similar SA populations. As standardisation would necessitate numerous resources, beyond the feasibility of a third world country, further investigation is warranted in order to implement evidence-based practice.

Secondary findings of the study revealed that the administration instructions and scoring criteria of the motor-enhanced subtests of the DTVP-2 should be reviewed in order to obtain more accurate results for the SA population.

An abnormal distribution of scores in all the subtests of the DTVP-2 was evident and further research is warranted in order to obtain more accurate results for the SA population.

In view of the superior performance of the SA sample (n = 134) on the DTVP-2's FG- and FC subtests and their significant correlation with the correspondingly subtests on the TVPS-R, the accuracy/suitability of the TVPS-R for the SA population is questioned.

6.3. RECOMMENDATIONS

Although it may be argued that the DTVP-2 is outdated, the second edition is still widely used and preferred by many OTs in SA. For this reason the researcher considers the DTVP-2 still relevant. Based on the results and conclusions drawn from this study, the following recommendations are made in terms of practice:

1. To establish psychometric property values specifically for the SA population in order to evaluate children with psychometrically stable measurement instruments that will provide SA OTs with accurate standardised test scores.

2. To review the content of the DTVP-2 for the SA population by means of an expert panel along with statistical analysis techniques such as the Rasch analysis.

3. With reference to the item difficulty and -linearity of the 4 motor-reduced subtests of the DTVP-2, the following adjusted item linearity is recommended (ordered according to their item difficulty values) in order to implement evidence-based practice to obtain more accurate results:

   Position in space: Item 1 – 4, 5, 6, 11, 9, 12, 13, 10, 7, 19, 22, 21, 15, 8, 14, 20, 16, 24, 18, 17, 23 and 25.

   Figure-ground: Item 1, 3, 2, 5, 4, 7, 6, 12, 10, 13, 17, 9, 8, 11, 15, 14, 18 and 16.

   Visual closure: Item 1, 2, 4, 6, 3, 5, 12, 7, 15, 9, 19, 13, 10, 11, 17, 16, 20, 8, 18 and 14.

Form constancy: Item 1, 4, 2, 3, 9, 7, 6, 8, 11, 5, 10, 14, 19, 12, 15, 16, 18, 17, 20 and 13.

4. If item adjustments are not made, therapists should apply evidence-based practice by not implementing the ceilling rule for the PS- and VC subtests in order to obtain more accurate results.

5. Occupational therapists in SA should subtract 1 standard score from the FG subtest standard score when evaluating girls as 1 less score is equal to SA boys, as well as the American norm of 10.

6. The administration and scoring criteria of the 4 motor-enhanced subtests of the DTVP-2 should be reviewed by a panel of experts in SA, researched and adjustments made in order to implement evidence-based practice.

In terms of future studies:

7. To investigate the accuracy of the adjusted item linearity recommended in point 3 of the motor-reduced subtests of the DTVP-2 in SA.

8. As the SA population comprises heterogeneous ethnicity, cultures and groups from different SES backgrounds, extensive research is necessary on the use of the DTVP-2 among different groups in SA. This research would include diverse age groups (4- to 11-year-old children), diverse culture groups (ethnicity) and children from differing SES backgrounds and different geographic locations in SA.

9. It would be valuable to gain some insight into the inter-rater reliability of the motor-enhanced subtests of the DTVP-2 in SA in view of the subjectivity involved when scoring these subtests. Since the researcher solely administrated and scored the DTVP-2 in this study, the DTVP-2 Response Booklets could be scored again by independent SA OTs in order to draw conclusions regarding the DTVP-2's inter-rater reliability.

10. Extensive research should be carried out on the newly published DTVP-3 in order to establish the accuracy and suitability of the DTVP-3 as a measurement instrument for the SA population. Unfortunately the DTVP-3 comprises 5 subtests – EH, FG, CO, VC and FC. The authors of the DTVP-3 (Hammill *et al*. 2013) reviewed the content of these 5 subtests and adaptations have been made such as an increased difficulty FG subtest, which may be more suitable for the SA population, as the study sample scored higher in relation to their American counterparts in this subtest. The researcher hypothesises that SA OTs might, in certain cases, revert to the DTVP-2 in order to obtain standardised scores for PS and VMS, as no other standardised measurement instrument descriptively measures these 2 constructs.

11. It would be valuable to conduct concurrent validity studies of the DTVP-2 with the DTVP-3 in order to compare norms, as well as the measurement properties of the 2 respective tests in SA.

6.4. LIMITATIONS

The limitations associated with this study were considered as follows:

Since this study served part of the requirements to obtain a Magister degree in OTx, the study population was restricted to English-speaking 5 years and 6 months to 5 years and 11 months boys and girls from the COT. For this reason the study population was not representative of the whole of SA. Owing to the restricted study sample comprising children of 5 years 6 months to 5 years 11 months, it was impossible to compute variance in scores. In addition, the small sample size made it difficult to compute full factor analyses on the subtests.

The study sample was also limited to only 134 participants. The researcher could apply only for a certain amount of leave and this available timeframe of the researcher affected the study sample size. The researcher did not have a bursary or any other research funding assistance and, as a result, the limited financial resources interfered with the overall execution of the study.

As the SA population comprises heterogeneous ethnicity and/or cultures, and cultural differences in visual perceptual skills were highlighted in this study, the researcher deemed that it would have been valuable to report the study sample's ethnicity and/or culture in order to shed some light on cultural differences in SA. However, this would have necessitated a larger sample size, which was not feasible in this study.

At the time the researcher commenced with this study, the DTVP-2 was still widely used by SA OTs, given that the DTVP-3 was published in 2013 and SA OTs could have been identified who used the DTVP-3. In reconsideration, it would have been of value for the SA OTx body of knowledge if the DTVP-3 had been used during the study.

6.5. TO CONCLUDE

Although the DTVP-2 is considered a comprehensive measurement instrument, the DTVP-2 should be used with caution in its current state to accurately measure 5 years and 6 months to 5 years and 11 months English-speaking SA children's visual perceptual skills. However, since it is deemed unfeasible to construct a new visual perceptual measurement instrument specifically for the SA population, and standardisation of the currently available measurement instruments would necessitate numerous financial- and human resources, further investigation is warranted in order to implement evidence-based practice. South African OTs should interpret and use the results of the DTVP-2 with care.

Results of this study contributed to the body of OTx knowledge with regard to reliability, validity and gender differences in test performance in the DTVP-2 for a sample of the SA population.

It is crucial to investigate a measurement instrument's psychometric properties before the measurement instrument is used in contexts that differ from the normative sample. The need for suitable and accurate measurement instruments, specifically for the SA population, is once more emphasised.

LIST OF REFERENCES

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1. American Occupational Therapy Association. 2014. Occupational therapy practice framework: Domain and process 3rd ed. *American Journal of Occupational Therapy, 68* (Suppl.1), S1–S48. http://dx.doi.org/10.5014/ajot.2014.682006.
2. American Optometric Association. 2010. Care of the patient with learning related vision problems. www.aoa.org/documents/QRG-20.pdf Date of access: 2011/03/13.
3. Ayres, A.J. 1989. Sensory Integration and Praxis Tests. Los Angeles, CA: Western Psychological Services.
4. Beery, K. 1989. Developmental Test of Visual-Motor Integration. Cleveland, OH: Modern Curriculum Press.
5. Beery, K.E. 1997. The Beery-Buktenica Developmental Test of Visual-Motor Integration with Supplemental Developmental tests of Visual perception and Motor Coordination Administration, Scoring and Teaching Manual. 4th ed, Revised. Parsippany, NJ: Modern Curriculum Press.
6. Beery, K.E., Buktenica, N.A. & Beery, N.A. 2004. Developmental Test of Visual-Motor Integration. 5th ed. Minneapolis, MN: Pearson Assessments.
7. Beery, K.E. & Beery, N.A. 2010. Developmental Test of Visual- Motor Integration. 6th ed. Minneapolis, MN: Pearson Assessments.
8. Brown, T., Davis, A. & Rodger, S. 2008. Factor structure of the four motor-free scales of the Development Test of Visual Perception. 2nd ed (DTVP-2). *American Journal of Occupational Therapy*. 62:502–513.
9. Brown, T. & Gaboury, I. 2006. The measurement properties and factor structure of the Test of Visual Perceptual Skills – Revised: Implications for occupational therapy assessment and practice. *American Journal of Occupational Therapy*. 60:182–193.
10. Brown, T. & Hockey, S.C. 2013. The validity and reliability of the Developmental Test of Visual Perception – 2nd Edition (DTVP-2). *Physical & Occupational Therapy in Pediatrics*. 33(4):426–439.
11. Brown, T., Lyons, C. & Unsworth, C. 2009. An evaluation of the construct validity of the Developmental Test of Visual-Motor Integration using the Rasch Measurement Model. *Australian Occupational Therapy Journal*. 56:393–402.

12. Burtner, P.A., Bordegaray, J., Moedl, D., Roe, R.J., Savage, A.R. & Wilhite, C. 1997. Critical review of visual perceptual tests frequently administered by pediatric therapists. *Physical & Occupational Therapy in Pediatrics*. 17(3):39–61.
13. Chan, G. & Brown, G.T. 2002. The reliability and construct validity of three form constancy perceptual scales. *New Zealand Journal of Occupational Therapy*. 49(2):22–32.
14. Cheung, P.P., Poon, M., Leung, M. & Wong, R. 2005. The development test of visual perception-2 normative study on the visual perception function for children in Hong Kong. *Physical & Occupational Therapy in Pediatrics*. 25(4):29–43.
15. Clutten, SC. 2009. The Development of a Visual Perception Test for Learners in the Foundation Phase. Research report (M.Ed). Pretoria: University of South Africa.
16. Colarusso, R. & Hammill, D.D. 1972. Motor-Free Test of Visual Perception. Novato, CA: Academic Therapy Publications.
17. Colarusso, R. & Hammill, D.D. 2003. Motor-Free Test of Visual Perception. 3rd ed. Novato, CA: Academic Therapy Publications.
18. CTB/McGraw-Hill. 1989. Comprehensive Tests of Basic Skills. Monterey, CA: Author.
19. Department of Health SA. 2004. Ethics in health research: Principal structure and processes. http://www.mrc.ac.za/ethics/DOHEthics.pdf. Date of access: 17/09/2015.
20. Department of Health SA. 2006. Guidelines for good practice in the conduct of clinical trials with human participants in South Africa. http://www.kznhealth.gov.za/research/guideline2.pdf. Date of access: 17/09/2015.
21. Du Plessis, S. & Louw, B. 2008. Challenges to preschool teachers in learners acquisition of English as language of learning and teaching. *South African Journal of Education*. 28:53–75.
22. Eksteen, T. 2007. The evaluation of the reliability of the motor-free visual perceptual test (third edition) when translated into Afrikaans, on an Afrikaans first language urban population (east of Pretoria, South Africa) aged 8 years 0 months to 8 years 11 months. Research report (MSTSH). Johannesburg: University of Witwatersrand.
23. Evans, R. & Cleghorn, A. 2014. Parental perceptions: a case study of school choice

amidst language waves. *South African Journal of Education.* 34(2):1–19.

24. Frostig, M., Lefever, D.W. & Whittlesey, J.R.B. 1966. Administration and scoring manual for the Marianne Frostig Developmental Test of Visual Perception. Palo Alto, CA: Consulting Psychologists Press.
25. Gardner, M.F. 1996. Test of Visual Perceptual Skills (Non-Motor) – Revised. Hydesville, CA: Psychological and Educational Publications.
26. Grove, S.K., Burns, N. & Gray, J.R. 2013. The Practice of Nursing Research: Appraisal, Synthesis and Generation of Evidence. 7th ed. St. Louis, MO: Saunders Elsevier.
27. Guntayuong, C., Chinchai, S., Pongsaksri, M. & Vittayakorn, S. 2013. Determination of normative values of the Developmental Test of Visual Perception (DTVP-2) in Thai children. *International Journal of Medicine and Pharmaceutical Sciences*. 3(2):113–126.
28. Hammill, D.D & Hresko, W. 1993. National Teacher Assessment and Referral Scales. Austin, TX: PRO-ED.
29. Hammill, D.D., Pearson, N.A. & Voress, J.K. 1993. Developmental Test of Visual Perception. 2nd ed. Texas: Pro-Ed. Inc.
30. Hammill, D.D., Pearson, N.A. & Voress, J.K. 2013. Developmental Test of Visual Perception. 3rd ed. Texas: Pro-Ed. Inc.
31. Harris, D.B. 1963. Children's Drawings as Measures Of Intellectual Maturity: A Revision and Extension of The Goodenough Draw-A-Man Test. Harcourt, NY: Brace & World Inc.
32. HPCSA (Health Professions Council of South Africa). 2010. List of tests classified as being psychological tests. http://www.hpcsa.co.za/Uploads/editor/UserFiles/downloads/psych/psychom_form_207.pdf. Date of access: 18/03/2015.
33. HPCSA (Health Professions Council of South Africa). 2008. Guidelines for good practice in the health care professions. Guidelines on the keeping of patient records. http://www.hpcsa.co.za/downloads/conduct_ethics/rules/generic_ethical_rules/booklet_14_keeping_of_patience_records.pdf. Date of access: 17/09/2015.

34. Herbst, I., Schoeman, W.J. & Huysamen, G.K. 1993. The development and evaluation of a developmental stimulation programme for black toddlers. *South African Journal of Psychology.* 23:87-95.
35. Herbst, I. & Huysamen, G.K. 2000. The construction and validation of developmental scales for environmentally disadvantaged preschool children. *South African Journal of Psychology.* 30:19–26.
36. Human Sciences Research Council. 2014. State of poverty and its manifestation in the nine provinces of South Africa. www.hsrc.ac.za. Date of access: 05/02/2015.
37. Huysamen, G.K. 1986. Sielkundige Meting - 'n Inleiding. Pretoria: Academica.
38. ICH. 1998. ICH guideline for good clinical practice. http://www.ich.org/fileadmin/Public_Web_Site/ICH_Products/Guidelines/Efficacy/E5_R1/Step4/E5_R1__Guideline.pdf. Date of access: 17/09/2015.
39. Janse van Rensburg, E. 2012. (OCTF1514). University of the Free State. (Study guide).
40. Joint Committee on Standards for Educational and Psychological Testing of the AERA, APA and NCME. 1999. Standards for Educational and Psychological Testing. Washington DC: American Educational Research Association.
41. Josman. N., Abdallah, T.M. & Engel-Yeger, B. 2006. A comparison of visual-perceptual and visual-motor skills between Palestinian and Israeli children. *American Journal of Occupational Therapy*. 60:215–225.
42. Kallenbach, A. 2007. Language for Academic Purposes: Performance of grade-one English Second Language (ESL) learners on the Diagnostic Evaluation of Language Variation (DELV). Research report (MASP). Johannesburg: University of Witwatersrand.
43. Lai, M.Y. & Leung, F.K.S. 2012. Visual perceptual abilities of Chinese-speaking and English-speaking children. *Perceptual and Motor Skills*. 114(2):433–445.
44. Lambert, M. 2013. Checklist for identifying visual perceptual difficulties in a student's schoolwork.
45. Leedy, P.D. & Ormrod, J.E. 2014. Pearson New International Edition. Practical Research. Planning and Design. Upper Saddle River, NJ: Pearson Education Inc.
46. Lombaard, A. 2014. Workshop 4: Concentration for the classroom: creating focus

and attention for optimal learning. (Workshop attended as part of continued professional development in Pretoria on 5 August 2014.) Pretoria. (Unpublished.)

47. Lotz, L., Loxton, H. & Naidoo, A.V. 2005. Visual-motor integration functioning in a South African middle childhood sample*. Journal of Child & Adolescent Mental Health*. 17(2):63-67.
48. Maree, K. ed. 2007. First Steps in Research. Pretoria: Van Schaik Publishers.
49. Mouton, J. 2001. How to succeed in your Master's & Doctoral Studies: A South African Guide and Resource Book. Pretoria: Van Schaik Publishers.
50. Morrow, N., Jordaan, H. & Fridjhon, P. 2005. The effects of educational context on the understanding of linguistic concepts in English and isiZulu by grade 7 learners. *South African Journal of Education*. 25(3):164–169.
51. Mostert, N. 2000. Werkboek vir skoolkinders met perseptuele leerprobleme. Welkom.
52. Muiños-Durán, M., Vidal-López, J., Rodán-González, A., Rifá-Giribet, M., Codina-Fossas, M., García-Montero, M., Gimeno-Galindo, P. & Javaloyes-Moreno, B. 2009. Training activities for visual perceptual skills. Visual Closure (Basic Level). Saera.
53. Nel, M. & Theron, L. 2008. Critique of a language enrichment programme for Grade 4 ESL learners with limited English proficiency: a pilot study. *South African Journal of Education*. 28:203–219.
54. Nunally, J.C. 1972. Educational Measurement and Evaluation. 2nd ed. NY: McGraw-Hill.
55. Oxford English Dictionary. Permission. http://www.oxforddictionaries.com/. Date of access: 11/01/2015.
56. Polit, D.F. & Beck, C.T. 2010. Essentials of Nursing Research: Appraising Evidence for Nursing Practice. 7th ed. Philadelphia: Lippincott Williams & Wilkins.
57. PsyLab Group. 2015. The Rasch measurement model. Introductory workshop. Aachen.
58. 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. Research report (MSTSH).

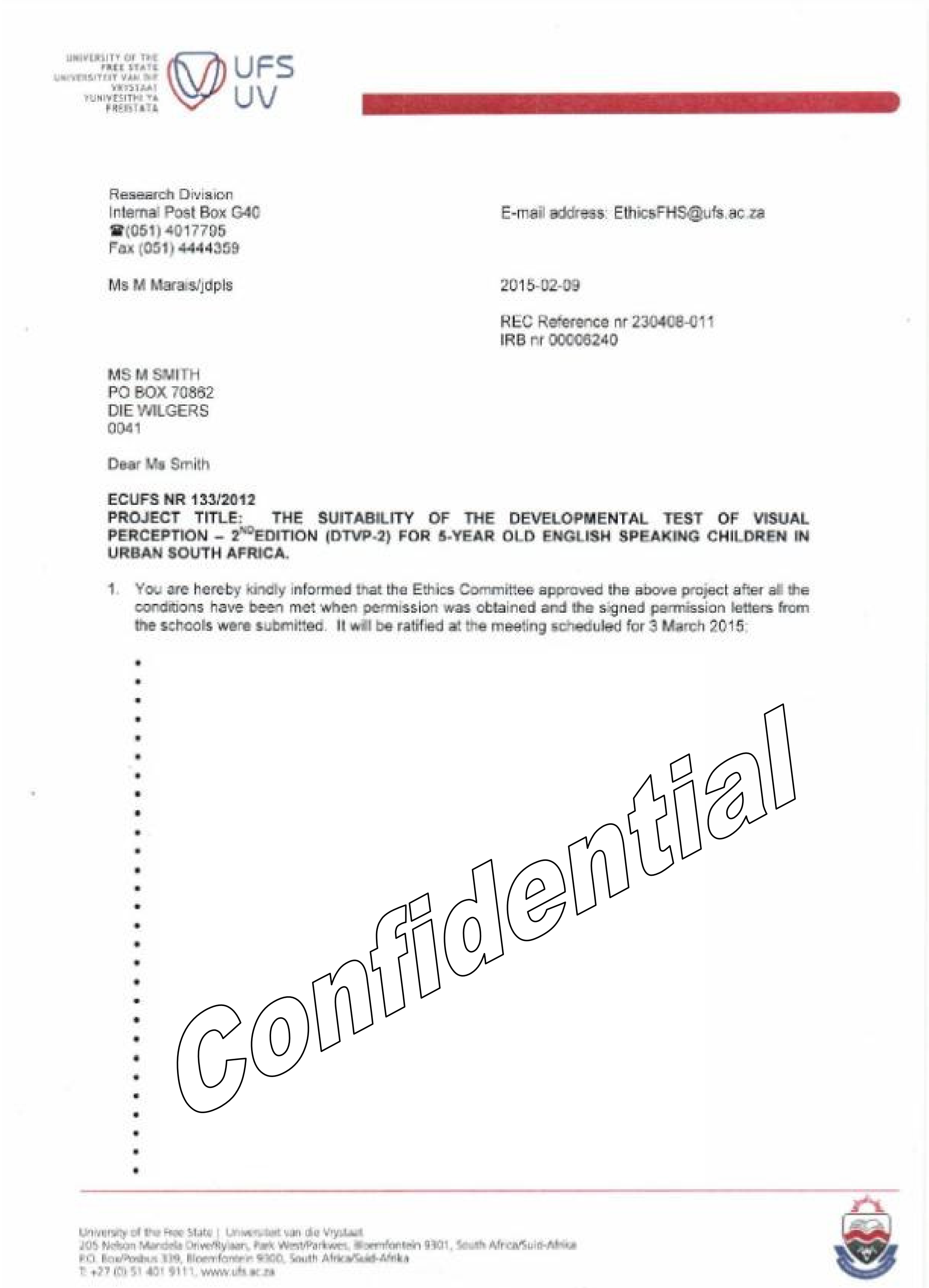
Johannesburg: University of Witwatersrand.

59. Richardson, P.K. 2010. Use of Standardised Tests in Pediatric Practice. (*In* Case-Smith, J., ed. Occupational Therapy for Children. 6th ed. St. Louis, MO: Elsevier/Mosby. p.216–243.)
60. Richmond, J. & Holland, K. 2011. Correlating the Developmental Test of Visual Perception-2 (DTVP-2) and the Test of Visual Perceptual Skills-Revised (TVPS-R) as assessment tools for learners with difficulties. *South African Journal of Occupational Therapy*. 41(1):33–37.
61. Schneck, C.M. 2010a. A Frame of Reference for Visual Perception. (*In* Kramer, P. & Hinojosa, J., ed. Frames of Reference for Paediatric Occupational Therapy. 3rd ed. Philadelphia: Lippincott Williams & Wilkens. p349–389.)
62. Schneck, C.M. 2005. Visual Perception. (*In* Case-Smith, J., ed. Occupational Therapy for Children. 6th ed. St. Louis, MO: Elsevier/Mosby. p.373–403.)
63. Schneck, C.M. 2010b. Visual Perception. (*In* Case-Smith, J., ed. Occupational Therapy for Children. 6th ed. St. Louis, MO: Elsevier/Mosby. p.373–403.)
64. The South African Institute for Sensory Integration. 2014. Sensory integration theory: Course 1. Johannesburg.
65. StatsSA. 2012. Census 2011. www.statssa.gov.za. Date of access: 05/01/2015.
66. StatsSA. 2014. Mid-year Population Estimates. www.statssa.gov.za. Date of access: 05/01/2015.
67. StatsSA. online. City of Tshwane. http://beta2.statssa.gov.za/?page_id=1021&id=city-of-tshwane-municipality. Date of access: 18/03/2015.
68. Stein, F. & Cutler, S.K. 2002. Psychosocial Occupational Therapy – A Holistic Approach. 2nd ed. Farmington Hills, Michigan: Delmar. p.241 – 255.
69. Thorley, M. & Mui Lim, S. 2011. Considerations for occupational therapy assessment for Indigenous children in Australia. *Australian Occupational Therapy Journal*. 58:3–10.
70. Van der Merwe, J., Smit, N. & Vlok. B. 2011. A survey to investigate how South African Occupational Therapists in private practice are assessing and treating poor handwriting in foundation phase learners: Part 1 demographics and assessment practices. *South African Journal of Occupational Therapy*. 41(3):3–11.

71. Van Romburgh, J.A. 2006. Die voorkoms van visuele-persepsieprobleme en die effektiwiteit van Arbeidsterapie groepbehandeling onder gr 1 kleurling kleuters. Research report (MOT). Bloemfontein: University of the Free State.
72. Visser, M.M. 2005. The association of an omitted crawling milestone on pencil grasp and control in a 5 & 6 year old population. Research report (MSTSH). Johannesburg: University of Witwatersrand.
73. Visser, M.M, Cronje, M., Kemp, B., Scholtz, M., Van Rooyen, W. & Nel, M. 2012. The DTVP-2 visual closure subtest: a closer look. *South African Journal of Occupational Therapy*. 42(2):21–25.
74. Wechsler, D. 1974. Wechsler Intelligence Scale for Children-Revised. San Antonio, TX: Psychological Corp.
75. Witthaus, S. 2002. Enhancing your child's development: You can make a difference. Pretoria: Nassou.
76. World Medical Association. 2008. Declaration of Helsinki. http://www.wma.net/en/30publications/10policies/b3/17c.pdf. Date of access: 17/09/2015.
77. Zaba, J.N. 1984. Visual perception versus visual function: invited reactions from optometrists. *Journal of Learning Disabilities*. 17:182–185.

ADDENDUM A

Permission:
Ethical Committee



UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS
UV

Research Division
Internal Post Box G40
☎(051) 4017795
Fax (051) 4444359

E-mail address: EthicsFHS@ufs.ac.za

Ms M Marais/jdpls

2015-02-09

REC Reference nr 230408-011
IRB nr 00006240

MS M SMITH
PO BOX 70862
DIE WILGERS
0041

Dear Ms Smith

ECUFS NR 133/2012
PROJECT TITLE: THE SUITABILITY OF THE DEVELOPMENTAL TEST OF VISUAL PERCEPTION – 2NDEDITION (DTVP-2) FOR 5-YEAR OLD ENGLISH SPEAKING CHILDREN IN URBAN SOUTH AFRICA.

1. You are hereby kindly informed that the Ethics Committee approved the above project after all the conditions have been met when permission was obtained and the signed permission letters from the schools were submitted. It will be ratified at the meeting scheduled for 3 March 2015:

•

2. Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.

3. Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

4. The Committee must be informed of any serious adverse event and/or termination of the study.

5. All relevant documents e.g. signed permission letters from the authorities, institutions; changes to the protocol, questionnaires etc. have to be submitted to the Ethics Committee before the study may be conducted (if applicable).

6. A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.

7. Kindly refer to the ETOVS/ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

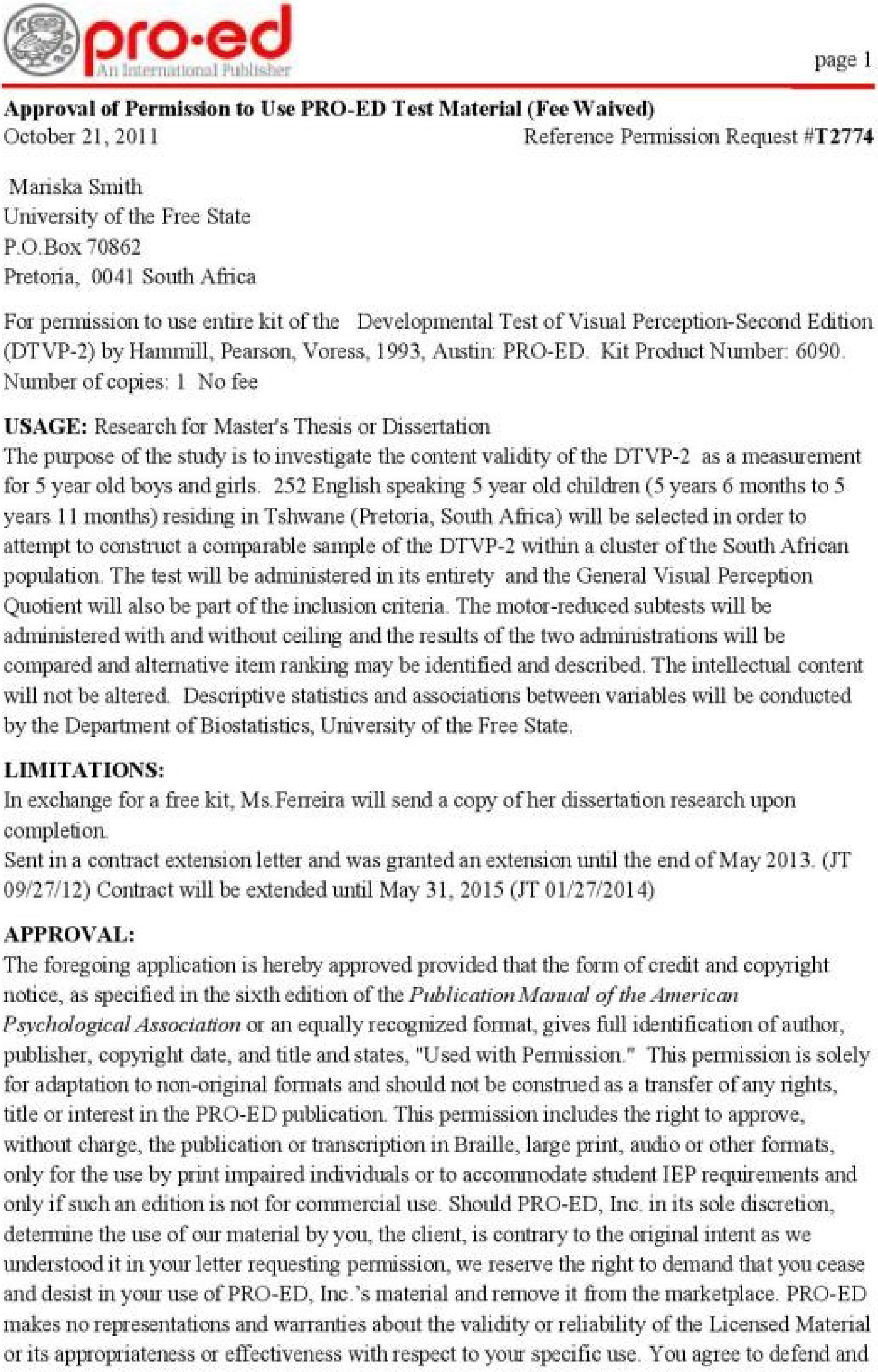
…………………………………………

DR SM LE GRANGE
CHAIR: ETHICS COMMITTEE

Addendum B

Permission:

PRO-ED, Inc. Publishers



pro·ed
An International Publisher

Approval of Permission to Use PRO-ED Test Material (Fee Waived)

October 21, 2011 Reference Permission Request #**T2774**

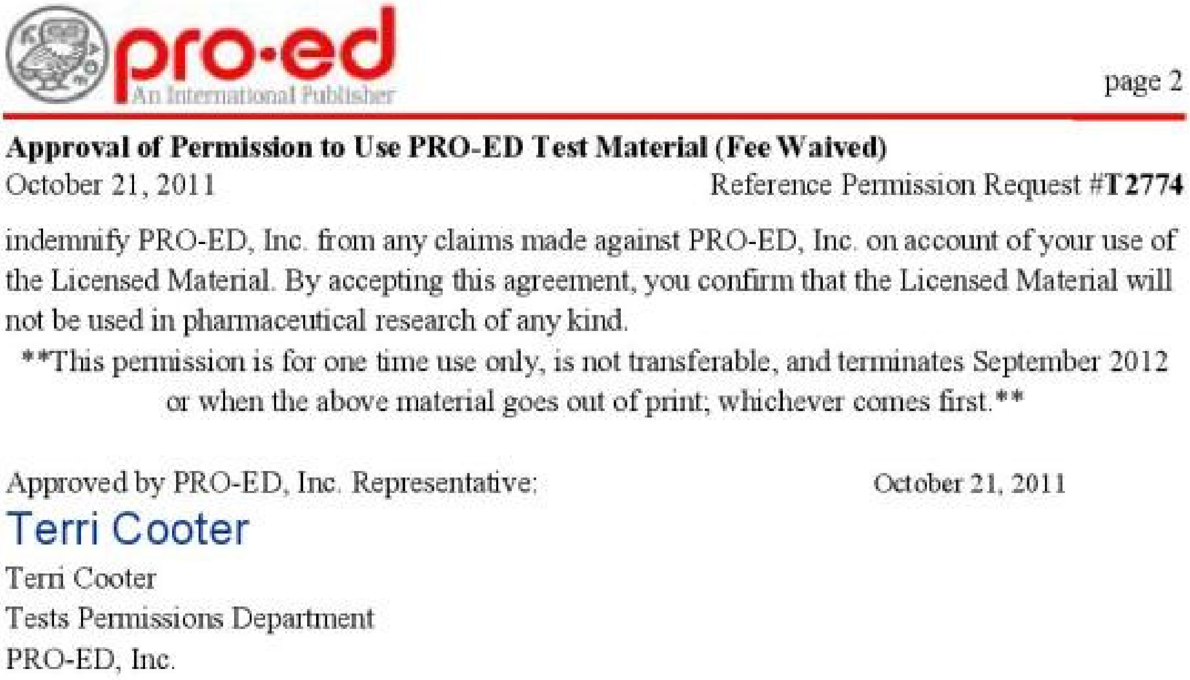
Mariska Smith
University of the Free State
P.O.Box 70862
Pretoria, 0041 South Africa

For permission to use entire kit of the Developmental Test of Visual Perception-Second Edition (DTVP-2) by Hammill, Pearson, Voress, 1993, Austin: PRO-ED. Kit Product Number: 6090. Number of copies: 1 No fee

USAGE: Research for Master's Thesis or Dissertation
The purpose of the study is to investigate the content validity of the DTVP-2 as a measurement for 5 year old boys and girls. 252 English speaking 5 year old children (5 years 6 months to 5 years 11 months) residing in Tshwane (Pretoria, South Africa) will be selected in order to attempt to construct a comparable sample of the DTVP-2 within a cluster of the South African population. The test will be administered in its entirety and the General Visual Perception Quotient will also be part of the inclusion criteria. The motor-reduced subtests will be administered with and without ceiling and the results of the two administrations will be compared and alternative item ranking may be identified and described. The intellectual content will not be altered. Descriptive statistics and associations between variables will be conducted by the Department of Biostatistics, University of the Free State.

LIMITATIONS:
In exchange for a free kit, Ms.Ferreira will send a copy of her dissertation research upon completion.
Sent in a contract extension letter and was granted an extension until the end of May 2013. (JT 09/27/12) Contract will be extended until May 31, 2015 (JT 01/27/2014)

APPROVAL:
The foregoing application is hereby approved provided that the form of credit and copyright notice, as specified in the sixth edition of the *Publication Manual of the American Psychological Association* or an equally recognized format, gives full identification of author, publisher, copyright date, and title and states, "Used with Permission." This permission is solely for adaptation to non-original formats and should not be construed as a transfer of any rights, title or interest in the PRO-ED publication. This permission includes the right to approve, without charge, the publication or transcription in Braille, large print, audio or other formats, only for the use by print impaired individuals or to accommodate student IEP requirements and only if such an edition is not for commercial use. Should PRO-ED, Inc. in its sole discretion, determine the use of our material by you, the client, is contrary to the original intent as we understood it in your letter requesting permission, we reserve the right to demand that you cease and desist in your use of PRO-ED, Inc.'s material and remove it from the marketplace. PRO-ED makes no representations and warranties about the validity or reliability of the Licensed Material or its appropriateness or effectiveness with respect to your specific use. You agree to defend and



Approval of Permission to Use PRO-ED Test Material (Fee Waived)

October 21, 2011 Reference Permission Request #**T2774**

indemnify PRO-ED, Inc. from any claims made against PRO-ED, Inc. on account of your use of the Licensed Material. By accepting this agreement, you confirm that the Licensed Material will not be used in pharmaceutical research of any kind.

This permission is for one time use only, is not transferable, and terminates September 2012 or when the above material goes out of print; whichever comes first.

Approved by PRO-ED, Inc. Representative: October 21, 2011

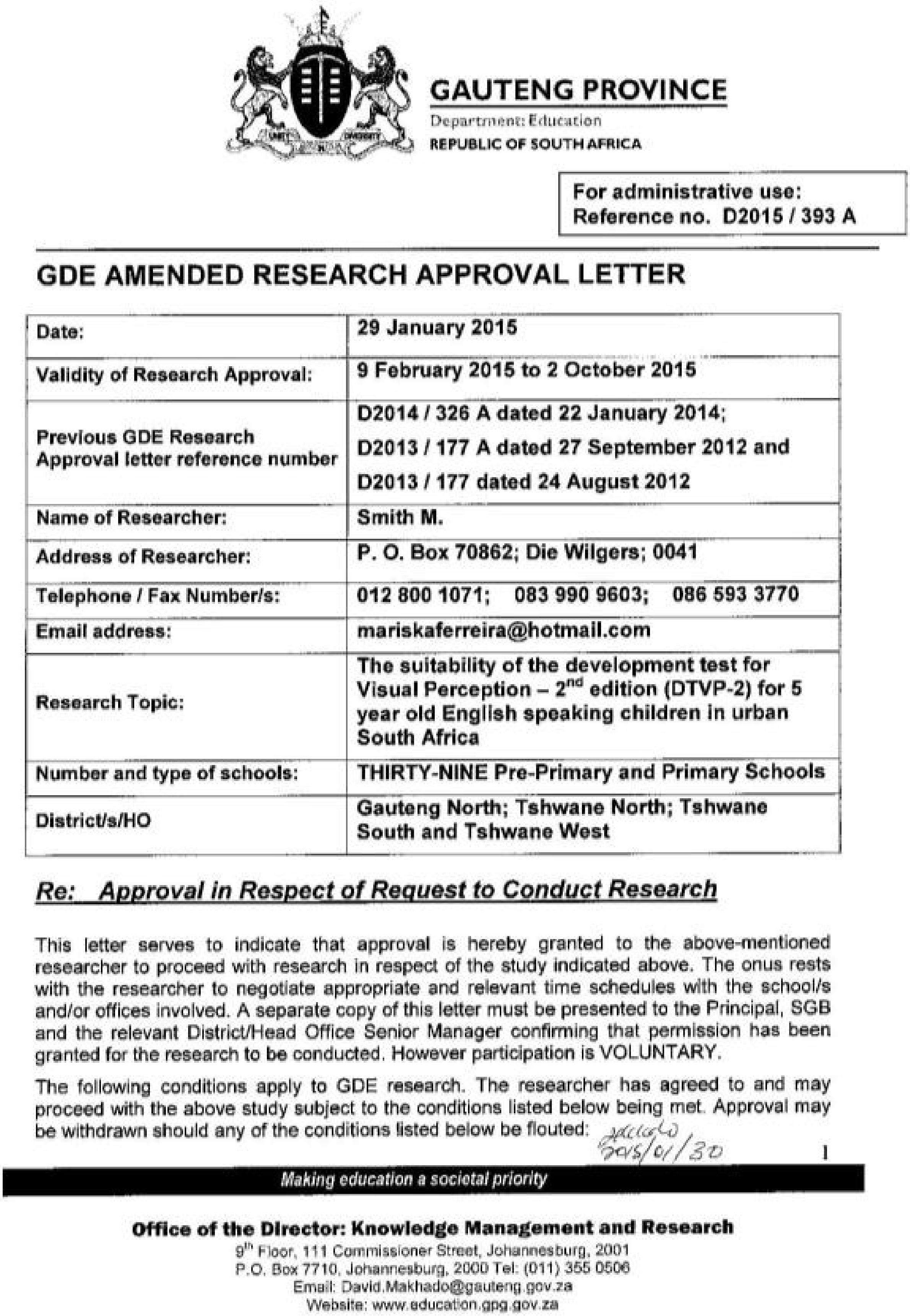
Terri Cooter

Terri Cooter
Tests Permissions Department
PRO-ED, Inc.

Addendum C

Permission:

Gauteng Department of Education



GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2015 / 393 A

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	**29 January 2015**
Validity of Research Approval:	**9 February 2015 to 2 October 2015**
Previous GDE Research Approval letter reference number	**D2014 / 326 A dated 22 January 2014;** **D2013 / 177 A dated 27 September 2012 and** **D2013 / 177 dated 24 August 2012**
Name of Researcher:	**Smith M.**
Address of Researcher:	**P. O. Box 70862; Die Wilgers; 0041**
Telephone / Fax Number/s:	**012 800 1071; 083 990 9603; 086 593 3770**
Email address:	**mariskaferreira@hotmail.com**
Research Topic:	**The suitability of the development test for Visual Perception – 2^{nd} edition (DTVP-2) for 5 year old English speaking children in urban South Africa**
Number and type of schools:	**THIRTY-NINE Pre-Primary and Primary Schools**
District/s/HO	**Gauteng North; Tshwane North; Tshwane South and Tshwane West**

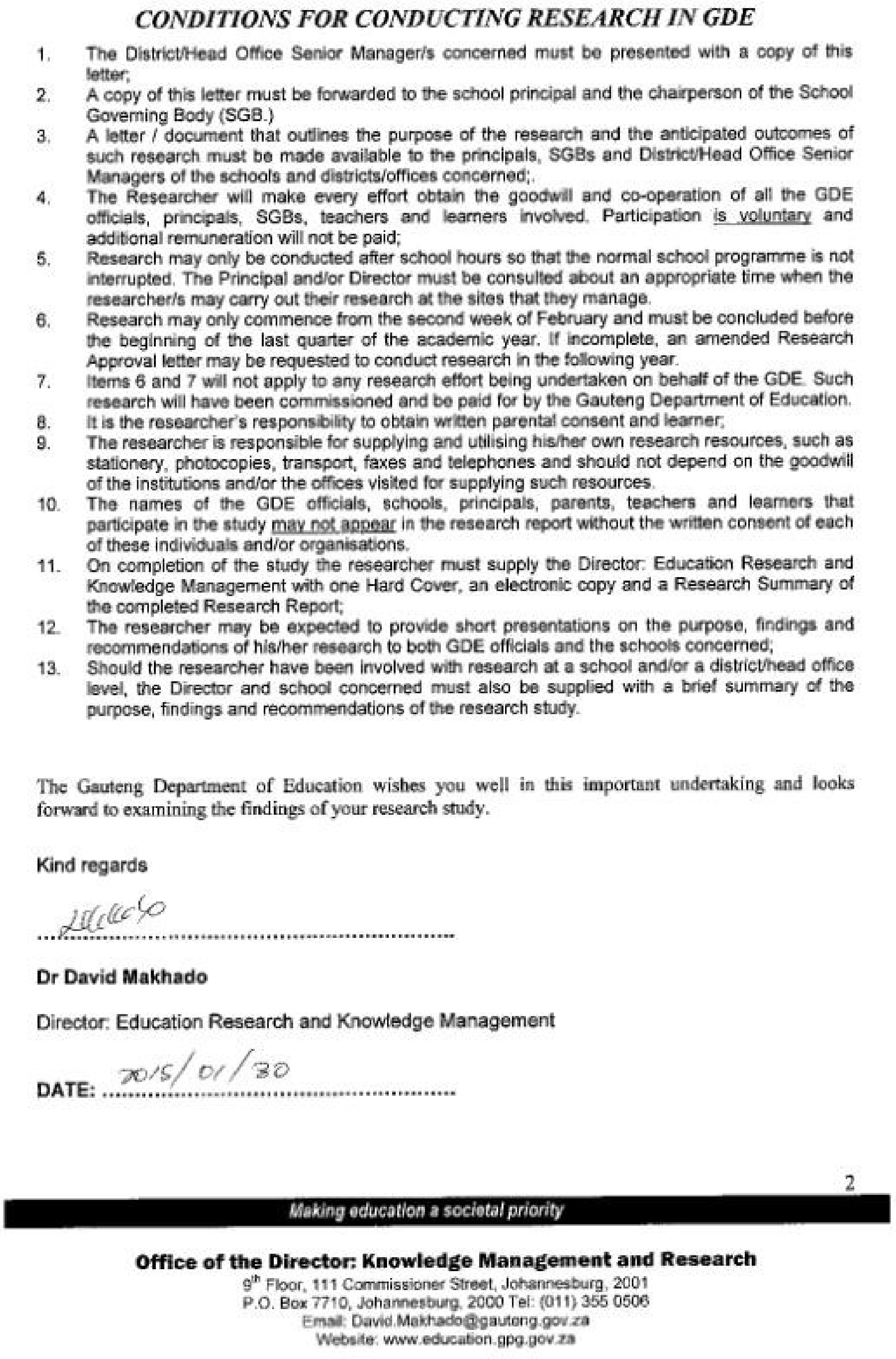
Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved. A separate copy of this letter must be presented to the Principal, SGB and the relevant District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted. However participation is VOLUNTARY.

The following conditions apply to GDE research. The researcher has agreed to and may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

2015/01/30

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za



CONDITIONS FOR CONDUCTING RESEARCH IN GDE

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter;
2. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB.)
3. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned;.
4. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, SGBs, teachers and learners involved. Participation is voluntary and additional remuneration will not be paid;
5. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal and/or Director must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
6. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
7. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
8. It is the researcher's responsibility to obtain written parental consent and learner;
9. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
10. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
11. On completion of the study the researcher must supply the Director: Education Research and Knowledge Management with one Hard Cover, an electronic copy and a Research Summary of the completed Research Report;
12. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned;
13. Should the researcher have been involved with research at a school and/or a district/head office level, the Director and school concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

....

Dr David Makhado

Director: Education Research and Knowledge Management

DATE: 2015/01/30

Addendum D

Research Request:
Principals, School Governing Body and Class teachers

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA
UFS
UV

(Date)

To whom it may concern

Research Request

My name is Mariska Smith, a qualified Occupational Therapist and registered student at the University of the Free State, Bloemfontein, for a Magister Degree in Occupational Therapy.

I am conducting a research study among Grade R children in Pre-Primary and Primary schools with the aim of evaluating the suitability of the Developmental Test of Visual Perception – 2nd edition (DTVP-2) as measurement instrument for 5-year old English speaking boys and girls from a selected area in South Africa.

I anticipate to perform the study during school hours in September 2012 among children aged 5 year 6 months to 5 years 11 months whose first and second language is English. Approximately 126 boys and 126 girls are needed for the study. Parents/caregivers who provide consent will be requested to complete a questionnaire to establish inclusion or exclusion from the study. Children that comply with the inclusion criteria and give assent, will be assessed with the DTVP-2. The evaluation will take approximately 60 minutes to complete and if needed, children will be given rest breaks during the evaluation. The evaluation will be free of charge and completely voluntary.

Ethical clearance (ECUFS NR 133/2012), as well as approval from the Gauteng Department of Education (D2013/177) has been obtained and I hereby invite your school to participate in the research study and subsequently request permission to conduct the research study at your school.

If you would like to take part, please provide written consent and send to [redacted] or fax to [redacted] by (date).

If you require any other information regarding the research study, please contact me at the provided email address or on my cellphone: [redacted].

Alternatively, the study leaders can be contacted:

Dr. S.M. van Heerden
Ph.D. (HPE) (UFS)
Dept. Occupational Therapy
University of the Free State
+27514012829
gnatrvh@ufs.ac.za

M.M. Visser
M.Occupational Therapy (WITS)
Dept. Occupational Therapy
University of the Free State
+27514012829
vissermm@ufs.ac.za

Thank you for your valuable time and looking forward to your response.

Yours faithfully

MSmith
MARISKA SMITH
OCCUPATIONAL THERAPIST

Addendum E

Principal Consent Form

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PRINCIPAL CONSENT FORM

I, ____ (name of principal) hereby give Mariska Smith consent to conduct the research study at the school / preschool stated below. I understand the procedure involved in the research study and acknowledge that the evaluation is free of charge and completely voluntary.

SCHOOL/ PRESCHOOL: ____

NAME OF PRINCIPAL: ____

SIGNATURE: ____

DATE: ____

THANK YOU FOR YOUR CO-OPERATION

MSmith____________________
Mariska Smith
Occupational Therapist

Addendum F

Research Information Pamphlet

RESEARCH INFORMATION PAMPHLET

I'm an Occupational Therapist
doing a research study and
would like to invite you
to give consent for your child to participate.

Please read the enclosed information that explains more about the study.

If you would like your child to participate,
please return the attached questionnaire
by (*date*) via:
email
mariskaferreira@hotmail.com
fax
0865933770
or to the class teacher
in the envelope provided.

Looking forward to your response.

Mariska Smith
Occupational Therapist

Occupational Therapists in South Africa use standardised tests to evaluate children's visual perceptual skills. One of these standardised tests that are frequently used by many Occupational Therapists in South Africa is the Developmental Test of Visual Perception – 2nd edition (DTVP-2).

AIM OF THE STUDY:
To evaluate the suitability of the DTVP-2 as a measurement instrument for 5-year old English speaking boys and girls from a selected area in South Africa.

Approximately 126 Boys and 126 Girls are needed to participate in the research study.

BENEFITS OF PARTICIPATION:
FREE visual perception evaluation.

RISKS OF PARTICIPATION:
There are no risks involved.

CHILDREN WILL BE CONSIDERED ELIGIBLE AS A PARTICIPANT IF HE/SHE-:

- Is aged between 5 years 6 months 0 days and 5 years 11 months 30 days on the day of testing.
- Can speak and understand English.
- Has been attending an English medium school for at least 2 years.

Unfortunately a child cannot participate if he/she:

- Have developmental delays.
- Is diagnosed with a sensory-, physical-, emotional- or intellectual impairment, such as:
  - Autism / Asperger Syndrome
  - Attention Deficit Disorder (ADD) / Attention Deficit Hyperactivity Disorder (ADHD)
  - Cerebral Palsy (CP)
  - Down Syndrome
  - Psychiatric conditions such as Conduct Disorder or Oppositional Deviance Disorder
- Has been tested with the DTVP-2 in the last 6 months.
- Previously received or currently receives Occupational Therapy or any other kind of therapy that can influence a child's visual perception.

Parents/caregivers will be informed via email and/or sms if enough boys and girls have been recruited for the research study.

PARENTS WILL BE REQUIRED TO-:

- Complete and return the questionnaire.
- Make sure that your child eats breakfast and has a lunchbox on the day of testing

You will receive a reminder the day before your child is tested.

TESTING:

- Will be done at the school during school hours during September and October 2012.
- Will be completed in one session.
- Will take approximately 1 hour to complete.

YOUR CHILD WILL BE REQUIRED TO-:

- Give permission to participate before the testing.
- Show different shapes and pictures in a picture book.
- Draw simple lines and pictures with a pencil in a book.

Parents/caregivers of children who perform below their developmental age norm will receive a letter after completion of the research study.

No therapy will be provided by the researcher after completion of the research study.

The contact details of the Occupational Therapy Association of South Africa (OTASA) will be provided should parents/caregivers be interested in further investigation and/or intervention.

COSTS INVOLVED:

There is **no cost** involved to participate in the study.

REMUNERATION:

No compensation will be provided for participation.

VOLUNTARY PARTICIPATION:

Participation is completely voluntary and, parents/caregivers and children may withdraw at any time, without any consequences.

CONFIDENTIALITY:

Information collected in the questionnaire, as well as during the testing will be kept in confidentiality – no personal information will be made public.

PUBLICATION OF RESULTS:

The results of the study will be made public in an accredited journal and/or presented at a course or congress. The Department of Education and the publishers of the DTVP-2 will receive a report of the results after the study is completed.

ETHICS:

Ethical approval has been granted by the Faculty of Health Sciences, the University of the Free State. ETOVS number:

If you have any questions or complaints, the secretary of the Ethics Committee of the Faculty of Health Sciences, University of the Free State can be contacted at 051 405 2812.

If you require additional information, please contact:

Researcher
M. Smith
B. Occupational Therapy (UFS)
☎ [redacted]
🖳 [redacted]

Study Leaders
Dr. S.M. van Heerden
Ph.D. (HPE)(UFS)
Dept. Occupational Therapy
University of the Free State
☎ 051 401 2829
🖳 gnatrvh@ufs.ac.za

Mrs. M.M. Visser
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Dept. Occupational Therapy
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Addendum G

Questionnaire

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QUESTIONNAIRE

INFORMED CONSENT

You have been invited to participate in a research study. Please note that by completing this questionnaire you are voluntarily agreeing to participate in this research study. You will remain anonymous and your data will be treated confidentially at all times. You may withdraw from this study at any given moment during completion of the questionnaire. The results of the study may be published and presented at congresses.

INSTRUCTIONS: Mark the appropriate block with an **X** or write your answer in the space provided.
TIME: The questionnaire will take no more than 30 minutes to complete.

Please note that the information is for statistical purposes only.

Identification code (for coding and tracking purposes):	*For office use* ☐☐☐☐ 1 – 4
1. What is your child's date of birth? (dd/mm/yyyy) __ __ / __ __ / __ __ __ __	☐☐☐☐☐☐☐☐ 5 – 12
2. Is your child a boy or girl? ☐ Boy ☐ Girl	☐ 13
3. Is your child: ☐ Left handed ☐ Right handed ☐ Uses both hands to do activities	☐ 14
4. Has your child attended an English medium pre-school for 2 years or more? ☐ Yes ☐ No **If you answered YES, please indicate the year your child started pre-school** ________________________	☐ 15 ☐☐☐☐ 16 – 19

5. What is your home language? ☐ Afrikaans ☐ English ☐ IsiZulu ☐ Setswane Other: ____________________	☐ 20 ☐☐ 21 – 22
6. Do you suspect that your child is in any aspect developmentally behind his/her age? ☐ Yes ☐ No **If you answered YES, please indicate** ______________________________ ______________________________ ______________________________	☐ 23 ☐☐ 24 – 25 ☐☐ 26 – 27 ☐☐ 28 – 29
7. Has the class teacher mentioned that she suspects that your child is in any aspect developmentally behind his/her age? ☐ Yes ☐ No **If you answered YES, please indicate** ______________________________ ______________________________ ______________________________	☐ 30 ☐☐ 31 – 32 ☐☐ 33 – 34 ☐☐ 35 – 36
8. Has your child ever been referred to or seen by any therapist for an evaluation or treatment of developmental delays or concerns? ☐ Yes ☐ No **If you answered YES, please answer questions 8.1. to 8.7.** 8.1. Why was your child referred to a therapist? ______________________________ ______________________________ ______________________________ 8.2. Please indicate the therapist: ☐ Educational Psychologist ☐ Occupational Therapist ☐ Physiotherapist ☐ Speech and Language Therapist Other: ______________________________	☐ 37 ☐☐ 38 – 39 ☐☐ 40 – 41 ☐☐ 42 – 43 ☐ 44 ☐ 45 ☐ 46 ☐ 47 ☐ 48

8.3. When was your child referred to the therapist (dd/mm/yyyy)?
__ __ / __ __ / __ __ __ __

☐☐☐☐☐☐☐☐ 49 – 56

8.4. For how long was your child seen by the therapist? Please provide the dates (mm/yyyy to mm/yyy):
__ __ / __ __ __ __ to __ __ / __ __ __ __

☐☐☐☐☐☐ 57 – 62
☐☐☐☐☐☐ 63 – 68

8.5. What were the problems identified by the therapist?
____
____
____

☐☐ 69 – 70
☐☐ 71 – 72
☐☐ 73 – 74

8.6. Is your child still seen by the therapist?
☐ Yes
☐ No

☐ 75

8.7. Was your child assessed with the Developmental Test for Visual Perception – 2nd edition (DTVP-2) in the last 6 months?
☐ Yes
☐ No

☐ 76

If you answered YES, please provide the date (dd/mm/yyyy):
__ __ / __ __ / __ __ __ __

☐☐☐☐☐☐☐☐ 1 - 8

9. Has your child's vision been tested by an optometrist?
☐ Yes
☐ No

☐ 9

If you answered YES, please answer questions 9.1. to 9.4.

9.1. When was your child's vision tested (dd/mm/yyyy)?
__ __ / __ __ / __ __ __ __

☐☐☐☐☐☐☐☐ 10 - 17

9.2. By whom was your child's vision tested?
____

☐☐ 18 - 19

9.3. Were any problems identified regarding vision?
☐ Yes
☐ No

☐ 20

	If you answered YES, please indicate:	
	______________________________	☐☐ 21 - 22
	______________________________	☐☐ 23 - 24
	______________________________	☐☐ 25 - 26
9.4.	Does your child wear glasses? ☐ Yes ☐ No	☐ 27
	If you answered YES, please give the reason: ☐ Far sighted ☐ Near sighted	☐ 28
	Other: ______________________	☐ 29
10.	Does your child have any of the following medical diagnoses which impacts on participation in activities of daily living?	
	☐ Autism	☐ 30
	☐ Intellectual impairment	☐ 31
	☐ Attention Deficit Disorder (ADD)	☐ 32
	☐ Attention Deficit Hyperactivity Disorder (ADHD)	☐ 33
	☐ Down Syndrome	☐ 34
	☐ Cerepral Palsy (CP)	☐ 35
	☐ Conduct Disorder	☐ 36
	☐ Oppisitional Defiant Disorder (ODD)	☐ 37
	Other: ______________________________	☐☐ 38 – 39

Please indicate your preference for correspondence and provide the necessary information in block letters:

☐ Email – email address: ______________________________________

☐ Fax – fax number: ______________________________________

☐ Sms – cellphone number: ______________________________________

Thank you for your valuable time to complete the questionnaire!

Please return the questionnaire in the envelope provided to the class teacher.
Alternatively the questionnaire can be
emailed to [redacted]
or faxed to [redacted].

Addendum H

Child information letter and assent form

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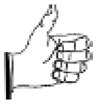
Identification code: ☐☐☐☐

I am an Occupational Therapist visiting your  (school). Your parents/caregivers said it is  (okay) that you can  (play) with me today. Now I want to ask if you want to come with me to (*insert area*) and play with me? If you want to play with me, we are going to sit on a  (chair) and  (write) with a  (pencil) in a  (book) and you are going to  (look) at lots of  (pictures). You will have to  (listen) carefully to what I say you must do. Remember, if you want to  (stop) you can stop at  (anytime) or if you want to go to the  (toilet) just let me know.

By making a ○ (circle) show that you know what we are going to do and asked questions. You can also ask questions later if you cannot think of them now.

Make a ○ (circle) around the one you choose:

☑ Yes, I want to play

☒ No, I don't want to play.

Addendum I

Data Score Sheet

DATA SCORE SHEET

INFORMATION

Name ____________________

Gender | Male (1) | Female (2) |

1st Date of evaluation (yy/mm/dd)
Date of birth
Cronological age y m d

Administrator name ____________________

School ____________________

Grade | RR (1) | R (2) |

DTVP-2 SCORING

SUBTEST 1

1. Eye-hand Coordination - prescribe 1
2
3
4

a b c d e f g h i j k l m n o p q r s

Eye-Hand Coordination RAW SCORE - prescribed
Eye-Hand Coordination STANDARD SCORE - prescribed

SUBTEST 2

2. Position in Space - prescribed

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

2. Position in Space - adapted

Position in Space RAW SCORE - prescribed
Position in Space STANDARD SCORE - prescribed

Position in Space RAW SCORE - adapted
Position in Space STANDARD SCORE - adapted

SUBTEST 3

3. Copying - prescribed

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Copying RAW SCORE - prescribed
Coping STANDARD SCORE - prescribed

CODING

1 - 4

5

6-11
12-17
18-23

24-25

26-27

28

29-37
38-46
47-65
1-17

18-20
21-22

23-47

48-72

73-74
75-76

77-78
1-2

3-22

23-24
25-26

SUBTEST 4

4. Figure-Ground	- prescribed	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	27-44
4. Figure-Ground	- adapted		45-62
Figure-ground RAW SCORE	- prescribed		63-64
Figure-ground STANDARD SCORE	- prescribed		65-66
Figure-ground RAW SCORE	- adapted		67-68
Figure-ground STANDARD SCORE	- adapted		69-70

SUBTEST 5

5. Spatial Relations	- prescribed	1 2 3 4 5 6 7 8 9 10	71-80
Spatial Relations RAW SCORE	- prescribed		1-2
Spatial Relations STANDARD SCORE	- prescribed		3-4

SUBTEST 6

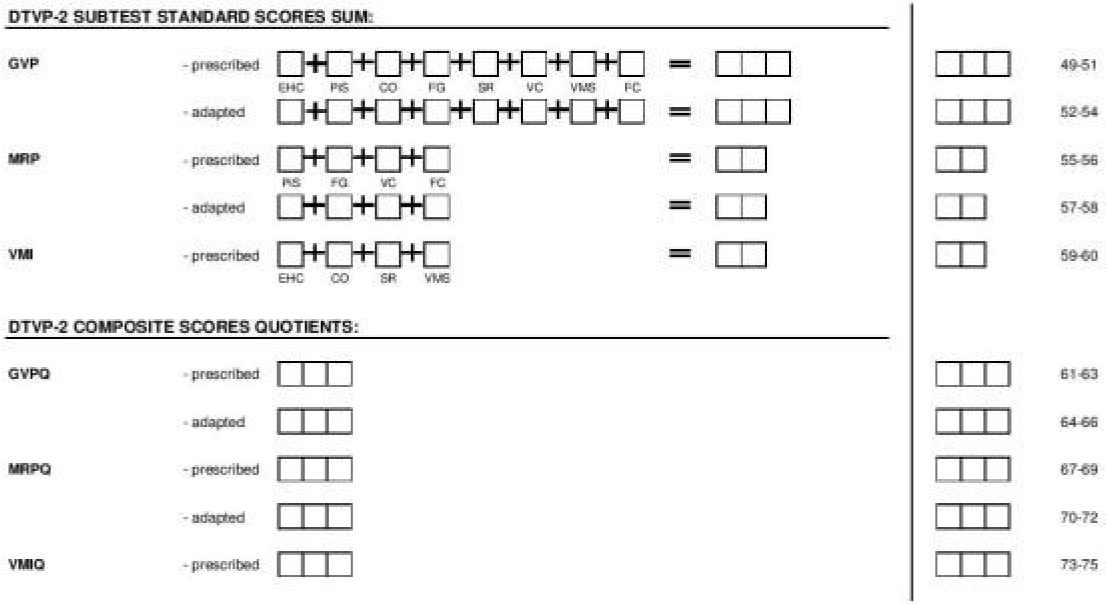
6. Visual Closure	- prescribed	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	5-24
6. Visual Closure	- adapted		25-44
Visual Closure RAW SCORE	- prescribed		45-46
Visual Closure STANDARD SCORE	- prescribed		47-48
Visual closure RAW SCORE	- adapted		49-50
Visual closure STANDARD SCORE	- adapted		51-52

SUBTEST 7

7. Visual-Motor Speed	Row	1 2 3 4 5 6 7 8	
	Squares		53-60
	Circles		61-68
Visual-Motor Speed RAW SCORE	- prescribed		69-70
Visual-Motor Speed STANDARD SCORE	- prescribed		71-72

SUBTEST 8

8. Form Constancy	- prescribed	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	1-20
8. Form Constancy	- adapted		21-40
Form Constancy RAW SCORE	- prescribed		41-42
Form Constancy STANDARD SCORE	- prescribed		43-44
Form Constancy RAW SCORE	- adapted		45-46
Form Constancy STANDARD SCORE	- adapted		47-48



DTVP-2 SUBTEST STANDARD SCORES SUM:

GVP	- prescribed	☐+☐+☐+☐+☐+☐+☐+☐ EHC PIS CO FG SR VC VMS FC	= ☐☐☐	☐☐☐	49-51
	- adapted	☐+☐+☐+☐+☐+☐+☐+☐	= ☐☐☐	☐☐☐	52-54
MRP	- prescribed	☐+☐+☐+☐ PIS FG VC FC	= ☐☐	☐☐	55-56
	- adapted	☐+☐+☐+☐	= ☐☐	☐☐	57-58
VMI	- prescribed	☐+☐+☐+☐ EHC CO SR VMS	= ☐☐	☐☐	59-60

DTVP-2 COMPOSITE SCORES QUOTIENTS:

GVPQ	- prescribed	☐☐☐	☐☐☐	61-63
	- adapted	☐☐☐	☐☐☐	64-66
MRPQ	- prescribed	☐☐☐	☐☐☐	67-69
	- adapted	☐☐☐	☐☐☐	70-72
VMIQ	- prescribed	☐☐☐	☐☐☐	73-75

Addendum J

Parents/caregivers results feedback letter

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Dear parents/caregivers

Evaluation feedback

Date of evaluation: 2012/__ /__
Date of Birth: 200 / __ /__
Chronological age: 5 years __ months

SUMMARY OF THE RESULTS

According to the Developmental Test of Visual Perception – 2nd edition (DTVP-2) your child's visual perceptual skills are developed below his/her developmental age when scored using the current American norms.

RECOMMENDATION

Unfortunately, I will not be able to provide therapy. However, the Occupational Therapy Association of South Africa (OTASA) can be contacted to obtain the contact details of an Occupational Therapist in your area should you be interested in further investigation and/or intervention:

OTASA
Tel: **012 362 5457**
Fax: **086 651 5438**
Email: otasa@otasa.org.za
Website: **www.otasa.org.za**

For any other enquiries, please contact Mariska Smith at [redacted] or [redacted]

Thank you for participating in the research study.

Regards

MSmith

MARISKA SMITH
B. OCCUPATIONAL THERAPY (UFS)

OPSOMMING

SLEUTELWOORDE

DTVP-2, Visuele perseptuele vaardighede, geskiktheid, Rasch analise, kruis-kulturele evaluasie, bewysgebaseerde praktyk, item volgorde en –moeilikheidsgraad, geldigheid, betroubaarheid

OPSOMMING

Aangesien daar beperkte omvattende visuele perseptuele vaardigheidsmeetinstrument, wat op 'n gestandardiseerde verteenwoordigende Suid-Afrikaanse populasie beskikbaar is, maak arbeidsterapeute in Suid-Afrika van meetinstrumente gebruik wat in ander lande gestandaardiseerd is om kinders se visuele perseptuele vaardighede te meet. 'n Meetinstrument wat dikwels deur Suid-Afrikaanse arbeidsterapeute gebruik word, die DTVP-2, is 'n betroubare en geldige meetinstrument vir die populasie waarop die toets gestandardiseerd is. Die geskiktheid van die DTVP-2 word egter in 'n kruis-kulturele omgewing, spesifiek in die Suid-Afrikaanse populasie, bevraagteken.

Die doel van die studie was om die geskiktheid van die Developmental Test of Visual Perception – 2nd edition (DTVP-2) as meetinstrument vir 5 jaar en 6 maande tot 5 jaar en 11 maande Engels-sprekende seuns en dogters van die stad van Tshwane, Suid-Afrika te ondersoek.

'n Kwantitatiewe, beskrywende, obserwerende studieontwerp was gevolg. Een honderd vier en dertig (134) studiedeelnemers is deur middel van 'n gestratifiseerde steekproeftrekking van uit Engelse taal van leer en onderrigskole, geleë in die vier opvoedkundige distrikte in die stedelike-voorstede van die stad van Tshwane, gewerf. 'n Self-geadministreerde vraelys was as siftingsmetode gebruik om kinders

se moontlikheid vir insluiting in die studie te bepaal, asook vir ouers/versorgers om ingeligte toestemming te gee. Kinders van ouers/versorgers wat die vraelyste teruggestuur het, is met die DTVP-2 ge-evalueer. Die DTVP-2 se motories-verhoogde subtoetse was geadministreer volgens die voorgeskrewe metode, terwyl elkeen van die motories-verlaagde subtoetse geadministreer was deur middel van ‛n aangepasde metode deur nie die plafon-reël te implementeer nie.

Resultate van die studie dui daarop dat die Suid-Afrikaanse studie steekproef se tellings verskil van die Amerikaanse normatiewe steekproef. Die posisie in ruimte- en visuele sluiting subtoetse lewer meer akkurate resultate wanneer die plafon-reël nie geïmplementeer word nie. Daar is vasgestel dat die DTVP-2 onbevooroordeeld vir geslag was, met die uitsondering van voorgrond-agtergrond, volgens die voorgeskrewe merk metode. Die DTVP-2 vertoon algehele aanvaarbare betroubaarheid, maar visuele sluiting, visuele-motoriese spoed en vormkonstantheid was onbetroubaar bevind. ‛n Rasch ontleding het getoon dat voorgrond-agtergrond en vormkonstantheid, van die motories-verlaagde subtoetse, 'n enkel eienskap meet en dat al vier die motories-verlaagde subtoetse van die DTVP-2 verwronge item volgorde en –moeilikheidsgraad het met gevolglike wantoepassing van die stop reël.

Daar is tot die gevolgtrekking gekom dat die DTVP-2 moet met omsigtigheid gebruik word om 5 jaar en 6 maande tot 5 jaar en 11 maande Engels-sprekende Suid-Afrikaanse kinders se visuele perseptuele vaardighede te meet. Interpretasie- en die oordrag van tellings moet met sorg aan ouers en/of gesondheidsorgverskaffers gedoen word. Daar word aanbeveel dat die Suid-Afrikaanse arbeidsterapeut sensitief is en/of evalueringsmetodes moet aan pas deur bewysgebaseerde praktyk te implementeer.

SUMMARY

KEY WORDS

DTVP-2, Visual perceptual skills, suitability, Rasch analysis, cross-cultural evaluations, evidence-based practice, item linearity, item difficulty, construct validity, reliability

SUMMARY

As there is limited comprehensive visual perceptual skills test that has been standardised on a representative South African population, occupational therapists in South Africa make use of measurement instruments standardised in other countries to measure children's visual perceptual skills. A measurement instrument frequently used by SA OTs, the DTVP-2, is a reliable and valid test for the population on which the test was standardised. However, the DTVP-2's suitability is questioned in a cross-cultural setting, specifically the SA population.

The aim of the study was to investigate the suitability of the Developmental Test of Visual Perception – 2^nd^ edition (DTVP-2) as a measurement instrument for 5 years and 6 months to 5 years and 11 month English-speaking boys and girls from the City of Tshwane, South Africa.

A quantitative, descriptive, observational study was conducted. One-hundred and thirty four (134) study participants were recruited by means of stratified random sampling from English Language of Learning and Teaching schools located within the four educational districts in the urban-suburbs of the City of Tshwane. A self-administered screening questionnaire was used as a screening method to establish children's eligibility for inclusion in the study, as well as for parents/caregiver to

provide informed consent. Children of parents/caregivers who returned the questionnaires were assessed with the DTVP-2. The DTVP-2's motor-enhanced subtests were administered according to the prescribed method, while each of the motor-reduced subtests of the DTVP-2 was administered with an adapted method of not implementing the ceiling rule.

Results of the study yielded that the SA study sample's scores differed to the American normative sample. The position in space- and visual closure subtests yielded more accurate results when the ceiling rule was not implemented. It was established that the DTVP-2 was unbiased for gender, with the exception of figure-ground, when scored according to the prescribed method. The DTVP-2 displayed overall acceptable reliability, however the individual subtests of visual closure, visual-motor speed and form constancy was found to be unreliable. A Rasch analysis revealed that figure-ground and form constancy of the motor-reduced subtests measured a single construct and the four motor-reduced subtests of the DTVP-2 exhibited distorted item difficulty and –linearity resulting in misapplication of the ceiling rule.

It is concluded that the DTVP-2 should be used with caution to measure 5 years and 6 months to 5 years and 11 months English-speaking children's visual perceptual skills and care must be taken when interpreting and conveying scores to parents and other health care professionals. It is recommended that South African occupational therapists adjust and/or be sensitive in their assessment procedures in order to inform evidence-based practice.