PSYCHOMETRIC EVALUATION OF THE QUICK SCREENING PROCEDURE FOR REFERRAL TO OCCUPATIONAL THERAPY (QSPOT) FOR FIVE YEAR OLDS WITH AND WITHOUT BARRIERS TO LEARNING

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy.

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DECLARATION

I, LAUREN JEANNIE VIAL, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

...LJVial...

26TH. day of ...MAY..............., 2016...

DEDICATION

This research study is dedicated to all learners in South Africa, who will benefit from early identification of their intrinsic barriers to learning through screening, and to the parents, teachers and health professionals who will be involved in that intervention.

ABSTRACT

Designed by a group of South African Occupational Therapists, the Quick Screening Procedure for Referral to Occupational Therapy (QSPOT) screens motor, praxis and sensory-perceptual performance skills related to intrinsic barriers to learning in children aged between 4 and 6 years.

The aim of this study was to determine the sensitivity and specificity of the QSPOT in identifying intrinsic barriers to learning in 5 year olds, as well as the concurrent criterion validity of the QSPOT compared to the Movement ABC-2, and the Developmental Test of Visual-Motor Integration, 6th Edition (VMI and Visual Perception subtests). Eighty-three learners in mainstream schools and Learners with Special Education Needs schools were assessed with all three tests.

Acceptable specificity was found for the QSPOT; however, sensitivity was unacceptably low. Adequate concurrent criterion validity was found between the QSPOT Total Score and the Movement ABC-2 Total Score, as well as between the QSPOT and DTVMI-VMI for Age-band 1 (5 years 0 months to 5 years 5 months). However, inadequate concurrent criterion validity was found for the QSPOT for Age-band 2 (5 years 6 months to 5 years 11 months).

Key words: Intrinsic barriers to learning, motor and praxis performance skills, sensory-perceptual performance skills, screening, screening procedures, sensitivity, specificity, concurrent criterion validity

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TABLE OF CONTENTS

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

DEFINITION OF TERMS

Activity item

"Activity" is synonymous with the words "project" and "undertaking"(p.18).[1] Therefore, for the purposes of this study, the *activity item* refers to the actual activity that the learner has to undertake during a particular task of the Quick Screening Procedure for Referral to Occupational Therapy[2,3] or during the Movement ABC-2[4] Components. The activity item is considered separate from the overall score of a particular QSPOT task, which also includes the observations that are ticked by the assessor.

At risk

A term used to describe a learner who is at risk of having difficulties[4], and/or who is at risk of developing intrinsic barriers to learning in the future[5]. This concern leads to the learner undergoing further investigation, as well as their performance being monitored. A score at or below the 16th percentile indicates at risk performance[4].

Barrier to learning

A barrier to learning is any factor or hindrance that affects a learner's ability to learn and perform effectively in educational activities[6]. The barriers may be temporary or permanent, and they may include specific disabilities or difficulties that are located within the learner, and/or hindrances within the same learner's environmental context[6–8].

Client factors

"*Specific abilities, characteristics, or beliefs that reside within the* (learner) *and may affect performance in areas of occupation.*"(p. 630)[9] They relate to body parts, as well as to the body functions which together make participation in activities possible. They are negatively affected by disabilities, impairments and sickness within the learner[9,10].

Concurrent criterion validity

The degree to which an assessment tool can obtain the same results as another test that is proven to assess the same or similar construct[11,12]. The results are presented in correlations that show the strength of agreement between tests[11].

Criterion-referenced tests

Standardized tests that consist of lists of criteria relating to levels of performance that the child has to achieve in order to pass the particular item. The scores of criterion-referenced tests measure a learner on the basis of his/her own performance rather than giving scores that provide a comparison with same-age peers[11].

Cronbach's alpha

A measurement that is usually used to show the level of relationship between items on a particular test, and to ensure that the items are measuring the same skill area that they were intended to[13,14].

Cut-off

For the purposes of this study, it is defined as the level of performance that would indicate at risk performance. A learner should achieve more than this score or level of performance to be considered age-appropriate (providing that a higher score on that particular instrument indicates better performance)[13]. Cut-off points have to be accurate in order for an instrument to have adequate sensitivity and specificity[15].

Educational performance

For the purposes of this study, it refers to all activities undertaken by the learner in the classroom and the surrounding school environment, including the completion of homework that may take place within and outside of the school environment. It includes being successful in or benefiting from the education curriculum[16].

Inclusive education

A framework which enables learners with intrinsic barriers to learning to be included in a mainstream school environment with adaptations to the physical environment and/or the learner's educational programme if necessary. It involves a shift from considering disabilities as being problems within the learner, to also considering the hindrances in the learner's external environment that also prevent participation in educational activities[7].

Internal consistency

A type of reliability that establishes the extent to which the items of a screening procedure or assessment are inter-related to the degree that they most likely assess a similar element of function or a similar skill[13,14]; however, high internal consistency does not mean that the tool measures only one skill[14,17].

Intrinsic barrier to learning

A disability, impairment or illness that is found within the learner[6,8]. It tends to affect a learner's specific abilities that allow him/her to participate in activities effectively[9,10].

Item

For the purposes of this study, it is a unit that is scored, such as a qualitative observation of function. It may also refer to the activities undertaken during various assessments that did not form part of the study, and it is also synonymous with the word "activity item" when referring to assessments that did form part of the study.

Learners

Refers to school-going children between pre-school age and 18 years[16]. For the purposes of this study, individuals within this age-group are sometimes referred to as children when discussing previous research studies that did not focus wholly on scholastic ability or educational performance.

Likelihood ratio

It refers to the odds that the QSPOT or the reference standard assessments used in this study would give a particular test result in learners with dysfunction, versus the odds that the same test result would occur in learners without dysfunction[13]. These odds are presented in ratios, and include two types, namely the positive likelihood ratio and the negative likelihood ratio[13,18].

"Lived body" (p.83)[19]

The feelings and perceptions that one has about living within one's own body, while engaging in the activities within the environments in which one spends time. Specific disabilities or difficulties may therefore negatively affect a learner's perception of themselves and their abilities to do certain tasks, compared to a learner who is performing appropriately[19].

Norm-referenced tests

Standardized tests which frequently consist of a wide variety of test items that may not be tasks that a learner would normally do as part of daily function; however, the scores on these items provide information regarding the child's level of development within various skills. They usually have strict administration and scoring procedures[11].

Occupation

Refers to the number of activities that are done as part of self-care, work, education, play and leisure within a specific time period, in a specific place, and according to the procedures and guidelines of one's social and cultural contexts[19].

Occupational Performance

Refers to the active performance of a number of activities that form part of the occupations of self-care, education and play that the learners may engage in during the course of daily life[19].

Percentile

A value that indicates how many learners achieve the same score or lower[11,13]. It provides a way in which learners can be compared against an expected level of performance[13]. A score at the 16th percentile is considered at risk performance[4].

Performance capacity

The learner's perceived view of his/her own capabilities when faced with tasks that are required within various environments. It is made up of a combination of the learner's personal experience of living and doing things within the body and using the body, in relation to the learner's physical and mental capabilities and skills that can be observed and measured[19].

Performance skills

Specific sequences of actions that learners use in order to complete tasks that form part of greater occupations such as educational performance, play and self-care[9,20]. This study looks at motor and praxis performance skills, and sensory-perceptual performance skills[9].

Predictive values

The likelihood that the result of a test or screening will accurately show whether or not the learner has difficulties. There are two types, namely the negative predictive value (which would show that a learner is performing appropriately when the learner does not have dysfunction) and the positive predictive values (which would show that the learner does have difficulties when they are in fact experiencing dysfunction)[13,18]. These values are referred to in the text; however, they were not included in the findings.

Reference standard

A standardized test that is used to evaluate the performance of another test being investigated through research. It is usually the most valid and reliable test available[21], and may or may not be considered a gold standard.

Screen assessment or screening

A short procedure that is made up of a small collection of age-appropriate tasks, which can verify if a learner requires a more comprehensive assessment[22].

Sensitivity

The probability that a learner with identified intrinsic barriers to learning will be identified as having difficulties in performance within the assessment that is designed to detect those same types of difficulties[13,18]. It is related to the positive likelihood ratio[18]. Adequate sensitivity ensures that learners with barriers to learning are not missed[13,23].

Specificity

The probability that a learner without difficulties will be identified as not having intrinsic barriers to learning[13,18]. Adequate specificity ensures that learners are not identified unnecessarily[13].

Task

A task is something that we do[20]. For the purposes of this study, a *task* refers to the activity being undertaken while also taking into account *how* the activity is being done. In the case of the QSPOT, the task refers to the activity item that the learner has to undertake, as well as the observation criteria that count toward the learner's score. Therefore, the *tasks* are differentiated from the *activity items* within the QSPOT and the Movement ABC-2.

ABBREVIATIONS

ASD:	Autism Spectrum Disorder
BOT-2:	Bruininks-Oseretsky Test of Motor Proficiency – 2nd Edition
CI:	Confidence Interval
DAP:	Draw-a-person
DCD:	Developmental Coordination Disorder
DoE:	Department of Education
DTVMI:	Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (referring to the entire test comprising of all three subtests)
DTVMI-VMI/VP:	Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (Visual-Motor Integration and Visual Perception subtests only)
DTVMI-VMI:	Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (Visual-Motor Integration subtest only)
DTVMI-VP:	Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (Visual Perception subtest only)
DTVMI-MC:	Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (Motor Coordination subtest only)
DTVP-3:	Developmental Test of Visual Perception, 3rd Edition
GDE:	Gauteng Department of Education
LSEN:	Learners with Special Education Needs
MABC-2:	Movement Assessment Battery for Children – 2nd Edition
OT:	Occupational therapist
OTPF II:	Occupational Therapy Practice Framework: Domain and Process, 2nd Edition
QSPOT:	Quick Screening Procedure for Referral to Occupational Therapy
PDD:	Pervasive Developmental Disorder
PDMS-2:	Peabody Developmental Motor Scales – 2nd Edition
SD:	Standard deviation
SIAS:	Screening, Identification, Assessment and Support

SLD:	Specific Learning Disability
UK:	United Kingdom
VMI:	Visual-motor integration
WOP:	Wall Model of Occupational Performance

CHAPTER 1: INTRODUCTION

1.1 Background

A barrier to learning is anything that prevents a child from performing effectively in activities that relate to the occupation of educational performance and learning[6]. Barriers to learning often only become apparent when learners show an inability to cope with or derive benefit from the learning process, which ultimately leads to school failure and dropping out[7,8,16]. It has been recognized that early and accurate detection of varying areas and levels of dysfunction within the learner, that hinder educational performance, is required if barriers to learning are to be addressed timeously[7,16,22]. These barriers can be located within the learner, at the centre for learning, in the education system and its curricula, as well as in the learner's immediate home environment, and community where economic, social and political contexts may also be hindrances to development and learning[7,8,16,24]. As a result of so many factors being associated with barriers to learning, a wide variety of service providers need to be involved in their prevention, identification and intervention[7,16,24].

Occupational therapists (OTs) are aware of and address some intrinsic barriers to learning that hinder a child's ability to learn and develop school-related outcomes such as reading, writing and numeracy[25–27]. These intrinsic barriers to learning include deficits in client factors and performance skills, especially motor and praxis performance skills, and sensory-perceptual performance skills[9,25,26,28]. Delays in the identification of these intrinsic barriers in learners as they start their formal education may cause under-achievement[25,29] and may have a significant impact on their ability to progress through later grades[7,8,16].

In order for these intrinsic barriers to learning to be identified and addressed, the South African Department of Education (DoE) developed the National Strategy on Screening, Identification, Assessment and Support (SIAS) document[24]. The aim was to improve learners' participation in, and level of benefit from learning activities, as well as to assist teachers and parents in promoting the learners' success. It placed emphasis on the accurate assessment of performance skills of all learners in Grade 0 and Grade 1[16,24].

Some of the existing standardized assessments that are commonly used by OTs to assess learners, include the Movement Assessment Battery for Children - 2nd Edition (MABC-2)[4,30,31], the Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (DTVMI)[32,33] and the Developmental Test of Visual Perception, 3rd Edition (DTVP-3)[33,34]. These standardized assessments are used to determine the presence of deficits in client factors and performance skills which underlie development of academic skills[26]. Some of these tests are considered reference standards for identifying problems in learning in children, but take a long time to administer and interpret[35]. It is not possible to screen the large numbers of learners in Grade 0 and Grade 1 as indicated in the inclusive education policies, if these standardized tests are used. While there is support from the DoE for the continued use of norm-referenced and criterion-referenced tests, the policies state that there should be a move from the present use of standardized psychometric testing of learners[7], which is not only lengthy and tedious, but also expensive[35]. It is emphasized that initial evaluations of learners should rather be conducted in the form of screen assessments[24].

The screen assessments should be norm-referenced[5,22] and/or criterion-referenced[7]. They should also be designed so that they can be administered by those concerned with intervention for barriers to learning, namely teachers and therapists in the allied health professions, including OTs[16,24]. Along with other professions, OTs have been challenged to develop screening procedures that can be applied to the South African context, and are easily accessible to all learners[35]. This is to support the implementation of inclusive education according to the Education White Paper 6[16] and the related policies[7,24].

The Occupational Therapy Association of South Africa has developed guidelines concerning screening in mainstream schools, and these include principles such as the avoidance of lengthy standardized testing during screening, the screening of only those learners for whom there is concern, and ethics of referring for further investigation if required[36]. Additional guidelines state that screen assessments should be user-friendly with a short administration time[5,37,38]. The validity, reliability, sensitivity and specificity of the screen assessment need to be ensured, in order to determine that the screen assessment evaluates what it is designed to detect[22,37,38], and that it differentiates between learners with and without barriers to learning[5,22,35,37].

1.2 Statement of the problem

In 2009, the West Rand Occupational Therapists in Private Practice in Gauteng, South Africa (hereon referred to as the West Rand OTs), undertook to develop a screen assessment of client factors, motor and praxis performance skills, and sensory-perceptual performance skills for Grade 0 leaners that could be administered and applied in the South African context. This screen assessment is called the Quick Screening Procedure for Referral to Occupational Therapy[2], hereon referred to as the QSPOT.

In an initial pilot study in 2009, the content validity and some aspects of construct validity for the QSPOT[2] was determined on a sample of 118 randomly-selected learners between the ages of 5 years 0 months and 5 years 11 months using the Rasch Analysis[39]. The results of the analysis showed, as expected, that a large majority of the learners scored in the normal range of functioning. It suggested that the scoring used at the time adequately discriminated the difficulty of the screening tasks. The results also suggested that the QSPOT was able to discriminate between learners with barriers to learning, from those who are typically developing in terms of their learning and performance in the classroom[2].

The QSPOT was then reviewed and it underwent several changes, thus requiring further investigation for standardization purposes. The revision of the QSPOT consisted of expanding the screen assessment to include learners between the ages of 4 years 0 months and 5 years 11 months, and dividing each age into two six-month age-bands[3,39]. The cutting sample was also changed, and several observation criteria were altered or added to the scoring sheet for various tasks.

The QSPOT is therefore currently undergoing new research and psychometric analysis by the West Rand OTs. The study by the West Rand OTs is currently focusing on determining the reference values or cut-off points for children aged between 4 years 0 months and 5 years 11 months in four six-month age-bands. They are also investigating the sensitivity and specificity of the screening against occupational therapy assessments used on the same sample, as well as the validity and reliability of the QSPOT. Inter-rater reliability of the instrument is also being considered[39]. This research report contributes to the bigger study in determining the psychometric properties, namely sensitivity and specificity, and concurrent criterion validity of the QSPOT in its current form at the time of the research study for 5 year old learners only.

1.3 Purpose of the Study

Since the QSPOT is a screening instrument, it was essential to determine if the QSPOT could discriminate and identify learners with intrinsic barriers to learning related to motor and praxis, and sensory-perceptual dysfunction. The accuracy of the test, by determining the sensitivity and specificity of the QSPOT, was established in order to determine its use in distinguishing 5 year old learners with barriers to learning, from those without barriers to learning.

In order to ensure that the constructs assessed by the QSPOT are similar to those assessed by other reference standard tests used to identify motor and praxis, and sensory-perceptual dysfunction in young children, the concurrent criterion validity of the QSPOT in relation to the other tests was determined.

1.4 Research Questions

How accurate is the QSPOT in identifying learners with barriers to learning, and what is the concurrent criterion validity of the QSPOT when compared to other standardized assessments that assess similar constructs in motor and praxis, and sensory-perceptual performance skills?

1.5 Aims of the Study

The aims of this study were to establish the sensitivity and specificity of the QSPOT, and to determine the concurrent criterion validity of the QSPOT by comparing it to other recognized standardized assessments.

1.5.1 Objectives of the Study

The objectives of the study are as follows:

- To determine the specificity and sensitivity of the QSPOT on a sample of 5 year old learners with and without intrinsic barriers to learning;
- To determine the specificity and sensitivity of the Movement Assessment Battery for Children – 2^{nd} Edition (MABC-2) and the Beery-Buktenica Developmental Test of Visual-Motor Integration, 6^{th} Edition (DTVMI-VMI/VP) on the same sample of 5 year old learners as reference standards in identifying client factors, as well as motor and praxis, and sensory-perceptual performance skills;
- To determine the concurrent criterion validity of the QSPOT compared to the MABC-2 and the DTVMI-VMI/VP in assessing similar constructs in motor and praxis, and sensory-perceptual performance skills in 5 year old learners;
- To determine the cut-offs at -1.00 SD or the 16^{th} percentile for Age-band 1 and Age-band 2 learners in the activity items of the QSPOT.

1.6 Justification of the study

Screen assessments such as the QSPOT, should be used to identify learners with internal barriers to learning[5,24,33,36]. These assessments should identify learners who perform poorly, as well as those who are at risk of dysfunction. They should also determine whether a more comprehensive evaluation is warranted, and what type of evaluation is required, which should result in appropriate referral to various service providers[5,22,24,36–38]. Therefore, the use of screen assessments like the QSPOT, will ensure that expensive in-depth assessment is only conducted on those learners who have been identified with particular internal barriers to learning, and that the most applicable in-depth assessments are carried out by the appropriate service providers[16,24,36]. This would allow greater numbers of learners with possible barriers to learning to be identified, resulting in a greater likelihood of them being referred for appropriate assessment, and any necessary therapies in order for their barriers to learning to be addressed[7,16,24].

Occupational therapists must investigate the psychometric properties of the assessments that they develop and use, and must therefore have sufficient understanding of psychometric properties in order to do so[11,14,15]. Psychometric evaluation of screen assessments such as the QSPOT are necessary, not only to investigate the effectiveness of the instrument, but also to ensure that the OTs using the QSPOT utilize and interpret the results of the QSPOT appropriately[11].

CHAPTER 2: LITERATURE REVIEW

This review of the literature presents an overview of barriers to learning, the distinctions between intrinsic and extrinsic barriers to learning, as well as the Screening, Identification, Assessment and Support Strategy, that was developed by the South African DoE in order to identify learners with barriers to learning. Client factors and performance skills assessed by OTs relating to intrinsic barriers to learning and the QSPOT will be considered. A review of the intrinsic barriers to learning commonly encountered within the South African school system, emphasizing the associated effects on the client factors and performance skills, will be presented. Research on the assessment of performance skills, and the methods and instruments used to screen and assess intrinsic barriers to learning will follow. The psychometric properties that are required to ensure that these screening and assessment tools are valid and reliable will conclude the literature review.

2.1 Barriers to learning

Barriers to learning affect the learners' engagement in learning activities, and also affect their ability to derive benefit from educational activities[7,16]. As a result, they can have serious consequences in terms of school progress and success, if the learner's educational support needs are not met. The South African DoE has taken a holistic view to education, recognizing that factors within and outside of the learner (intrinsic and extrinsic respectively) interact to affect a learner's educational performance[7,8,16]. As such, a multi-disciplinary approach between various levels of government, as well as educational and health professions, is necessary for both intrinsic and extrinsic barriers to learning to be addressed optimally[7,16,24].

2.1.1 Intrinsic barriers to learning

The White Paper 6[16] and the related inclusive education policies[7,24] published by the South African DoE call for a change in the previous perception that disabilities are deficits that exist only within the learner. Today, intrinsic barriers to learning are not defined as they were in the special education theory that formed part of the previous South African education system. Instead, *intrinsic* barriers distinguish the impairments or disabilities occurring within a learner, from any co-occurring *extrinsic* barriers or hindrances to learning outside of the learner[7,16].

In the 2001 to 2011 Situation Analysis of Children with Disabilities (South Africa)[40], it was acknowledged that South Africa does not have a measuring tool with which to accurately measure the population of children with disabilities in the country. The development of such a measuring tool is hindered by the frequent change in learners' function and dysfunction[40], due to the continuous development that occurs in childhood[22,41].

According to the World Health Organisation, between 2.2 % and 2.6 % of learners in school can be identified as having intrinsic barriers to learning in the form of client factor and performance skill deficits that result in disabilities or impairments. In 2001, it was projected that if one were to apply this statistic to the South African context, there could be approximately 400,000 learners with varying levels of intrinsic barriers to learning[16]. In 2011, it was determined that the figure for learners with disabilities could be as high as 474,000, without also considering those learners with mild and moderate disabilities. Furthermore, the estimate for children with disabilities under 17 years at the time, ranged between 1.4 % and 11.2 % of the total population in South Africa. However, based on the questions in the survey used for data collection, it is likely that the upper 11.2 % included children with severe, as well as mild and moderate disabilities[40].

Occupational therapists understand how these disabilities may result in difficulties in daily education, as well as in self-care and play activities[19,27]. These disabilities can affect normal development in the physical and mental performance components of a learner in varying combinations[19,26,29]. Disabilities also affect the learner's "lived body"(p. 83)[19] experience, which then negatively affects the learner's motivation to attempt new tasks or to learn new skills[19]. The OT therefore assesses and treats numerous aspects related to various disorders, conditions, impairments and resulting disabilities within the learner, which may present an intrinsic barrier to learning in the preschool and school settings[9,26,27,29].

The policies agree that various types of intrinsic barriers to learning require differing levels of support[6,7,16,24], and recognize that some barriers may be permanent, thus requiring long-term intervention, while other intrinsic barriers only require intervention for a specified time[7,8,16]. Occupational therapy intervention is concerned with providing direct therapeutic intervention to improve the learner's abilities in the specific areas of weakness[9,27,42,43], as well as indirect intervention through the provision of assistive devices to the learner[26,27,43] and/or strategies to the teacher which aim to facilitate the learner's progress[26,27,42,43]. Additional types of intervention may also be necessary in the case of some learners who are affected by undesirable external factors that exacerbate the intrinsic barrier to learning, and that further hinder educational performance[6–8,16,24].

2.1.2 Extrinsic barriers to learning

When assessing intrinsic barriers to learning, the OT looks at the learner's occupational performance of educational activities within the classroom and the playground[26,27,33,42,43]. The OT evaluates the relationship between the learner's capabilities, the demands of the activities expected of the learner, the objects involved in those activities, and the environments or spaces in which the task is performed[9,26,27]. If the intrinsic barrier is not supported by the external environment, then the external environment can become an extrinsic barrier[6,7,16], and the OT may suggest changing the learner's environment or the activity in some way that can facilitate educational performance[26,27,42,43].

Low socio-economic status has multiple effects on learning that tend to affect the school, home and community environments in which learners participate and function[44,45]. A household may have insufficient finances for basic needs[24], let alone for school transport[8] and health and therapy services[46] which amplify existing intrinsic barriers[7,16]. Low parental education[44] and a lack of exposure to early learning activities that would have mitigated the effects of low parental education[47], result in learners being more vulnerable to developing intrinsic barriers to learning, such as hyperactivity and behavioural difficulties[44], as well as lower language, graphomotor skills and elements of cognition[47]. Grade 12 and tertiary levels of parental and maternal education has also been associated with decreasing prevalence of intrinsic barriers to learning in South Africa[40]. Low parental education could result in learners' intrinsic barriers not being recognized by their parents[40], or they may be at risk of having their existing barriers exacerbated[44]. Therefore, low socio-economic status, along with associated poor provision of education services, tend to cause devastating extrinsic barriers to learning in South Africa.

Poor provision of and access to quality education services, associated with extrinsic barriers to learning, are due to continuing discrepancies in the level of services provided to schools in lower socio-economic areas[6,8,16,46]. Limited schools and support services, that address barriers to learning[7,8,16,46], lead to long waiting lists at the available special schools[6,16]. Services that would be appropriate for a learner's needs may not be available, which leads to inappropriate services being provided[7,8,16]. In some parts of the country, there are insufficient numbers of adequately trained teachers and teacher support staff[6,16]. Limited numbers of educational facilities[8,16] also lead to over-crowding of classrooms, which further negatively impacts the degree to which learner's educational needs are met[6,8,16].

Barriers may also exist in the very educational system that is meant to benefit the learner, such as inflexibilities of the curriculum and evaluation procedures[6,7,16,24], as well as having to learn in a second or third language[6–8]. Finally, substance abuse, community and domestic violence[8], as well as discrimination based on gender, race and culture[7,8,16] can also disrupt learning activities.

The identification of intrinsic and extrinsic barriers is important for providing learners with the support that they require, in order to facilitate successful educational performance. It is important to determine whether any extrinsic factors of the learners may also have implications for their screening and assessment. Extrinsic environmental factors, including socio-economic status[48,49], as well as the space in which the screening or assessment is taking place[4,11,22,32], and even the familiarity of the assessor[4,22], can have negative effects on the results of screenings and standardized assessments. Taking all of this into account, the South African DoE developed the Screening, Identification, Assessment and Support Strategy[24], which provides guidelines to address barriers to learning in South African schools.

2.2 Overview of the Screening, Identification, Assessment and Support Strategy in South Africa

In 2008, the South African DoE published the National Strategy on Screening, Identification, Assessment and Support (SIAS) in order to provide appropriate support to the learners with barriers to learning. Their assessment of the current situation at that time indicated the lack of infrastructure and procedures whereby learners could be screened, identified, formally assessed, and referred for appropriate intervention. The explanation of the strategy's stages is dependent on the National Strategy on Screening, Identification, Assessment and Support[24] document. The SIAS process is illustrated in Figure 2.1.

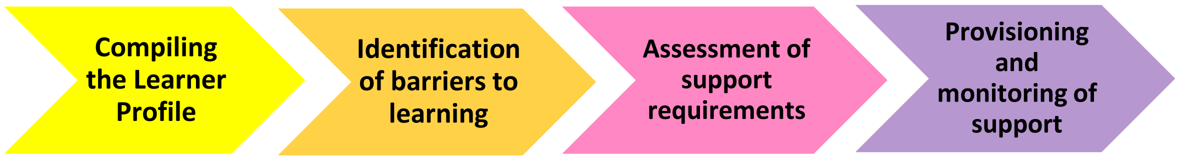


Figure 2.1 Outline of the four stages of the National Strategy on Screening, Identification, Assessment and Support (SIAS)

2.2.1 Stage 1: Compiling the Learner Profile

Stage 1 is carried out when the learner starts formal schooling, namely in Grades 0 and 1[24]. The SIAS document[24] states that only "basic"(p.12) background information is gathered when compiling the Learner Profile at this stage. The learner's personal background information and medical history, the relationships within the home, and the family perceptions of the learner's personality, capabilities and struggles are explored. A basic overview of promoting and hindering factors to learning and development, and existing support structures within the home and community environment, are discussed briefly with the family. The importance of face-to-face interviews, especially when the learner is identified as being at risk of possible barriers to learning, is also emphasized[24]. Thus, the extent of the information gathered is still quite broad.

In addition, diagnostic profiles are completed by healthcare practitioners for learners who are at risk of, or who have known intrinsic disabilities, at this stage[24]. These diagnostic profiles are not to be confused with the more in-depth assessments of Stage 3. The profiles also cannot be used alone to recommend school placement, or the levels and types of support that a learner requires, but only serves to provide more information about the learner's condition and functional limitations[24].

It is unclear as to when screening by healthcare practitioners, such as OTs, is supposed to take place within the SIAS process. Perhaps this is why Roberts[50] considered the SIAS process in terms of the stages indicated by the name of the strategy itself, namely *Screening*, *Identification*, *Assessment* and *Support*, rather than using the descriptions of the stages provided in the SIAS document. According to a diagram (p.22) in the SIAS document[24], all learners should be screened by early childhood development practitioners and health services, in order for early identification to occur and early intervention to be provided. A second diagram (p.23)[24] indicates that screening of known at risk learners should take place around the time that the Learner Profile of Stage 1 is completed for admission to Grade 0 or Grade 1. Therefore, the role of OTs in the initial determination of barriers to learning has been accommodated in the provision included in the SIAS strategy, namely for healthcare providers to be involved in the screening processes[7,16,24]. However, the DoE also suggested that screen assessments be mainly conducted using teacher-produced and teacher-completed checklists[7], and these are now part of the screening process[24].

Several criticisms regarding teachers' involvement in screening have arisen as a result of research. Insufficiencies in teacher training on the SIAS were noted at a low socio-economic school in 2011, where teachers holding existing diplomas and degrees with varying years of experience, displayed inadequate understanding of what screening and identification entailed, as well as when and how screening was to be carried out. It was suggested that improved teacher training regarding the SIAS process was needed[50]. An OT research study, conducted by Vermaas[42] at 50 schools in the Free State during 2010, found that teachers did not have sufficient knowledge of the developmental level that is expected of grade 1 learners. Difficulties in identifying a typical learner in terms of spatial concepts, drawing and naming shapes, and gross motor development were noted. Although the findings cannot be generalized to the South African population at large, it is disconcerting to note that these findings were found across the schools used in the research study[42]. The findings of these studies indicate the difficulties that teacher-produced checklists, and teacher-produced screen assessments, may have in accommodating the teachers' abilities in identifying learners who are not meeting the expectation of their age-group. Inappropriate expectations of teachers regarding development could lead to learners being identified with barriers to learning unnecessarily, or not being identified at all[42].

The continued inclusion of child development and healthcare professionals, such as OTs, in the SIAS screening and assessment process may also be indirect. For example, OTs should offer teacher training regarding the performance skills of the specific learner age-groups that teachers aim to teach[42]. In addition, OTs can be involved in the development of appropriate screen assessments[35], since research shows that child development and healthcare professionals, due to their expertise, are frequently involved in the development and evaluation of screening and assessment tools, that are used by teachers and parents[4,35,51]. In particular, OTs have been involved with the creation of reliable teacher checklists to use in identifying learners with visual-perceptual difficulties in the classroom. The information obtained from the teachers using these checklists proved to be a valuable supplement to the findings of the standardized visual perceptual tests conducted on the sample of learners attending a remedial school[35]. Occupational therapists have also been involved in the production of screenings such as the QSPOT[2,39,52], and assessments, such as the Task-Based Assessment[53], the Wall Model of Occupational Performance (WOP) for Children: Assessment Instrument[54] and the Clinical Observations of Gross Motor Items[55], that are administered by OTs.

2.2.2 Stage 2: Identification of barriers to learning and development

If learners are identified as being at risk of barriers to learning during Stage 1, more comprehensive information is gathered. Interviews with the parents or caregivers may be held once again to gather more information about the effects of any extrinsic factors in the family and home environments. The learner is assessed through curriculum assessments conducted during the school day within the natural school environment, in order to determine the suitability of the physical school environment, the curriculum, and the teaching system to the learner's needs and capabilities. This is followed by already starting to list possible interventions that can aid the learner's progress[24].

It can be deduced that the results of the screen assessments are also taken into account during Stage 2, as lists of further investigations required are compiled at this stage. The teacher also has to integrate observations of the learner in the classroom, the learner's current work, observations of the learner's previous work in his/her portfolio, and the learner's self-reports of perceived difficulties. Previous healthcare assessments and school reports, and any other written information from parents, caregivers and previous teachers, may also be taken into account in Stage 1 and/or in this stage[24]. However, insufficiencies in teacher knowledge and training could likely result in challenges in identifying learners correctly within the classroom[42,50]. Once a learner is identified as needing support for barriers to learning, the completion of the Individual Support Plan is initiated by filling in the history of support received up until the present, and the progress or lack thereof that was made[24].

Since this research study is concerned with screening learners in order to identify those who are at risk of intrinsic barriers to learning, the next two stages will only be discussed briefly.

2.2.3 Stage 3: Assessment of support requirements – Determining the level and nature of support needed

Further investigations and in-depth assessments, which were recommended by the screen assessments, are carried out in Stage 3. The assessments conducted by the relevant healthcare providers, such as OTs, provide findings and recommendations regarding the degree and types of support required. Any healthcare providers and childhood development practitioners working within public and private sectors, and non-governmental organizations, and who provide intervention for barriers to learning, may be involved[24]. Hindrances to the carrying out of the SIAS process include discrepancies in the availability and accessibility of these kinds of services in various parts of the country, as reported by the DoE[8,16,24].

2.2.4 Stage 4: Implementation of an individual support plan

During this stage, the learner support plan is finalized and implemented. The level of support is determined by taking into account the types of barriers experienced by the learner, and the types and frequency of intervention that have been recommended. Low level support (Levels 1 and 2) may include changes to teaching methods or the introduction of enabling mechanisms to the classroom environment. Moderate (Level 3) and higher levels of support (Levels 4 and 5) incorporate intervention at a greater frequency, with increasing collaboration between all stakeholders in the learner's education. Of particular importance is human support, which includes teachers, district-based support teams, parents, caregivers, and various professional sources of hands-on intervention for barriers to learning, and expert recommendations that enable the learners' improved performance[24]. Greater involvement of the parents and caregivers is also widely advocated[7,8,24,56]. Research has shown that South African teachers are passionate and innovative[57], but that some may lack sufficient skills needed to provide various types of learner support to learners with[42,50,57] and without dysfunction[42,50]. Improved training for teachers regarding normal development and dysfunction[7,42], as well as the behavioural difficulties[16,42,56] and educational support needs[6,16,50,56,57] of learners with disabilities has been advocated for locally. However, this does not only apply to South Africa, as research conducted in America has also advocated for improved training of general education teachers to enable them to manage learners with mild and severe barriers to learning[58].

In summary, health professionals, such as OTs, can and do play a valuable role within the SIAS process, where the role in screening and assessment has been advocated for learners with barriers to learning. The screen assessments used and created by OTs need to contain various client factors and performance skills to identify at risk learners with a wide range of intrinsic barriers for further assessment.

2.3 The client factors and performance skills investigated by occupational therapists

Occupational therapists assess and provide therapeutic intervention for specific client factors and performance skills which are lacking in learners with intrinsic barriers to learning. Client factors and performance skills can be assessed directly, and deficits can also be identified where dysfunction in the occupation of educational performance is noted[26,43]. Therefore, relevant client factors and performance skills pertaining to educational performance should be included in screen assessments.

2.3.1 Client factors

The term *factor* can be defined as an element that affects the overall outcome or result of something larger than itself[1]. When applied to the occupation of educational performance, the Occupational Therapy Practice Framework, 2nd Edition (OTPF II)[9] defines *client factors* as the internal and external structures, systems and functions of the body that form the basis of the learner's abilities. These include both physiological and psychological systems and functions[9,10]. They also include other personal characteristics that make up the learner as a living and feeling person, and which affect the learner's ability to perform activities and the overall occupation of educational performance[9]. Therefore, client factors are not actions, but they form the base from which the learner can carry out specific actions in order to participate in activities[10,20].

By definition, a number of client factors are required to produce a performance skill, which in turn is required for performing activities and occupations at large[9,10]. If deficits in client factors are present due to an illness, impairment or disability[9], they can negatively affect a learner's participation[10,43], resulting in intrinsic barriers to learning. The degree to which deficits in client factors impact on the learner's performance, and the limitations that the deficits pose to the activities and occupations expected of the learner, is initially determined during screening and assessment[43]. The neuro-musculoskeletal and movement-related body functions, as well as sensory and mental functions are most important for this study, and are discussed below. The following section is substantially reliant on the OTPF II[9] and related literature for definitions.

2.3.1.1 Sensory client factors

According to the OTPF II[9], sensory client factors include the specific bodily functions of registering sensory input from the body and external environment through the six senses, namely vision, tactile, proprioception, vestibular, olfaction and gustation. Integration of these sensory inputs is also a sensory client factor[9,43]. The OTPF II[9] addresses the concept of visual sensory function as being the reception of visual information from the visual fields of the eyes, and the degree of visual acuity at varying distances. The sensory client factor of hearing includes not only the ability to hear sounds, but also to locate where sounds are coming from. Tactile sensory client factors involve the learner's ability to respond and react appropriately to touch, as well as the learner's awareness of pain, pressure and temperature. Proprioceptive client factors involve the learner's awareness of his/her body position within the surrounding environment. Vestibular sensory client factors include the ability to react to and use gravity to move appropriately and comfortably[9]. In addition, modulation and processing of tactile, vestibular and proprioceptive information is important for development, and the regulation of mental client factors such as attention, concentration and learning[59,60].

2.3.1.2 Physical client factors

Neuro-musculoskeletal and movement-related body structures and functions can be considered to be physical client factors, and include joint range of motion, as well as the tone, strength[9,43] and endurance of the musculature[9]. Structures and functions for postural control and involuntary movements such as reflexes, and righting and equilibrium are also included[9]. Mechanisms for control of voluntary movement such as oculomotor control, bilateral integration, midline crossing[9], eye-hand coordination[9,43], praxis[43], and gross and fine motor control[9] are also included. Additional physical client factors include the cardiac, respiratory, vascular, metabolic and immune systems and functions, among several others[9]; however, they are not important for this study.

Physical client factors do not describe how the learner goes about the activity, but they describe the functions of the body parts and systems that are used to carry out those actions[20]. When physical client factors are used in combination, the various body structures and functions allow the learner to produce performance skills which in turn enable participation in activities[9,10], such as those performed in the classroom. They may also require additional client factors, such as the addition of sensory and mental client factors[26].

2.3.1.3 Mental client factors

Mental client factors include all the cognitive processes that a learner requires in order to attend to, remember, process, learn and think during educational activities. Cognitive abilities also include concept formation, judgment and insight. Within the framework of mental client factors, emotional client factors include coping skills and the ability to regulate behaviour[9]. Body image, self-concept and self-esteem are also considered to be mental client factors[9,10]. Conditions and impairments that result in intrinsic barriers to learning have a direct negative effect on mental client factors[9], such as the learner's subjective experience and cognitive perception of their own bodies, minds and the world[19]. The development of mental and physical client factors are also linked, and when impairments in physical and mental client factors occur together, they result in severe effects to functioning and development[61].

The ability to discriminate the quality and meaning of the different types of sensory input mentioned earlier falls within the boundaries of perceptual client factors, which are categorized as mental client factors within the OTPF II[9,10]. The ability to process multiple types of sensory information, and interpret their meaning simultaneously, is also considered to be a perceptual mental client factor[9]. Visual-cognitive skills or perceptual client factors include visual aspects of attention, memory, visual processing[62] as well as visual-spatial perception[9,62]. They also include perceptions of time and environmental space[9]. Tactile, vestibular and proprioceptive sensory discrimination together are important for physical client factors such as coordination and praxis, which form the motor and perceptual performance skills needed to perform daily educational tasks such as writing[59,60].

2.3.2 Performance skills

A *skill* is a proficiency or capability when referring to things that one knows how to do[1]. Client factors are used in varying combinations to provide the base for performance skills[9]. The OTPF II[9] defines performance skills as the abilities that learners show they have when participating in and executing activities. They are chains of small individual actions that can usually be observed, and that are used in combination to perform activities[9,20]. As a child develops, they expand their repertoire of performance skills that can be used in goal-directed activities[9,41]. Therefore, the execution and completion of a task, such as a school-related activity, would require the achievement and use of many different performance skills[9,20,42]. Various types of performance skills include motor and praxis skills, sensory-perceptual skills, emotional regulation skills, cognitive skills, and communication and social skills[9]; however, this study is only concerned with the first two categories.

2.3.2.1 Sensory-perceptual performance skills

According to the OTPF II, *sensory-perceptual performance skills* are defined as:

"Actions or behaviors a (learner) *uses to locate, identify, and respond to sensations and to select, interpret, associate, organize, and remember sensory events based on discriminating experiences through a variety of sensations that include visual, auditory, proprioceptive, tactile, olfactory, gustatory, and vestibular" (p640).*[9]

Visual sensory-perceptual performance skills would comprise various combinations of visual sensory client factors, such as sensory discrimination, and mental client factors such as spatial perceptual and spatio-temporal perception[9]. Visual sensory-perceptual performance skills include examples such as locating a particular colouring pencil from a surrounding clutter, or being able to move on to the next line when necessary while reading[60,62]. The roles of visual reception client factors, and visual perceptual client factors and performance skills, are important for sensory perception when completing a wide range of daily activities[59,60,62].

The ability to locate objects using only touch sensation (stereognosis) is considered to be a performance skill[9]. Client factors of tactile and proprioceptive sensory awareness and perceptual discrimination[9] before a motor act is produced (feedforward), as well as after or as the movement is produced (feedback), are important for anticipatory postural control mechanisms[63]. Client factors of vestibular and proprioceptive discrimination in turn are important for projected movement action sequencing[59], and are discussed later under motor and praxis performance skills.

School-related tasks require various types of sensory-perceptual performance skills[42,62] and visual-motor performance skills[42,62,64], and not only the motor and praxis performance skill components[42,62]. For example, when copying from the board, the learner would use sensory perceptual and motor performance skills in order to sit upright at the table[59,65]. He/she would simultaneously use visual sensory-perceptual performance skills to look at the board and keep his/her place while forming the letters on the page, which requires both sensory-perceptual and motor and praxis performance skills[60,62]. The formation of the letters would require motor and praxis performance skills, as well as visual sensory-perceptual performance skills[59,62,65].

2.3.2.2 Motor and praxis performance skills

There is an overlap in terminology with regard to motor and praxis performance skills. In addition, there is also an overlap with sensory-perceptual performance skills, as sensory discrimination is important for movement[41,59,60].

Motor performance skills

According to the OTPF II[9], *motor performance skills* include the individual movement components that are combined to perform a movement action within the environment, while interacting with or using objects during an activity. They also include the processes of planning and putting the aspects of the movement together in order to execute both familiar and unfamiliar movements. Therefore, there is an overlap in the meaning of the terms of *motor* and *praxis,* as both require planning[9].

The motor performance skill would not be the skill of drawing with a pencil, but rather the skills of having to reach for the pencil and the page, stabilize the page with one hand and grip the pencil with the other, and then press the pencil to the paper, and move and lift it when necessary[20,42]. Therefore, *motor performance skills* according to the OTPF II[9], and *motor skills* according to Fisher[20], are sometimes seen as being synonymous when taking their respective reported definitions into account. For example, the term *motor skill* may be used to refer to the movement components such as reaching and gripping[20].

Client factors and performance skills relating to movement are categorized differently according to various resources. For example, when investigating the teachers' knowledge of Grade 1 performance skills, Vermaas[42] considered posture and midline crossing (which are client factors[9,43]) to be performance skills, and related them to the manners in which learners positioned themselves in relation to the desk and task within the classroom[42]. Therefore, client factors have been referred to as performance skills when relating them to function.

Both gross and fine motor skills require sensory-perceptual performance skills, and thus they can also be referred to as sensorimotor skills[41] or perceptual-motor skills[28,66]. However, motor skills also refer to what the child does. For example, the classification of gross motor skills has included the fundamentally important skills of sitting, crawling, and walking which tend to be attained in a developmental sequence, and are said to be followed by and include the acquisition of additional gross motor skills, such as running, jumping and ball skills[41]. However, the term *fundamental motor skills* is used to describe two types of motor skills from which all other gross motor sports and games develop. These include *locomotor skills* which are concerned with movement of the whole body (such as hopping and running), and *object control skills* which involve using the hands and feet to interact with an object (such as catching and kicking a ball)[67,68]. However, these types of motor outputs are also referred to as *tasks* in the literature, specifically when they are goal-directed and purposeful, such as running and kicking a ball in a game of soccer[69].

Fine motor skills include aspects such as grasping and releasing, as well as the movement of objects within the hand using the fingers, all of which are referred to as *manipulation*[20,41,70] or *in-hand manipulation*[41], or as motor and praxis performance skills[9]. The MABC-2[4] groups its fine motor skill activities under the term *manual dexterity*. However, fine motor skills can also refer to actual activities, such as cutting[41,53,70,71] and threading beads[41,53], while these can also be referred to as *tasks*[4,25,59,69]. Furthermore, the terms *motor skill* and *motor task* are also sometimes used synonymously in occupational performance activities. For example, the motor task of tying shoelaces[53] is also included in lists of fine motor skills that are acquired by children in the literature[4,70], as well as within research[42,53]. Therefore, the terms *motor skill* and *motor task* are sometimes used synonymously in both gross and fine motor skills. These concepts have also been used synonymously in the development and/or evaluation of motor skill checklists and screen assessments in order to aid the early identification of learners with motor coordination difficulties[4,53].

In the frame of reference for Motor Skill Acquisition[69], a task or activity is the product of various subsystems, which are used simultaneously to produce a sequence of movement actions which combine to form a particular task. Within the same frame of reference, a learner is said to have a *skill*, if he/she is able to perform the movement task consistently well with the least amount of effort. This definition of *skill* versus *task* accepts that the *task* could refer to drawing a picture of a person on paper[69]. However, the motor *skill* would include being able to grasp and use the pencil effectively while supporting the paper in order to draw an age-appropriate picture timeously, while using an efficient amount of mental and physical effort[20]. In addition, the acts of stabilizing and gripping, which are seen as the products of subsystems in the Motor Acquisition frame of reference[69], can be likened to the combinations of client factors acting together, which ultimately form the base from which performance skills emerge[9,20].

While it was sometimes unclear as to which motor skill theoretical concepts were being used in various literature, it was noted that *motor skills*[41,51,72] and *motor and praxis performance skills*[9] were considered to be part of an overall type of occupation or movement activity. This definition accepts that jumping and hopping can be considered as the motor skills that are used in a hop-scotch activity, which is part of the occupation of play[41], as well as part of physical education within educational performance. Therefore, although there are subtle differences in the way that these concepts are described in the literature, there does not seem to be a significant difference in the use of terminology.

Praxis performance skills

According to the OTPF II[9], *praxis skills* include the ability to carry out an unfamiliar activity, while using movement actions, as well as visual, spatial-perceptual and sequencing abilities within a set period of time in an organized and fluid manner, and by following demonstrations or verbal instructions. The term *praxis* thus refers to the physical movement action itself, as well as the formation of the idea of movement, the planning and execution of the movement, and any corrections to the movement that are required during the movement sequence. Praxis also involves a learner's knowledge about the functions of objects, and the various ways in which they can be used and interacted with[60,73]. The OTPF II[9] refers to praxis as a *performance skill*, while praxis can also be referred to as a *client factor*[43].

As movement cannot be separated from the required sensory feedforward and feedback information during movement[59,60,63,73], the literature often refers to motor skills as *sensorimotor* skills[41,72], or *perceptual-motor skills*[28,66]. The term *sensorimotor* merely takes into account that motor skills require adequate function of sensory client factors and discrimination of sensory input, as well as physical and mental client factors, and motor and praxis performance skills. Anticipatory postural control, such as leaning and reaching for a pencil, the combination of which could be considered a motor and praxis performance skill[9], also requires a combination of sensory-perceptual performance skills[63]. Projected movement action sequencing also requires a combination of sensory-perceptual performance skills, and motor and praxis performance skills in order to interact with a moving object, or to react to changes in the environment[59,60]. However, the actual activities that involve the use of projected action sequences, such as star-jumps, jumping over moving obstacles, and catching a ball bouncing off of the floor[74], can still be referred to as motor skills or tasks when considering the categorizations of gross motor movements in the literature that were discussed previously. Overall, all motor skills require sensory-perceptual, as well as motor and praxis performance skills regardless of the terminology used.

2.4 The intrinsic barriers to learning commonly encountered in the South African school system and the associated client factors and performance skills

Various conditions and disorders, such as those associated with intrinsic barriers to learning, cause deficits in physical, sensory and mental client factors, as well as in various performance skills, such as sensory-perceptual, and motor and praxis performance skills[9]. The following section will review the most common types of intrinsic barriers to learning that are encountered within the South African school system, in order of prevalence according to the 2001 to 2011 Situation Analysis of Children with Disabilities (South Africa)[40], as well as the client factors and performance skills that are affected. The percentages outlined below are based on the count of severe disabilities only, and therefore, the total prevalence of disabilities is likely higher if taking into account milder degrees of disability in each category[40].

2.4.1 Visual and auditory sensory disabilities

According to the 2001 to 2011 Situation Analysis[40], visual impairments make up 23.0 %, of learners with severe disabilities, and make up 0.6 % of the total population of learners in South Africa. Hearing impairments make up 21.2 % of learners with severe disabilities, and 0.5 % of the total population of learners in South Africa[40]. Visual and auditory client factors, as well as the visual and auditory sensory-perceptual performance skills are negatively affected, causing intrinsic barriers to learning[75]. Attending centres for learning that do not cater for these types of intrinsic barriers, amplify the difficulties experienced[8]. Vision and hearing screenings identify children with these deficits if conducted at a young age[76]. Developmental screening of vision and hearing by healthcare services occurs through the use of the Road to Health Booklet, and the DoE also aims to roll out visual and hearing screenings as part of the SIAS process across South Africa in order to identify learners at school-age[40]. Furthermore, an OT screen assessment may also aid in identifying these learners for needs of further assessment, such as the visually impaired learner who also presents with deficits in postural control and motor skills[75] during the tasks.

2.4.2 Intellectual disabilities

Intellectual disabilities make up 15.7 % of the population of learners with severe disabilities, and 0.4 % of the total population of learners in South Africa[40]. These disorders are related to lower intelligence quotients[29,76,77]. The associated deficits in mental client factors of learning[29,77], reasoning and problem solving[77] result in varying degrees and combinations of intellectual, cognitive and behavioural dysfunction[76,77]. Sensory discrimination and sensory processing (mental perceptual client factors[9]) have not been found to be barriers in children with mild intellectual disabilities[78]. However, lower fine motor performance[78,79] and gross motor performance[79] (particularly in object control skills[79,80] and other skilled gross motor activities[78]) are still associated with various degrees of intellectual disabilities.

Learners with varying degrees of mental retardation have significant difficulties in progressing through the early primary school grades, due to difficulties in mental client factors and the performance skills of learning, and retaining the knowledge and concepts taught in school[29]. Therefore, it becomes clear that these deficits result in severe barriers to learning[29,77], and also negatively affect adaptive occupational performance in play[29] and self-care[29,76,77,79].

Intellectual disabilities are usually first identified at an early age via screening, but are only confirmed at school-age through intelligence testing[29,77]. There have been numerous research studies which have investigated or considered the use of existing standardized assessments in identifying learners with intellectual disabilities[31,79,81]. The use of screening procedures has already become more common in the early identification of possible intellectual disabilities before school-going age, which allows support structures to be put in place timeously[81].

Autism Spectrum Disorders (ASD)[77], previously known as Pervasive Development Disorders (PDD)[82], are categorized as psychiatric disorders. Higher functioning forms of Autism are characterized by a better functional prognosis, including a higher IQ, and better social and communication skills[29,77,82]. However, ASD was included under the heading of intellectual disabilities in this literature review due to the significant dysfunction that the disorders can cause, and as a result of the frequent co-occurrence of intellectual disabilities[29,77,82] in up to 80 % of cases[82]. These disorders are characterized by varying degrees of impairments in socialization, communication and behaviour[29,77,82]. When considering the 2001 to 2011 Situation Analysis[40], South African parents may have included children with ASD within the 5.1 % of children with disabilities in communication, and/or within the 9.8 % of children with emotional and behavioural difficulties. The prevalence of ASDs in the United States and in other countries is reported as being approximately 1 % of the population when considering either adult, child or general samples[77].

Autism Spectrum Disorders result in varying deficits in planning and organization, adaptability, language and communication, as well as sensory processing difficulties. All of these cause varying degrees of barriers to learning[29,77] regardless of intelligence level[77], and educational support is generally required[29,77]. Poor awareness of sensory input, and/or poor ability to filter out excess sensory input[29,72,77], combined with deficits in motor and praxis performance skills, particularly in gross motor skills[72], are reported in the literature. These deficits result in learners with ASD having difficulties in attending to and participating in goal-directed activities[72,77], and they relate to very poor performance in self-care[72] and play[29,77] overall. Sensory processing difficulties can also result in significant problems in dealing with changes in routine and activities[29,77], such as those that occur throughout the school day.

Screening before the age of 2 years is recommended[82], and language delay is a good indicator of ASD[77]. However, learners with and without ASD are not always identified appropriately and timeously at this young age, as the presentation of young children between the age of 2 and 4 years is still developing[23]. Therefore, some children with ASD may only be identified later[77].

There has been a wide range of research regarding the profile of dysfunction in different combinations of client factors, performance skills, and occupational performance in learners with varying degrees of intellectual disabilities[78–80] and ASD[23,72], which should help to improve the identification process of these intrinsic barriers. Research has also shown that the assessment of gross and fine motor skills in children with these conditions can provide valuable information regarding daily function[72,79]. In particular, Volman *et al*[79] found that the assessment of gross and fine motor skills in children with intellectual disabilities may be more valuable than the assessment of performance mental abilities (namely planning, visual-spatial skills and constructional abilities) in predicting levels of function in self-care, social skills and mobility. Therefore, research seems to advocate for the inclusion of sensory-perceptual client factors and performance skills, as well as motor and praxis client factors and performance skills, in screen assessments used to identify learners with intellectual barriers to learning.

2.4.3 Physical disabilities

The 2001 to 2011 Situation Analysis[40] found that physical disabilities make up 14.9 % of the learners with severe disabilities, and 0.4 % of the total population of learners in South Africa. Physical disabilities may include traumatic brain injuries, cerebral palsy, spina bifida, congenital bone or musculoskeletal defects, and muscular dystrophies to name a few. These disorders tend to affect the neuro-musculoskeletal and movement-related client factors of the learner[29], which ultimately result in impaired motor and praxis performance skills, among others[9]. They result in a variety of dysfunction, ranging from hindrances to accessing the classroom or playground equipment, to impairments in the ability to use tools and materials for scholastic tasks, such as pencils and mathematical equipment. Self-care activities such as eating, drinking, basic hygiene, toileting and dressing, that also form part of daily life at school, may be negatively affected[26].

Alertness, concentration, motivation, physical endurance and levels of participation may be negatively affected by cardiac and respiratory disorders[29]. Alertness, concentration and behaviour may be negatively affected by thyroid dysfunction[83]. Occupational therapists would refer the learner for the appropriate medical investigations if they are suspected during screening. Overall, physical conditions are usually identified at an early age or at the age of onset, as their effects can be more noticeable[29], and thus parents and teachers may already be aware of them by the time the learner starts formal schooling.

2.4.4 Mild disabilities

Emotional, behavioural and psychological barriers to learning constitute 9.8 % of the disabilities in the South African population of severely disabled learners; however, the learners with milder disabilities were not included. This category of disability constitutes 0.2 % of the total population of learners[40].

In research, the term *mild disabilities* is attributed to learners who have difficulties in a narrower range of function. Learners with mild disabilities are generally not identified as easily as those learners with more evident physical and intellectual disabilities[25,58], and therefore, the learners may not receive the required support in the classroom[58]. Munkholm & Fisher[25] found a difference in the level of motor and process performance skills of learners with mild disabilities, when compared to age-matched typically performing learners. They also projected that learners with mild disabilities (but with greater difficulties) would perform worse on both motor and process performance skills, compared to the learners in their sample who may have had milder difficulties.

Identification of learners with mild disabilities, namely Attention Deficit Disorders[25,58], Developmental Coordination Disorder (DCD), disorders of sensory integration[25], some behavioural disorders[58], and general learning disabilities[25,58], would require the use of valid and reliable screen assessments that can discriminate the above signs of these disorders. Differences in levels of performance related to varying degrees of specific mild disabilities, compared to that of typical learners, should also be investigated[25] and taken into account during the development of such screening procedures.

2.4.4.1 Attention Deficit Disorders

Attention Deficit Disorders are characterized by varying combinations of hyperactivity, impulsivity and difficulties in organizing, paying attention to, and persevering with tasks, as well as avoidance of activities that inherently demand sustained periods of attention. It is widely reported that attention deficits cause intrinsic barriers to learning, as well as negative effects to other areas of occupational performance[29,77]. This disorder is often identified during primary school years[77], and is often associated with learning disabilities[77,83–85]. Learners with ADHD without hyperactivity are not as easily recognized[77].

Razza *et al*[86] showed that learners from a low socioeconomic background with better concentration at 5 years of age, performed better in persevering with learning tasks, following classroom routines, reading and mathematics at the age of 9 years. Meyer & Sagvolden[87] showed that South African children with various presentation types of ADHD have difficulties in fine motor performance when compared to typical children, especially in younger children aged between 6 and 9 years. The same study also showed that a timed activity involving fine motor coordination and spatial orientation, and a non-timed activity demanding fine motor accuracy and the ability to plan ahead, both highlighted fine motor skill dysfunction in children with ADHD[87]. Therefore, screen assessments should at least contain opportunities to record observations regarding a learner's level of concentration during the test, while activities that demand motor accuracy with an aspect of speed would also be beneficial.

2.4.4.2 Developmental Coordination Disorder

Developmental Coordination Disorder (DCD) is associated with a wide range of effects on motor skills[88–91], behavioural and emotional responses[77,88], self-esteem[77,88] and social interaction[88]. Difficulties in the client factors and performance skills that are associated with attention[77], proprioceptive and tactile processing[92], postural control[92], motor planning[77,92], gross and fine motor skills[77,89,90,92], as well as deficits in visual perceptual and visual-motor performance skills are noted[89,90]. These deficits appear in varying combinations forming subtypes which have been investigated in several research studies[89–91], although no definite subtypes have been agreed upon[89]. Macnab *et al*[89] confirmed several subtypes of DCD: (1) greater fine motor impairment, but with adequate balance which limits the gross motor impairment; (2) adequate visual-motor integration (VMI) (copying of shapes) with definite motor skill impairment particularly in gross motor skills; (3) general deficits in all areas of gross and fine motor skills as well as visual perceptual and visual-motor development (also termed "Mix dyspraxia" (p.624)[90]); (4) Visual perceptual and VMI deficits associated only with fine motor skill deficits (also referred to as "Visual spatial and visual constructional dyspraxia" (p.624)[90]); and (5) perceptual strengths with poor gross motor performance in running and agility with some added fine motor skill impairment[89].

In a longitudinal research study by Stephenson & Chesson[88], parents reported that their children with DCD had difficulties such as clumsiness, clowning behaviour, tendencies to be bullied, as well as tendencies to avoid or refuse to participate in activities, and difficulties in coping. The same study showed that the effects of DCD tend to continue, resulting in difficulties in handwriting, spelling and mathematics as the learner progresses through the grades. Learners with DCD also continue to experience dysfunction in self-care and play due to gross and fine motor coordination difficulties[77,88]. Slowness of movement in the completion of all the activities associated with occupational performance is also reported[77]. Decreased motivation and reluctance to participate in complex or challenging movement activities due to a perception of poor motor skills[88,93], may also result in declines in muscular strength and physical fitness over time[77,93].

Although the onset is at a young age, DCD is difficult to diagnose before the age of 5 years due to the wide variation of what is considered to be normal development[77]. Research by Rodger *et al*[92] showed that qualitative and quantitative aspects of motor performance are important in identifying children who are at risk of DCD, and recommended the use of test activity items that require sustained motor performance. Since timed and untimed motor accuracy activities were found to be useful in the identification of fine motor difficulties in children with ADHD[87], they may also prove useful in identifying learners who are at risk of DCD, due to the fact that DCD is frequently associated with ADHD[77,87]. Due to the impact that motor coordination deficits can have on self-care[88,92], screen assessments should contain a self-care activity requiring fine motor skills, such as fastening buttons or tying shoelaces[33,53].

2.4.4.3 Disorders of sensory processing

Disorders of sensory processing are characterized by deficits in a variety of client factors related to sensory processing, motor performance, and mental client factors such as attention and perception[59,60]. However, deficits are not due to the dysfunction of sensory receptors[59]. Deficits in sensory processing impact the learner's ability to interact appropriately with objects, and respond appropriately to the environment, which ultimately affects activity participation and occupational performance[59,60]. A learner may refuse to participate in certain activities based on the sensory properties of the movement, objects, materials and/or the environment involved[59,60], and thus they may also be at risk of poor gross and fine motor skills[59]. Some learners have unpredictable behaviour, where an over-active learner may constantly get up out of his seat and disrupt his learning, and that of his classmates, but may not respond to instructions or school bells[59]. The learner who does not respond to sounds or touch may still be overlooked because they are otherwise very well-behaved[60]. Overall, they may receive frequent negative feedback from teachers and family, as they are often misunderstood to be lazy[60], rude, naughty and fussy[59].

Disorders of praxis are characterized by combinations of difficulties in planning and executing familiar and unfamiliar movement patterns, particularly gross and fine motor activities that require rhythm, timing and directional changes[59,60,73]. Dyspraxia is not due to any physical or cognitive disability, including sensory deprivation[59]. It is noted to be similar to DCD, but requires the presence of sensory-perceptual client factor and performance skill deficits, in addition to the motor and praxis performance skill deficits[73]. Bilateral Integration and Sequencing Disorder (BIS) is associated with deficits in the discrimination of vestibular and proprioceptive information, while Somatodyspraxia involves deficits in the discrimination of proprioceptive and tactile sensory information[59,60,73]. Somatodyspraxia causes greater sensory-perceptual and motor and praxis performance skill deficits than BIS[59,73], as well as significant clumsiness[59,60], impulsiveness[60], and difficulties in organizing and performing tasks, that normal developing children learn and do easily[59,60]. Although the standardized test used to diagnose these disorders is an American test, research by van Jaarsveld[94] found these patterns in a South African group of children. However, another research study by van Jaarsveld *et al*[95] found that South African children performed better than the American counterparts in aspects relating to balance, motor coordination and praxis.

Overall, the presentation of these learners varies significantly among children, and the learners can be very difficult to identify and diagnose. However, observations of a learner's performance in activities are still useful, and these should be undertaken during the screen assessment, as well as in the classroom and on the playground[59].

2.4.4.4 Learning disabilities

Learners at risk of developing learning disabilities in the future may or may not have their difficulties recognized and assessed at an early age. Some learners grow out of their difficulties[66], while others may develop a learning disability that endures throughout their school and working careers[29,84,85]. Unfortunately, there is currently no accurate method of discriminating between them. In addition, the presence or absence of various risk factors, such as low birth weight, family history of learning difficulties, delays in reaching developmental milestones, and signs of behavioural difficulties, do not predict or negate the possibility of developing a learning disability in the future[66]. Some disorders have also been found to be associated with handedness. Steenhuis *et al*[96] showed that dyslexia and difficulties in learning to read were more likely to be found in left-handed and ambidextrous learners, when compared to true right-handed learners in a large sample of over 7,400 children. Another study by Cairney *et al*[97] found a statistically significant percentage (p=0.002) of left-handed individuals in a small sample of children who were diagnosed as being at risk for DCD. However, not all left-handed learners develop these difficulties[96,97].

Learners with learning disabilities are also difficult to recognize and identify in the classroom, as they frequently appear normal[85]. However, they present with a gap between their actual level of performance, and the potential level of performance that would otherwise be expected when taking their average to above-average intelligence scores into account[29,85]. Their narrow range of dysfunction results in varying levels of difficulties in acquiring and mastering academic skills[29,84,85]. Screening and in-depth assessment is supported in the literature[66]. Therefore, it is important that screening procedures and assessments be developed, which can discriminate the group of learners who are at risk of future long-term learning disabilities.

Several taxonomies of learning disabilities exist[29,77,84,85]. Learning disabilities are characterized by various combinations of deficits in client factors and performance skills, and are associated with specific learning disorders (SLD)[29,84,85], such as the comprehensive list that is described by the Learning Disabilities Association of America (LDAA)[85]. The list of SLDs produced by the LDAA[85] differs from the list produced by the National Center for Learning Disabilities (NCLD)[84] only in that the LDAA recognizes all the disorders listed below as being types of *S*LDs, and also addresses visual perceptual/visual-motor deficits separately from Non-verbal Learning Disabilities.

Non-verbal Learning Disabilities (NVLD)

Non-verbal Learning Disabilities are characterized by a significant discrepancy between verbal IQ scores and motor, visual-spatial and social performance skills, in favour of verbal function. Deficits include difficulties in fine motor skills, following multiple-step instructions, and applying learned information to other similar tasks, as well as clumsiness, poor spatial skills and poor organizational skills. The NVLDs resemble some of the mild disabilities that were described earlier, whereas conditions such as Dyspraxia and ADHD are noted to be separate from the SLDs described by the LDAA[85]. It is logical to assume that the difficulties in motor and process performance skills in school-related tasks that were experienced by learners with mild disabilities, such as attention- and movement-related disorders[25], may also apply to learners with true NVLD. Since NVLD is also associated with fine motor difficulties, these learners may have difficulties in handwriting[85], as well as in spelling and mathematics[84], which are the main avenues for school performance assessment.

Visual-perceptual/Visual-motor deficits

Visual-perceptual and visual-motor client factors and performance skills are required for efficient development and use of age-appropriate motor and praxis performance skills, such as reaching, grasping, manipulating[62,98] and balance while moving[98]. Therefore, visual-perceptual/visual-motor deficits are frequently associated with NVLDs[84,85]. Difficulties in learning to recognize and read letters may result from delayed ability to recognize, name and copy shapes[48,62]. Difficulties in visual-perceptual and visual-motor abilities also lead to difficulties in performing scholastic tasks such as spelling[62], copying, writing[62,64,85] and mathematics which affects performance evaluations negatively[64].

Daly *et al*[99] confirmed that the ability to copy the first nine forms of the DTVMI allowed greater handwriting success to be achieved by 5 year old learners with adequate VMI skills. Higher VMI performance is generally associated with the ability to copy and write letters[32,64,99], the correct spacing of words and letters while writing, and the spatial organization of math work[64]. Although research shows that learners from disadvantaged backgrounds and a lack of learning activities are at a higher risk of VMI difficulties[48,49,100], these learners would not be classified as having an SLD[77].

Additional Specific Learning Disabilities according to the LDAA

Dysgraphia is characterized by poor legibility of handwriting, where written expression[84,85], spelling and copying may also be negatively affected[85]. Dyslexia[77,84,85], Auditory Processing Disorder (APD) and Language Processing Disorder (LPD)[85] cause difficulties in reading, comprehension, spelling, and learning. Dyscalculia results in difficulties with varying combinations of mathematical skills[77,84,85]. All of these disorders are only identified or diagnosed at school-going age[85]; however, they may be preceded by motor and perceptual skill difficulties in earlier years[66].

Taking the literature into account, suggestions regarding the screening for all the above SLDs and mild disabilities include the following: Firstly, deficits in sensory-perceptual and motor and praxis performance skills are associated with NVLDs (mild disabilities) and dysgraphia (or handwriting difficulties)[85], and should therefore be included in screen assessments. The use of timed and untimed fine motor skill tasks has also been advocated in identifying motor skill difficulties. Secondly, deficits in VMI[62,64,99] and visual perceptual client factors[62,98], and the associated visual sensory-perceptual performance skills should also be included to aid in the identification of learners who are at risk for visual perceptual/visual-motor SLDs and dysgraphia (or severe handwriting difficulties). The screen assessments should also include opportunities for the teachers to contribute their observations toward the outcome of the screening results, especially in terms of visual perceptual difficulties[35].

2.5 Occupational therapy assessment of performance skills and client factors related to barriers to learning in specific learning disabilities

A substantial amount of information, regarding the kinds of motor and perceptual activities that would provide valuable opportunities to screen for the client factors and performance skills relating to intrinsic barriers, can be located in the literature and research studies.

2.5.1 Assessment of motor and praxis performance skills

The OTPF II[9] recognizes the importance of determining the type of relationship that exists between the learner's level of function, and the demands of the activity and the environment. This is imperative when describing the unique combinations of strengths and impairments that learners with barriers to learning may have[9]. The focus on the inter-relationships between the learner, task and environment is also supported by and agreed upon by the Motor Acquisition frame of reference[69], and the authors of standardized tests such as the MABC-2[4]. Therefore, the focus on the learner, task and environment should be incorporated into screening procedures designed to detect difficulties in motor and praxis performance skills.

Research has been conducted using standardized assessment tools that make provision for the assessment of gross motor skills in terms of *reflexes and stationary skills*[72,78], *locomotor skills*[80] *or locomotion skills*[72,78], as well as *object control*[80] or *object manipulation skills*[72,78]. According to the literature, *locomotor skills*[80] and *locomotion skills*[72,78,101] synonymously refer to whole-body movements used to move through the environment, such as running, jumping and hopping. *Object control skills*[80] and *object manipulation skills*[72,78,101] synonymously refer to whole-body movements undertaken to manipulate a ball while in a moving or stationary position, such as bouncing a ball rhythmically, and kicking. Although the MABC-2[4] does not use this categorization in the grouping of its tasks, it does nonetheless contain tasks that would fall within the boundaries of stationary, locomotor and object control skills. Therefore, it can be assumed that assessment tools that test a combination of different categories of whole-body movement assess the gross motor skill construct better, and this principle of movement task selection would also be beneficial in the development of screening procedures.

The terms of object control skills and object manipulation skills are not synonymous with fine motor skills. Instead, fine motor control is considered in categories such as manual dexterity[4,102], as well as in smaller components of hand preference[33], in-hand manipulation[33,41,54,70], grasping[33,54,101], tool handling or manipulation[41,54], and VMI[32,41,101]. Fine motor skills applicable to 5 year olds include threading beads, drawing and cutting[41,53,54]. The addition of self-care tasks to screenings and assessments, such as donning a shirt[53] and fastenings[33,101], is supported, as these are related to fine motor skills[53,70,72] and are practical in the school setting where screening may take place[53]. Therefore, a variety of fine motor tasks should be selected for inclusion in screening procedures to provide an overview of the types of fine motor skills that are expected of learners in a specific age-group[53].

When assessing praxis, many OTs use a combination of standardized tests of praxis, as well as clinical observations of the learner's strengths and weaknesses in the client factors and performance skills that relate to praxis. Opportunities to observe client factors of automatic midline crossing, left-right awareness and hand preference can indicate deficits in bilateral integration and praxis. Motor and praxis performance skills, such as the use of projected action sequencing, and the simultaneous and timeous movement of both sides of the body in tasks, such as star-jumps and stride-jumps, are observed. Observations of the learner's ability to anticipate the movement, start and complete the movement, and stop the movement timeously should be recorded[74]. Therefore, in order for signs of difficulties in motor and praxis performance skills to be identified in screening, a combination of locomotor skills, object control skills, and fine motor activities is essential.

The literature also highlights structural features that assessments of motor and praxis skills should have. Firstly, practice sessions should be provided to ensure optimal understanding on the part of the learner in order to gain the most accurate measurement of the learner's current performance[4,101]. Secondly, research advocates for the assessment of children in tests that provide sustained periods of movement activity, including opportunities to engage in more than one formal trial. Thirdly, tests also need to provide information regarding motor planning and bilateral integration and sequencing in order to be effective, and tests that do not do so tend to be criticized[92]. Finally, timed activities that involve motor accuracy and planning are useful in identifying fine motor skill difficulties related to movement coordination and concentration[87]. The MABC-2[4] is one such test that consists of timed and untimed gross motor and fine motor activities to identify DCD and other movement difficulties. Overall, the literature supports the inclusion of timed and untimed activities for evaluating both gross and fine motor skills.

2.5.2 Assessment of sensory-perceptual performance skills and visual perception client factors

Too many tasks in an assessment tool of short duration is criticized in research[103]. Therefore, it is highly unlikely that a desirably short screening procedure would be able to evaluate signs of dysfunction in all sensory-perceptual performance skills and visual perceptual areas. However, learners generally use a combination of these skills at any one time during tasks[62], and thus opportunities to record observations pertaining to a variety of these areas should at least aid in identifying at risk learners.

The visual nature of tasks, and the need to listen to and follow instructions, provide opportunities to observe aspects of visual processing and auditory processing. Important areas of sensory perception to include in screening procedures include vestibular, proprioceptive and tactile sensory discrimination, as dysfunction in these are associated with a variety of learning difficulties, such as gross and fine motor skill difficulties[59,60,73]. Therefore, a screen assessment should provide the learner with the opportunity to copy one or two movement patterns that require feedforward and feedback sensory discrimination, projected action sequencing, and bilateral integration and sequencing. Examples include star-jumps and interaction with a moving object[74]. When a learner engages in school-related tasks such as copying shapes or writing on a line, they are not only using motor and praxis performance skills, but visual perceptual and visual-motor skill components as well[62]. Visual-motor function is also considered in fine motor aspects of grasping and reaching, as well as in gross motor movements, and in visually controlled movement within the environment while using objects[98]. Therefore, screen assessments should allow for observations of both the motor and perceptual aspects of any tasks assessed.

Assessment of visual perception usually includes object form perception which allows a learner to initially discriminate properties of visual information being received[62], including recognition of a form regardless of colour, size or position in the environment (form constancy); recognition of incomplete objects (visual closure); and the discrimination of objects from a cluttered background (figure-ground)[34,62]. Opportunities to observe the child in sorting and classifying visual information are also important in assessing visual-cognitive functions[62], and can easily be included in screen assessments.

Visual-spatial perception includes the learner's ability to determine the spatial relationships between him/herself and another object or person (position in space), as well as the spatial relationships between objects such as letters in a word, and the orientation of objects such as letters and numbers[62]. Although difficulties in depth perception may be suspected when difficulties in catching are noted[62], topographical orientation (or wayfinding[98]) would most likely not be included in screen assessments. Constructional praxis activities that require a learner to construct something either by building or connecting pieces, or drawing a shape or picture, are used to assess fine visual-motor skills[98]. Since learners from disadvantaged backgrounds show poorer performance in VMI tests such as the DTVMI[49,100], it may not be wise to stratify normative samples strictly according to socioeconomic status when standardizing screen assessments for South African children.

Areas which have more in common with scholastic tasks, such as form perception, position in space, spatial abilities, and VMI skills[62] would be preferential in screen assessments. Therefore, a screening procedure would likely assess learners for visual sensory-perceptual performance skills effectively if it included visual-motor tasks (such as drawing a person and copying[100]), as well as a matching and sorting activity. Fine motor skill tasks, such as cutting and threading beads within the screen assessment, should include opportunities to score the visual sensory-perceptual performance skills that are involved in those fine motor skills[62]. Teacher-completed checklists[35] and mandatory observation periods of learners[33] could aid in the screening of difficulties in remaining perceptual areas.

2.6 Instruments to be used in occupational therapy to identify deficits in specific learning disabilities

The use of specific instruments, that provide reliable and valid assessments of performance skills and client factors, is one way to identify learners with dysfunction[26,33]. They include short screen assessments and lengthier in-depth assessments, both of which may be standardized[33].

2.6.1 Screen assessments

2.6.1.1 The purpose and ethical practices regarding the use of screen assessments

The primary reason for conducting a screen assessment is to determine if the learner requires further in-depth assessment or intervention[5,22,33,36,38]. In multidisciplinary settings, the findings of a number of screenings can be combined in order to determine which disciplines would provide the most appropriate forms of comprehensive assessment and intervention if necessary[33]. The inherent danger of learners being over-screened can be solved through the use of clear outlines as to which specific areas each healthcare profession will evaluate based on their specific areas of expertise[38].

Screen assessments are conducted on children in various ways around the world, namely to determine a child's developmental level during a general health examination[33,38,104], or larger numbers of learners may be screened in order to identify those who require further assessment[33]. South Africa is among other countries where learners are generally screened following a referral from the teacher[52], or as a result of parental concern that an in-depth assessment may be required[33,52].

The screening of large numbers of learners within the South African context has been requested by the DoE in the White Paper 6[16] and the inclusive education policies[7,24]. However, the OTASA Ethics Committee proposes that screen assessments should not be compulsory[52]. Therefore, if OTs are to be included in the SIAS screening process in an optimal manner, discussions of limitations of practice need to take place with the South African DoE. There is some agreement between the two bodies though. The OTASA Ethics Committee states that OTs should only screen learners who have been referred[52], while the SIAS[24] advocates for background information and documentation on the learner to be considered when referring for screening and in-depth assessment.

Even though the guidelines of the American Academy of Pediatrics (AAP)[38] on developmental screening is for the age of birth to 3 years, they are still applicable to screening for intrinsic barriers to learning. The OTASA Guidelines[36] and other literature sources were also consulted to give the following guidelines: Firstly, the process and aim of the screening should be explained as part of the consent process[36,52,104]. Secondly, the caregivers should be made aware of any fees being charged for the screen assessment as part of the consent process. Thirdly, a written report must be prepared for each learner screened, and the parents should be notified regardless of the results[36,52]. Finally, in the event of a positive identification on a screening, the importance of the learner undergoing an in-depth assessment should be conveyed to the parents[36,104], and the fact that the screening cannot confirm the dysfunction should be clarified[104]. A mandatory list of all the appropriate healthcare providers in the family's specific geographical area must be given to the family for them to choose who to consult[36,52].

2.6.1.2 Aspects to consider and procedures when creating screen assessments

The OTASA Guidelines[36] discourage the use of home-made tests, and has called for existing tools to be used, including those under current development, such as the QSPOT. Professionals need to make sure that the most up-to-date screen assessments are used[5].

The Developmental Screening Rubric[37] provides a detailed guide of the important features of screening instruments, and it is also supported by additional literature as outlined below: Firstly, the purchase cost of the screening instrument by the health professional[12,37,38], and the running cost of the instrument in use with clients is an important consideration[12,37], as financial status has been found to be a barrier to screenings being carried out[104]. Secondly, the screening instrument must be easy to use and score[37,38]. Thirdly, the tasks should be familiar to the learners[22,37], and thus should also be culturally sensitive[22,37,38]. It has also been suggested that screen assessments used by OTs should include observations and activities across the motor, social and self-help domains[33], meaning the assessments should be multi-dimensional[11,37]. Fourth, an administration time of less than 20 to a maximum of 30 minutes is considered optimal[37]. A screen assessment thus consists of only a few tasks[22].

Fifth, a screening process that provides opportunities for multiple stakeholders, such as parents and teachers, to contribute information[22,33,37,38], is considered to have an advantage[37]. The screening process should also therefore provide opportunities to assess the learner's capabilities in various areas in which barriers to learning occur[5,22,33], namely the home environment, classroom and playground[33]. In this way, information regarding the reason for the screening referral can also be obtained and taken into consideration when drawing to a conclusion[5,22,33]. Sixth, screening instruments should be designed such that they can be re-administered periodically if necessary[22,38] or as the child develops[38]. Finally, screening instruments, that have had their validity and reliability checked, are generally favoured in clinical practice[5,22,33,37,38].

Screen assessments, like any other standardized tests used by OTs, should include a manual, which has documented information about the screen assessment's psychometric properties[11,12]. The manual should also contain information regarding the administration procedures[11,37,105], specifications and limitations in which the screening tasks can be adapted if necessary, and limitations of use and the types of conclusions that can be drawn[11,37]. Information regarding the diversity of gender and culture in the normative sample, the extent to which the sample was representative of the population that the assessment is intended for, as well as how the findings could be generalized to the target population, should be included[11,37]. Information regarding the type and appropriateness of research design and statistical techniques used, and the level of blinding of the assessors during the standardization process also need to be made available[12]. Therefore, screen assessments should have sufficient information on their validity and reliability, sensitivity and specificity in order to ensure that they are appropriate evidence-based tools[5,37,38]. Therefore, screen assessments should also be standardized tests[22,33,37,38].

2.6.2 Standardization and in-depth assessment tools

Over the years, the occupational therapy profession has developed, and has made increasing use of standardized tools for the purposes of initial assessment, determining a prognosis, and monitoring progress. The use of standardized testing has allowed OTs to be able to assign numeric values to an individual's performance, which then imply meaning which aids to determine the need for further assessment or intervention[11,12]. There are two main types of standardized assessments used to assess learners with identified dysfunction, namely norm-referenced and criterion-referenced tests.

Norm-referenced tests compare the performance of learners against peers of the same age in order to determine whether or not they are performing typically for the age-group[11,105]. Advantages of using norm-referenced tests include the following: Firstly, they provide averages of performance and can identify learners with dysfunction, as well as those who are at risk for dysfunction in the future. Secondly, these tests have standardized administration procedures which can control for possible variation in the presentation of the tasks and instructions by different assessors. Thirdly, they also undergo significant amounts of standardization, such that their validity and reliability are often well-established[11].

The manner in which a norm-referenced assessment tool was standardized must be described in the test manual, so that the quality of standardization can be evaluated by clinicians wanting to select assessment tools for clinical practice. Standardization is obtained by administering the test to large groups of participants that are representative of the variety of geographical areas, socio-economic status, races, and ethnic backgrounds of the population that the assessment tool is intended for. Initial standardization of an assessment tool is performed using the normal-developing population[11,12]. Standardization of the scores involves the use of a statistician and/or statistical software to determine the averages, ranges of standard deviations (SD) and possible scoring error effects, and to ensure that specific scores indicate accurate differences between learners with and without dysfunction[11,105].

Disadvantages of norm-referenced tests include lengthy administration times, and that the content of the test is sometimes very general, and can contain tasks that do not have meaningful significance in terms of function within a specific occupational performance area[11]. The validity of the tests to other populations also needs to be established due to differences in norms between various cultures and countries[32,95,106,107].

In the case of criterion-referenced tests, learners are not compared to a normal sample. Instead, the learner is marked according to whether he/she is able to perform the specific skills or not[11,105]. Many criterion-referenced tests take on the form of a checklist, and the profile of successes and failures in meeting the criteria ultimately guides intervention decisions and planning[11]. Therefore, they provide more detailed and meaningful information, especially since the activities contained often relate to function[11,105]. Disadvantages include the possibility of inadequate standardization due to reduced statistical analysis[11].

Tests that have features of both norm-referenced and criterion-referenced tests likely contain the best of both types of tests. They provide the benefits of quality observations of performance in meaningful, functional, or developmental milestone-related tasks. They also have the validity, reliability, sensitivity and specificity of norm-referenced tests that indicate whether learners are performing appropriately relative to their age-group[11].

The two standardized tests used in this research study are:

2.6.2.1 The Movement Assessment Battery for Children – 2nd Edition (MABC-2)

The MABC-2[4] is a standardized norm-referenced test that was developed for purposes of: (1) identification of learners who are at risk of movement dysfunction or who have existing movement dysfunction; (2) planning of intervention; and (3) reassessment of learners in order to evaluate the effectiveness of therapy programmes carried out. It has also been widely used in research studies conducted internationally[31,106,108–110] and locally[111]. The test consists of the movement test, as well as a movement skill checklist[4]. For the purposes of this research study, only the movement test component is discussed below. The scoring of the measure is based solely on what the learner is able to do, such as the times in which the learner is able to perform specific tasks, or the number of successful attempts or errors made. These raw scores are converted to standard scores, which are added to form composite scores, which are then used to obtain the percentile range. The percentiles of the Total Score are used to identify what level of movement difficulty, if any, the learner is experiencing, and these levels are presented in a three-colour "Traffic Light system" (p.176)[4]. Standard errors of measurement are provided on the 90 % and 95 % confidence intervals (CI). The movement test record form also consists of qualitative observations that are presented in the form of a checklist for each task and overall performance; however, these do not impact the scoring[4].

The MABC-2 was standardized on 1,172 children aged between 3 years 0 months to 16 years 11 months from the United Kingdom (UK), the sample of which was stratified for gender, race, geographical location and level of parental education[4]. Many studies from all over the world have also contributed to the standardization of the MABC-2[4,103].

Adequate reliability and validity from studies on the MABC-2 are reported in the manual[4]. However, the inclusion of information regarding the reliability and validity of the MABC to indicate adequate reliability and validity of the MABC-2 has been criticized[30]. A literature search was conducted for the purposes of this literature review, and the findings were pleasing overall. Research has shown adequate internal consistency values for the three MABC-2 subtests ranging between Cronbach's alpha values of 0.81 and 0.88 [108], with excellent internal consistency for the Total Score[31,108]. Test-retest reliability was excellent for the activity items and composites (ranging between Cronbach's alpha = 0.88 to 0.99)[108], and excellent for the Total Score (Cronbach's alpha = 0.96 [31] and 0.97 [108]). The MABC-2 has also been found to have precise measurement capabilities[31], and is cited to be a reliable and valid assessment tool in international populations[4,103,108].

Although a study by Niemeijer *et al*[106], using a Dutch translation of the test, found that Dutch children performed better than the UK sample (on which the MABC-2 was initially standardized), they admitted that higher performance may well have been obtained because the discontinuation rules of the MABC-2 were not used in their study. In contrast, adequate cross-cultural validity for the MABC-2 is reported for populations such as Taiwan[108] and Cyprus[4]. Schoemaker *et al*[109] found moderate agreement between the MABC-2 test, MABC-2 checklist, and a separate parental questionnaire known for identifying children (between 5 and 15 years old) with DCD. The MABC-2 has also been used to evaluate other motor skill checklists[51,111]. Adequate concurrent criterion validity was noted for the MABC-2 when compared against the Peabody Developmental Motor Scales – 2nd Edition (PDMS-2)[101] and the Bruininks-Oseretsky Test of Motor Proficiency – 2nd Edition (BOT-2)[102] in the assessment of intellectual disabilities[31]. The MABC-2 has been found to have adequate discriminant validity and sensitivity[31,108] (ranging between 70 % and 72 %[31]) in detecting clinical change following intervention programmes, and therefore its use in monitoring therapy is also supported[31,108]. Adequate specificity (88 %) but inadequate sensitivity was found in a study of the MABC-2 test and Checklist with children experiencing motor skill difficulties[109]. However, specificity of 97 % has been found in a South African study[111].

2.6.2.2 The Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (DTVMI-VMI/VP)

The DTVMI-VMI assessment is a gold-standard for the assessment of visual-motor integration function[32], and has been historically used in research within South Africa[28,49,100] and overseas[64,99,112]. Therefore, it is recognized as having adequate cross-cultural validity[32,48,113]. Several South African research studies have found that African[48,49] and coloured children[49], as well as children from lower socio-economic backgrounds[48,49,100], tend to score lower on the DTVMI-VMI. However, Venter & Bham[113] found that that the DTVMI still predicted academic performance in predominantly African samples from higher and lower socio-economic backgrounds. Therefore, since the DTVMI is widely used in the South African context, the DTVMI was also used for this research study.

The number of forms that the learner copies, and the number of forms that the learner is able to match are counted to produce raw scores. Scoring ceilings are applied when calculating the number of successes. Raw scores are converted to standard scores, scale scores and percentiles. Standard errors of measurement at the 95 % CI are provided, but only vary according to age-group for the DTVMI-VMI[32].

Adequate validity and reliability for clinical use and use in research are reported in the manual. It is reported to have adequate test-retest reliability (0.88, 0.85 and 0.84 for the DTVMI-VMI, DTVMI-MC and DTVMI-VP respectively) in children between 5 and 12 years of age. Excellent values for inter-scorer reliability are recorded for the DTVMI-VP (0.98), DTVMI-MC (0.94) and DTVMI-VMI (0.93). Adequate concurrent validity has also been found with other tests assessing VMI[32].

Brown *et al*[112] used the Rasch Measurement Model with a sample of 430 preparatory school learners, and revealed that the 5th Edition DTVMI-VMI subtest assesses a uni-dimensional construct of VMI. Past research on previous DTVMI editions is still valid for consideration, as good agreement has been obtained between all revisions of the DTVMI[32]. Limited information regarding the sensitivity and specificity of the DTVMI is available. Its use in identifying learners with handwriting difficulties has been questioned, where adequate specificity (86%) but unacceptable sensitivity was found[114]. In contrast, adequate relationships have been found between the DTVMI-VMI, and the ability to write individual letters[99], and to copy sums and a written passage[64], and educational performance areas of mathematics, reading and writing[28], although sensitivity and specificity were not measured in any of these studies. However, the manual[32] reports adequate predictive validity of academic difficulties.

2.6.3 Psychometric properties and psychometric evaluation of screen assessments

Since the QSPOT is a screen assessment, the following review refers to the desired psychometric properties as applied to screen assessments, and the principles that need to be adhered to when evaluating a screen assessment. The literature states that there are no set rules on what correlation coefficients and other values should be used when evaluating psychometric properties of screen assessments, such as questionnaires, and that it is possible for clinicians to also decide what coefficient strengths to use[115].

The literature reports that it is good practice to assess typically performing children with an instrument first, before proceeding to screen or assess children with identified barriers to learning with the same instrument[4,11,34]. Therefore, this practice should also be followed when investigating a screen assessment.

2.6.3.1 The properties of the items

When considering the properties of a screen assessment, the item variances should be investigated. This is to ensure that the levels of difficulty of the respective items do not impact the screen assessment's ability to identify learners who do, or do not require further investigation, accurately[51]. Therefore, item variance also impacts a screen assessment's level of sensitivity and specificity. Floor and ceiling effects are calculated in order to ensure that the majority of the individuals are not achieving the lowest and highest scores, thereby indicating that items are too easy or too difficult respectively[115]. While the DTVP-3[34] uses 86 % and above to indicate a ceiling effect, a limit of 70 % has been used in research on a motor checklist[51]. Furthermore, a screening questionnaire is said to have an advantage if no floor or ceiling effects are noted in a sample of 50 participants[115]. Items that are too easy or too difficult should therefore be removed[34,51] or adapted in some way, or items should be added to fill in the missing levels of difficulty, so that validity and reliability can be improved[115]. Odd items that are inappropriate for the purposes of a screen assessment as a whole should also be removed[12], as inappropriate items directly impact the validity of the screen assessment[115].

2.6.3.2 Sensitivity and Specificity

Sensitivity is the screen assessment's ability to detect barriers to learning when they are present[15,116,117]. High sensitivity results in a low false-negative rate, meaning only a small possibility that a learner with dysfunction would be found as having no dysfunction[13,116]. High sensitivity of a screen assessment is therefore important as it helps to ensure that learners are not skipped[5,23,116]. A screen assessment has good *specificity* if it is able to eliminate dysfunction when it is in fact absent[13,116,117]. It should have a low false-positive rate, meaning that there should be a small possibility of a learner without existing barriers to learning being identified as having barriers to learning[13]. Sensitivity and specificity are therefore required for accurate assessment tools, in order to ensure that the appropriate identifications of learners with barriers to learning are made[15,116,117]. These properties are always considered in relation to one another when evaluating instruments[15,117].

Cut-off points are necessary to calculate sensitivity and specificity of a test[15,116,117]. The current sensitivity and specificity of an instrument is calculated by administering it to groups of participants with and without known dysfunction[13], followed by analysing the results pertaining to the identification of the dysfunction using a 2 x 2 Table method[13,15]. The calculated values should be quoted with 95 % CI to provide an indication of how precise the value is. A difference in CI of 20 % is noted as being less precise, while a difference of less than five percent is considered to be very precise[15]. Many studies have deemed values of below 80 % as indicating unacceptable levels of sensitivity and specificity, while 80 % to 89 % has also been said to indicate fair levels, and 90 % and above has been used to indicate good levels of sensitivity and specificity[117]. Research on a motor checklist quoted levels of 70 % as being acceptable, although the motor checklist achieved higher levels in the study[116]. Therefore, it is possible to set the minimum for sensitivity and specificity depending on the nature and purpose of the test[15]. For a screening procedure such as the QSPOT, it may be necessary to raise the level of sensitivity in order to identify learners, who are at risk for specific difficulties, while lowering the specificity of the instrument. However, OTs would need to keep in mind that higher numbers of false positive test results may be obtained[15].

Sensitivity and specificity cannot be calculated meaningfully without also considering the positive and negative predictive values respectively, and the positive and negative likelihood ratios respectively[15,118]. However, only likelihood ratios were considered in this study. A positive likelihood ratio shows the odds with which a learner has dysfunction if they performed poorly on the screen assessment, and therefore, the higher the value is than 1.00, the better the sensitivity is said to be. In contrast, a negative likelihood ratio represents the odds with which a learner does not have dysfunction if they performed well on the test, and the value should therefore be as small and as far away from 1.00 as possible[15,118]. Likelihood ratios can also be discussed in terms of probabilities that dysfunction may be present or absent[119].

2.6.3.3 Validity

Validity studies, which assess the accuracy of an instrument, consider content validity[12], construct validity, criterion validity[11,12], discriminant validity[109] and cultural validity[107]. *Criterion validity* is established by comparing the degree to which the instrument agrees with another more accurate instrument in discriminating a particular skill or characteristic; ie. a *reference standard* or a *gold standard*[11,12,115].

Criterion validity has two subtypes. Firstly, concurrent criterion validity measures the degree to which the screen assessment is able to predict performance on another similar test. The quality and accuracy of the gold standard used has to be considered carefully for its ability to assess the desired construct and for its predictive ability. A poor quality tool could have serious repercussions on the measures of validity obtained for the instrument being investigated, which would also affect the types of improvements that are made to the instrument in the future[11]. Correlations of 0.70 and above against a gold standard are considered acceptable for both criterion validity[11,115]. Secondly, predictive validity is the screen assessment's ability to identify learners who may be at risk of barriers to learning in the future[11] as they progress through the school system. Predictability is therefore very important for screen assessments[5]. Longitudinal studies have been used to evaluate the predictability of a test, as they evaluate whether earlier test results of a particular instrument predicted the presence or absence of dysfunction accurately at a later stage[11,32]. However, only concurrent criterion validity was considered for this study.

Often involving expert opinion, the content validity of a screen assessment is determined by analysing the test items to ensure that they assess a skill in its entirety[11,12]. The *cultural validity* of screen assessments should be evaluated in order to avoid incorrect conclusions being drawn with regard to a learner from a diverse cultural background. The process may consist of rigorous translation, and/or making changes to improve the cultural sensitivity of the instrument (only if necessary), which would then be followed by extensive standardization[107]. Construct validity determines whether the screen assessment agrees with known theoretical understanding regarding assessment of specific skills in samples of children who would be expected to have those difficulties[11,12].

2.6.3.4 Reliability

Reliability is investigated in order to determine if the results gathered from administration of the screen assessment are consistent[11,12], and whether the instrument is consistently able to discriminate the differences between clients on the specific trait being measured[12]. There are several types, namely internal consistency[14,17,109,120], test-retest reliability[11,13], and inter-rater reliability[11], of which only internal consistency formed part of this study.

Internal consistency is measured using Cronbach's coefficient alpha to determine the degree to which items are inter-related[13,17,120] to the extent that they are able to measure a similar construct[13,14,51,109]. However, it does not measure the degree to which the tool is unidimensional or multidimensional, as a multidimensional assessment can also have a high degree of inter-relatedness between the items[17,120]. A Cronbach's alpha value of 0.70 and above is considered acceptable[115], and has been sought after in research[17,51,108,120]. However, the simple use of a prescribed minimum Cronbach's alpha is risky[17,120], as this measure of reliability should never be evaluated without also taking into account the length and number of items in the tool, the Cronbach's alpha values of each specific subtest or item, the strength of the inter-item correlations[17], and the validity and number of constructs being measured[120].

2.7 Summary

The concept of barriers to learning, and the method in which the DoE of South Africa aims to identify learners with barriers to learning has been introduced. The review has considered the evidence of the importance of screening, while emphasizing the place of screening in the SIAS process. The performance skills and client factors that would be valuable inclusions in screen assessments as evidenced by research, and the features that constitute valid and reliable assessments, have also been reviewed. The following chapter will discuss the methodology and data analysis, emphasizing how the literature guided the research study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research Design

This study used a quantitative non-experimental[121], cross-sectional[13], correlational[121] research design. No intervention was tested. The study aimed to establish some psychometric properties of a South African developed screening tool by field-testing it on a sample of South African children with and without intrinsic barriers to learning between the ages of 5 years 0 months to 5 years 11 months. The concurrent criterion validity between the QSPOT and two standardized tests used to identify learning disabilities, namely the MABC-2 and the DTVMI-VMI/VP, as well as the accuracy of the QSPOT in terms of specificity and sensitivity, was determined. Each learner was assessed once using all three tests, namely the QSPOT, the MABC-2 and the DTVMI-VMI/VP.

The QSPOT was administered by the researcher. Two research assistants assessed a portion of the learners with the MABC-2 and DTVMI-VMI/VP to ensure blinding in a portion of the results. Each learner's performance in the tests was analysed according to his/her own individual results across each of the three tests, and thus each learner served as his/her own comparison when determining the concurrent criterion validity of the QSPOT with the MABC-2 and the DTVMI-VMI/VP.

3.2 Population

South African children between the ages of 5 years 0 months to 5 years 11 months with and without intrinsic barriers to learning formed the population for this study.

3.2.1 Sample

3.2.1.1 Schools

The selection of schools for the study was based on convenience within the Gauteng Province in terms of travelling distances. Selection of schools was also based on the willingness to participate in the research study, and the acknowledgement of the presence of learners who were suitable for the study.

Mainstream and LSEN schools who were interested in taking part in the study received a letter explaining the study and were asked to sign a consent form (Appendix A). The inclusion criteria were explained, and the teachers and/or Heads of Foundation Phase set out to select the learners who they believed would be most appropriate to the study. Grade 0 learners were initially sampled. When it became necessary to also use Grade 00 learners and learners from unspecified grades, an altered letter explaining this was provided to the applicable mainstream schools and LSEN schools.

3.2.1.2 Learners

The sample was drawn from learners who attended the mainstream and LSEN schools that participated in the research study. The learners attended Grade 0, Grade 00 and unspecified grades in some nursery schools and primary schools.

Learners were divided into two six-month age-bands, namely 5 years 0 months to 5 years 5 months (Age-band1), and 5 years 6 months to 5 years to 11 months (Age-band 2), as these are the age-bands used on the QSPOT[39]. The teachers at the schools were asked to select equal numbers of boys and girls for each sub-group, and from various racial groups. In this way, the researcher attempted to ensure a stratified representation of the sample in terms of gender (approximately 50 % male[122]) , while attempting to ensure that the different racial groups of South Africa (namely African, White, Indian, Coloured and Asian[123]) were also represented.

Discrepancies in the number of learners within each age-band were corrected by requesting learners of certain ages, genders and races at the remaining schools. The inclusion criteria for the learners in the mainstream schools and LSEN schools are discussed in the sections below.

3.2.1.3 Participants in the mainstream schools

Sixty-seven parent information sheets and informed consent forms (Appendix B), as well as background questionnaires were given to the teachers to give to the parents of the learners selected for the study. When it became necessary to also use Grade 00 learners, an altered letter explaining this was provided to parents whose children were in Grade 00.

Inclusion criteria for the study included the following:

- The learner had to be within the age-band of 5 years 0 months to 5 years 5 months, or within the age-band of 5 years 6 months to 5 years 11 months;
- The learner had to be in a mainstream class;
- Consent from parents or legal guardians for each learner was required;
- The learner had to be performing typically within the classroom setting;
- The learner had to have no history of severe physical or neurological diagnoses, nor any existing or identified learning problems reported in the completion of the questionnaires.

Of the 67 consent forms and questionnaires that were returned to the school by the parents, 17 learners were excluded from the study, and were therefore not assessed. These included the following: two learners who had previous histories of therapies and medication for the intervention of intrinsic barriers to learning; ten learners who were already 6 years of age by the time the forms were handed out and/or returned to the schools; one learner was absent at the time that the assessments were to take place, and had turned 6 years of age by the time she returned to school; and the final four learners were excluded due to the saturation of participants obtained and assessed in the second six-month age-band.

In the case of missing questionnaires and omitted information in the questionnaires returned, the researcher contacted the parents via email (if email addresses were provided) or telephonic communication and texting in order to trace the missing forms and to obtain missing information.

Informed consent and valid questionnaires were received for 50 learners, and they were assessed for the mainstream sample. Of the 50 learners who were assessed, two learners were excluded from the study due to illness and physical injury in the period between administrations of the tests. Therefore, the total sample size of learners in the mainstream schools for Age-band 1 and Age-band 2 was 48 learners.

3.2.1.2 Participants in the LSEN schools

Approximately 50 parent information sheets, informed consent forms (Appendix B) and background questionnaires in total were given to the teachers to give to the parents of the learners selected for the study. When it became necessary to obtain 5 year old learners from Grade 00 classes and unspecified grades within LSEN schools, an additional cover letter was attached to the information letter to explain this.

Inclusion Criteria:

- The learner had to be within the age-band of 5 years 0 months to 5 years 5 months, or within the age-band of 5 years 6 months to 5 years 11 months;
- The learners had to be attending an LSEN school;
- The learner could alternatively attend a mainstream school, but needed to have a pre-existing diagnosis, existing assessment reports from therapists or specialists, and/or the presence of existing barriers to learning. Parents of learners with identified intrinsic barriers to learning in the mainstream schools were given an additional cover letter to explain this;
- Parents or legal guardians were required to give consent to have their child participate in the study;

The sample also included those learners who had received past intervention measures for the identified barriers to learning, and learners who were receiving therapeutic or medical intervention for the identified barriers at the time of the research study;

Learners with a variety of identified barriers to learning were considered; however, learners with severe to profound intellectual and physical impairments, that would result in them not being able to understand the instructions or being unable to attempt the items, were excluded from the study. However, some children with physical impairments and severe intellectual impairments were given the opportunity to participate in the study due to a shortage of learners who met the initial criteria for the LSEN sample.

Some learners had already undergone recent testing at the time of the study, although they did not have assessment reports yet. There was a shortage of available learners in the appropriate age-bands with identified and diagnosed intrinsic barriers to learning, such as SLDs. Additional learners with unconfirmed diagnoses due to inconclusive test results were still assessed for the study. Learners in mainstream schools who showed evidence of intrinsic barriers to learning, and who had been placed in remedial classes, and/or who were receiving extra lessons, were also assessed for the study. However, many of these learners had not yet been referred for testing, or had not been assessed due to a lack of finances, or due to parental refusal to follow-up on recommendations made by the school.

Informed consent was obtained for 43 learners for the LSEN sample. Eight learners were excluded from the study due to being in the incorrect age-group. One learner was withdrawn from the study by the parent before the assessments took place, and another learner refused to accompany the therapist. The remaining 33 learners were assessed for the study; however, four of these learners were subsequently eliminated. The first learner had significant physical impairment which only became apparent once he had been called out of the classroom; the second had significant difficulties in understanding and executing the gross motor activity items of the MABC-2; the third had significant behavioural and concentration difficulties and also refused to continue; and the fourth learner was erroneously assessed when she was already 6 years of age. Thus, the LSEN sample consisted of 29 learners.

3.2.1.3 Sample size

The QSPOT contains five tasks. The sample size was calculated using a ratio of ten participants per task, giving a sample size of 50 participants in each group. Eighty-three learners were assessed in total. However, the scores of only 77 learners were used in the calculation of results due to some learners being eliminated from the study.

3.3 Research instruments

3.3.1 Demographic Questionnaires (Appendix C and Appendix D)

The parents were asked to fill out a questionnaire. The first page of the questionnaire included the learner's name, date of birth, and contact details of the parents, along with a designated space for an assigned code. This page was kept separate, while the remaining pages of the questionnaire only had the assigned code recorded for confidentiality purposes. There were two separate questionnaires: one for learners in the mainstream schools (Appendix C), and one for learners with identified barriers to learning (Appendix D). When the study was expanded to include learners in Grade 0, Grade 00 and unspecified grades, the parents were requested to indicate their child's grade. The background information questionnaires required details of the learners' history of difficulties, therapies, other interventions, and support structures. Learners in the mainstream sample were expected to have no difficulties or past therapies reported, while learners with identified intrinsic barriers were expected to have these details reported.

The questionnaires also required details regarding the parents' educational level for the purposes of determining the learners' socioeconomic status. The level of parental education has been used as one of the tools to determine the socio-economic status of the participants in several studies[44,45], including studies on the MABC-2[109], and the DTVMI-VMI[49,113]. However, due to the small sample size, the stratification considered in this study included only three increments, namely (1) less than 12 years of school education; (2) a Grade 12 qualification; and (3) a college or university qualification[47,86]. Socioeconomic stratification for both the mainstream and LSEN samples was ensured by using a variety of private schools, semi-private schools, and government schools. Most of the government schools were located in urban areas, while one was located within a township. This produced a range of levels of education attained by the learners' parents. Due to difficulties in obtaining permission to conduct the study at non-fee paying schools, no non-fee paying learners were obtained for the study.

3.3.2 Quick Screening Procedure for Referral to Occupational Therapy (QSPOT) (Appendix E)

The QSPOT has been designed to screen learners between the age of 4 years 0 months to 5 years 11 months for the presence of intrinsic barriers to learning[2,39], especially learning disabilities. The authors have incorporated two six-month age-bands within each age-group. The authors plan to expand the QSPOT to include 6 year olds[2], where the current version of the QSPOT incorporates norms for 6 year olds[2,3]; however, no research on the 6 year age-band has yet been conducted[39]. This study focused only on the fifth year age-band: namely

5 years 0 months to 5 years 5 months (referred to as Age-band 1), and 5 years 6 months to 5 years 11 months (referred to as Age-band 2)[39].

Figure 3.1 shows the outline of the tasks of the QSPOT. The QSPOT includes pencil-and-paper activity items namely drawing a person and copying shapes from stimulus cards. Shapes include horizontal and vertical lines, a cross, circle, square, triangle, a rectangle with a diagonal cross within and a diamond, with the added criterion of having to name as many of the forms as possible. It also contains a single activity item for cutting, a single activity item for static balance and an additional criterion of static balance with eyes closed, and lastly, a single activity item for catching[2,39]. Administration time is approximately 15 to 20 minutes[39].

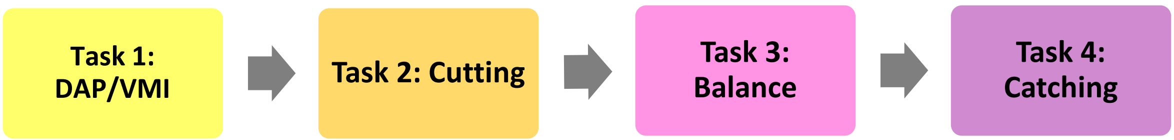


Figure 3.1 The components of the Quick Screening Procedure for Referral to Occupational Therapy

For each task, the learner's performance on the specific activity item is evaluated in order to determine if they meet the norm for the age-band. If the learner does not pass the norm for the activity item, a weighting of three points is added to the corresponding task score[2,3].

As the learner progresses through the various tasks, the therapist conducting the QSPOT is also required to indicate various observation criteria that are of concern for each task. The West Rand OTs provide guidelines in the QSPOT manual[2] regarding when it is appropriate to indicate observation criteria as being a concern. However, additional guidelines were also obtained during consultation with one of the authors, namely that a criterion should be indicated as being a concern if: (1) that performance skill or client factor is causing difficulties for the child in the task, or if the child is not coping with the task; and/or (2) the child requires further investigation with regard to that criterion or the activity item itself; and/or (3) the dysfunction of the performance skill or client factor may hinder further development in the future. Overall, the indication of a specific criterion should be carefully considered if the child is coping with the task.

The number of criteria that the therapist indicates, as well as the added weighting of three points in the event of failure to pass the norm for the activity item, is added to give a subtotal for each task. The subtotals of the tasks are also added to provide a Total Score[2,3]. The previous reference values for the QSPOT that were obtained for research during initial pilot studies conducted by the West Rand OTs can no longer be used for clinical practice or further research studies due to various reasons. The West Rand OTs are currently establishing new cut-off scores[39], and no cut-offs existed at the time of this particular research report study on 5 year olds.

For each task and Total Score, the QSPOT has made provision for differentiation between Typical, At Risk, and Problematic Performance levels[2,3,52]. Raw score totals for each of the QSPOT tasks were originally categorized according to percentiles, and the same percentile differentiation will likely be used again by the West Rand OTs. Performance at or above the 25th percentile was considered *Typical* performance, while *At Risk* was considered to be below the 25th percentile but above the 5th percentile, and *Problematic* performance was considered to be at or below the 5th percentile[2,52].

Although not directly required by the QSPOT, rigour was ensured by the following procedures: Firstly, the verbal instructions printed in the manual for all four tasks were typed onto cue cards in order to ensure consistency of administration. Secondly, the same left-handed and right-handed scissors were used throughout the research study for Task 2: Cutting. Thirdly, the evenness of the floor was determined with a spirit level for Task 3: Balance. Finally, the prescribed distance between the researcher and the learner was measured and marked on the floor with tape for Task 4: Catching.

3.3.3 Movement Assessment Battery for Children – 2nd Edition (MABC-2) (Appendix F)

The MABC-2[4] consists of two assessment procedures: a checklist and the formal standardized motor skill test. The second edition test has been expanded to assess children aged between 3 and 16 years. The test is divided into three age-bands: Age-band 1 for children aged 3 to 6 years; Age-band 2 for children aged 7 to 10 years; and Age-band 3 for children aged 11 to 16 years.

For each age-band, the test activity items are divided into three components of Manual dexterity, Aiming and catching, and Balance[4]. For the purposes of this study, only the first age-band tests were administered. Manual dexterity activity items include posting coins into a money box, threading beads onto a string, and the completion of a drawing trail. Aiming and catching activity items include catching a bean bag, and throwing a bean bag onto a mat. Balance activity items include standing on one leg, walking on a line with heels raised, and jumping on mats[4].

The MABC-2 was selected as a comparison tool with the motor and praxis performance skills measured on the QSPOT for the following reasons:

- The MABC-2 consists of both unilateral and bilateral fine motor tasks to assess fine motor performance, which are related to the unilateral and bilateral aspects and scoring criteria of the cutting and pencil-and-paper tasks in the QSPOT;
- The MABC-2 assesses similar constructs of balance and ball skills as the QSPOT;
- The MABC-2 has been used frequently in research studies regarding motor skill dysfunction[4,31,108–111], and has undergone extensive research overall[4]. It has also been used as a *reference standard* against which other tools are being developed[51,111].

The MABC-2 uses similar terminology to the QSPOT regarding the levels of performance, and the percentile ranges for typical, at risk and problematic performance correlated with the QSPOT. However, the percentile ranges apply to the Total Score of the MABC-2 test, and not to the composite scores. In the MABC-2, performance above the 16th percentile is considered to indicate the *absence* of a movement difficulty, while the 9th and 16th percentiles indicate *at risk* performance, and *definite* movement dysfunction is denoted by performance at or below the 5th percentile[4]. Therefore, z scores were calculated using the means and standard deviations provided in the MABC-2 manual[4] during the comparison to the QSPOT.

No standardized verbal instructions are provided in the MABC-2 manual; however, basic outlines regarding the instructions, demonstration procedures, and criteria for failures of trials are listed for each task[4]. Verbal instructions and demonstration procedures were formulated from these basic outlines and typed onto cue cards and quick reference sheets in order to ensure the maximum consistency of administration. Rigour was ensured by the following: Firstly, the layouts of the mat and materials for the manual dexterity tasks were measured consistently. Secondly, the evenness of the floor was established using a spirit level for the balance tasks. Thirdly, distances for the catching and throwing tasks were measured and marked with tape. Finally, the mats were taped down to the floor for the catching, throwing and jumping tasks.

3.3.4 Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Edition (VMI and Visual Perception subtests, ie. DTVMI-VMI/VP) (Appendix G 1 and Appendix G 2)

The DTVMI[32] assessment consists of a Visual-Motor Integration (VMI) test and two supplemental tests for Visual Perception (VP) and Motor Coordination (MC). Only the Short-form VMI and supplemental VP subtests were used for the purposes of this study. The Short-form VMI subtest consists of 21 items in which geometric forms are copied. The VP subtest requires children to discriminate between similar geometric forms in order to match them[32].

The DTVMI was selected as a comparison tool for the sensory-perceptual performance skills measured on the QSPOT for the following reasons:

The VMI subtest assesses similar constructs to the copying task in the QSPOT;

The VP subtest relates partly to the expectation of the child having to identify several shapes as part of the copying section in the QSPOT;

The DTVMI assessment has been used historically as a research tool[32,48,49,100,112]; it is considered one of the most researched assessment tools of its kind[32]; and it has been shown to have adequate predictability[28,113] and applicability[28,49,100,113] in the South African context.

Standardized verbal instructions are provided for the DTVMI-VMI/VP subtests in the manual[32], and these were typed onto cue cards to control for variation and random systematic errors of administration.

3.4 Procedures

3.4.1 Approval of research

Ethical clearance was obtained from the Human Research Ethics Committee at the University of the Witwatersrand (Appendix H). Approval of the study was obtained from the Gauteng Department of Education (GDE) (Appendix I).

Once the Ethical Clearance and GDE Approval had been obtained, permission was obtained from the schools to conduct the research on the school premises. The researcher approached 12 mainstream schools in total. Seven of these mainstream schools indicated that they had learners who suited the inclusion criteria, and granted the permission to conduct the assessments on the premises. The researcher approached approximately 25 LSEN schools. Six of these LSEN schools indicated the presence of learners who suited the inclusion criteria, and gave permission to conduct the research on the premises. Due to a shortage of learners who were the appropriate age and who presented with the appropriate skill levels and types of intrinsic barriers to learning, an additional three mainstream schools were approached. Two of these gave permission for the research to be conducted on several learners with identified barriers to learning on the premises.

3.4.2 The Research Assistants

The researcher advertised for research assistants on the OTASA website. Applicants sent their curriculum vitae to the researcher, and suitable applicants were contacted and interviews were held. Due to a shortage of responses to the advertisements placed on the occupational therapy website and the shortage of available therapists, the researcher also contacted fellow colleagues and interviews were held with these therapists as well.

The following research assistants were selected: Research Assistant 1 had 13 years of experience in paediatrics and had also undergone further post-graduate training. Research Assistant 2 had five years of experience in community-based therapy for adults and paediatrics, and also had experience working as a tutor for a local university.

Neither of the research assistants had previous exposure to the MABC-2. Thus, the selected applicants each received training in the MABC-2 in the form of two workshops ranging between three and four hours long. The workshops were held separately as it was not possible to provide training to both research assistants simultaneously. A two to three hour session of compulsory independent study of the test was also required between the two workshops. During the second workshop, the research assistants were given opportunities to clarify misinterpretations, and ask questions that had been compiled during the independent study of the test. Both sessions incorporated teaching and practice sessions of the MABC-2. Further details regarding the above elements of the training can be found in Appendix J.

As part of the second three-hour workshop, the research assistants were then required to watch a video of an assessment conducted by the researcher on a typically-developing child within a mainstream setting, and they were required to score the learner's performance by filling in the record forms. The results were compared to the researcher's assessment results for the same child. Scoring errors were discussed in order to prevent similar errors being made again during data collection. The research assistants were given the opportunity to practice scoring those activity items again.

The results obtained by both research assistants were compared using point-by-point agreement[11]. A one- to zero-point difference in standard score was taken as indicating agreement, as long as the scores were still within the same range of performance, such as the scores being located within the typical range. Research Assistant 1 obtained 91.67 % and Research Assistant 2 obtained 83.33 % point-by-point agreement (inter-rater reliability) with the researcher. Point-by-point agreement between Research Assistant 1 and Research Assistant 2 was 91.67 %. Therefore, in terms of this research study, inter-rater reliability was adequate[11]. However, the one-point score differences were discussed, and the scoring of these activity items was discussed and practiced, along with those activity items for which there was poor agreement, in order to prevent further errors in the study. Both research assistants were involved in assessing the learners in the mainstream school sample. The assessments of the mainstream learners were conducted first before the assessments of the LSEN learners.

Only Research Assistant 2 aided in the data collection for the LSEN sample. Research Assistant 2 scored the assessment video taken of a learner with known intrinsic barriers to learning in an LSEN setting before commencing any data collection for the LSEN sample. A similar procedure was followed as for the video of the typically developing learner. The point-by-point inter-rater reliability coefficient for Researcher 2 was 75 %, and was therefore higher than the inter-rater reliability of 70 % that was required in the Peersman *et al*[51] study on a motor skill checklist. A few scoring discrepancies were noted and discussed, and scoring was practiced again before assessing learners for the study.

3.4.3 Data Collection

3.4.3.1 Procedures regarding ethical considerations

A letter explaining the study was handed out and informed consent was obtained from the parents of the learners selected for the study. The pages of the demographic questionnaire that contained the personal background and medical history were coded, while the identifying information was kept separate in a secure location. The QSPOT record forms, as well as the assessment forms for the MABC-2 and DTVMI-VMI/VP were also coded.

The learner was viewed as giving verbal assent by any combination of the following: (1) responding with "Yes"; (2) exiting the classroom ahead of the researcher and/or research assistant without any further questions; and/or (3) by accompanying the researcher and/or research assistant willingly. The teacher signed a verbal assent form (Appendix K) to witness each learner's assent to participate. Assent forms were completed for each learner for both sets of assessments.

Parents were allowed to withdraw their children from the study at any time with no consequences. Although learners were gently encouraged to participate, a learner's refusal to participate was accepted.

A short report containing the results of the QSPOT, the MABC-2 and the DTVMI-VMI/VP, as well as recommendations, was given for each learner. This was to follow the principle that all parents and caregivers should be notified of the screen assessment results, regardless of the learner's outcome[36,52]. Reports were also given for the learners who refused participation, and for learners whose testing had to be terminated. The reports were given in sealed envelopes to protect confidentiality of information.

3.4.3.2 Data Collection Procedures

The teachers were requested to select learners according to the inclusion criteria for the particular school setting concerned. The consent forms and background questionnaires were given out to the respective parents. The forms were returned by the parents, and the learners who met the criteria were selected for the study.

The learners near the top of each age-band in age were assessed first at each respective school, so that they did not move into another age-band before they could be assessed. Random number generation tables were used to determine which learners would be assessed first using the screening, and which learners would be assessed first using the two standardized assessments. Random number generation tables were also used to determine which of the two tests (MABC-2 or DTVMI-VMI/VP) would be administered first on each specific learner.

At each school, a group of learners were selected to be screened using the QSPOT first, and a second group of learners were selected to undergo the MABC-2 and the DTVMI-VMI/VP first. On the second day of the data collection, the groups of learners attended sessions in order to complete the second set of assessments. There was no more than a three-day gap between the two assessments in the mainstream sample, and no more than a four-day gap existed between assessments in the LSEN sample in these cases.

Data collection took place in three different ways. Firstly, the researcher and research assistant assessed learners concurrently on the days that the research assistants were available, and where the schools were able to accommodate two separate assessment rooms. The testing was conducted in relatively quiet areas at each school, and consistent rooms were used where possible. Secondly, the testing was conducted on separate days in the same area when schools did not have the space to accommodate both the researcher and the research assistant simultaneously. In this case, the QSPOT was administered by the researcher on one day, while the MABC-2 and DTVMI-VMI/VP assessments were administered by the research assistants on a separate day. Thirdly, the researcher conducted the QSPOT on one day, and the MABC-2 and DTVMI-VMI/VP on another day when the research assistants were not available at all.

Learners were taken out of the classroom in agreement with the teachers. The teachers were given a choice of two or three learners to send first. If the researcher was at the school on her own, only one learner was fetched at a time. When a research assistant was available, two learners were fetched from the classroom and were introduced to the researcher and/or research assistant, followed by giving the learners a general outline of the proceedings. The teacher signed the verbal assent form to witness the assent given by the learners to participate.

When the research assistants were aiding data collection, the researcher was blinded to the results of the MABC-2 and DTVMI-VMI/VP assessments, and the research assistants were also blinded to the results of the learners on the QSPOT, which was the planned procedure for this study. However, the researcher completed the majority of both the QSPOT and the standardized assessments on specific learners since the availability of the research assistants was quite limited.

When the researcher had to complete both the QSPOT and the standardized assessments on some children, the researcher tried to ensure some blinding as follows: Firstly, the researcher ensured that all the necessary items had been completed in the DTVMI-VMI/VP subtests, and that all the raw scores and observations in the MABC-2 had been recorded before moving on to the respective outstanding assessment. Secondly, each learner's unique code and birth date were written on the QSPOT record form and its cutting activity, as well as on the assessment forms for the standardized tests so that the list of the learners' names would not need to be consulted when calculating the chronological age of the respective learner and when completing the subsequent scoring. Thirdly, the results of the QSPOT were not consulted when scoring the DTVMI-VMI, and the results of the QSPOT were not consulted when assigning scores to the MABC-2.

It should be noted that some codes were naturally recognized by the researcher as belonging to certain children without referring to the list of names. Accuracy and consistency of scoring was ensured by scoring each item of the standardized tests according to the manuals, thus limiting the degree of researcher bias.

The researcher scored all of the QSPOT forms. In order to ensure accuracy, the researcher ensured that all the necessary criteria had been indicated before moving on to the next activity item of the QSPOT. The researcher was also in contact with the West Rand OTs and authors of the QSPOT during the course of the months in which the research was conducted. The marking of the QSPOT Task 1: DAP/VMI and Task 2: Cutting for the mainstream group was reviewed in consultation with one of the authors of the QSPOT in order to ensure that the learners' work was being scored correctly, and that discrepancies were corrected where applicable. The standards of scoring obtained through this were applied to the rest of the data collected for the QSPOT. During the course of the study, scoring discrepancies were noted between the mainstream and LSEN groups with regard to the QSPOT and the way in which certain activity items were scored. These were corrected as they were recognized by the researcher, by consulting the QSPOT manual and the guidelines given by the author of the QSPOT. However, the researcher did not consult the standardized assessment results at any point.

The research assistants scored the MABC-2 and the DTVMI-VP subtests as they were conducted. The researcher scored the DTVMI-VMI subtests regardless of whether she administered the assessment or not. However, the research assistants frequently scored the DTVMI-VMI subtests even though they were informed that they did not have to. The researcher checked the scoring in these cases, and made corrections where necessary, and in consultation with the research assistants where possible.

3.5 Data Analysis

The assessment data were captured onto Microsoft Excel Spreadsheets. STATISTICA v12.5[124] software was used to obtain descriptive statistical data for the variables considered in the study.

Descriptive statistics were obtained for the overall total sample of learners whose data could be used in the study, for the mainstream and LSEN groups respectively, and for the two age-bands. As a result of much of the data not being normally distributed, the medians, as well as lower and upper quartiles were also shown in the case of the scores obtained by the learners in the various groups.

Since no cut-off scores for the tasks and Total Score of the QSPOT existed at the time of the research study, means and standard deviations for the QSPOT for this research sample had to be calculated. Unrealistic z scores were obtained when using the means and standard deviations of the mainstream sample alone. Therefore, the means and standard deviations of the total group were used to calculate the z scores for comparison. Due to the fact that the LSEN group (n=29) made up 37.66 % of the total group of learners (n=77), the results can only be applied to this sample. The determination of the levels of sensitivity and specificity was not affected due to the fact that this determines the accuracy of the QSPOT in identifying typical learners and learners with intrinsic barriers respectively. In addition, the calculation of concurrent criterion validity was not affected due to the fact that some of the learners in the LSEN group were not identified with difficulties, and due to the fact that the objective was to determine the level of agreement of the results of the QSPOT and the MABC-2 and DTVMI-VMI/VP, and not to standardize the QSPOT.

Non-parametric statistics were used to analyse the data, as the samples in Age-band 1 and Age-band 2, as well as the total group (n=77) were not normally distributed in many aspects of the tests. A Mann-Whitney U test was used to determine whether statistical differences were found between the results of the mainstream and LSEN groups, and between the results of Age-band 1 and 2. In the case of analysing the cut-offs for the activity items, the 16th percentile was presented when the data were not normally distributed.

Sensitivity and specificity were calculated using a z score cut-off of -1.00 SD and less in the mainstream and LSEN groups in each of the four tasks of the QSPOT using the means and standard deviations of the total group (n=77), and the same was done for the MABC-2 and the DTVMI-VMI/VP. Sensitivity and specificity were also calculated for each of the activity items (based on the numbers of learners who failed or passed the norm for each activity item) within the respective tasks of the QSPOT using MedCalc® Statistical Software[18].

Since a higher score on the QSPOT indicates lower performance, the z scores were reversed to allow better performance on the QSPOT to be placed on the positive side of the normal curve, to enable comparison with the MABC-2 and DTVMI-VMI/VP. The z scores calculated for the QSPOT were correlated to the z scores calculated for the MABC-2 and DTVMI-VMI/VP standard scores using Spearman's Rank Order coefficients for all groups (n=77) and for each age-band. Table 3.1 shows the correlation intervals and interpretation terminology that were used for the purposes of this study. Agreement between tests was discussed in terms of relationships rather than correlations as presented below.

Table 3.1 Interpretation of correlation coefficients by Kielhofner(p.263)[125] and Dawson[13]

Correlations between 0.00 and 0.20	"Negligible"[125] or little/no[13] relationship
Correlations between 0.20 and 0.40	A "low"[125] or weak[13] relationship
Correlations between 0.40 and 0.60	A "moderate"[125] relationship
Correlations between 0.60 and 0.80	A "high"[125] or strong relationship
Correlations between 0.80 and 1.00	A "very high"[125] or excellent[13] relationship

Cronbach's alpha calculations were also performed using STATISTICA v12.5 software[124], in order to determine the internal consistency of the QSPOT for this sample.

Cut-off points which constitute *at risk* performance were established using the data for the mainstream sample of learners (n=48) on the QSPOT activity items. This was also to determine the possibility of any changes to scoring that could enhance the overall sensitivity of the QSPOT tasks and Total Score. The data for each activity item were gathered and recorded as follows:

Task 1 A: DAP activity item was analysed by counting the number of body parts (excluding the trunk) drawn, and the total number of body parts drawn by each learner.

Task 1 B: VMI activity item was analysed by counting the number of shapes that each learner was able to copy, and the proportions of learners who were able to draw and name each of the shapes were also considered.

Task 2: Cutting activity item was analysed by considering the number of learners who were able to cut out the picture adequately, and the number of learners who were penalized on the various observation criteria.

Task 3: Balance activity item was analysed by recording the amount of time that learners were able to stand on one leg with eyes open and with eyes closed.

Task 4: Catching activity item was analysed by recording the number of times out of ten that each learner was able to catch the beanbag. In addition, the numbers of catches in two hands away from the chest, in two hands against the chest, and in one hand for each learner was also recorded.

The means and standard deviations, medians and the cut-offs for each activity item were then determined. Performance that would be considered at risk and lower was calculated by subtracting 1.00 SD from the mean if the data were normally distributed, or by using the 16th percentile, where the data were not normally distributed. The Mann-Whitney U test was used to determine whether statistical differences lay between the performance of Age-band 1 and Age-band 2 learners.

3.6 Summary

In summary, the methods in which the study was carried out have been presented. The data collection procedures, and the ways in which the data were analysed to meet the research objectives have been explained. The following chapter presents the results of the study.

CHAPTER 4: RESULTS

4.1 Introduction

The scores of the QSPOT, and the two standardized tests, namely the MABC-2 and the DTVMI-VMI/VP, were compared for 50 learners from mainstream schools and 33 learners from LSEN schools. As described in Chapter 3, two of the 50 typical learners attending mainstream schools were excluded, and the total sample size of learners in the mainstream sample was 48 learners. Four learners were excluded from the 33 learners assessed at the LSEN schools. Thus, the LSEN sample consisted of 29 learners, giving a total sample size of 77 participants.

The correlations between the results of the QSPOT and the MABC-2 and the DTVMI-VMI/VP for the total group, consisting of the mainstream and LSEN participants, were considered for two different age-bands, namely 5 years 0 months to 5 years 5 months (referred to as Age-band 1), and 5 years 6 months to 5 years 11 months (referred to as Age-band 2). Internal consistency and accuracy of the QSPOT was also investigated for the total group of participants. The performance of the mainstream participants on the activity items of the QSPOT was analysed in order to determine cut-off points that would constitute at risk performance and failure of a specific QSPOT activity item.

4.2 Demographics of the participants

4.2.1 Personal demographics

The demographics of the total group and the participants attending mainstream and LSEN schools are reported in Table 4.1. Although there was no statistical difference between the mean age of the Age-band 1 participants when comparing the mainstream and LSEN groups, this was not true for the Age-band 2 participants as the participants in the LSEN schools were significantly older. The gender ratio between the mainstream group and the LSEN group revealed a significant difference for gender ($p = 0.00$) for both boys and girls, as more boys were assessed in the LSEN group than girls.

As far as possible, equal numbers of boys and girls within the mainstream group were recruited in terms of the two six-month age-bands, leading to no significant statistical difference in the gender ratio within Age-band 1 and Age-band 2 in the mainstream group. There was no significant difference between the number of boys in Age-band 1 and Age-band 2 in the LSEN group; however, there was a significant statistical difference between the numbers of girls assessed (Table 4.2).

Table 4.1 Age and gender of the total group, and the mainstream and LSEN groups

		Total Group (n=77)	Mainstream Group (n=48)	LSEN Group (n= 29)	p value
Age	**Age-band 1:** 5 years 0 months to 5 years 5 months	**n (%)**			
		35 (45.45)	23 (47.92)	12 (41.38)	0.64
		Mean (SD) Median (Lower-upper quartiles)			
		5 years 3 months (1.47 months) 5 years 3 months (5 years 2 months-5 years 6 months)	**5 years 3 months (1.49 months)** 5 years 4 months (5 years 2 months-5 years 5 months)	**5 years 3 months (1.38 months)** 5 years 2 months (5 years 1 month-5 years 4 months)	0.16
	Age-band 2: 5 years 6 months to 5 years 11 months	**n (%)**			
		42 (54.55)	25 (52.08)	17 (58.62)	0.64
		Mean (SD) Median (Lower-upper quartiles)			
		5 years 9 months (1.71 months) 5 years 9 months (5 years 8 months-5 years 11 months)	**5 years 9 months (1.78 months)** 5 years 8 months (5 years 8 months-5 years 11 months)	**5 years 10 months (1.37 months)** 5 years 11 months (5 years 9 months-5 years 11 months)	0.03*
Gender		**n (%)**			
	Male	47 (61.04)	22 (45.83)	25 (86.21)	0.00**
	Female	30 (38.96)	26 (54.17)	4 (13.79)	0.00**

Statistical Significance: p ≤ 0.05*   Statistical Significance: p ≤ 0.01**

Table 4.2 Gender of participants within Age-band 1 and 2 for the mainstream and LSEN groups

	Gender	Age-band 1 (n=35)	Age-band 2 (n=42)	p value
		n (%)		
Mainstream (n=48)	**Male**	10 (28.57)	12 (28.57)	0.64
	Female	13 (37.15)	13 (30.95)	0.66
LSEN (n=29)	**Male**	9 (25.71)	16 (38.10)	0.14
	Female	3 (8.57)	1 (2.38)	0.00*

Statistical Significance: p ≤ 0.05*   Statistical Significance: p ≤ 0.01**

4.2.2 Nationality and race

Out of 76 responses on the questionnaire, 97.37 % (n=74) of the participants were born in South Africa, and thus the group could be considered as a South African sample for which the QSPOT is intended. Table 4.3 shows the racial statistics of the groups, and shows that the mainstream group and LSEN group were comparable with the total group in terms of racial distribution.

Table 4.3 Race statistics of the total group, and the mainstream and LSEN groups

		Total Group (n=77)	Mainstream Group (n=48)	LSEN Group (n= 29)	p value
		n (%)			
Race	**Black**	36 (46.75)	26 (54.16)	10 (34.48)	0.15
	White	34 (44.16)	17 (35.42)	17 (58.62)	0.09
	Indian	7 (9.09)	5 (10.42)	2 (6.90)	0.80

Statistical Significance: $p \leq 0.05$* Statistical Significance: $p \leq 0.01$**

4.2.3 Parental education level

Table 4.4 indicates the maternal level of education and Table 4.5 indicates the paternal level of education to show that the groups consisted of participants from various backgrounds. The numbers of valid responses on the questionnaire for each group are indicated by (n). The parental education levels for the mainstream and LSEN groups were not statistically different in terms of maternal levels of education (Table 4.4).

Table 4.4 Level of maternal education within the total group, and the mainstream and LSEN groups

	Total Group (n=72)	Mainstream Group (n=46)	LSEN Group (n=26)	p value
	n (%)			
Mother: Below Matric	5 (6.94)	3 (6.52)	2 (7.69)	0.97
Mother: Matric	21 (29.17)	10 (21.74)	11 (42.31)	0.21
Mother: Tertiary	46 (63.89)	33 (71.74)	13 (50.00)	0.08

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

Table 4.5 Level of paternal education within the total group, and the mainstream and LSEN groups

	Total Group (n=69)	Mainstream Group (n=45)	LSEN Group (n=24)	p value
	n (%)			
Father: Below Matric	6 (8.70)	3 (6.67)	3 (12.50)	0.77
Father: Matric	20 (28.98)	10 (22.22)	10 (41.67)	0.32
Father: Tertiary	43 (62.32)	32 (71.11)	11 (45.83)	0.05*

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

There was no statistical difference between the groups for paternal education for below-matric and matric-level education. However, there was a statistical difference between the groups with regard to paternal tertiary education ($p = 0.05$), where a higher percentage of fathers of mainstream learners had tertiary education (Table 4.5).

4.2.4 Schooling

The mainstream group consisted of participants from Grade 0 and Grade 00, while the LSEN group consisted of some participants from unspecified grades in addition to the afore-mentioned grades. Out of 76 responses, 96.05 % (n=73) of the participants had attended nursery school prior to entering the grade that they were currently in when they were assessed in 2014.

Ninety-eight percent (n=47) of the mainstream participants were attending their first year in Grade 0 (n=43) or Grade 00 (n=4) at the time of being assessed for this research study. One of the participants was repeating the grade at the time due to starting school a year early. Of the 21 valid responses in the LSEN group, nine participants (42.86 %) were attending their first year in Grade 00, while 12 participants (57.14 %) were attending their first year in Grade 0. The remaining LSEN participants were not attending structured Grade 0 or Grade 00 classes.

4.2.5 Diagnoses and conditions for the LSEN sample (n=29)

The participants' diagnoses and reported deficits are reflected in Table 4.6. The table allows for the fact that some participants were identified with more than one type of intrinsic barrier.

Table 4.6 Number of participants presenting with various conditions within the LSEN group (n=29)

Physical disability	Intellectual disability	Autism Spectrum Disorders	Epilepsy (petit mal)	Attention Deficits/ Remedial/ OT/ Dyspraxia	Emotional difficulties	Hearing and/or Speech difficulties
Confirmed diagnoses (n) **Unconfirmed diagnoses (n)**						
1	2	2	2	6	3	8
0	3	4	0	9	1	2

Autism Spectrum Disorders and intellectual disabilities were reported by teachers, parents and therapists; however, not all of the participants with these disorders had been formally diagnosed by a paediatric neurologist or psychiatrist. Participants on the Autism Spectrum also had associated emotional and behavioural difficulties. In some cases, intrinsic barriers to learning such as ADHD and remedial difficulties had not been formally diagnosed; however, these participants were attending remedial classes in mainstream and LSEN schools, and/or remedial lessons within a mainstream school. With regard to the category of hearing and/or speech difficulties, one participant had bilateral hearing aids, while the remaining nine participants had identified speech delays.

4.2.6 Preference of the hand and foot

Statistics of hand and foot preference are discussed below in terms of QSPOT Task 1: DAP/VMI, Task 2: Cutting and Task 3: Balance. Ninety-six percent (n=46) of the mainstream participants used their right hands to draw and cut out. In comparison, 72.41 % (n=21) of the LSEN participants used the right hand for drawing, while only 68.97 % (n=20) used the right hand for cutting. Overall, most of the participants used their right hands for the drawing and cutting activity items. All of the mainstream participants used a consistent hand for drawing and cutting. Participants who used both hands during any of these tasks, or who swapped hands between these tasks, were only found within the LSEN group.

It was observed that the variation that occurred within the LSEN group with regard to left-handedness and unestablished hand preference resulted in 13.79 % (n=4) of the LSEN participants using their left hands to draw, while 6.90 % (n=2) used their left hands to cut out. Fourteen percent (n=4) of the LSEN participants used both hands to draw, while 24.14 % (n=7) used the scissors in both hands during the cutting task.

Overall, most of the participants used the left leg for one-leg standing with eyes open for the QSPOT, which included 64.58 % (n=31) of the mainstream participants and 68.97 % (n=20) of the LSEN participants. Fifty-two percent (n=25) of the mainstream participants and 65.52 % (n=19) of the LSEN participants used the left leg during the QSPOT one-leg standing balance item with eyes closed. Forty-two percent (n=20) of the mainstream participants and 41.38 % (n=12) of the LSEN participants did not use the same leg for one-leg standing balance with eyes open and eyes closed.

4.2.7 Test Mechanics

There was no statistical difference between the number of participants who were assessed by the researcher and the research assistants when comparing the mainstream and LSEN groups (Table 4.7).

Table 4.8 reflects the numbers of participants who were assessed first using the QSPOT and the numbers of participants who were assessed first using the standardized tests, namely the MABC-2 and the DTVMI-VMI/VP. There were no statistical differences between the numbers of participants in the mainstream and LSEN groups who were assessed first using the QSPOT or by using either standardized test.

Table 4.7 Number of participants who were assessed by the researcher and the research assistants for the MABC-2 and the DTVMI-VMI/VP

	Mainstream Group (n=48)	LSEN Group (n=29)	p value
	n (%)		
Assessed by the researcher	31 (64.58)	17 (58.62)	0.67
Assessed by the research assistants	17 (35.42)	12 (41.38)	

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

Table 4.8 Number of participants who were assessed first with the QSPOT, and who were assessed first using either the MABC-2 or the DTVMI-VMI/VP

	Total Group (n=77)	Mainstream Group (n=48)	LSEN Group (n=29)	p value
	n (%)			
QSPOT first	38 (49.35)	24 (50.00)	14 (48.28)	0.30
MABC-2 first	39 (50.65)	24 (50.00)	15 (51.72)	0.99
DTVMI-VMI/VP first	38 (49.35)	24 (50.00)	14 (48.28)	0.86

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

4.3 The sensitivity and specificity of the reference standard tests used in this research study

Before the results of the sensitivity and specificity of the QSPOT can be shown, it was necessary to determine if the sensitivity and specificity levels of the reference standard tests, namely the MABC-2 and DTVMI-VMI/VP, were similar for the total group (n=77) in this research study to that recorded in research. The values for sensitivity and specificity, the positive and negative likelihood ratios, as well as the 95 % CI for each assessment are presented. Since the CI are large, the sensitivity and specificity values are most likely not precise, and should be interpreted with caution. Values of 70 % and above were taken to indicate acceptable levels of sensitivity and specificity for the purpose of this study, particularly for the QSPOT, for the following reasons: (1) a prescribed minimum at this level has been used in previous research on a motor checklist[116]; and (2) a lower value may be selected in the case of the need to identify at risk learners[15], such as in the case of the QSPOT.

The participants who had been identified with intrinsic barriers to learning (n=29) prior to undergoing testing for the research study made up 37.66 % of the sample, which was considered to be the prevalence (95 % CI 26.87 % to 49.44 %) of intrinsic barriers of the total sample in this study. Since this prevalence is higher than the prevalence of intrinsic barriers to learning in the overall population of South Africa, the positive and negative predictive values could not be included[18].

4.3.1 Sensitivity and specificity of the Movement ABC-2 for the total group

Table 4.9 shows the values for sensitivity and specificity that were calculated for the MABC-2 using MedCalc® Statistical Software[18]. The MABC-2[4] recognizes z scores of between -1.00 and -1.33 SD as indicating that a learner may be at risk of a movement difficulty. However, scores that were -1.00 SD and lower for the MABC-2 were taken as failures for the purposes of this study, as a screening procedure is required to discriminate learners with definite intrinsic barriers, as well as those who are at risk for intrinsic barriers[5,22,33,38].

Table 4.9 Sensitivity and specificity of the Movement ABC-2 for the total group (n=77)

Movement ABC-2 (n=77)	Sensitivity %	Specificity %	Positive Likelihood Ratio	Negative Likelihood Ratio
	95 % Confidence intervals			
Manual Dexterity Component (≤ -1.00 SD)	62.07	**70.83**	2.13	0.54
	42.27 to 79.29	55.93 to 83.04	1.26 to 3.60	0.32 to 0.88
MABC-2 Aiming & Catching Component (≤ -1.00 SD)	24.14	**97.92**	11.59	0.77
	10.34 to 43.55	**88.89 to 99.65**	1.50 to 89.46	0.63 to 0.96
MABC-2 Balance Component (≤ -1.00 SD)	65.52	**81.25**	3.49	0.42
	45.67 to 82.04	67.36 to 91.03	1.83 to 6.66	0.25 to 0.71
MABC-2 Total Score (≤ -1.00 SD)	58.62	**83.33**	3.52	0.50
	38.94 to 76.48	69.78 to 92.52	1.74 to 7.10	0.32 to 0.78

This research study found acceptable specificity values for the MABC-2 Manual Dexterity Component (70.83 %), the Balance Component (81.25 %) and the Total Score (83.33 %), and good specificity for the Aiming and Catching Component (97.92 %).

In contrast, unacceptable sensitivity was found for all the MABC-2 Components and Total Score. The MABC-2 Balance Component (65.52 %) and the MABC-2 Manual Dexterity Component (62.07 %) achieved the highest sensitivity levels, while the MABC-2 Aiming and Catching Component (24.14 %) achieved the lowest level of sensitivity.

Overall, the results confirmed that the MABC-2 was adequate at eliminating those without intrinsic barriers to learning, but that it failed to accurately identify an adequate number of participants with intrinsic barriers to learning in motor and praxis, and sensory-perceptual performance skills.

The positive likelihood ratios of over 1.00 indicate a high probability that an intrinsic barrier to learning is present if the participant has scored at -1.00 SD[15,118], and that further testing should be done to confirm this. The negative likelihood ratios below 1.00 show that the MABC-2 identified the majority of participants without intrinsic barriers correctly; however, some negative likelihood ratios were close to 1.00, and thus some participants with difficulties may have been missed[118,119].

4.3.2 Sensitivity and specificity of the Developmental Test of Visual-Motor Integration (VMI and VP subtests) for the total group

Table 4.10 shows the sensitivity and specificity values for the DTVMI-VMI and DTVMI-VP for the total group. The -1.00 SD protocol was taken for the DTVMI-VMI/VP, as scores equal to and below -1.00 SD are termed to be below-average and lower by the DTVMI manual[32], as well as to align with the -1.00 SD protocol used for the QSPOT.

Table 4.10 Sensitivity and specificity of the Developmental Test of Visual-Motor Integration for the total group (n=77)

Developmental Test of VMI (n=77)	Sensitivity %	Specificity %	Positive Likelihood Ratio	Negative Likelihood Ratio
	95 % Confidence intervals			
DTVMI-VMI (≤ -1.00 SD)	31.03	**97.92**	14.90	0.70
	15.32 to 50.83	**88.89 to 99.65**	1.99 to 111.62	0.55 to 0.90
DTVMI-VP (≤ -1.00 SD)	48.25	**83.33**	2.90	0.62
	29.46 to 67.46	**69.77 to 92.50**	1.39 to 6.05	0.43 to 0.90

In this study, the DTVMI-VMI presented with good specificity (97.92 %), and the DTVMI-VP presented with acceptable specificity (83.33 %). Similarly to the MABC-2, both the DTVMI-VMI and DTVMI-VP achieved unacceptable sensitivity values, indicating that they failed to accurately identify an adequate number of participants with intrinsic barriers to learning in motor and praxis, and sensory-perceptual performance skills.

The positive likelihood ratios of over 1.00 indicate that the participants with identified intrinsic barriers to learning were identified as having difficulties[15,118], and as such they require further assessment. The negative likelihood ratios below 1.00 show that the DTVMI-VMI/VP identified the majority of participants without intrinsic barriers correctly; however, the negative likelihood ratios were close to 1.00, indicating that some participants with difficulties may have been missed[118,119].

In conclusion, the MABC-2 and DTVMI-VMI/VP showed adequate specificity, but showed inadequate sensitivity in this research study sample, indicating that 70.83 % to 97.92 % of participants *without* dysfunction were not identified with intrinsic barriers to learning, and that only 24.14 % to 65.52 % of the participants *with* intrinsic barriers to learning were identified with these assessments (Table 4.9 and Table 4.10).

4.4 Sensitivity and specificity of the Quick Screening Procedure for Referral to Occupational Therapy for the total group

The sensitivity and specificity of the QSPOT tasks and Total Score, as well as that of the QSPOT activity items are outlined below.

4.4.1 Differentiation between the mainstream group and LSEN group using the Quick Screening Procedure for Referral to Occupational Therapy within this research sample

Sensitivity and specificity of the QSPOT tasks and Total Score were first considered by evaluating the statistical difference between the mainstream and LSEN groups of participants in terms of their relative performance. Due to the fact that some of the data were not normally distributed, Table 4.11 shows the means, standard deviations, medians and lower to upper quartiles. Due to the reverse scoring on the QSPOT, the upper quartiles are the smaller values, indicating a better performance.

There were statistical differences between the performance of the mainstream and LSEN groups on all four tasks ($p = 0.00$) and the Total Score ($p = 0.00$) using the Mann Whitney U test (Table 4.11). Therefore, the QSPOT was able to discriminate between the participants with dysfunction from those who were expected to perform appropriately within the sample used for this research study. However, the score distributions were not normally distributed overall, and thus care should be taken in interpretation.

When considering the total group, the distributions were negatively skewed and not normally distributed: QSPOT Total Score (-1.09; Lilliefors $p < 0.01$), Task 1: DAP/VMI (-1.06; Lilliefors $p < 0.01$), Task 3: Balance (-0.45; Lilliefors $p < 0.01$) and Task 4: Catching (-1.65; Lilliefors $p < 0.01$). Task 2: Cutting (0.27; Lilliefors $p < 0.05$) was positively skewed and not normally distributed. When considering the LSEN group, normal score distributions were obtained for Task 1: DAP/VMI (0.00; Lilliefors $p < 0.15$) and the Total Score (-0.35; Lilliefors $p > 0.20$), while the remaining tasks were not normally distributed.

Table 4.11 The participants' performance in the Quick Screening Procedure for Referral to Occupational Therapy according to group

QSPOT	Total Group (n=77)	Mainstream Group (n=48)	LSEN Group (n=29)	p value
	Mean (SD) Median (Lower-Upper quartiles)			
Task 1: Draw-a-person (DAP) / Visual Motor Integration (VMI)	**5.70 (4.04)** 5.00 (8.00-3.00)	**3.98 (2.10)** 3.50 (6.00-2.00)	**8.55 (4.84)** 10.00 (12.00-4.00)	0.00**
Task 2: Cutting	**5.96 (3.21)** 6.00 (9.00-3.00)	**5.04 (2.97)** 6.00 (7.00-2.00)	**7.48 (3.03)** 8.00 (10.00-6.00)	0.00**
Task 3: Balance	**3.18 (2.49)** 2.00 (6.00-1.00)	**2.21 (1.88)** 1.00 (4.00-1.00)	**4.79 (2.55)** 6.00 (7.00-2.00)	0.00**
Task 4: Catching	**1.81 (2.85)** 0.00 (2.00-0.00)	**0.90 (1.90)** 0.00 (1.00-0.00)	**3.31 (3.49)** 1.00 (7.00-1.00)	0.00**
Total Score	**16.65 (9.91)** 14.00 (22.00-9.00)	**12.13 (5.77)** 10.50 (15.00-8.00)	**24.14 (10.84)** 23.00 (32.00-17.00)	0.00**

A lower QSPOT score indicates better performance[2,3], ie, lower quartile score > upper quartile score.
Statistical Significance p ≤ 0.05* Statistical Significance p ≤ 0.01**

4.4.2 Sensitivity and specificity of the tasks and total score of the Quick Screening Procedure for Referral to Occupational Therapy

The sensitivity and specificity of the QSPOT Total Score and tasks were analysed using the –1.00 SD z score cut-off as an indication of failure on the test, so the results could be compared to the sensitivity and specificity of the reference standard tests used in the study (MABC-2 and DTVMI). Since the data for the tasks were not all normally distributed, the sensitivity and specificity of the QSPOT *activity items* were also analysed according to the number of participants who had passed or failed the end-products or performance for each activity item in the four tasks.

4.4.2.1 Sensitivity and specificity of the tasks and total score of the Quick Screening Procedure for Referral to Occupational Therapy using the z scores of the total group

The sensitivity and specificity was calculated for the QSPOT tasks and total score by gathering the numbers of participants in the total group (n=77) who had passed and failed on the QSPOT Total Score, and the numbers of participants who had passed and failed each of the QSPOT tasks. The z scores that were calculated using the means and standard deviations of the total group (n=77) for the QSPOT Total Score and each task score were used. The -1.00 SD protocol was followed, where participants with z scores at or below -1.00 SD were deemed to have failed the respective tasks or on the total score. MedCalc® Statistical Software[18] was then used to calculate the sensitivity and specificity of the QSPOT using the total group of participants. Table 4.12 shows the sensitivity and specificity values for the QSPOT using the z scores.

Good levels of specificity were obtained for the QSPOT Task 1: DAP/VMI (100.00 %), Task 2: Cutting (97.92 %), Task 3: Balance (93.75 %), Task 4: Catching (93.75 %) and the Total Score (97.92 %) for the total group.

Table 4.12 Sensitivity and specificity of the Quick Screening Procedure for Referral to Occupational Therapy using the z scores for the total group (n=77)

QSPOT (n=77)	Sensitivity %	Specificity %	Positive Likelihood Ratio	Negative Likelihood Ratio
	95 % Confidence Interval			
Task 1: DAP/VMI	51.72	**100.00**	-	0.48
	32.54 to 70.54	**92.53 to 100.00**	-	0.33 to 0.70
Task 2: Cutting	37.93	**97.92**	18.21	0.63
	20.71 to 57.73	**88.89 to 99.65**	2.48 to 133.80	0.48 to 0.85
Task 3: Balance	58.62	**93.75**	9.38	0.44
	38.94 to 76.48	**82.80 to 98.69**	3.01 to 29.26	0.28 to 0.68
Task 4: Catching	34.48	**93.75**	5.52	0.70
	17.96 to 54.33	**82.78 to 98.62**	1.65 to 18.41	0.53 to 0.92
Total Score	37.93	**97.92**	18.21	0.63
	20.69 to 57.74	**88.93 to 99.95**	2.48 to 133.80	0.48 to 0.85

As with the MABC-2 and DTVMI, unacceptable sensitivity was found for all the QSPOT tasks and Total Score. The QSPOT Task 1: DAP/VMI (51.72 %) and Task 3: Balance (58.62 %) achieved the highest sensitivity levels, while QSPOT Task 4: Catching (34.48 %) achieved the lowest level of sensitivity.

Overall, a similar pattern for sensitivity and specificity was obtained for the QSPOT, as well as the MABC-2 and the DTVM-VMI/VP, where adequate specificity but poor sensitivity was found for this sample. This confirmed that the QSPOT was adequate at eliminating those without intrinsic barriers to learning, but that it failed to accurately identify an adequate number of participants with intrinsic barriers to learning in motor and praxis, and sensory-perceptual performance skills.

Again, the positive likelihood ratios over 1.00 indicate that the majority of those identified on the QSPOT with barriers to learning should be assessed further. The negative likelihood ratios below 1.00 show that the QSPOT identified the majority of participants without intrinsic barriers correctly; however, some negative likelihood ratios were close to 1.00, and thus some participants with difficulties may have been missed[118,119].

4.4.2.2 Sensitivity and specificity of the Quick Screening Procedure for Referral to Occupational Therapy for the total group using failure of each activity item in the four tasks

The sensitivity and specificity of the activity items of the QSPOT tasks were also investigated in terms of the numbers of participants who had passed or failed the end-products or performance produced. The participants who failed the end-products or performance expected within the activity item for each task were penalized with an additional weighting of three points as per scoring protocol of the QSPOT. Therefore, the numbers of participants who failed or passed were counted based on whether this weighting had been applied or not (Table 4.13).

Table 4.13 Sensitivity and specificity of the Quick Screening Procedure for Referral to Occupational Therapy for the total group (n=77) – an analysis of the activity items

QSPOT (n=77)	Sensitivity %	Specificity %	Positive Likelihood Ratio	Negative Likelihood Ratio
	95 % Confidence Interval			
Task 1 A: DAP item	**75.86**	66.67	2.28	0.36
	56.45 to 89.66	51.59 to 79.59	1.45 to 3.57	0.18 to 0.71
Task 1 B: VMI item	55.17	**93.75**	8.83	0.48
	35.70 to 73.54	**82.78 to 98.62**	2.81 to 27.71	0.32 to 0.72
Task 1 B: VMI item (naming shapes)	20.69	**100.00**	-	0.79
	7.99 to 39.72	**92.60 to 100.00**	-	0.66 to 0.96
Task 2: Cutting item	**79.31**	37.50	1.27	0.55
	60.27 to 91.95	23.96 to 52.65	0.95 to 1.69	0.25 to 1.23
Task 3: Balance item A (Eyes open)	65.52	**75.00**	2.62	0.46
	45.67 to 82.04	60.40 to 86.35	1.50 to 4.57	0.27 to 0.78
Task 3: Balance item B (Eyes closed)	62.07	**75.00**	2.48	0.51
	42.26 to 79.31	60.40 to 86.36	1.41 to 4.38	0.31 to 0.83
Task 4: Catching item	34.48	**89.58**	3.31	0.73
	17.96 to 54.33	**77.33 to 96.49**	1.26 to 8.73	0.55 to 0.97

The following QSPOT activity items obtained good specificity, namely the QSPOT Task 1: VMI activity item (93.75 %) and the Task 1: VMI naming shapes activity item (100.00 %), while acceptable specificity was found for the QSPOT Task 3: Balance on one leg with eyes open (75.00 %), the Task 3: Balance on one leg with eyes closed item (75.00 %), and Task 4: Catching activity item (89.58 %).

The Task 1 A: DAP activity item and Task 2: Cutting activity item were found to have low specificity levels. Therefore, learners may be identified with a problem on these two items when they may not have one.

Poor levels of sensitivity were found for most of the QSPOT activity items; however, exceptions included the Task 1: DAP item (75.86 %) and Task 2: Cutting item (79.31 %). The acceptable sensitivity for these two items indicates that they identified an acceptable percentage of those participants with identified dysfunction.

Again, the positive likelihood ratios over 1.00 indicate the majority of those identified on the QSPOT with intrinsic barriers to learning should be assessed further; however, the positive likelihood ratios were not as high as for the QSPOT tasks and Total Score according to z scores (compare to Table 4.12). The negative likelihood ratios below 1.00 show that many participants without intrinsic barriers were identified as not having difficulties on the QSPOT. However, since some ratios are still high[118,119], this may indicate that some participants with intrinsic barriers to learning may have been missed on various activity items.

In conclusion, the QSPOT showed an imbalance between the levels of sensitivity and specificity of the task scores, the Total Score, as well as for the activity items of the tasks themselves.

4.5 Validity and reliability of the Quick Screening Procedure for Referral to Occupational Therapy

4.5.1 Concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy and the Movement ABC-2 for Age-band 1 and Age-band 2

Spearman’s rank order correlation coefficients were used to establish concurrent validity, as analysis using Lilliefors values showed that the majority of the scores were not normally distributed. The correlations were obtained by comparing the z scores for the QSPOT with the z scores of the MABC-2 and the DTVMI-VMI/VP. Negative correlations were produced as a lower score on the QSPOT indicates better performance, while a higher score on the MABC-2 and the DTVMI-VMI/VP indicates better performance. Therefore, the z scores of the QSPOT were reversed to allow better performance on the QSPOT to be placed on the positive side of the normal curve, thus also allowing for positive correlations. For the purposes of this study, correlations of 0.60 and above were considered to be strong[125] and thus of acceptable value.

The MABC-2 Manual Dexterity component and tasks (posting coins, threading beads and drawing trails) were correlated with the fine motor tasks on the QSPOT (Task 1: DAP/VMI and Task 2: Cutting). The MABC-2 Balance Component and tasks (one-leg balance, walking heels raised and jumping on mats) were correlated with the QSPOT Task 3: Balance, while the MABC-2 Aiming and Catching component and tasks (catching a beanbag and throwing a beanbag onto a mat) were correlated with the QSPOT Task 4: Catching.

4.5.1.1 Age-band 1

Table 4.14 shows the correlations between the QSPOT tasks and the MABC-2 Components and tasks for Age-band 1 (n=35). A strong correlation was found between the QSPOT Total Score and the MABC-2 Total Score (r=0.68), indicating that the tests do measure similar components of fine and gross motor skills.

Table 4.14 Correlations for the z scores of the Quick Screening Procedure for Referral to Occupational Therapy and the z scores of the Movement ABC-2 for Age-band 1

QSPOT	Movement ABC-2 (n=35)			
	Manual Dexterity Component (MD Test 1,2,3)			**Total Score**
Task 1: Draw-a-person (DAP) / Visual Motor Integration (VMI)	**rho**			**rho**
	0.53			0.59
	1. Posting coins	**2. Threading beads**	**3. Drawing trail**	
	0.44	0.49	0.43	
Task 2: Cutting	0.49			0.52
	1. Posting coins	**2. Threading beads**	**3. Drawing trail**	
	0.38	0.47	0.36	
	Balance Component (Bal Test 1,2,3)			**Total Score**
Task 3: Balance	**rho**			**rho**
	0.69			0.56
	1. One-leg balance	**2. Walk heels raised**	**3. Jumping on mats**	
	0.71	0.55	0.53	
	Aiming and Catching Component (AC Test 1,2)			**Total Score**
Task 4: Catching	**rho**			**rho**
	0.54			0.43
	1. Catching beanbag	**2. Throwing beanbag onto mat**		
	0.63	0.36		
	Manual Dexterity Component	**Aiming and Catching Component**	**Balance Component**	**Total Score**
Total Score	**0.62**	0.43	**0.64**	**0.68**

All correlations were significant at $p < 0.05$.

In Age-band 1, a strong correlation was also found between the QSPOT Task 3: Balance and the MABC-2 Balance Component, while only moderate correlations were found between the fine motor tasks of the QSPOT and the MABC-2 Manual Dexterity Component, and between the QSPOT Task 4: Catching and the MABC-2 Aiming and Catching Component.

The fine motor components presented with moderate correlations between the QSPOT Task 1: DAP/VMI (which involved drawing and visual perception) and the MABC-2 Manual Dexterity Component tasks (which involved fine manipulation, drawing and visual perception). Weak correlations were found between the QSPOT Task 2: Cutting (which involved bilateral fine manipulation) and the MABC-2 posting coins item (which involved unilateral fine manipulation), and the MABC-2 drawing trail item (which involved drawing and VMI). The correlation for cutting and the MABC-2 threading beads item, both of which involve bilateral fine manipulation, was moderate.

The correlation for the QSPOT Task 3: Balance and the MABC-2 one-leg balance activity item was strong as both QSPOT balance activity items assess static balance, whereas the correlations were moderate for the MABC-2 walking heels raised and MABC-2 jumping on mats items, where dynamic balance was assessed.

The correlation for the QSPOT Task 4: Catching and MABC-2 catching task was strong, as only catching was involved in the QSPOT item. Therefore, a weak correlation for the MABC-2 item of throwing a beanbag onto the mat reflected the lack of a specific activity item that measured the ability to throw accurately at a target in the QSPOT.

4.5.1.2 Age-band 2

Table 4.15 shows the correlations of the z scores of the QSPOT and the z scores of the MABC-2 for Age-band 2 (n=42). The correlation between the QSPOT Total Score and the MABC-2 Total Score were lower for Age-band 2 than Age band 1, where only a moderate correlation was found. Only moderate correlations were found for the QSPOT tasks and the relevant MABC-2 Components, and these were also lower for Age-band 2 compared to Age-band 1.

In Age-band 2, Task 1: DAP/VMI in the QSPOT showed a moderate correlation to the MABC-2 Manual Dexterity Component for the drawing trail (both of which involve drawing and VMI), and weak correlations with the MABC-2 threading beads and posting coins activity items which are fine manipulation tasks.

A moderate correlation was found between cutting in the QSPOT and the unilateral manual dexterity item of posting coins in the MABC-2 for Age-band 2. The correlations between QSPOT Task 2: Cutting and the MABC-2 Manual Dexterity threading beads (both of which involve bilateral manual dexterity) and the MABC-2 drawing trail item (a drawing and visual perceptual task) were weak.

The Task 3: Balance on the QSPOT had a similar pattern of correlation to the MABC-2 Balance Component as was found in Age-band 1 for static and dynamic balance items, with the correlation being slightly lower. Similar lower correlations were found for the QSPOT Task 4: Catching and the MABC-2 Aiming and Catching Component with the correlation for the MABC-2 catching task again being higher than that for the MABC-2 throwing item.

Table 4.15 Correlations for the z scores of the Quick Screening Procedure for Referral to Occupational Therapy and the z scores of the Movement ABC-2 for Age-band 2

QSPOT	Movement ABC-2 (n=42)			
	Manual Dexterity Component (MD Test 1,2,3)			Total Score
Task 1: Draw-a-person (DAP) / Visual Motor Integration (VMI)	rho			rho
	0.44			0.49
	1. Posting coins	2. Threading beads	3. Drawing trail	
	0.33	0.31	0.42	
Task 2: Cutting	0.49			0.40
	1. Posting coins	2. Threading beads	3. Drawing trail	
	0.49	0.35	0.32	
	Balance Component (Bal Test 1,2,3)			Total Score
Task 3: Balance	rho			rho
	0.51			0.52
	1. One-leg balance	2. Walk heels raised	3. Jumping on mats	
	0.63	0.46	0.40	
	Aiming and Catching Component (AC Test 1,2)			Total Score
Task 4: Catching	rho			rho
	0.37			0.47
	1. Catching beanbag	2. Throwing beanbag onto mat		
	0.53	0.17		
	Manual Dexterity Component	Aiming and Catching Component	Balance Component	Total Score
	rho			rho
Total Score	0.54	0.47	0.53	0.58

Moderate and strong correlations were significant at $p < 0.05$.

Overall, Age-band 1 showed better concurrent criterion validity of the QSPOT compared to Age-band 2. The results indicate some overlap in the items and tasks on the QSPOT and MABC-2 assessments, but the correlation on the Total Score indicates that r^2 = 46.24 % of the total variation in the one assessment for Age-band 1 can be explained by the other, whereas this this is only r^2 = 33.64 % in Age-band 2.

4.5.2 Concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy and the Developmental Test of Visual-Motor Integration for Age-band 1 and Age-band 2

Table 4.16 shows the correlations between the QSPOT and the DTVMI-VMI/VP using Spearman's rank r correlations for Age-band 1 (n=35) and Age-band 2 (n=42).

When considering Age-band 1, strong correlations were found between the DTVMI-VMI and the QSPOT Task 1: DAP/VMI (both of which require fine motor skills related to drawing and VMI skills), as well as Task 2: Cutting (which is a bilateral fine motor skill).

Table 4.16 Correlations for the z scores of the Quick Screening Procedure for Referral to Occupational Therapy and the z scores of the Developmental Test of Visual-Motor Integration for Age-band 1 and 2

QSPOT	Developmental Test of Visual-Motor Integration for Age-band 1 (n=35)	
	Visual-Motor Integration (VMI)	Visual Perception (VP)
	rho	
Task 1: Draw-a-person (DAP) / Visual Motor Integration (VMI)	**0.75**	0.50
Task 2: Cutting	**0.67**	0.34
Total Score	**0.77**	0.47
QSPOT	**Developmental Test of Visual-Motor Integration for Age-band 2 (n=42)**	
	Visual-Motor Integration (VMI)	**Visual Perception (VP)**
	rho	
Task 1: Draw-a-person (DAP) / Visual Motor Integration (VMI)	0.56	0.37
Task 2: Cutting	**0.60**	0.39
Total Score	**0.73**	0.47

Moderate and strong correlations are significant at $p < 0.05$.

The analysis of Age-band 2 showed a lower moderate correlation between the DTVMI-VMI and the QSPOT Task 1: DAP/VMI. As for Age-band 1, a strong correlation was found between the DTVMI-VMI and QSPOT Task 2: Cutting for Age-band 2; however, the correlation was slightly lower. The strong correlation between the QSPOT Task 1: DAP/VMI and the DTVMI-VMI indicates that r^2 = 56.25 % of the total variation in the one test can be explained by the other for Age-band 1; however, this was only r^2 = 31.36 % for Age-band 2.

The correlations between the DTVMI-VP and the QSPOT Task 1: DAP/VMI and Task 2: Cutting, and the Total Score ranged between moderate and weak for both age-bands.

Overall, the concurrent criterion validity between the QSPOT and the DTVMI-VMI/VP was lower for Age-band 2 compared to Age-band 1. The strong correlation between the QSPOT Total Score (r=0.77) and the DTVMI-VMI indicates that r^2 = 59.29 % of the variance in the one test is explained by the other for Age-band 1, while r^2 = 53.29 % of the variance in one test can be explained by the other for Age-band 2. This was not the case for the QSPOT and the DTVMI-VP, where only weak to moderate correlations were found.

In conclusion, the concurrent criterion validity of the QSPOT with the MABC-2 and the DTVMI-VMI/VP was better for Age-band 1 than Age-band 2. Acceptable correlations were found between the similar tasks of balance and catching in the QSPOT and the MABC-2, as well as between the Total Scores of the QSPOT and MABC-2 for Age-band 1, compared to only one adequate correlation between one-leg standing balance in the QSPOT and MABC-2 for Age-band 2. The concurrent criterion validity of the QSPOT was also better for the MABC-2 and the DTVMI-VMI than the DTVMI-VP, indicating that the QSPOT assesses similar constructs of visual-motor integration performance skills compared to visual perceptual performance skills.

4.5.3 Internal consistency of the Quick Screening Procedure for Referral to Occupational Therapy

Cronbach's alpha was used to determine the item-to-total correlations between the individual tasks of the QSPOT and the QSPOT Total Score with the specific task deleted from the calculation. The overall Cronbach's alpha value for the QSPOT total test is 0.78, which shows acceptable internal consistency for the test using the total group. This indicates that the test items measure the same construct related to intrinsic barriers to learning, even though there are substantial differences between the tasks within the QSPOT.

Acceptable alpha scores of over 0.70 [115] were obtained for Task 2: Cutting, Task 3: Balance and Task 4: Catching; however, the Cronbach's alpha value for Task 1: DAP/VMI was slightly below the acceptable limit (Table 4.17), indicating that the task has two components which may be different, resulting in lower inter-correlations. The average inter-item correlation for the QSPOT was moderate (r=0.48); however, this was expected as the QSPOT was designed to detect different skills across the tasks, although a slightly lower value is desired.

Table 4.17 Cronbach's alpha for the Quick Screening Procedure for Referral to Occupational Therapy for the total group (n=77)

QSPOT (n=77)	Task 1: DAP/VMI	Task 2: Cutting	Task 3: Balance	Task 4: Catching
Total Score	0.66	**0.73**	**0.72**	**0.77**

Table 4.18 shows the Spearman's rank r item-to-total correlations for the QSPOT for the total group. This non-parametric analysis revealed excellent correlations for Task 1: DAP/VMI (r=0.80) and Task 2: Cutting (r=0.82), and a strong correlation for Task 3: Balance (r=0.70), but only a moderate correlation was obtained for Task 4: Catching.

Table 4.18 Spearman's Rank r item-to-total correlations for the Quick Screening Procedure for Referral to Occupational Therapy for the total group (n=77)

QSPOT (n=77)	Task 1: DAP/VMI	Task 2: Cutting	Task 3: Balance	Task 4: Catching
Total Score	**0.80**	**0.82**	**0.70**	0.49

All correlations were significant at $p < 0.05$.

In summary, adequate Cronbach's alpha values of 0.70 and above[115] were found for the QSPOT Task 2: Cutting, Task 3: Balance and Task 4: Catching. The average inter-item correlation was moderate, and strong item-to-total correlations were obtained for QSPOT Task 1: DAP/VMI, Task 2: Cutting and Task 3: Balance. Overall, the QSPOT showed adequate internal consistency of scores for the test. This means that the number of tasks, and the observation criteria, along with the weighting of the activity items, are likely related, but may still be multi-dimensional[14,17,120].

4.6 Analysis of the Quick Screening Procedure for Referral to Occupational Therapy using the group of participants without identified barriers to learning in order to determine cut-off points for at risk performance in Age-band 1 and Age-band 2

At the time of the research study, the QSPOT provided norms that learners were expected to meet if they were performing appropriately for their age-group (referred to as *minimum performance requirements* for the purposes of this study). These performance requirements are used by therapists to pass or fail a learner's end-product or performance on the activity items. For most of the tasks, no performance requirements were provided for Age-band 1 and Age-band 2 specifically. Appendix L shows these norms (Column 1), but also shows the level of performance that related to a cut-off (Column 2) at the time of the research study. Therefore, the cut-offs in Column 2 of Appendix L should be consulted throughout this section.

The scoring and minimum performance requirements (and therefore the cut-offs) of the QSPOT at the time of the research study produced weak and moderate correlations for the QSPOT in comparison with many aspects of the MABC-2 and the DTVMI-VMI/VP. When considering Age-band 1, the results showed greater concurrent criterion validity for the QSPOT with the MABC-2 and the DTVMI-VMI/VP, while lower concurrent criterion validity was found for Age-band 2. This may have been due to some differences in the types of skills assessed by the QSPOT, MABC-2 and the DTVMI-VMI/VP, as well as a shortage of specific cut-offs for each age-band. This study set out to determine the cut-offs at -1.00 SD and the 16th percentile, that would indicate *at risk* performance in the activity items, and which therefore indicate a problem in performance.

Research shows that standardization procedures are conducted on a sample of individuals without identified dysfunction[106,111,112]. Therefore, only the means, standard deviations, medians, and scores at -1.00 SD and scores at the 16th percentile for the mainstream group (n=48) were considered in determining the cut-offs for each of the two age-bands. Gender was not taken into consideration, as numerous existing standardized tests that assess similar constructs to the QSPOT are gender-free, including the MABC-2[4] and DTVMI[32] that were used as reference standards in this research study.

When the data were normally distributed, the cut-offs for Age-band 1 and Age-band 2 learners on the various activity items were calculated using the data of performance of the participants at -1.00 SD. In the cases where the data were not normally distributed, the 16th percentile was used.

4.6.1 Quick Screening Procedure for Referral to Occupational Therapy - Task 1: Draw-a-Person and Visual Motor Integration

For the QSPOT Task 1: DAP/VMI, the mainstream Age-band 1 learners yielded z scores that were normally distributed (-0,11; Lilliefors $p < 0.10$). In contrast, the Age-band 2 learners yielded z scores for Task 1: DAP/VMI that were negatively skewed (-0.58), and the data were not normally distributed ($p < 0.01$).

4.6.1.1 Task 1 A: Draw-a-Person

Cut-off indicating at risk performance (compatible with the minimum performance requirements of the QSPOT[2,3] at the time of the research study): A body and seven or fewer parts; A drawing that gives the impression that the skill has been taught; A drawing without arms and/or legs.

In this research study, two dimensional bodies were drawn by 81.25 % (n=39) of the mainstream participants, while stick bodies were drawn by 8.33 % (n=4) of the participants. Although there was no statistical difference between the age-bands, the results indicated that there was a difference in the performance of the mainstream Age-band 1 and Age-band 2 participants in the number of body parts they drew (Table 4.19).

Table 4.19 Means, standard deviations (SD), medians, cut-offs (-1.00 SD or 16th percentile) and p values for Task 1 A: Draw-a-Person for Age-band 1 and 2

Activity Item	Mainstream Group (n=48)	Age-band 1 (n=23)	Age-band 2 (n=25)	p value
QSPOT Task 1 A: DAP	**Mean (SD) Median Cut-off: - 1.00 SD (16th percentile)**			
	Cut-off = at risk and lower performance			
No. of body parts (excl. body)	8.52 (1.58) **9.00** **Cut-off:** 6.94 **(7.00)**	**8.26 (2.05)** 8.00 **Cut-off:** **6.21** (7.00)	8.76 (0.97) **9.00** **Cut-off:** 7.79 **(8.00)**	0.33
Cut-off	**7 body parts**	**6 body parts**	**8 body parts**	
	Mean (SD) Median Cut-off: - 1.00 SD (16th percentile)			
	Cut-off = at risk and lower performance			
No. of body parts (incl. body)	9.42 (1.68) **10.00** **Cut-off:** 7.74 **(8.00)**	**9.09 (2.17)** 9.00 **Cut-off:** **6.92** (8.00)	9.72 (1.02) **10.00** **Cut-off:** 8.70 **(9.00)**	0.24
Cut-off	**8 body parts**	**7 body parts**	**9 body parts**	

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

The mainstream Age-band 1 participants showed negatively skewed scores for the number of body parts drawn (-0.35), and the total number of body parts drawn (-0.38); however, the score distributions were normal ($p > 0.20$ and $p < 0.10$ respectively). Therefore, an Age-band 1 learner should be considered *at risk* if only able to draw seven body parts, including a body (-1.00 SD below the mean). This means that some Age-band 1 learners may be identified with difficulties when they do not have any.

The mainstream Age-band 2 participants yielded negatively skewed scores for the number of body parts drawn (-0.37) and for the total number of body parts drawn (-0.66); however, neither element was normally distributed ($p < 0.01$). Therefore, an Age-band 2 learner should be considered *at risk* if only able to draw a person with nine parts, including the body (16th percentile). Therefore, some Age-band 2 learners with difficulties may be missed if the current performance requirements of the QSPOT are used (Appendix L).

4.6.1.2 Task 1 B: Visual Motor Integration

Cut-off indicating at risk performance (compatible with the minimum performance requirements of the QSPOT[2,3] at the time of the research study): Ability to copy five or fewer shapes.

There was no statistical difference between Age-band 1 and Age-band 2 participants for the QSPOT Task 1 B: VMI activity item (Table 4.20).

Table 4.20 Means, standard deviations (SD), medians, cut-offs (-1.00 SD or 16th percentile) and p values for Task 1 B: Visual Motor Integration for Age-band 1 and 2

Activity Item	Mainstream Group (n=48)	Age-band 1 (n=23)	Age-band 2 (n=25)	p value
QSPOT Task 1 B: VMI	**Mean (SD)** **Median** **Cut-off: - 1.00 SD (16th percentile)**			
	Cut-off = at risk or lower performance			
Total no. of shapes drawn (required six shapes)	5.94 (0.24) **6.00** **Cut-off:** 5.70 **(6.00)**	5.91 (0.29) **6.00** **Cut-off:** 5.62 **(6.00)**	5.96 (0.20) **6.00** **Cut-off:** 5.76 **(6.00)**	0.79
Cut-off	**6 shapes**	**6 shapes**	**6 shapes**	
	Mean (SD) **Median** **Cut-off at -1.00 SD (16th percentile)**			
	Cut-off = at risk or lower performance			
Total no. of shapes drawn (incl. rectangle and diamond)	6.29 (0.58) **6.00** **Cut-off:** 5.71 **(6.00)**	6.17 (0.58) **6.00** **Cut-off:** 5.59 **(6.00)**	6.40 (0.58) **6.00** **Cut-off:** 5.82 **(6.00)**	0.24
Cut-off	**6 shapes**	**6 shapes**	**6 shapes**	

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

The number of basic shapes drawn by Age-band 1 and Age-band 2 participants yielded negatively skewed distributions (-3.14 and -5.00 respectively), and neither set of data was normally distributed ($p < 0.01$). When considering the total number of shapes drawn, Age-band 1 participants obtained scores that were not skewed (0.02), while Age-band 2 participants obtained scores that were negatively skewed (-0.28). However, the data were not normally distributed for either age-band ($p < 0.01$). For both Age-band 1 and Age-band 2, the cut-offs at the 16th percentile are the same as the medians.

According to the results of this study, the ability to draw six required shapes, and the ability to draw six shapes in total, may be considered *at risk* performance, and therefore, additional shapes may need to be incorporated into this activity item in order for more reliable cut-offs to be obtained. This may be related to the ceiling effects that were noted for all six of the required shapes, and which accounted for the skewed distribution of the data (Figure 4.1). A ceiling effect was noted when more than 70 % of the participants were successful at copying a particular form.

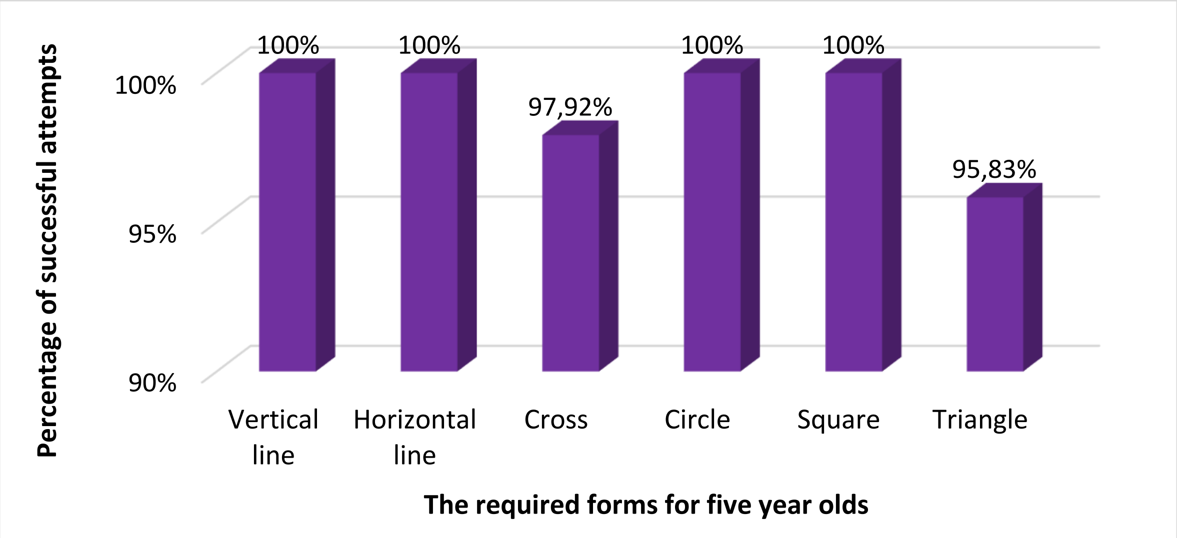


Figure 4.1 Percentage of mainstream participants who copied the required forms correctly in Task 1 B: Visual Motor Integration

Fewer mainstream participants were able to copy the cross (n=47) and triangle (n=46) correctly (Figure 4.1). Thirty-five percent (n=17) were able to draw the rectangle with a diagonal cross adequately. Gross representations of the diamond were obtained by 31.25 % (n=15) of the participants in the QSPOT Task 1 B: Visual Motor Integration, while only one participant was able to draw a diamond that matched the criteria of the DTVMI-VMI[32].

Possible shapes to name include the cross, circle, square, triangle, rectangle and diamond in any combination[2]. Cut-off indicating *at risk* performance (compatible with the minimum performance requirements of the QSPOT[2,3] at the time of the research study): Naming of two out of six shapes.

There was no statistical difference between Age-band 1 and Age-band 2 participants in naming shapes (Table 4.21). The data for Age-band 1 and Age-band 2 participants were negatively skewed (-0.88 and -0.84 respectively), and neither were normally distributed ($p < 0.01$), resulting in the cut-offs being based at the 16th percentile.

Table 4.21 Means, standard deviations (SD), cut-offs (-1.00 SD or 16th percentile) and p values for Task 1 B: Visual Motor Integration (naming shapes component) for Age-band 1 and 2

Activity Item	Mainstream Group (n=48)	Age-band 1 (n=23)	Age-band 2 (n=25)	p value
QSPOT Task 1 B: VMI	**Mean (SD)** **Median** **Cut-off at -1.00 SD (16th percentile)**			
	Cut-off = at risk or lower performance			
Total no. of shapes named	5.02 (0.89) **5.00** **Cut-off:** 4.13 **(4.00)**	5.09 (0.95) **5.00** **Cut-off:** 4.14 **(4.00)**	4.96 (0.84) **5.00** **Cut-off:** 4.12 **(4.00)**	0.53
Cut-off	**4 shapes**	**4 shapes**	**4 shapes**	

Statistical Significance $p \leq 0.05$* Statistical Significance $p \leq 0.01$**

According to the results of this research study, Age-band 1 learners and Age-band 2 learners should be considered *at risk* if only able to name four out of six shapes. This means that the current cut-off of naming two shapes (based on the performance requirements of the QSPOT[2,3]) is set too low for both age-bands.

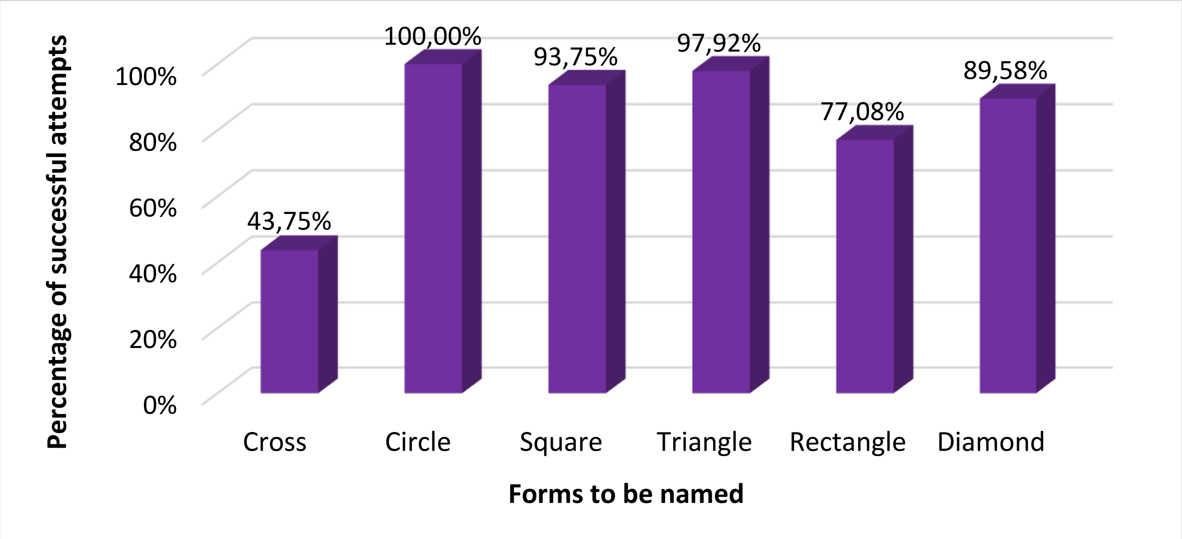


Figure 4.2 Percentage of mainstream participants who named the forms correctly in Task 1 B: Visual Motor Integration

Most of the mainstream participants were able to name between four and six shapes adequately. The cross was the only shape that did not show a ceiling effect, where less than half of the mainstream participants were able to name it correctly (Figure 4.2).

4.6.2 Quick Screening Procedure for Referral to Occupational Therapy - Task 2: Cutting

For the QSPOT Task 2: Cutting, the mainstream Age-band 1 participants yielded z scores that were positively skewed (0.55; Lilliefors $p > 0.20$) while the mainstream Age-band 2 participants yielded z scores that were not skewed (-0.03; Lilliefors $p < 0.15$). Both sets of data were normally distributed.

No definite scoring criteria existed for Age-band 1 and Age-band 2 learners with regard to differentiating *at risk* and *problematic* performance from typical performance. A learner failed the task if: Unable to produce good cutting on curves, corners and straight lines[2,3]; Unable to keep the clown together as a single unit (Appendix L Column 2).

Therefore, the results are discussed in terms of the number of participants in the mainstream group who succeeded, compared to those who failed the cutting activity item. Figure 4.3 illustrates the comparison of Age-band 1 and Age-band 2 of the mainstream group, in terms of whether they were able to cut out the picture adequately, and who were consequently penalized by a weighting of three points.

Although more leaners in Age-band 2 than Age-band 1 were able to produce adequate end-products in the mainstream group, the difference was not statistically significant (p=0.43). The majority of the Age-band 1 and Age-band 2 participants did NOT meet the criteria to pass the cutting activity item.

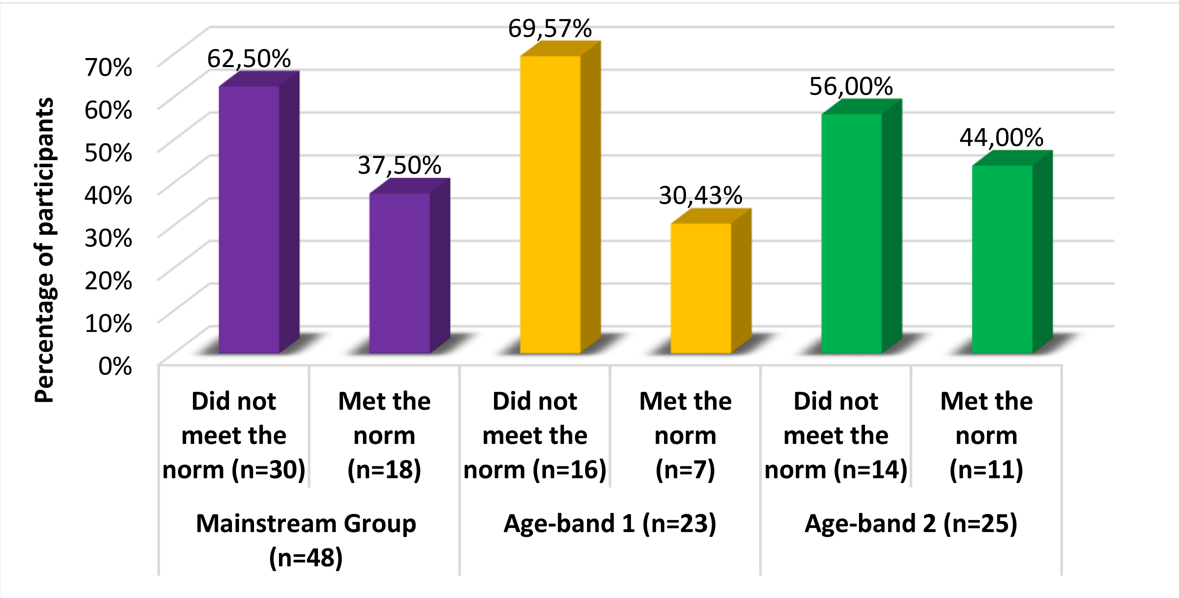
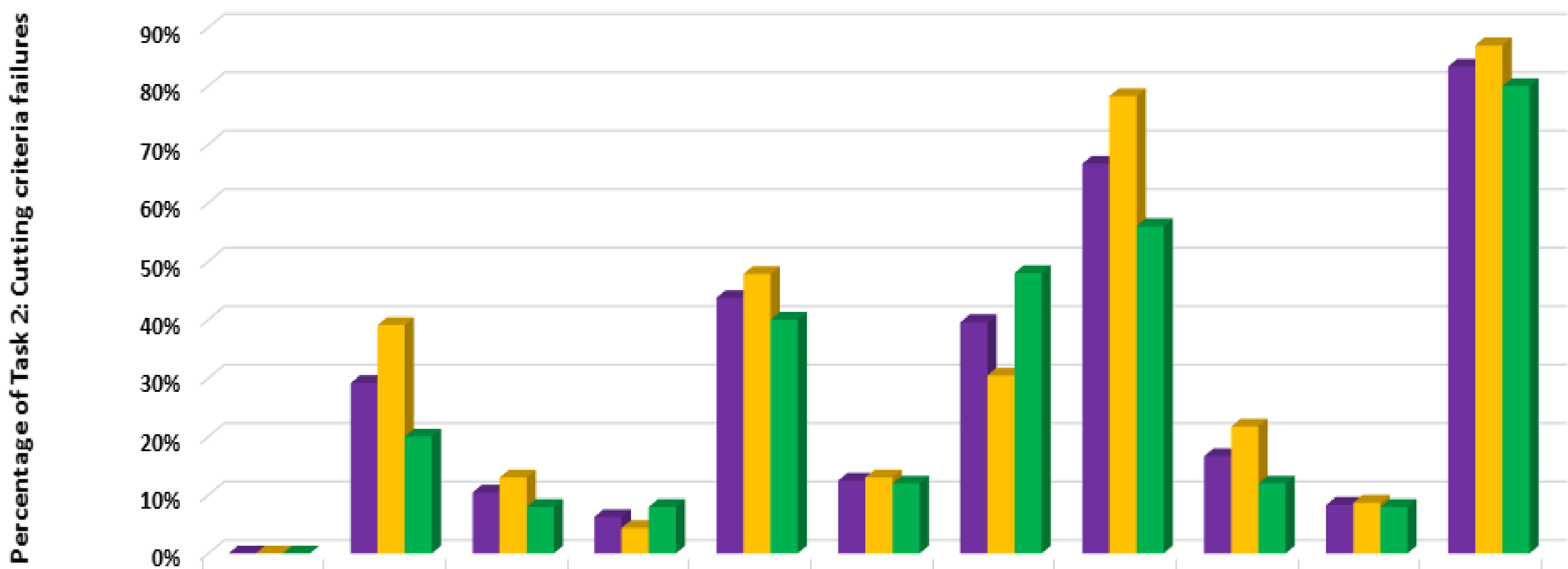


Figure 4.3 Percentage of successful and failed cutting end-products produced by the mainstream group, and Age-band 1 and 2 in Task 2: Cutting



	Preferred Hand	Co-ordinated use of supporting hand	Postural adjust-ments	Associated move-ments	Functional positioning & task execution	Scissor grip	Wrist position	Control of direction	Smooth controlled execution	Fast/ Impulsive/ Poor attention to detail	Neatness & Accuracy
Mainstream group (n=48)	0,00%	29,17%	10,42%	6,25%	43,75%	12,50%	39,58%	66,67%	16,67%	8,33%	83,33%
Age-band 1 (n=23)	0,00%	39,13%	13,04%	4,35%	47,83%	13,04%	30,43%	78,26%	21,74%	8,70%	86,96%
Age-band 2 (n=25)	0,00%	20,00%	8,00%	8,00%	40,00%	12,00%	48,00%	56,00%	12,00%	8,00%	80,00%

Figure 4.4 Percentage of the mainstream group, and Age-band 1 and 2 who failed specific criteria in Task 2: Cutting

Figure 4.4 shows that a high percentage of participants were identified as having difficulties in *"control of direction when cutting"* and *"neatness and accuracy"* in all three of the groups shown. In addition, the Age-band 1 participants had more difficulties in meeting the criteria for *"coordinated use of supporting hand"*, *"control of direction when cutting", and "smooth controlled execution",* as well as for *"neatness and accuracy,"* "*postural adjustments" and "functional positioning"* when compared to Age-band 2 participants. However, none of these criteria showed statistical differences in the Mann Whitney U test. Twenty-nine percent (n=14) of the participants in the mainstream group were unable to keep the picture of the clown together as a single unit. Overall, the results showed that the cutting activity item may be too difficult, and/or the scoring criteria may be too strict, especially for Age-band 1.

4.6.3 Quick Screening Procedure for Referral to Occupational Therapy - Task 3: Balance

The mainstream Age-band 1 and Age-band 2 participants yielded negatively skewed data (-0.59 and -1.07 respectively), and the data were not normally distributed ($p < 0.01$) for the QSPOT Task 3: Balance z scores.

Cut-off indicating *at risk* performance (compatible with the minimum performance requirements of the QSPOT[2,3] at the time of the research study): Standing on one leg with hands on hips and eyes open for less than 9.50 seconds. NB: One-leg standing balance times were rounded off to the nearest unit (MABC-2 protocol[4]).

In contrast with the z score data for Task 3: Balance itself, the data for one-leg standing with eyes open were normally distributed for mainstream Age-band 1 participants (-0.13; Lilliefors $p < 0.20$) as well as for Age-band 2 participants (0.12; Lilliefors $p > 0.20$) (Table 4.22). Thus the cut-offs were based at -1.00 SD for both Age-band 1 and 2.

According to the results of this study, an Age-band 1 learner could be considered *at risk* if only able to stand on one leg with hands on the hips (eyes open) for eight seconds (at -1.00 SD). An Age-band 2 learner could be considered *at risk* if only able to stand on one leg with hands on the hips (eyes open) for nine seconds (at -1.00 SD). This means that the current cut-off used by the QSPOT is adequate for Age-band 2, but that the current cut-off may be set too high for Age-band 1 learners.

Due to the fact that the learners are evaluated on their performance on one leg in the QSPOT[2,3], the times were comparable to the one-leg standing balance task on the best leg in the MABC-2[4]. Relatively large standard deviations were noted for the one-leg standing times obtained in both the QSPOT and MABC-2.

Table 4.22 Means, standard deviations (SD), medians, cut-offs (at -1.00 SD or 16th percentile) and p values for Task 3: Balance for Age-band 1 and 2

Activity Items	Mainstream Group (n=48)	Age-band 1 (n=23)	Age-band 2 (n=25)	p value
QSPOT Task 3	**Mean (SD)** **Median** **Cut-off: -1.00 SD (16th percentile)**			
Task 3 A: One-leg standing with eyes open(sec)	**17.19 (8.49)** 17.50 **Cut-off:** **8.70** (7.00)	**17.09 (8.85)** 19.00 **Cut-off:** **8.24** (6.00)	**17.28 (8.33)** 17.00 **Cut-off:** **8.95** (9.00)	0.94
Cut-off	**9 sec**	**8 sec**	**9 sec**	
MABC-2 One-leg standing with eyes open: Best leg (sec)	**Mean (SD)** **Median**			
	20.10 (8.71) **19.50**	**18.04 (8.35)** 18.00	22.00 (8.77) **27.00**	0.14
	Mean (SD) **Median** **Cut-off: -1.00 SD (16th percentile)**			
Task 3 B: One-leg standing with eyes closed (sec)	3.01 (2.50) **2.00** **Cut-off:** 0.51 **(1.00)**	2.65 (2.05) **2.00** **Cut-off:** 0.60 **(0.00)**	3.34 (2.85) **3.00** **Cut-off:** 0.49 **(1.25)**	0.36
Cut-off	**1 sec**	**0 sec**	**1.25 sec**	

Statistical Significance: $p \leq 0.05$* Statistical Significance: $p \leq 0.01$**

Cut-off indicating *at risk* performance (compatible with the minimum performance requirements of the QSPOT[2] at the time of the research study):

Ability to stand on one leg with hands on the hips for less than two seconds.

Seventy-five percent (n=36) of the mainstream participants were able to stand on one leg with eyes closed for varying periods of more than two seconds. Of the 12 mainstream participants who were not able to stand on one leg with eyes closed, 58.33 % (n=7) were in Age-band 1.

For the times of one-leg standing balance (eyes closed), Age-band 1 participants yielded positively skewed data that were not normally distributed (0.74; Lilliefors $p < 0.05$). Age-band 2 participants also yielded positively skewed data that were not normally distributed (1.81; Lilliefors $p < 0.01$). Thus, the cut-off was based on the 16th percentile for both Age-band 1 and 2.

According to the results of this study, an Age-band 1 learner should be considered *at risk* if unable to stand on one leg with hands on hips and eyes closed at all. An Age-band 2 learner should be considered *at risk* if unable to stand on one leg for more than 1.25 seconds. Therefore, the current cut-off for one-leg standing (eyes closed) for Age-band 1 and Age-band 2 may be set too high, which may lead to learners being identified with difficulties when they may not in fact have dysfunction with regard to this particular skill.

4.6.4 Quick Screening Procedure for Referral to Occupational Therapy - Task 4: Catching

Both Age-band 1 participants (-1.92) and Age-band 2 participants (-3.00) obtained negatively skewed z score data that were not normally distributed ($p < 0.01$) for QSPOT Task 4: Catching.

Cut-off indicating at risk performance (compatible with the minimum performance requirements of the QSPOT[2,3] at the time of the research study): Ability to catch five or fewer out of ten beanbags.

Catching in one hand is also allowed in the MABC-2[4], and therefore, this was accepted within the administration of the QSPOT as well. In this research study, the majority of participants in the mainstream group (n=43; 89.58 %), Age-band 1 (n=19; 82.61 %) and Age-band 2 (n=24; 96.00 %) were able to obtain a score of six or more catches. Therefore, a ceiling effect was noted for this activity item.

Figure 4.5 signifies the number of beanbags caught in various manners, namely in two hands away from the chest, in two hands against the chest, and in one hand. The total numbers of catches in the mainstream group and each age-band are also shown.

The Age-band 2 participants caught a higher number of beanbags in their hands away from their chests, while Age-band 1 participants caught a higher number of beanbags against the chest. Age-band 2 participants collectively caught the beanbag on more occasions than the participants in Age-band 1.

Table 4.23 shows the cut-offs at -1.00 SD and the 16th percentile that constitute at risk performance for the catching activity item of the QSPOT, using the results of this research study. Only the values for catching in the hands away from the chest and the total number of catches are shown, as separate analyses for catching in one hand and against the chest revealed no difference in the scoring. There were statistical differences when comparing the performance of mainstream Age-band 1 and Age-band 2 participants.

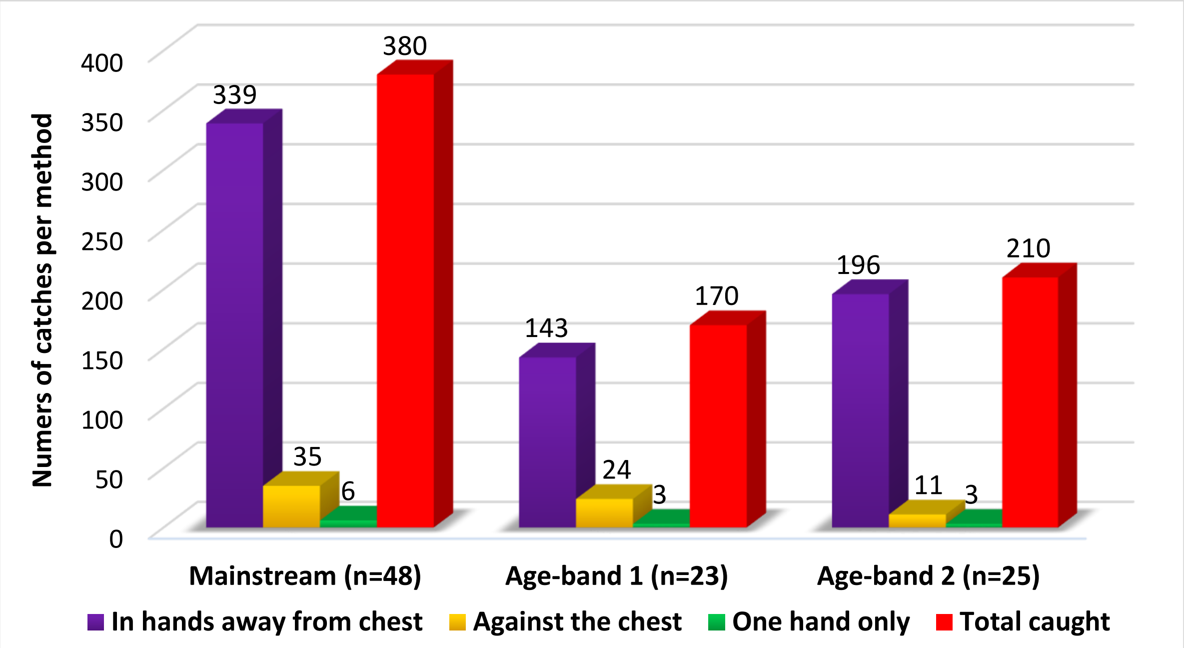


Figure 4.5 Number of beanbags caught per method by the mainstream group, and Age-band 1 and 2 in Task 4: Catching

Table 4.23 Means, standard deviations (SD), medians, cut-offs (at -1.00 SD or 16th percentile) and p values for Task 4: Catching for Age-band 1 and 2

Activity Items	Total Group (n=48)	Age-band 1 (n=23)	Age-band 2 (n=25)	p value
QSPOT Task 4	**Mean (SD) Median (Lower-upper quartiles) Cut-off: -1.00 SD (16th percentile)**			
	Cut-off = at risk and lower performance			
No. caught in two hands away from the chest	7.06 (2.30) 7.50 **Cut-off:** 4.76 **(5.00)**	6.22 (2.70) **7.00** **Cut-off:** 3.52 **(2.00)**	**7.84 (1.55)** 8.00 **Cut-off:** **6.29** (6.50)	0.00**
Cut-off	**5 catches**	**2 catches**	**6 catches**	
	Mean (SD) Median			
Total no. of catches	7.92 (1.58) **8.00** **Cut-off:** 6.34 **(7.00)**	7.39 (1.78) **8.00** **Cut-off:** 5.61 **(5.00)**	**8.40 (1.22)** 8.00 **Cut-off:** **7.18** (7.00)	0.05*
Cut-off	**7 catches**	**5 catches**	**7 catches**	
	Mean (SD) Median			
MABC-2 catching total score	8.00 (1.46) **8.00**	**7.26 (1.51)** 7.00	8.68 (1.03) **9.00**	0.00**

Statistical Significance p ≤ 0.05*   Statistical Significance p ≤ 0.01**

Age-band 1 participants showed negatively skewed scores for catching in the hands (-0.86; Lilliefors $p < 0.01$) and for the total beanbags caught (-0.71; Lilliefors $p < 0.05$), and neither were normally distributed for the QSPOT catching activity item. The cut-offs were therefore based on the 16th percentile.

According to the results of this study, an Age-band 1 learner may be considered *at risk* if only able to catch a beanbag five times out of ten. This is compatible with the current scoring used by the QSPOT. Furthermore, an Age-band 1 learner may be considered at risk if only able to catch a beanbag twice in the hands away from the chest.

Age-band 2 participants showed negatively skewed data for catches in the hands away from the chest (-0.37; Lilliefors $p > 0.20$) and for the total number of beanbags caught (-0.71; $p < 0.10$), where both were normally distributed. Therefore, the cut-offs were based on -1.00 SD for Age-band 2.

An Age-band 2 learner may be considered *at risk* if only able to catch a beanbag seven times out of ten (using any method), indicating that the current scoring of the QSPOT is set too low for Age-band 2 learners. Alternatively, an Age-band 2 learner may be considered *at risk* if only able to catch a beanbag in the hands away from the chest six times out of ten. Therefore, some Age-band 2 learners with difficulties may be missed if the current scoring of the QSPOT is used.

In conclusion, the results of the analysis indicated that the scoring of various activity items of the QSPOT should be different for Age-band 1 and Age-band 2. Therefore, the cut-offs for failing those QSPOT activity items should also be set at different levels for each of the two age-bands for those specific tasks. Differences between the performance of Age-band 1 participants compared to Age-band 2 participants were found for the Task 1 A: DAP activity item, Task 3 A: Balance on one leg with eyes open, Task 3 B: Balance on one leg with eyes closed, and the Task 4: Catching activity item. Task 2: Cutting also showed a difference in performance between Age-band 1 and Age-band 2, where more Age-band 1 participants failed the activity item and failed certain criteria of performance, compared to Age-band 2 participants. Similar performance across the age-bands was found for the Task 1 B: VMI activity item, and Task 1 B: VMI (naming shapes aspect).

4.7 Summary

The sensitivity and specificity of the QSPOT were investigated using the z scores of the QSPOT Total Score for the total group. Overall, adequate specificity and inadequate sensitivity were found for the QSPOT tasks and Total Score, indicating that although the screening may be good at identifying learners without barriers to learning, it may not be good at identifying those learners who need to be assessed and/or who have intrinsic barriers to learning.

Concurrent criterion validity of the QSPOT was investigated by comparing the QSPOT z scores with those of the MABC-2 and DTVMI-VMI/VP. Adequate concurrent criterion validity of the QSPOT Total Score when compared to the MABC-2 Total Score was found. Age-band 1 showed better concurrent criterion validity, where Task 3: Balance also showed adequate concurrent criterion validity with the MABC-2 Balance Component. Adequate concurrent validity of the QSPOT Task 1: DAP/VMI and Task 2: Cutting were found when compared against the DTVMI-VMI; however, inadequate relationships were found between the fine motor tasks of the QSPOT and the DTVMI-VP. The QSPOT was found to have adequate internal consistency overall.

The inadequate correlations were thought to be due to differences in the types of skills that the reference standards were assessing compared to the QSPOT. However, the cut-offs of performance in the activity items were also investigated to determine any differences in typical performance that could be expected of Age-band 1 compared to Age-band 2. Differences in performance of Age-band 1 and Age-band 2 learners were found in several activity items of the QSPOT, indicating that some activity items should be scored differently for these age-bands.

In the next chapter, the results will be discussed in relation to a critical analysis of the QSPOT, and the suitability of the reference standards used in the study. In addition, the findings will be related to research, and will be followed by recommendations regarding further improvement to the QSPOT as a screening instrument.

CHAPTER 5: DISCUSSION

5.1 Introduction

The discussion will first cover the demographics of the sample, and the ways in which the tests were administered to the participants. This will be followed by discussing the research objectives, with the main focus being on the sensitivity and specificity, concurrent criterion validity, and internal consistency, as well as an analysis of the activity items of the QSPOT, as determined by the results of this study.

5.2 Demographics of the participants

5.2.1 Age, gender, race and limb preference

In order to stratify the sample for gender according to the approximate 50 % ratio of boys to girls in Pre-grade 0 and Grade 0[122], similar numbers of boys to girls were found for the mainstream group, as well as for Age-band 1 and Age-band 2 within the mainstream group. However, the mainstream group had slightly more girls (54.17 %) than boys overall (Table 4.1). This was the result of more girls being identified without barriers to learning, and the teachers being less concerned about their development (Table 4.1 and Table 4.2).

Overall, more boys were assessed for the LSEN group in this research study (Table 4.1). This is supported by the well-documented gender discrepancies in the population of children with identified intrinsic barriers to learning, such as the fact that two-thirds of children with learning disabilities across racial and ethnic groups are male[84]. Numerous studies on handwriting difficulties[114], disorders in sensory integration[94], Autism[72], intellectual disabilities[31,78], visual perceptual difficulties[35], ADHD[87], and DCD[88,92,108] have also reported study samples that comprised of 60 % boys or more.

The mean and median ages of the total group (n=77) showed a good disparity across each of the two age-bands, indicating an appropriate central tendency (Table 4.1). Although the researcher attempted to obtain a sample that represented the various racial groups of South Africa, a racially stratified sample was not obtained. This study did not achieve the typical racial statistics that were reported in the 2013 Mid-year Population Estimates for South Africa[123], in which it was reported that the vast majority of the country's population is African, including within the population of children aged between 5 and 9 years. This is because the total group of participants for this research study showed almost equal numbers of African (46.75 %) and white participants (44.16 %), followed by a minority of Indian participants (9.09

%). No coloured or Asian participants were obtained for the study, as the teachers did not identify them for either the mainstream or LSEN groups (Table 4.3).

Although the total group (n=77) in this study had more left-handed boys (n=6 in drawing, n=3 in cutting) than left-handed girls (n=1 in drawing and cutting), almost all the mainstream participants used their right hands to draw and cut out during the QSPOT. No cases of unestablished hand preference were noted in the mainstream group. These findings regarding the handedness of this sample are all in support of research that has shown an over-representation of right-handedness compared to left-handedness[96,112], and which has also shown that right-handed individuals are less likely to report intrinsic barriers to learning such as dyslexia[96].

In terms of drawing, more than two thirds of the LSEN participants were also right-handed, while 13.79 % were left-handed. Unestablished hand preference in the drawing and cutting tasks (13.79 % and 24.14 % respectively) was noted only in the LSEN group of participants, where both hands were used in the activities, and where different hands were used for drawing compared to cutting in some cases. The literature reports lower rates of left-handedness[126] and unestablished hand preference[96,126] compared to what was obtained in this study. Therefore, the strong link between left-handedness[96,97] and unestablished hand preference[96] with the presence of intrinsic barriers to learning that is reported in the literature, was also shown in this research study.

Approximately two thirds of the mainstream participants, and a similar percentage of the LSEN participants used their left leg in the QSPOT Task 3: Balance one-leg standing activity item with *eyes open*. Peters[127] concluded that the supporting lower limb is the non-preferred limb, whereas the limb used in a skill, such as kicking a ball, is the preferred limb. Peters[127] as well as Forseth & Sigmundsson[128] have also agreed that the non-preferred limb is the left lower limb in the majority of people. Therefore, it is possible that most of the participants used their non-preferred limb for one-leg standing with eyes open in the QSPOT, as they would do when kicking a ball with the right-side preferred leg. Forseth & Sigmundsson[128] also noted that typically developing children performed better on the non-preferred leg in some static balance activities, particularly in static one-leg standing on a balance beam (eyes open), compared to their preferred leg.

When considering one-leg standing balance with *eyes closed*, half of the mainstream participants and almost two thirds of the LSEN participants used the left leg. However, approximately 41.67 % of the mainstream participants and 41.38 % of the LSEN participants used a different leg in one-leg standing with eyes open compared to one-leg standing with eyes closed. Furthermore, similar percentages of mainstream (27.08 %; n=13) and LSEN participants (24.14 %; n=7) swapped to the right leg, and similar percentages of mainstream

(14.58 %; n=7) and LSEN participants (17.24 %; n=5) swapped to the left leg. These participants may have perceived their chances of success in one-leg standing with eyes closed to be better if they used a different leg (probably their preferred leg) in the activity. This is logical as one-leg standing balance with eyes closed has been found to be more difficult[128].

The tendency to swap the use of a particular leg between static balance tasks with eyes open and eyes closed does not appear to be explicitly reported in the literature. Forseth & Sigmundsson[128] only showed that performance in one-leg standing balance with *eyes closed* on the preferred (right side or skilled) leg was better compared to the non-preferred leg for two one-leg standing balance tasks, although the difference was small. Therefore, it appears that caution should be taken in drawing to conclusions with regard to a learner's performance if only assessing one-leg standing balance on a single leg. As a result, the QSPOT should allow for the assessment of one-leg standing balance (eyes open and eyes closed) on both legs. However, the results from this study should be compared to the results of the research currently being conducted by the West Rand OTs.

5.2.2 Socioeconomic status

The mainstream and LSEN participants were taken from a variety of independent and public suburban schools, and a range of levels of parental education were obtained as the participants came from a range of different socioeconomic circumstances. The LSEN group did not contain participants from a low socio-economic status, as only middle to upper class suburban schools were used. It is possible that the higher tertiary levels of education of the mainstream participants' parents played a role in this study (Table 4.4 and Table 4.5), in that the finding is consistent with previous research that shows a higher parental education level being associated with less likelihood of intrinsic barriers to learning[40,44], such as hyperactivity, behavioural difficulties, interpersonal difficulties and socio-emotional difficulties [44].

Almost all the mainstream and LSEN participants had attended nursery school. Therefore, this research study did not reflect the previous research by Umek *et al*[47] that showed a link between a lack of nursery school attendance and reported intrinsic barriers to learning once a child starts formal schooling.

5.2.3 Diagnoses in the LSEN group

The LSEN group consisted of participants with a wide variety of conditions namely physical disabilities, ASD, ADHD, epilepsy, intellectual disabilities, hearing and language disorders, and difficulties such as dyspraxia and bilateral integration and sequencing difficulties (Table 4.6). Some of the participants in this group were receiving occupational therapy at the time they were assessed. In addition, five participants were identified as having remedial difficulties by the teacher, but were not formally diagnosed, and were attending remedial classes within mainstream schools, or were receiving extra support within the mainstream class at school. Participants with unconfirmed diagnoses had to be used in the study as there was a lack of 5 year old participants with the appropriate types of intrinsic barriers to learning that the QSPOT was designed to detect. In many cases, the participants within the LSEN group had more than one type of intrinsic barrier.

5.3 The accuracy of the Quick Screening Procedure for Referral to Occupational Therapy in discriminating dysfunction

In order to determine whether the QSPOT differentiated between participants with and without intrinsic barriers to learning, the first objective of the study was to establish the accuracy of the test with 5 year old learners using the sensitivity and specificity, as well as the positive and negative likelihood ratios for the QSPOT. The results of this study showed there was a statistically significant difference between the performance of the mainstream and LSEN groups when considering the means and standard deviations of the scores of the QSPOT (Table 4.11). This indicates that the QSPOT identified a true difference in level of performance between the two groups, in favour of the mainstream participants who performed better.

Firstly, the content of fine motor tasks in the QSPOT is considered. Beery & Beery[32] indicate that activities which are similar to the fine motor skill tasks of the QSPOT, namely the drawing of a person, copying of shapes, as well as cutting, are appropriate for evaluating learners of this age. Both the DAP[100] (which was ironically linked with school readiness in the past despite the wide variety of professionals who questioned its use at that time[129]), and the copying aspect of Task 1 (due to the similarity with VMI tests that incorporate the copying of shapes[32]) assess VMI[2,3]. The inclusion of the VMI aspect was also considered important in this screening procedure, as VMI has been linked in one way or another to handwriting function in the lower grades[32,99] and higher primary school grades[64,114]. It has also been linked to the ability to organize numbers on a page so that sums can be calculated correctly[64]. Cutting was also a suitable choice activity for the QSPOT, as: (1) cutting skills are included in a variety of other assessments[53,54,102] that evaluate motor skills in children; and (2) it is also recognized as being important for the development of the strength of the intrinsic muscles in the hand and pre-writing skills[130], as well as eye-hand and bilateral coordination at a Grade 0 level[53].

Based on a prevalence of 37.66 % in this study (as 29 out of the total group of participants were identified with intrinsic barriers to learning), low and unacceptable sensitivity scores for

QSPOT Task 1: DAP/VMI (51.72 %) and Task 2: Cutting (37.93 %) were obtained. However, the positive likelihood ratio for Task 2: Cutting showed that the participants who obtained a z score of -1.00 SD or less are 18 times more likely to be experiencing dysfunction in their cutting skills than the participants who did not have difficulties (Table 4.12). This indicates that although Task 2: Cutting did not identify all the participants who were expected to have dysfunction, the identification of at risk performance or dysfunction is likely to be accurate when a learner does score -1.00 SD or lower on the task.

It is accepted that simply assigning a score to the end-product does not provide adequate information as to possibly which client factor deficits and performance skill components may be lacking[105]. The QSPOT compensates for this by including observation criteria that break each of the four tasks down into the steps and processes that a learner would use to perform the respective activity items. These observations also contribute to the learner's score on the QSPOT[2,3], and is linked to the concept that OT assessment scores should be augmented with qualitative observations of performance because of the complex nature of skills[105]. Thus, the QSPOT allows learners to be assessed on their overall performance in the fine motor tasks, including the wide variety of client factors, as well as motor and praxis, and visual sensory-perceptual performance skills, and perceptual-motor skills that are involved. In particular, the high specificity of Task 2: Cutting showed the benefit of scoring both the end-product as well as the observation criteria, as the actual cutting activity item identified too many participants as having difficulties when considered on its own (Figure 4.3).

The two QSPOT gross motor tasks of one-leg standing balance with hands on the hips (eyes open and eyes closed), and catching and throwing a beanbag in two hands[2,3] appear to be appropriate gross motor skills to include in the assessment of 5 year olds. This results from the fact that variations of these activities form part of the WOP Assessment Instrument[54], as well as standardized tests, namely the BOT-2[102] and the MABC-2[4] which can be used to assess the same age-group. Similar to the results for fine motor skills, low and unacceptable sensitivity scores were obtained for QSPOT Task 3: Balance (58.62 %) and Task 4: Catching (34.48 %) (Table 4.12). The positive likelihood ratios indicate that the participants who scored at -1.00 SD and lower in Task 3: Balance may be nine times more likely to be experiencing dysfunction, while those participants who scored at -1.00 SD and lower in Task 4: Catching may be five times more likely to be experiencing dysfunction, compared to participants who did not show difficulties in these tasks.

Once again, not all the LSEN participants presented with gross motor deficits, however, the lower mean scores on Task 3: Balance and Task 4: Catching indicate that the sample of participants had fewer deficits in their gross motor skills overall, compared to fine motor skills (Table 4.11). This bias may have resulted from the teachers selecting the participants based on the fine motor performance that is required for academic activities in the classroom. This is supported by Schoemaker *et al*[109], where teachers had difficulties in filling out items on motor coordination checklists, that also incorporated gross motor skills that related to functions not readily observed in the school or classroom environment. This appears to be true in the South African school context as well, as Vermaas[42] found that teachers may have difficulties in recognizing typical and atypical development of gross motor skills in children, although some difficulties in recognizing typical and atypical fine motor development were also noted in the same study.

In order to establish if the different *activity items* within the four tasks on the QSPOT were more accurate in identifying learners with intrinsic barriers to learning, the sensitivity and specificity of each activity item was analysed (Table 4.13). Adequate sensitivity was found for both the DAP activity item (75.86 %) and the cutting activity item (79.31 %), indicating these activity items are more accurate in identifying 5 year old learners with possible intrinsic barriers to learning relating to fine motor and praxis, and sensory-perceptual performance skills. However, the specificity scores for these activity items were unacceptable - DAP activity item (66.67%) and the cutting activity item (37.50%), indicating that learners were over-identified with difficulties on these two items. In particular, the low specificity for the cutting activity item was due to the majority of participants in the mainstream group failing to cut out the picture appropriately, which lead to a large number of false-positive identifications.

In contrast, the VMI activity item, consisting of copying a number of shapes, appeared to be more accurate in identifying those learners without difficulties in the fine motor skill of drawing (93.75 %), while the sensitivity also remained unacceptable (55.17 %) (Table 4.13). This result was related to what may be inappropriate cut-off points for performance on the DAP activity item for Age-band 1 (Table 4.19), and on the VMI activity item for both Age-band 1 and 2 (Table 4.20), while ceiling effects were also noted for the copying of all six of the required shapes (Figure 4.1). However, the results showed that if a learner is identified with dysfunction in being able to copy the shapes of the QSPOT, they are eight times more likely to be experiencing dysfunction in VMI and fine motor skills related to drawing, than a child who does not have difficulties on these items or with those types of skills. When using the nomogram for Bayes' nomogram[15,131], the positive likelihood ratio shows that learners who score -1.00 SD or lower have an 80 % probability of needing to be assessed further (Table 4.13). In addition, the VMI activity item aspect of naming shapes demonstrated excellent specificity (100.00 %), while sensitivity was inadequate (20.69 %). The negative likelihood ratio indicates that some mainstream learners with specific difficulties such as naming shapes, may have been missed due to the cut-off of naming two shapes being too low in comparison to the cut-off of four shapes that was found to indicate *at risk* performance in this research study (Table 4.21). Ceiling effects were noted for the naming of most of the shapes (Figure 4.2), while the QSPOT appears to expect learners to name too few shapes overall.

Adequate specificity was found for both one-leg standing balance activity items, as well as the catching activity item in the QSPOT, while inadequate sensitivity scores were obtained (Table 4.13). Therefore, the results for these activity items were similar as for Task 3: Balance and Task 4: Catching overall. Out of all the activity items, the one-leg standing balance activity items were the least effective for eliminating those learners without dysfunction relating to static balance. In addition, the high specificity and low sensitivity indicate that the majority of the participants performed well in the catching activity item (Table 4.13), resulting in a ceiling effect being noted for the total number of catches. The cut-offs and scoring for some of these activity items for Age-band 1 and 2 respectively may have also affected the results (Table 4.22 and Table 4.23).

When taking all the above into account, inadequate sensitivity was also found for the QSPOT Total Score in identifying fine and gross motor skill deficits and sensory-perceptual performance skill deficits overall (37.93 %) (Table 4.12). This supports the literature that indicates that motor and praxis, and sensory-perceptual performance skills are commonly affected in varying combinations in different conditions. For example, learners with some types of SLDs may present with fine motor dysfunction, but not necessarily gross motor dysfunction[77]. Learners with DCD; however, may present with dysfunction in fine motor and gross motor skills, with a greater degree of impairment in either one[77], where these features form part of subtypes of DCD that were described by Macnab *et al*[89], and that were reviewed earlier. In contrast, sensory-integrative dyspraxia tends to be associated with dysfunction in motor and praxis, as well as sensory-perceptual performance skills[73]. Wuang *et al*[78] also found that gross motor skills are less impaired than fine motor skills in children with intellectual disabilities, while Hartman[80] found that locomotor types of gross motor skill performance, such as stationary balance, was superior to object control gross motor performance such as catching in a sample of children with mild and borderline intellectual disabilities.

Overall, the low sensitivity rates of the QSPOT tasks and Total Score, as well as that of some specific activity items, confirms that the QSPOT may identify intrinsic barriers to learning for the constructs related to motor and praxis and sensory-perceptual performance skills in learners with only certain conditions. Using the nomogram for Bayes' theorem[15,131], the positive likelihood ratio (based on the prevalence of 37.66 % for the Total Score for this research sample) indicates that those identified with possible barriers to learning have a 90 % probability of having problems or of being at risk of an intrinsic barrier to learning. This would warrant the need for learners with scores of -1.00 SD and lower to be assessed further, as they may be 18 times more likely to have difficulties, compared to a typically developing learner (Table 4.12). Overall, the accuracy of the QSPOT Total Score (in this sample) indicates that it identified less than 50 % of the participants who were expected to have dysfunction. The presumed reason for this is that the QSPOT may not be sensitive to learners with unconfirmed diagnoses, as well as other intrinsic barriers to learning in which motor and praxis and sensory-perceptual performance skills are not problematic.

In contrast, the QSPOT revealed adequate and high specificity scores for each of the four tasks, some activity items, and the Total Score (97.92%) (Table 4.12). Therefore, the QSPOT identifies learners who are not expected to have dysfunction correctly with regard to the types of skills that this instrument is designed to assess. This finding was confirmed by the negative likelihood ratios of less than 1.00 which indicate that only 20 to 30 % of learners (using the nomogram for Bayes' theorem[15,131]) without intrinsic barriers to learning have a probability of having difficulties in the motor and praxis and sensory-perceptual performance skills assessed in the QSPOT, despite achieving an adequate score. The higher specificity and lower sensitivity overall may be a serious disadvantage of the QSPOT in its current form. This means that the imbalance between sensitivity and specificity of the QSPOT needs to be corrected, so as not to miss those learners who do present with intrinsic barriers to learning.

Due to the fact that the data for the total group had to be used in order to calculate z scores for the QSPOT tasks and Total Score, the means and standard deviations had the potential to be altered negatively. When considering the Total Score (-1.09; Lilliefors $p < 0.01$), Task 1 DAP/VMI (-1.06; Lilliefors $p < 0.01$), and Task 4: Catching (-1.65; Lilliefors $p < 0.01$), the levels of the negative skewness were inclined towards 1.00 SD below that expected in the normal distribution, indicating that some learners did not perform well on these tasks. These skewed means and standard deviations (Table 4.11) were then used in comparison to the reference standard tests, the normative data of which were calculated on random samples of participants, and adjusted to fit a normal distribution[4,32].

The low sensitivity of the QSPOT tasks, as well as inadequate levels of sensitivity of the QSPOT activity items, shows that some of the learners in the LSEN group did not perform poorly in the QSPOT. This indicates that the means and standard deviations of the total group may not be as skewed as originally thought by dysfunction in the LSEN group. This is nonetheless still considered to be a limitation of the study.

5.4 Reference standards for the accuracy of the Quick Screening Procedure for Referral to Occupational Therapy

In order to establish whether the accuracy of the QSPOT was representative of motor and praxis, and sensory-perceptual performance skills in the participants assessed in this study, the specificity and sensitivity, as well as the likelihood ratios of the MABC-2 and the DTVMI-VMI/VP were established for the same sample of 5 year old participants.

The MABC-2, DTVMI-VMI, DTVMI-VP and the QSPOT all presented with the same patterns of adequate and high specificity, but inadequate sensitivity for the Total Scores and in the various components and tasks of each instrument. However, imbalances between sensitivity and specificity have also been found in other research using the MABC-2[31,108,109] and the DTVMI[114] respectively. The general imbalance between sensitivity and specificity across all three instruments confirms that not all the participants with intrinsic barriers to learning presented with deficits in motor and praxis, and sensory-perceptual performance skills, due to the variety of conditions and unconfirmed diagnoses that were found within the LSEN group.

When the accuracy of the assessment of fine motor skills was considered, the DTVMI-VMI (which was created to measure fine motor skills and eye-hand coordination[32]), obtained a specificity score (97.92 %) (Table 4.10) that was higher than that obtained by the MABC-2 Manual Dexterity Component (70.83 %) (Table 4.9). The lower specificity scores for the MABC-2 Manual Dexterity Component indicate that this test identified fewer participants correctly, as 29.17 % (n=14) of participants without intrinsic barriers to learning were identified with a problem and needing further assessment. This is compared to zero participants on the QSPOT Task 1: DAP/VMI (specificity 100.00 %) (Table 4.12), and only two participants altogether that were falsely identified on the QSPOT Task 2: Cutting and the DTVMI-VMI (specificity 97.92 %) (Table 4.12 and Table 4.10). Overall, the specificity scores for all three assessments with regard to fine motor skills were above the minimum that is considered acceptable in research[116,117.]

Overall, the fine motor tasks of the MABC-2, DTVMI-VMI, and the QSPOT Task 1: DAP/VMI and Task 2: Cutting yielded inadequate sensitivity for identifying difficulties in fine motor and praxis skills (Table 4.9, Table 4.10 and Table 4.12). The MABC-2 Manual Dexterity Component (62.07 %), and Task 1: DAP/VMI (51.72 %) identified more participants with intrinsic barriers to learning correctly, compared to the QSPOT Task 2: Cutting (37.93 %). This may be due to the lack of any timed fine motor activities in the QSPOT, that are used for assessment in the MABC-2 Manual Dexterity Component[4], and which have been shown to enhance sensitivity in identifying learners with dysfunction in fine motor skills, particularly those associated with ADHD, and particularly the combined subtype[87].

Visual perceptual skills were assessed on the DTVMI-VP, with a lower specificity score (83.33 %) than the DTVMI-VMI (97.92 %) (Table 4.10). The specificity of the DTVMI-VMI in this research study was higher than that found by Goyen[114]. The lower specificity score for the DTVMI-VP indicates that this test identified fewer participants correctly, as 16.67 % (n=8) of the participants without intrinsic barriers to learning were identified with a problem, and as needing further assessment, compared to zero participants identified by the QSPOT Task 1: DAP/VMI (specificity 100.00 %) (Table 4.12). The specificity values for both instruments were above the acceptable minimum of 70 %[116,117], while the sensitivity scores for the DTVMI-VMI, DTVMI-VP and the QSPOT Task 1: DAP/VMI for identifying visual perceptual difficulties were not.

The QSPOT-1 Task 1: DAP/VMI and DTVMI-VP identified 51.72 % and 48.25 % of the participants with intrinsic barriers to learning respectively (Table 4.12 and Table 4.10), as being at risk of having dysfunction and needing further assessment. The similar trend of increased specificity and inadequate sensitivity in both instruments may indicate that some of the participants in the LSEN group may have been experiencing other types of visual perceptual difficulties, or they may not have had visual perceptual dysfunction at all. In hindsight, the DTVMI-VP may not have been the most appropriate instrument to use in comparing sensitivity levels to the QSPOT for the visual sensory-perceptual performance skills that are involved in the fine motor skill activities screened, due to the strong motor and visual-motor components that form part of drawing and cutting[41,62]. Adding the DTVMI-MC, with its visual-motor aspect of replicating the picture above by drawing within the paths of each item[32], may therefore have provided a better comparison to the fine motor tasks of the QSPOT.

When assessing gross motor skills, the QSPOT Task 3: Balance (93.75 %) achieved a higher specificity score than the MABC-2 Balance Component (81.25 %) (Table 4.12 and Table 4.9). Overall, the results gave the impression that the QSPOT was better able to identify the participants who were not expected to have dysfunction. The negative likelihood ratios of approximately 0.40 for both tests indicate that less than 20 % of the participants without barriers to learning had a probability of having some dysfunction in gross motor skills related to balance.

The specificity score for the MABC-2 Balance Component in this study (Table 4.9) was similar to a specificity score of 88 % found in another research study on a South African sample of learners without ASD, or other intellectual or neuromotor dysfunction[111]. This may indicate stability of the score in the South African context in eliminating dysfunction in balance. The sensitivity of the MABC-2 Balance Component for this study (65.52 %) (Table 4.9) was inadequate, but was the highest out of the three components, and the Total Score. This may partly confirm the results of Liu *et al*[110] who found that the MABC-2 Balance Component identified children with balance difficulties more efficiently than the other two subtests.

Similar sensitivity was found for the MABC-2 Balance Component (65.52 %) and the QSPOT Task 3: Balance (58.62 %) (Table 4.9 and Table 4.12), indicating that these tests identified approximately 60 % of the LSEN participants as having dysfunction relating to balance. This finding also indicates that the dynamic balance items in the MABC-2[4] did not make a meaningful difference in enhancing the sensitivity of the MABC-2 Balance Component relative to the static nature of the activity items in QSPOT Task 3: Balance. The positive likelihood ratios for the MABC-2 and QSPOT balance tasks (Table 4.9 and Table 4.12) indicate an approximate 60 % to 80 % probability of learners having balance dysfunction if identified. Although the MABC-2 Balance Component identified more LSEN participants as having balance dysfunction, the QSPOT Task 3: Balance seemed to be more accurate in the identification of the LSEN participants when considering the respective probability of dysfunction for each task. Overall, the findings indicate that it may not be necessary to add a dynamic balance activity to the QSPOT; however, the addition of a dynamic balance activity may increase sensitivity to dynamic balance difficulties.

The MABC-2 Aiming and Catching Component (97.92 %) and the QSPOT Task 4: Catching (93.75 %) (Table 4.9 and Table 4.12) both achieved good levels of specificity, even though the structures of the tests were different. The MABC-2[4] contains two separate activity items for catching and throwing at a target respectively, while the QSPOT[2,3] only contains a catching activity item with little focus on throwing accuracy. Therefore, both instruments have a similar ability in eliminating those with intrinsic barriers to learning, whereas neither had adequate sensitivity. The QSPOT Task 4: Catching (sensitivity 34.48 %) appeared to perform better in identifying participants with dysfunction than the MABC-2 (sensitivity 24.14 %) (Table 4.12 and Table 4.9) for aiming and catching skills. On the whole, neither test identified many gross motor skill difficulties with regard to catching and throwing, indicating that the sample performed well in aiming and catching overall. It would also appear that assessing only catching in the QSPOT identified slightly more participants with intrinsic barriers to learning as having dysfunction in this particular gross motor skill, compared to the MABC-2.

While the findings of this study seem to indicate that not all the participants in the LSEN sample presented with intrinsic barriers to learning in the form of motor and praxis, and sensory-perceptual performance skills, there is a possibility that the scoring on the tests may not be appropriate for the South African context. This is supported in a study by van Jaarsveld *et al*[95], which indicated that South African learners performed better on certain motor skills than American children, such as static and dynamic balance, as well as bilateral coordination. These differences were found in a sample of older children (aged from 6 years 0 months to 8 years 0 months) from middle- to upper-class backgrounds, with no significant difference for children aged from 4 years 0 months to 5 years 11 months. However, the younger age-group in that study was less than half the size of the older group[95], and there is still the possibility that similar findings would have been obtained if the younger group had included a similar number of participants as the older group.

Overall, the QSPOT Total Score and the DTVMI VMI (sensitivity 97.92 %) (Table 4.12 and Table 4.10) showed a similar ability to identify participants *without* dysfunction in performance skills, and better ability when compared to the DTVMI-VP (83.33 %) and the MABC-2 Total Score (83.33 %) (Table 4.10 and Table 4.9). The findings for the specificity of the MABC-2 Total Score in this study were not as high as that of 88 % found in the study by Schoemaker *et al*[109] and that of 97 % found by Venter *et al*[111]. Overall, the MABC-2 Total Score (sensitivity 58.62 %) (Table 4.9) appeared to be better at identifying participants with dysfunction in comparison to the DTVMI-VP (48.25 %) (Table 4.10), the QSPOT Total Score (37.93 %) (Table 4.12) and the DTVMI-VMI (31.03 %) (Table 4.10). In addition, the sensitivity of the MABC-2 in this study was also higher than that of 41 % found in the study by Schoemaker *et al*[109].

5.5 The concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy

The third objective of the study was to determine the concurrent criterion validity of the QSPOT-1, and the MABC-2 and DTVMI-VMI/VP, to establish if the tests assessed similar constructs in motor and praxis, and sensory-perceptual performance skills in 5 year old learners. The reliability of the tests in terms of internal consistency was also determined to establish if the various items on the tests delivered consistent scores for the participants in this study.

The QSPOT Total Score showed a strong correlation with the DTVMI-VMI for both age-bands (Table 4.16). A strong correlation to the MABC-2 Total Score for Age-band 1 (Table 4.14) was noted, but this was not the case for Age-band 2 (Table 4.15). This signified inadequate concurrent criterion validity for the QSPOT for motor skills as assessed by the MABC-2 in Age-band 2.

The concurrent criterion validity of the QSPOT for fine motor skills against the MABC-2 is discussed first, followed by gross motor skills in order to align with the layout of the tasks for the QSPOT. This will be followed by discussing the concurrent criterion validity of the QSPOT for VMI and visual perception against the DTVMI-VMI and DTVMI-VP.

5.5.1 The concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy with the Movement ABC-2 for fine motor skills for Age-band 1 and Age-band 2

Overall, the results showed a moderate correlation between the fine motor activities of the QSPOT and the fine motor component that is assessed by the MABC-2. However, the relationships were not strong enough to show adequate concurrent validity for fine motor skills in either Age-band 1 or Age-band 2, even though the correlations were statistically significant.

The QSPOT pencil-and-paper tasks, namely Task 1 A: DAP and Task 1 B: VMI, yielded moderate correlations with the MABC-2 Manual Dexterity Component for fine motor skills, although this was slightly lower for Age-band 2 (Table 4.15) than for Age-Band 1 (Table 4.14). The results for Age band 2 showed a higher correlation between the QSPOT pencil-and-paper tasks and the MABC-2 drawing trail, which therefore also reflected the expected findings, as both items require pencil control.

It is clear from the moderate and weak correlation results between the QSPOT pencil-and-paper tasks and the three MABC-2 Manual Dexterity Component activity items, that they are assessing different constructs of fine motor skills. The QSPOT activity items of DAP and copying shapes are also fundamentally different from the MABC-2 drawing trail, as the DAP and VMI activity items require constructional praxis, due to the need to draw and assemble forms[98]. However, the correlations between the QSPOT Task 1: DAP/VMI, and the MABC-2 posting coins and drawing trail items for both age-bands were lower than the correlation for a DAP test and the same manual dexterity items of the MABC-2 (r=0.66) that is cited in the MABC-2 manual[4] and by Mayson[132]. A second fundamental difference includes the fact that the MABC-2[4] allows a practice session and two formal trials in the drawing trail in order to obtain a sample of the learner's best performance. However, the MABC-2 drawing trail only allows a 5 year old a maximum of two errors before he/she earns a below-average score[4], whereas the QSPOT Task 1: DAP/VMI may allow learners to redeem their performance or show their true performance over the length of time of the DAP and VMI activity items. This also may have resulted in the fewer false-positives for the QSPOT Task 1: DAP/VMI.

The QSPOT fine motor task of cutting yielded a weak correlation to the MABC-2 drawing trail for both age-bands. However, the QSPOT cutting task yielded similar results to that of the QSPOT paper–and-pencil tasks, with moderate correlations to the MABC-2 threading beads activity item in Age-band 1, and the MABC-2 posting coins activity item in Age-band 2. This is not an unexpected result as threading beads and cutting, as well as posting coins (due to the structuring of this MABC-2 item[4]), all require varying degrees of static-manipulative bilateral hand use, and moderate correlations were expected, particularly for the items of cutting and threading beads.

The results found may reflect the fact that the MABC-2 does not contain a cutting item, and that the MABC-2 bilateral activity of threading beads is timed[4], whereas the QSPOT cutting task is not timed. While threading beads and posting coins are also learned skills, cutting is a more complex learned skill which requires the practice and consolidation of a variety of skills to achieve competence[133], as was seen in this study where the majority of the participants did not meet the norm of quality expected in the cutting activity item (Figure 4.3). This item may need revision in terms of the expectations for the observation criteria of "*neatness and accuracy"* and "*control of direction"*, especially in Age-band 1 (Figure 4.4). The poor performance of the mainstream participants in the cutting task also appears to have affected the correlation of the fine motor skill scores of the MABC-2 and QSPOT Task 2: Cutting.

Although there are some similarities in these fine motor tasks, the fundamental differences between the fine motor tasks of the instruments likely influenced the results. In addition, differences regarding the observations that are also scored on the QSPOT[2,3], compared to the similar types of qualitative observations that are not taken into account when scoring the MABC-2[4], may have also affected the results. However, this feature of scoring the observation criteria in the QSPOT is considered a strength, as the inclusion of both quantitative and qualitative information allows the therapist to determine what aspects of the client factors and performance skills are affecting the learner's participation in the tasks. This aids to guide further assessment, and ultimately the intervention of those difficulties[105].

5.5.2 The concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy with the Movement ABC-2 for gross motor skills for Age-band 1 and Age-band 2

The QSPOT balance task correlated well with the MABC-2 for balance skills, as strong correlations were obtained between Task 3: Balance of the QSPOT and the one-leg balance item of the MABC-2 in both Age-band 1 (Table 4.14) and Age-band 2 (Table 4.15). This result was not unexpected as both tests assess static balance activities. The MABC-2 activity items of walking with heels raised and jumping on mats are dynamic balance activities, and are therefore different from static balance activities. As expected, only moderate correlations between these MABC-2 items and Task 3: Balance were obtained, with higher correlations being found for Age band 1. Although the sensitivity results indicated that the QSPOT may not require the addition of a dynamic balance activity, the results of the concurrent validity indicate that Task 3: Balance may require these changes for Age-band 2. This is supported by the fact that various assessments that test gross motor skills in children, include both static and dynamic activities[4,54,101,102].

The concurrent criterion validity of the QSPOT Task 3: Balance for Age-band 2 was likely affected by several fundamental differences in the structure and scoring of Task 3: Balance and the MABC-2 one-leg balance item. Firstly, 5 year olds are not permitted to use their arms for balance and have to keep their hands on their hips during the QSPOT one-leg standing balance activity item[2], whereas the MABC-2 allows the learners' arms to hang freely for balancing[4]. Secondly, the MABC-2 also allows practice sessions followed by two formal trials on either leg, thus enabling the learner's best performance to be measured[4]. Thirdly, a minimum of ten seconds was required to pass the QSPOT item at the time of the study[2,3], while a time of eight seconds is sufficient to obtain an average score in the MABC-2[4].

The second type of gross motor skill that the QSPOT includes is that of catch-and-throw using a beanbag[2,3]. Age-band 1 (Table 4.14) showed a strong correlation between the catching activity items of the QSPOT and the MABC-2, while the correlation for Age-band 2 (Table 4.15) was moderate. Once again, several differences exist between the aiming and catching skills assessed by the catching items of the MABC-2 and the QSPOT. Firstly, the assessor and learner stand two metres apart in the QSPOT[2,3], compared to 1.8 metres apart in a demarcated space for the MABC-2[4]. Secondly, the 5 year old is required to catch a beanbag at least four times out of ten to obtain an average score in the MABC-2[4], compared to the minimum of six catches required in the QSPOT[2,3]. Thirdly, the MABC-2[4] catch score is likely set lower in order to account for its strict criteria, namely that 5 year olds must catch in the hands away from the chest, or at least have good control over the beanbag before bringing it to the chest for further stability. This is contrasted slightly by the QSPOT[2,3] which recognizes that some 5 year olds may still catch with their hands against their chests. Since the results of this study showed that typical 5 year olds catch beanbags mostly in their hands away from the chest (Figure 4.5), there may be a need to make the scoring criteria of the QSPOT stricter, specifically for Age-band 2 learners.

The QSPOT only showed a moderate correlation with the MABC-2 for aiming and catching overall for Age-band 1 (Table 4.14), and a weak correlation for Age-band 2 (Table 4.15). This is because throwing and catching are different skills, and the QSPOT Task 4: Catching focuses on the screening of catching, and not throwing. Essentially, the MABC-2 assesses the same gross motor skills as the QSPOT, but extends the scope of the skills assessed as it is a full assessment used for identification of and planning of intervention for motor difficulties[4].

Similarly for fine motor skills, the use of the qualitative observation criteria when calculating the learner's score in the QSPOT[2,3], may have also affected the concurrent criterion validity of the QSPOT for one-leg balance and for catching, particularly for Age-band 2. Once again, this is considered a strength of the QSPOT, rather than a criticism. Overall, there was a strong agreement between the gross motor tasks of the QSPOT and the activity items of the MABC-2 that were similar; however, only moderate relationships were obtained between the fine motor tasks as they are dissimilar in some respects. Age-band 1 showed better concurrent criterion validity of the QSPOT than Age-band 2. When considering the coefficient of determination[13], 46.24 % of the score on one test can be explained by the other test for Age-band 1, compared to Age-band 2 which showed a much lower coefficient.

As presented in Section 5.6, there appeared to be differences between the cut-offs of the QSPOT activity items (used at the time of the research study) compared to the cut-offs that were found in this study. In particular, the cut-offs that indicate *at risk* performance (found in this study), also differed for Age-band 1 and 2 in respect of the activity items of drawing a person, one-leg standing balance (eyes open and closed) and catching. These differences may have affected the results for fine and gross motor skills, and are likely due to the ongoing developmental process that children undergo. Therefore, the QSPOT needs to ensure that the appropriate skill levels are represented for both Age-band 1 and Age-band 2 learners.

5.5.3 The concurrent criterion validity of the Quick Screening Procedure for Referral to Occupational Therapy with the Developmental Test of Visual-Motor Integration for sensory-perceptual skills for Age-band 1 and Age-band 2

As expected, a strong correlation was indeed obtained between the pencil-and-paper tasks of the QSPOT and the DTVMI-VMI for Age-band 1 (Table 4.16), and the correlation obtained was the same as that between the DTVP-2 and the DTVMI-VMI (r=0.75) that is reported in the DTVMI manual[32]. Therefore, the concurrent criterion validity of the QSPOT for visual sensory-perceptual performance skills such as that used in drawing a person and copying shapes, was adequate and above the minimum prescribed for the purpose of this study. The strong correlation obtained between Task 1: DAP/VMI and the DTVMI-VMI supported the study by Lotz[100] that found significant moderate correlations between the DTVMI-VMI and the Good-Enough Harris test in 6 to 13 year old South African children. As mentioned earlier, the DAP and VMI activity items are constructional praxis activities by nature, and they therefore appear to be a suitable combination to include within Task 1: DAP/VMI, especially in Age-band 1. This compatibility is important, especially if the DAP and copying aspects will continue to be combined into a single task in future editions of the QSPOT.

When considering Age-band 2; however, only a moderate correlation was found between Task 1: DAP/VMI and the DTVMI-VMI in this research study (Table 4.16). There are several possible reasons which may have affected the concurrent criterion validity of the QSPOT with the DTVMI-VMI for Age-band 2. Firstly, the DTVMI-VMI has strict measuring criteria, involving the use of a ruler and protractor, that are used to either pass or fail an attempt to copy a figure[32]. In contrast, the QSPOT[2,3] does not contain measuring guidelines to score the shapes copied. Secondly, only the number of successful copying attempts up until a ceiling of three incorrect responses count toward a learner's score on the DTVMI-VMI[32], whereas the number of shapes that the learner has to copy, as well as qualitative observations, count toward the learner's score on the QSPOT[2,3].

Strong correlations between the Task 2: Cutting and the DTVMI-VMI were also obtained for both Age-band 1 and 2 (Table 4.16), indicating the validity of Task 2: Cutting when compared to the constructs assessed by the DTVMI-VMI. This is likely due to the fact that cutting does require integration of eye-hand coordination, bilateral coordination and manual dexterity[41], as well as VMI, since VMI is essentially the simultaneous use of visual perception, finger movements and eye-hand coordination[32]. This result was also obtained even though many of the participants failed the task, and it is therefore possible that the cutting activity item, together with the observation criteria that are included in the task score, are appropriate for assessment at the 5 year old level.

The above findings also confirm that drawing and cutting tasks on the QSPOT do indeed assess perceptual-motor skills such as that of the DTVMI-VMI, due to the necessary processing and perception of sensory input that they require[59]. Therefore, this may show the concurrent validity of the QSPOT in measuring sensory-perceptual performance in a variety of tasks, and not only in terms of being able to copy, as well as recognize and name shapes. Overall, the QSPOT fine motor tasks showed a better relationship with visual-motor integration as assessed by the DTVMI-VMI, than with the fine motor skills assessed in the MABC-2. This applies for both Age-band 1 and 2.

However, correlations of the fine motor skill tasks on the QSPOT with visual perception as tested by the DTVMI-VP were inadequate (Table 4.16). The only related aspect of the QSPOT Task 1: DAP/VMI to the DTVMI-VP was the criterion of having to recognize shapes in order to name them. This is the result of the fact that a learner must first discriminate the qualitative aspects of the shape (visual discrimination and form constancy) which are visual processing performance skills[62], but also the ability to attach a name to the shape (basic shape concept[54]) which is a higher-cognitive client factor according to the OTPF II[9]. Overall, it is likely that the DTVMI-VP was not the most suitable test to compare to the fine VMI and cutting tasks of the screening, due to the fact that sensory-perceptual, visual perceptual, and motor processes are all used in those tasks, and not only visual perception alone[59,62].

The strong correlations shown by Age-band 1 between Task 1: DAP/VMI and the DTVMI-VMI also showed an overlap of skills assessed by the items, where 56.25 % of the information from one test can be explained by the other test, whereas the coefficient of determination showed less overlap for Age-band 2 between the tests, indicating that the QSPOT Task 1: DAP/VMI may need to be expanded for Age-band 2 learners.

5.5.4 Internal consistency of the Quick Screening Procedure for Referral to Occupational Therapy

The Cronbach's alpha value of 0.78 for the total sample on the QSPOT indicated adequate internal consistency of the instrument, and is therefore above the minimum which is commonly accepted in research[17,115,120], and in studies conducted on screen assessments for children[51,107,108]. This indicates consistency of the items in the QSPOT, indicating reliability in participants with and without dysfunction.

The instrument also achieved a moderate inter-item correlation of r=0.48, indicating that the tasks are inter-related, but not necessarily unidimensional[17]. This was expected as the QSPOT assesses pencil-and-paper activities, cutting, static balance and catching, which can be grouped into constructs such as gross and fine motor skills, or gross and fine visual-motor skills. A two-dimensional test consisting of six items, that has an average inter-item correlation of 0.50, and an overall Cronbach's alpha value of 0.60 is considered to have acceptable reliability for a standardized assessment, due to the number of dimensions and items[17]. Therefore, the QSPOT with its four main tasks, an average inter-item correlation of 0.48, and an overall Cronbach's alpha of 0.78, performed well with regard to this type of reliability.

Adequate internal consistency was found for Task 2: Cutting, Task 3: Balance and Task 4: Catching, whereas the pencil-and-paper tasks only produced a Cronbach's alpha of 0.66 (Table 4.17), which would be considered to be below an adequate level. However, this may be due to the small study sample, and Tavakol & Dennick[14] warn against the dangers of discarding items and whole instruments unnecessarily based on instinctive interpretation of Cronbach's alpha. The problem might also lie with the pairing of a DAP and copying shapes within one task score; however, the South African research study by Lotz *et al*[100] counteracts this interpretation due to the significant relationship found between similar activities.

Analysis also showed excellent item-to-total correlations for Task 1: DAP/VMI and Task 2: Cutting for this study, thus indicating a strong relationship between the constructs used for these tasks. Task 3: Balance showed a strong relationship to the QSPOT Total Score (Table 4.18). Since the larger portion of points is located within the fine motor and visual-motor tasks of the QSPOT, it can be said that Task 3: Balance showed a strong relationship to these fine motor tasks in particular. This relationship may exist because postural control forms the base for reaching and grasping during activities[133,134], which is confirmed by the fact that more skilled movements of the limbs, such as the arms and hands, only start to develop after the muscle function of the neck and trunk provides enough support[134]. As a result of the fact that inadequacies in proximal stability can negatively affect a child's fine motor skills, proximal stability and postural control client factors form part of the assessment of underlying factors that affect function[135]. Therefore, the relationship between the QSPOT fine motor and balance tasks was not surprising.

Only a moderate item-to-total correlation was found for Task 4: Catching (Table 4.18). Generally, tasks with inadequate item-to-total correlations are deleted; however, Tavakol & Dennick[14] state that this should only apply to items with correlations around zero. Furthermore, the calculation of Cronbach's alpha on the overall test score of an instrument, and therefore, the totalling of subtest scores in the same instrument, should be questioned when the instrument is dealing with more than one construct[14]. Overall, the findings indicate that further psychometric research should be completed before it can be accepted that a total score can be used for the QSPOT.

The difference in the concurrent criterion validity found for Age-band 1 and 2 indicated that investigation into the present cut-off criteria for scoring the QSPOT activity item end-products and performance for the two age-bands was needed, to see if they played a role in the results. The addition of two six-month age-bands for the age of 5 years in the QSPOT resulted in the need to determine separate cut-offs of performance in the activity items for each age-band, as these were not yet available for all the tasks (Appendix L) at the time that this research study was conducted.

5.6 Determining the cut-off points of at risk performance in the activity items of the Quick Screening Procedure for Referral to Occupational Therapy for Age-band 1 and Age-band 2

Therefore, the final objective was to determine the cut-offs for Age-band 1 and Age-band 2 learners in the activity items of the QSPOT, which would enable a distinction between learners with typical performance and learners with a possible intrinsic barrier to learning, particularly a learning disability that presents with motor and praxis, and sensory-perceptual performance skill deficits.

Only the data of the mainstream group of participants were used to investigate whether the existing cut-offs at the time of the research (based on the minimum requirements of performance stipulated in the QSPOT manual[2] and on the record form[3]), were accurate. Since the cut-offs obtained in this study are based on -1.00 SD or the 16th percentile, it is important to note that the findings of this objective can be compared with the cut-offs that are based on the minimum performance requirements of the QSPOT at the time of the study (Appendix L).

5.6.1 Task 1 A: Draw-a-person

According to the norms obtained in this study, the typical Age-band 1 learner can be considered *at risk* if only able to draw a person consisting of seven parts including the body (Table 4.19). This means that the current cut-off indicating inadequate performance on the QSPOT[2,3] (ie. drawing a total of eight body parts including the body) may be set too high for Age-band 1 learners, because they drew fewer body parts than the Age-band 2 participants on average. This could result in learners being identified with dysfunction unnecessarily, and this may have resulted in the reduced specificity of the DAP activity item that was noted in this study (Table 4.13).

On the other hand, Age-band 2 learners may be considered *at risk* if only able to draw a total of nine body parts including the body (Table 4.19). This means that the current expectation of the QSPOT for 5 year olds to draw a body and eight parts[2,3] may actually be the cut-off point at which Age-band 2 learners should be failed, which could result in learners who are at risk being missed. This could have also resulted in negative effects to the sensitivity of the DAP activity item, where the CI showed that sensitivity for the DAP activity item may still be unacceptable (Table 4.13). Research by Dağlioğlu[136] showed that the DAPs matured in Turkish children aged from 5 to 7 years; however, the study did not consider the children in six-month age-bands. Therefore, no direct support was found for the finding that Age-band 2 learners should be drawing more body parts compared to Age-band 1 learners. However, the lack of age-specific scoring criteria for the DAP activity item in the QSPOT can be deemed appropriate as Picard[137] found significant differences in the drawings of girls and boys in children aged between 8 to 9 years, and between 11 to 12 years of age, but not in children aged 5 to 6 years.

5.6.2 Task 1 B: Visual Motor Integration (copying shapes and naming shapes)

The selection of the six basic required shapes in the QSPOT for 5 year olds is supported by various developmental guides (WOP Assessment Instrument[54] and Grobler[138]), and is therefore appropriate. Standardized tests such as the DTVMI were also consulted in the initial development of the QSPOT, and the order of the shapes in the QSPOT[2,3] VMI activity item is the same as the order in which they appear in the DTVMI-VMI, although the DTVMI-VMI[32] also includes many other shapes in amongst them. This is beneficial, as a Rasch analysis has found that the sequence of the forms in the DTVMI-VMI generally corresponds with an increase in levels of difficulty as a child progresses through the test[112], where no inconsistencies in the hierarchical ordering were found for the specific forms which also appear in the QSPOT[2,3].

According to the results of this study, Age-band 1 and Age-band 2 learners could be considered *at risk* if only able to draw a total of six out of the eight possible shapes in the QSPOT (Table 4.20). This may indicate that the VMI activity item may need to be expanded further by increasing the number of shapes for copying. Ceiling effects, which indicate that the demand of an activity may be too easy[51], were found for all six required shapes (Figure 4.1), and they exceeded the limit of 70 % used in the Peersman *et al*[51] study on a motor skill checklist. In comparison, far fewer participants were able to copy the rectangle with the inserted diagonal cross and the diamond, thus supporting their use in older children (Figure 4.1).

The lack of additional shapes following the triangle and preceding the rectangle with the inserted diagonal cross (which is expected of children aged 6 years 0 months according to the QSPOT[2,3]), and the lack of different shapes following the rectangle and preceding the diamond (which is expected of children aged 6 years 6 months according to the QSPOT[2,3]) is a concern. A diamond is also not included in the DTVMI-VMI Short Form, which is applicable in children between 2 and 7 years of age[32]. The DTVMI-VMI Short Form contains a similar shape to a diamond, namely a tilted square (item 21); however, this also is also likely to be too difficult for children under the age of 5 years 8 months[32]. The WOP Assessment Instrument[54] only requires a tilted square at 7 years, and a diamond between 8 and 9 years of age. Therefore, there seems to be a gap in the progressive level of difficulty in the shapes to be copied on the QSPOT VMI activity item for Age-band 2 learners. This could have affected the concurrent criterion validity for Age-band 2, as well as the ability of the VMI activity item, and Task 1: DAP/VMI overall, to identify participants with dysfunction in this sample, as sensitivity of the VMI activity item and Task 1: DAP/VMI were low.

As a result of the above findings, either the scoring of the rectangle with the diagonal cross in Task 1: DAP/VMI for Age-band 1 and Age-band 2 should also be adjusted, or a few more shapes should be added in the sequence between the triangle and the rectangle. The DTVMI manual[32] and the WOP Assessment Instrument[54] show the “Right oblique line” (p.38)[32] (/) and the diagonal cross (x) as being appropriate shapes for 5 year olds to copy, although both shapes precede the triangle in the respective assessments. If additional shapes are added to the QSPOT, research would have to be undertaken in order to determine whether there is a gradual increase in difficulty as the sequence of items progresses, and to ensure that there are no redundancies in the level of difficulty of any particular items[112].

The results of this research study indicate that 5 year olds should be considered *at risk* if only able to name four of the six possible shapes, regardless of age-band (Table 4.21). This means that the current cut-off of naming two shapes as indicating inadequate performance (Appendix L Column 2) is too low, and may therefore be too easy to achieve, resulting in the ceiling effects noted (Figure 4.2). Unless the scoring cut-off for the shape naming activity item is adjusted, those leaners with possible barriers to learning may not be identified.

5.6.3 Task 2: Cutting

More than two thirds of the mainstream Age-band 1 participants and just over half of the Age-band 2 participants were unable to pass the cutting activity item according to the norm set for quality (Figure 4.3). Verdonck & Henneberg[139] emphasize the importance of considering socio-economic status when assessing fine motor skills, as low socio-economic status can have negative effects to fine motor development. This also applies to cutting skills, as low socio-economic status may have resulted in a lack of exposure to the activity[139]. However, since most of the mainstream participants in this study attended middle- to upper-class nursery schools, it is likely that most of them had prior exposure to scissors and cutting, and the poor performance of the sample was therefore not likely due to difficulties in motivation and self-confidence based on a lack of prior experience[140]. Therefore, it was assumed that these results reflect the discrepancies between what the literature shows is appropriate for cutting by 5 year olds, and what the QSPOT requires.

The quality of cutting out different types of shapes and lines is still developing between the ages of 4 to 6 years, as bilateral coordination, eye-hand coordination and dexterity needed to manipulate the paper and scissors adequately, is still developing during this period[41,133]. This was confirmed by the Age-band 2 participants being better able to cope with the activity item than Age-band 1 participants (Figure 4.3 and Figure 4.4). Therefore, inadequate quality of work may still be expected in 5 year olds[54,133]; whereas the QSPOT[2,3] differs in respect to the literature in expecting controlled cutting around curves by 4 years 6 months. The WOP Assessment Instrument[54] as well as Gutmayer[133] agree that 5 year olds may still produce poor quality of work when cutting out circles. Gutmayer[133] also found that 5 year olds seemed to have more difficulty in cutting out a semi-circle, and the most difficulty in cutting out a circle, compared to other shapes, namely a straight line, triangle and a square.

The performance of the QSPOT cutting activity item may have been affected by the types of lines that the participants needed to cut on. The straight lines, curves (circles) and corners included are all deemed appropriate for 5 year olds according to various resources[54,70]; however, the addition of some tight curves, and concave directional changes may result in the clown image being deemed too complex by 5 year old children. The lines are also 1 mm thick, which Ratcliffe *et al*[71] included as being the thinnest lines on which Grade 1 learners were required to cut. The difficulty the participants had in cutting out the picture was also confirmed by the 29.17 % (n=14) of the participants who seemed to show confusion with regard to the lines in the image and consequently cut the picture into pieces, as well as by the avoidance behaviours of 10.42 % (n=5) of the participants, who cut roughly around the image followed by announcing their completion of the task. A large majority of participants were penalized with regard to neatness and accuracy (Figure 4.4).

Beery & Beery[32] report that a deviation of 6.35 mm from the line while cutting out a "simple picture" (p.175) is permissible in children of 5 years 11 months. No definite scoring procedures in judging accuracy in a quantitative and measureable manner are listed for the QSPOT cutting item[2,3]. Therefore, both the scoring criteria and picture type may have contributed to the large majority of the participants in this sample not being able to pass the cutting item on the QSPOT. While Stodden *et al*[67] explained that gross motor activities (that are deemed to exceed a child's level of competence), would discourage active movement on the part of the child, the same could be said of a complex cutting activity affecting a child's motivation to attempt the task.

In order for the cutting activity item to be more specific to learners without dysfunction, while still being able to identify learners with dysfunction, some changes may need to be made. Motivation to attempt the task is likely to be maintained by breaking the activity item into separate parts[140], and spreading the segments of the image over two to three pages. These pages could then be presented in order of difficulty (determined by research) as the learner achieves each goal. Considering the results of the study by Gutmayer[133], the order may include the triangle first, then the squares (ie. the bow tie), followed by the head (ie. curves). This may provide a step-by-step increase in difficulty which the children may feel more adept to attempt and accomplish. In addition, making the lines to cut on thicker and providing set measurements for the acceptable deviation from the line may also assist in improving the specificity of the cutting activity item, which at the current point, seems to be identifying too many learners as being dysfunctional. Since the cutting out and pasting of simple shapes is appropriate for 5 year olds[138], these learners could be expected to paste the clown together. If such changes are made, the cutting activity item will have to be reinvestigated and normed in order to identify what the cut-offs would be at the 16th percentile.

5.6.4 Task 3: Balance on one leg with eyes open and with eyes closed

According to the results of this study, Age-band 2 learners could be considered *at risk* if only able to stand on one leg for nine seconds, while Age-band 1 learners could be considered *at risk* if only able to stand on one leg with hands on their hips and with eyes open for 8 seconds (Table 4.22). This would mean that the current cut-off of less than 9.50 seconds (Appendix L) may be too high for Age-band 1 where balance is screened using only one leg and one trial, compared to the MABC-2[4], which assigns an average score to a one-leg standing balance time of eight seconds for 5 year olds, after one practice session and two formal trials on each leg. Therefore, the current cut-off used by the QSPOT for balance on one leg with eyes open can be considered adequate for Age-band 2, but not for Age-band 1 learners.

When considering developmental norms, Case Smith[41] states that 5 year olds should be able to stand on one leg with eyes open for between eight and ten seconds, while the WOP Assessment Instrument[54] suggest that the average time should be between ten and 12 seconds. Similarly, Grobler[138] suggests more than nine seconds for Age-band 1, while Beery & Beery[32] and Grobler[138] agree on an average of 12 seconds and more respectively for Age-band 2. In summary, the cut-offs for at risk performance expressed by the literature range between seven seconds[4,41] and nine seconds or less[54,138]. However, none of these norms or cut-offs include positioning the hands on the hips as required in the QSPOT[2,3], and this may have resulted in lower one-leg standing balance cut-offs for Age-band 1 in the QSPOT compared to some of the literature. While the cut-offs found for Age-band 2 in this study also appear to align with the literature, a time of nine seconds on one foot with hands on the hips in the PDMS-2[101] indicates partial achievement in a 5 years 0 month old child, indicating that the cut-off for an Age-band 2 learner in the QSPOT may still be higher. Further research and/or comparison to the results of the research study being conducted by the West Rand OTs should be undertaken to justify the cut-offs for this activity item.

When considering the activity item of one-leg standing with hands on hips and eyes closed, most of the mainstream learners were able to attempt the activity item, and were able to maintain the position for two or more seconds in this research study. Thus, this activity seems to be within the range of ability for 5 year olds. Age-band 2 learners could be considered *at risk* if only able to stand on one leg with hands on hips and eyes closed for 1.25 seconds, while Age-band 1 learners may be considered *at risk* if unable to do so at all (Table 4.22). In addition, most of the participants who could not perform the activity were in Age-band 1.

Both of the one-leg standing balance activity items showed the best balance between sensitivity and specificity, although the sensitivity scores of these activity items were still considered unacceptable. The only disadvantage is the difficulty in having to time one-leg standing with eyes closed in the case of a learner who is only able to maintain this position for two seconds or less. Therefore, it may be beneficial for other forms of standing balance to be considered for inclusion in the QSPOT for 5 year olds. Possibilities may include testing the ability to stand on tip-toe[54,138].

5.6.5 Task 4: Catching

The mainstream group of participants in this study showed that most of the beanbags were caught in the hands away from the chest by both Age-band 1 and Age-band 2 participants. Age-band 2 participants caught more beanbags in their hands, while Age-band 1 participants caught more beanbags against the chest (Figure 4.5). This is to be expected as Age-band 2 participants were expected to show better accuracy and development of catching skills. Therefore, the method of catching appears to also be important for each age-band, rather than only the number of beanbags that should be caught.

The QSPOT currently recognizes a 5 year old learner who catches five or fewer out of ten beanbags as having difficulties[2,3]. It is likely that the cut-off of the MABC-2 catching activity item is lower because its criteria are more strict for catching compared to the QSPOT[4]. Although a ceiling effect was noted for the total number of beanbags caught, the activity item for Task 4: Catching was the only item that showed a highly significant difference between the performance of Age-band 1 and Age-band 2 participants, namely in terms of catching in the hands away from the chest. According to the results of this study, an Age-band 1 learner may be considered *at risk* if only able to catch five out of ten beanbags, and if only able to catch two out of those five beanbags in the hands away from the chest (Table 4.23). This may partially support the current allowance of the QSPOT for catches against the chest, particularly for girls aged 5 years 6 months[2,3]. However, since several tests[4,54,101] are gender-free, the current cut-off of five catches of a beanbag in the QSPOT is appropriate for all Age-band 1 learners.

The results of this study showed that Age-band 2 learners should be considered *at risk* if only able to catch seven out of ten beanbags in total, and that six of the seven catches should be in the hands away from the chest (Table 4.23). Therefore, the current cut-off of catching five beanbags in the QSPOT[2,3] (Appendix L Column 2) may be set too low for Age-band 2. It is therefore recommended that this cut-off be researched before applying it to future editions of the QSPOT, as the mainstream sample performed well in this activity item. However, the sensitivity of Task 4: Catching (Table 4.12), and the catching activity item itself (Table 4.13), may have been negatively affected by this scoring discrepancy for Age-band 2.

When considering the literature, the Clinical Observations of Gross Motor Items[55] allows some catches of a 20 cm ball against the body in children aged between 5 years 0 months and 5 years 5 months. The same instrument indicates that children aged 5 years 6 months and older may still have difficulties in catching a 20 cm ball displaced to the side. The WOP Assessment Instrument[54] expects 5 years 6 month old children to catch a 20 cm ball in their hands, while the same child may be able to catch a tennis ball four times out of ten[138]. Other than the cut-off of three catches of a beanbag that is considered at risk performance in the MABC-2[4], the literature therefore generally referred to catching 20 cm balls and tennis balls. Therefore, the above findings could not be explicitly compared to the literature.

Adding another type of ball skill activity to the QSPOT would make it more comparable to other literature and assessments. Possible alternatives and/or additions to the QSPOT for

Age-band 1 may include bouncing and catching a 20 cm ball[54,55] or tennis ball[138] with two hands. Possible changes for Age-band 2 may include catching a tennis ball rather than a beanbag, involving a cut-off of three catches that would signify at risk or problematic performance[138], as well as bouncing and catching a tennis ball with one hand, involving a cut-off of one out of three catches as indicating at risk performance[101].

5.7 Summary

The QSPOT was found to have adequate specificity overall for the tasks and the total score; however, inadequate sensitivity was noted. Furthermore, there were some discrepancies where the scoring for individual activity items of drawing a person and cutting meant that the items showed adequate sensitivity, but inadequate specificity. Concurrent criterion validity for the QSPOT for gross motor skills, fine motor skills, VMI and visual perception skills was higher for Age-band 1 than for Age-band 2 overall. Several possible reasons for this have been explained and compared with current literature, and included problems with the LSEN sample which contained a number of participants with unconfirmed diagnoses, and who were likely not experiencing the kinds of difficulties that all the tests used in this study were designed to detect.

Although one needs to interpret these findings with care, the QSPOT showed the ability to differentiate typically developing learners accurately when taking into account each task score and Total Score. The cut-offs of the activity items of the QSPOT were also investigated, and some discrepancies between the performance of Age-band 1 and Age-band 2 learners were noted for several activity items, indicating that the scoring cut-offs may need to be changed for these activities. In addition, there were some indications that the activity items require expansion, particularly for Age-band 2 learners. Results regarding the relatedness of the tasks in the QSPOT also showed that further research may be needed in order to ensure that a Total Score can be used within the QSPOT. Until this is investigated through research, OTs may need to base their clinical opinions on the learners' performance on each task score, and make recommendations regarding needs for further assessment according to the cluster of difficulties that are noted on the QSPOT.

CHAPTER 6: CONCLUSION

The QSPOT has been designed to detect difficulties in fine and gross motor and praxis performance skills, as well as sensory-perceptual performance skills in learners between the ages of 4 to 6 years, although only the age-bands of 4 years 0 months to 5 years 11 months have been considered in research[39]. The skills that the QSPOT has incorporated, and the difficulties it has been designed to detect, have been linked in varying combinations to numerous types of intrinsic barriers to learning, including learning disabilities[29,66,84,85] (especially NVLDs[84,85]), disorders of sensory integration[59,73,94], ADHD[87], and various cognitive deficits[29,78–80]. Research in South Africa has confirmed the importance of fine motor skills and perceptual-motor skills for Grade 1 learners in learning to read, write and do mathematics[28]. Therefore, the creation and investigation of screenings such as the QSPOT, is important in order for the SIAS process to be successful in ensuring that all learners at risk for intrinsic barriers to learning related to these performance skills, can be identified early in their academic careers so that appropriate intervention can be introduced[24].

This study considered the ability of the QSPOT to discriminate learners with intrinsic barriers to learning related to fine and gross motor and praxis performance skills, as well as sensory-perceptual performance skills. Adequate specificity, but inadequate sensitivity for each of the tasks and the Total Score, was found on the QSPOT. Similar results were found for other standardized assessments routinely used to assess these performance skills, namely the MABC-2 and the DTVMI-VMI/VP, which were used as reference tests in the study.

The low sensitivity of all three tests may be accounted for by the selection of the LSEN group who presented with a variety of diagnoses and conditions which may not result in deficits in fine and gross motor and praxis performance skills, as well as sensory-perceptual performance skills. The QSPOT was able to identify the participants with intrinsic barriers in these skills, but did not identify all the participants in the LSEN group as having dysfunction. When considering the literature, various conditions result in different combinations of skill deficits. Therefore, not all learners with intrinsic barriers to learning will present with difficulties in all areas of gross and fine motor and praxis performance skills, and sensory-perceptual performance skills. This would have resulted in certain learners not being identified. It is; however, advisable to investigate the QSPOT further with regard to accuracy of identifying learners with dysfunction, as sensitivity is most important when considering the accuracy of an instrument[23].

This study also evaluated the concurrent criterion validity of the QSPOT, and this was found to be strong in relation to the DTVMI-VMI, which has been found to be culturally fair[32,48,113] and has been widely used for research in South Africa[49,100]. Poor concurrent criterion validity was found for the QSPOT and the DTVMI-VP in this study, indicating that the QSPOT does not assess constructs similar to those assessed in this subtest of the DTVMI.

In contrast, there was limited information on the use of the MABC-2 on the South African population, and due to various scoring differences, the concurrent criterion validity of the QSPOT and the MABC-2 was moderate to weak for Age-band 2. The concurrent criterion validity of the QSPOT, when compared to the MABC-2 and DTVMI-VMI, was higher for Age-band 1 for fine motor skills, visual perception and VMI, as well as for balance and catching when compared to the MABC-2.

The results for sensitivity and specificity, as well as validity showed that further investigation regarding the activity items of the QSPOT was needed. In this research study, differences between Age-band 1 and Age-band 2 were noted for the drawing of a person, where the current cut-off that indicates difficulties may not be valid for either age-band. This is the result of the fact that Age-band 1 learners may still be developing appropriately if drawing a total of seven parts on their DAPs, while Age-band 2 learners may be at risk if they meet the current criteria of the QSPOT to draw a body and eight parts. Similar performance was found across both Age-band 1 and Age-band 2 for the cut-offs at -1.00 SD and the 16th percentile for copying and naming shapes. The results indicated that the number and variety of shapes included in the copying aspect of the VMI activity item may need to be extended in order to improve the ability to identify learners with problems, especially in Age-band 2. Furthermore, the current cut-off of naming less than three shapes may be set too low, as the results of this study indicated that 5 year olds might be at risk if unable to name four or more shapes.

Too many participants failed the cutting activity item, creating problems for identifying learners accurately, particularly those learners who may very well be performing appropriately. Changes to the scoring and allowances for deviations from the line while cutting may be necessary, presumably for Age-band 1 learners more than Age-band 2 learners. However, the majority of Age-band 2 participants were also unable to meet the cut-off for cutting. This particular activity item showed the importance of using qualitative information when calculating scores, as the use of observation criteria in conjunction with the performance on the cutting activity item itself, yielded adequate specificity.

The results of this study indicated that the cut-off for standing on one leg with eyes open and eyes closed for Age-band 1 learners is less than that of Age-band 2 learners. The current cut-off used by the QSPOT to indicate difficulty in one-leg standing with eyes open was shown to be applicable to Age-band 2, but not to Age-band 1. In addition, the current cut-off used by the QSPOT in one-leg standing with eyes closed is only applicable to Age-band 2 learners, while Age-band 1 learners should only be considered at risk if unable to perform the activity item at all. The results of this study also showed that there are significant differences between the catch rate and types of catches that can be expected of Age-band 1 learners compared to Age-band 2 learners. While the current cut-off of the QSPOT may still be accurate for Age-band 1 learners, Age-band 2 participants were shown to catch more beanbags in total, and therefore the cut-off currently used by the QSPOT may be too low when considering the higher cut-off found in this study. In addition, Age-band 2 participants were shown to catch most of the beanbags in their hands away from their chests regardless of gender.

The results therefore indicated that the cut-off points for these activity items should be adjusted for each age-band, and this may improve the sensitivity and specificity of the tasks and activity items. Adjusting the cut-offs may also improve the QSPOT's concurrent criterion validity with other tests. Overall, the QSPOT showed the potential to be an accurate screening procedure for use on the South African population; however, it does require further improvement and investigation according to the results of this study.

6.1 Limitations of the Study

The sample of learners used in this study cannot be considered to be representative of the South African population at large, due to the fact that the sample was not racially stratified and that most of the schools were in middle to upper class suburban areas, with only one school in a low socio-economic area. The sample of participants was also small, and many items reflected abnormal distributions, and thus interpretation must be done with care, even though non-parametric data analysis was used.

There were significant difficulties in locating learners within LSEN schools who were within the required age-band, and who were experiencing various SLDs (according to the subtypes outlined by the LDAA[85]) and other similar intrinsic barriers to learning. The sample from LSEN schools contained a number of participants who suffered with moderate to severe intellectual impairment, and thus they often performed significantly below the norm required for the screening, and also performed equally poorly on the reference standard tests used in the study. There was also only a small number of participants with milder forms of dysfunction, and some of them were not identified by the QSPOT on various tasks. Therefore, the results of the study cannot be projected accurately for learners with SLDs, such as NVLDs and visual perceptual deficits, and other barriers which result in milder forms of motor dysfunction. The prevalence of learners with identified difficulties should have been lower, especially since the means and standard deviations of the total group had to be used for calculating z scores for the QSPOT, which were then used to calculate the sensitivity, specificity and concurrent validity of the instruments in the study. Therefore, the initial search for 50 children from LSEN schools in addition to the 50 children from mainstream schools was incorrect, and more participants in the mainstream sample instead would have been beneficial.

There were some problems with the reference standards chosen. The MABC-2 assessment contained fine motor and gross motor skill activities that differed from those that the QSPOT considers. For this reason, only the concurrent criterion validity of the QSPOT tasks compared to similar activity items of the MABC-2 was emphasized. The DTVMI-VP was not the most suitable test for use in comparing with the visual perception components of the QSPOT fine motor skills. The DTVMI-MC subtest should have also been administered to the learners, as it would have provided a better comparison to the strong visual-motor components that are part of the QSPOT fine motor skills.

Although it was the initial intention that the researcher be blinded to the results of the participants on the DTVMI and the MABC-2, this research study did not achieve the level of blinding that was desired. This was due to the fact that the research assistants were not always available to assist with data collection. Therefore, the researcher assessed 64.58 % of the mainstream participants and 58.62 % of the LSEN participants using the reference tests, compared to the 35.42 % of the mainstream participants and 41.38 % of the LSEN participants who were assessed by the research assistants (Table 4.7). In order to reduce bias, the tests were administered in a random order to participants (Table 4.8), and the strict scoring criteria described in the MABC-2 and DTVMI manuals were adhered to.

6.2 Recommendations for further studies

The fact that the participants in this study performed well in gross motor skills, means that further research should be undertaken to investigate whether South African children are indeed performing better in gross motor skills compared to international samples. Confirmation of this would then influence the types of tasks included, and the levels of performance that would be required to identify South African learners with difficulties in gross motor skills, when developing screening procedures and assessments for the South African population.

The cut-offs that distinguish passes and failures on the QSPOT activity items (that were found in this study) can be applied to the data in order to determine new z scores. This could be followed by rerunning the sensitivity and specificity tables, and calculating the concurrent validity with the MABC-2 and the DTVMI-VMI/VP, in order to determine whether any improvements in these psychometric properties occur. The scoring of the QSPOT should be altered so that a high score indicates better performance in order for easier comparison to other tests in future validity and reliability studies. This was not done for the present research study, as it would have made the project unmanageable.

Further research is required to investigate all the cut-offs of the activity items for Age-band 1 and Age-band 2, as differences were found between the age-bands, and the cut-offs found in this study deviated from the cut-offs based on the existing performance requirements of the QSPOT at the time of the research study. In addition, it was noted that certain activity items should be expanded to be more relevant for Age-band 2 learners.

The authors of the QSPOT could also consider a three-point Likert-scale for measuring achievement in the cutting and copying items, in order for learners to achieve the maximum score, a partial score or a fail. The cutting item needs to be investigated in terms of measurable ways of marking deviations from the line, and creating a standardized measuring and scoring system, in order to ascertain that all therapists score the cutting activity item in the same way. Changes to the layout of the cutting worksheet for the QSPOT could also be considered. All cutting end-products carried out in the current research studies could also be reviewed by a panel of OTs in order to standardize the scoring.

In terms of reproducing the study, it is recommended that a larger sample of participants be used for each of the mainstream and LSEN groups, with the prevalence of learners with intrinsic barriers to learning reflecting the current prevalence of mild and severe intrinsic barriers to learning in South Africa at the time that the research study is conducted. However, the sample of participants would need to include those with identified difficulties in gross and fine motor and praxis, and sensory-perceptual performance skills.

Finally, the MABC-2 should be standardized on a large sample of South African learners to determine whether the current international norms suit the South African population, or whether the norms may need to be adjusted for better or worse performance than the UK normative sample on which the MABC-2[4] was standardized. The protocol used in the study by Niemeijer *et al*[106] should be replicated, where the participants should perform both formal trials for each activity item on the MABC-2 in order to ensure valid norms.

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Occupational Therapy

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PERMISSION TO CONDUCT RESEARCH

Mr/s ______________________________________

Principal
School: ____________________________________

Dear Principal/Governing Body

Psychometric Evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning

I am Lauren Vial, an Occupational Therapist currently studying for a Master's Degree in Occupational Therapy at the University of the Witwatersrand. I am conducting a research project on screening tools which can be used to identify children with difficulties that affect learning and that may hinder their performance in the classroom.

It is important to be able to identify children with difficulties at an early age in order for these difficulties to be addressed so the impact on their progress can be addressed. In this study, we want to learn if a new screening tool developed on South African children, the Quick Screening Procedure for Referral to Occupational Therapy – Version 1 (QSPROT-1), is valid so that in the future this quick screening can be used to screen large numbers of Grade 0 children to ensure that any problems with learning related to motor and perception skills are not missed.

Although the research study title states the term "Grade 0", recent developments in the study have caused me to use children who attend Grade 00 and Grade 0 classes. I would like to invite your school to participate in the research study.

What is involved in the study:

Parents of Grade 0 children will be requested to complete a questionnaire in which contact details and demographic information are included.

The children will be required to participate in two testing sessions on separate days at a time agreed to by the school. The children will be asked to complete the QSPROT-1, which takes approximately 15 minutes and includes drawing a person, copying and naming shapes, cutting, one-leg standing and catching a bean bag.

The following will be performed by another researcher, [..........]. The children will be asked to complete the Movement ABC-2 which takes approximately 20 minutes, and includes three manual dexterity items (ie. posting coins into a money box, threading beads onto a string, and a drawing trail), aiming and catching items (ie. catching a bean bag and throwing a bean bag onto a mat), and three balance items (ie. one-leg standing, walking on a line with heels raised and jumping on mats). They will then be asked to complete the Beery-VMI which

THERAPEUTIC Sciences

takes approximately 15 minutes to administer, and includes copying and matching several shapes.

What would be required:

I would require two separate rooms where I and the researcher could set up for the screenings. The rooms would need to be quiet, and which could be used consistently throughout the study.

Risks:

None of the tasks across the tests place the children at risk, and mats are placed on the floor for standing on one leg, jumping and catching activities should the child over-balance. All unnecessary furniture will be removed from the room.

Benefits of participating in the study:

The screenings will be conducted free of charge. Feedback reports on results will be provided to the parents on request, and should the parents agree, they can give the report to the school to enable the teacher to address the identified difficulties. Should difficulties be identified, a feedback report with recommendations for support will automatically be provided to the parents, along with names and contact numbers of specific service providers in the area.

Participation is voluntary:

Children will be introduced to the researchers and will be required to state whether they would like to participate in the study or not with the teacher as a witness who will sign a form to verify the assent given. The school, the parent and/or child may discontinue participation at any time.

Confidentiality:

Efforts will be made to keep personal information of the children and parents confidential. The front page of the demographic questionnaire will be kept separate from the rest of the questionnaire. All demographic questionnaires, consent forms, as well as assessment and observation forms will be coded, with no name recorded on them. As far as possible, names will not be disclosed by the researchers. However, absolute confidentiality cannot be guaranteed. Personal information may have to be disclosed if required by law. The Human Research and Ethics Committee may inspect and/or copy all records for quality assurance and data analysis.

Contact details of researcher/s:

For further information, please contact the researcher, Lauren Vial at 082 492 7648 or on email: laurenj.vial@gmail.com. Any ethical queries or reporting of study-related adverse events should be made to the chairperson of the Wits Human Research Ethics Committee, Prof. P. Cleaton-Jones at 011 717 1234.

I look forward to working with your school, the parents and the children.

____

Lauren Vial

PERMISSION TO CONDUCT RESEARCH AT THE SCHOOL

I, ____,

the principal/governing body hereby give/s permission for the research study titled **Psychometric Evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning** to be conducted at this school, ____.

I agree to the conditions that have been stated in the information document.

______________________________ ______________________________

Signed Date

Occupational Therapy

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INFORMATION SHEET

PARENTS

Psychometric Evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning

Dear Parent/Guardian:

I am Lauren Vial, an Occupational Therapist currently studying for a Master's Degree in Occupational Therapy at the University of the Witwatersrand. I am conducting a research project on Screening Tools which can be used to identify children with difficulties that affect learning and that may hinder their performance in the classroom.

It is important to be able to identify children with difficulties at an early age in order for these difficulties to be addressed so the impact on their progress can be addressed. In this study, we want to learn if a new screening tool developed on South African children, the Quick Screening Procedure for Referral to Occupational Therapy – Version 1 (QSPROT-1), is valid so that in the future this quick screening can be used to screen large numbers of Grade 0 children to ensure that any problems with learning related to motor and perception skills are not missed.

I would like to invite you and your child to take part in this research study.

<u>What is involved in the study:</u>

You will need to complete a questionnaire in which contact details and demographic information are included.

Your child will be asked to participate in two testing sessions on separate days at a time agreed to by the teacher. Your child will be asked to complete the QSPROT-1 which takes approximately 15 minutes, and includes drawing a person, copying and naming shapes, cutting, one-leg standing and catching a bean bag.

The following will be performed by another researcher. Your child will be asked to complete the Movement ABC-2 which takes approximately 20 minutes, and includes three manual dexterity items (ie. posting coins into a money box, threading beads onto a string, and a drawing trail), aiming and catching items (ie. catching a bean bag and throwing a bean bag onto a mat), and three balance items (ie. one-leg standing, walking on a line with heels raised and jumping on mats). They will then be asked to complete the Beery-VMI which takes approximately 15 minutes to administer, and includes copying and matching several shapes.

25 girls and 25 boys will be assessed in the mainstream school setting. 25 girls and 25 boys will be assessed in the LSEN school setting. The children whose consent forms and questionnaires are returned first, and who meet certain qualifying criteria, will be assessed.

Risks:

None of the tasks across the tests place the children at risk, and mats are placed on the floor for standing on one leg, jumping and catching activities should the child over-balance. All unnecessary furniture will be removed from the room.

Benefits of being in the study:

Screenings performed by therapists operating within and outside of your child's school would be charged for. Since this is a research project, all screenings will be conducted free of charge. Feedback on your child's performance will be provided on request; however if specific difficulties are found, a report with the appropriate recommendations will automatically be provided, along with names and contact numbers of specific service providers in your area.

Participation is voluntary:

You and your child may choose to participate in this study. The screening will be conducted if permission is given by one or both parents; however, information regarding both parents necessary for the study is required on the questionnaire.

You may withdraw at any time, and benefits of taking part in the study will still be provided. For example, if you withdraw after the assessments have been conducted, a report will still be provided should any difficulties have been found.

Children will be introduced to the researchers and will be required to state whether they would like to participate in the study or not. The teacher will act as a witness and will sign a form to verify the assent given.

Confidentiality:

Efforts will be made to keep personal information confidential. The front page of the demographic questionnaire will be kept separate from the rest of the questionnaire. All demographic questionnaires, consent forms, as well as the assessment and observation sheets used will be coded, with no name recorded on them. As far as possible, names will not be disclosed by the researchers.

However, absolute confidentiality cannot be guaranteed. Personal information may have to be disclosed if required by law. The Human Research and Ethics Committee may inspect and/or copy all records for quality assurance and data analysis.

Contact details of researcher/s:

For further information, please contact the researcher Lauren Vial at 082 492 7648 or on email: laurenj.vial@gmail.com. Any ethical queries or reporting of study-related adverse events should be made to the chairperson of the Wits Human Research Ethics Committee, Prof. P. Cleaton-Jones at 011 717 1234.

I look forward to working with you and your child.

____

Lauren Jeannie Vial

Code (for administrator use only): ____________

INFORMED CONSENT FORM

Please sign the form below and return it to the school stapled with the questionnaire.

I, ____ the parent/guardian of ______________________________________at ______________________________ hereby give consent my child to participate in the research entitled **Psychometric Evaluation of the Quick Screening Procedure for Referral to Occupational Therapy – Version 1 (QSPROT-1) for Grade 0 learners with and without barriers to learning.**

I also accept the conditions which have been explained in the Information Sheet pertaining to the study. I understand that participation in the study will not result in any additional costs to me.

____________________________ ____________________________

Signed Date

APPENDIX C

DEMOGRAPHIC INFORMATION

MAINSTREAM SCHOOL

To be kept separate.

Please complete the following form and return it to the school:

Name of child: ______________________________

Date of Birth: ______________________________

Contact Details: Name: ______________________________

Contact No.: (c) ____________________

(h) ____________________

Email: ____________________

Name of Current School: ______________________________

Teacher: ______________________________

Code (for administrator use only): ____________________

DEMOGRAPHIC INFORMATION

MAINSTREAM SCHOOL

Code (for administrator use only): ______________________

Mother's Education Level: ___________________________________

Mother's Occupation: _______________________________________

Father's Education Level: ___________________________________

Father's Occupation: _______________________________________

Please complete the questions so we can get to know your child. Please make sure all the questions below are completed:

Age: ____

Gender: Male ☐ Female ☐

Was your child born in South Africa?

Yes ☐ No ☐

Did your child attend a Nursery School or play group?

Yes ☐ No ☐

Is this your child's first year in Grade 0 or Grade 00? Please indicate your child's grade.

Yes ☐ No ☐

Have difficulties with school work been identified?

Yes ☐ No ☐

If yes, by who were the difficulties in school work identified?

Please tick the applicable blocks and provide details of the age when the difficulties were identified, and the types of difficulties.

Difficulties in school work were identified by the:

Parent ☐

Age when the difficulties were identified: ____

Types of difficulties: ____

____

____

Teacher ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ____

____

____

____

Therapist (Occupational/Physiotherapy/Speech/Remedial) ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ____

____

____

____

____

____

Educational Psychologist ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ____

____

____

____

General Practitioner (GP) ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ____

____

Neurologist ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ____

____

Optometrist ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ______________________________

____

Other ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ______________________________

____

APPENDIX D

DEMOGRAPHIC INFORMATION

LSEN SCHOOL

To be kept separate.

Please complete the following form and return it to the school:

Name of child: ____

Date of Birth: ____

Contact Details: Name: ____

Contact No.: (c) ____________________________

(h) ____________________________

Email: ____________________________

Name of Current School: ____

Teacher: ____

Code (for administrator use only): ____________________

DEMOGRAPHIC INFORMATION

LSEN SCHOOL

Code (for administrator use only): ____________________

Mother's Education Level: ________________________________

Mother's Occupation: ___________________________________

Father's Education Level: ________________________________

Father's Occupation: ___________________________________

Please complete all the questions so we can get to know your child:

Please make sure all the questions below are completed:

Age: ______________________________________

Gender: Male ☐ Female ☐

Was your child born in South Africa?

Yes ☐ No ☐

Did your child attend a Nursery School or play group?

Yes ☐ No ☐

Is this your child's first year in Grade 0?

Yes ☐ No ☐

Have difficulties with school work been identified?

Yes ☐ No ☐

If yes, by who were the difficulties with learning identified?

Please tick the applicable blocks and provide details of the age when the difficulties were identified, and the types of difficulties.

Difficulties in school work were identified by the:

Parent ☐

Age when the difficulties were identified: ____

Types of difficulties: ____

____

____

Teacher ☐

Age when the difficulties were identified: ______________________________________

Types of difficulties: ____

____

____

____

Therapist (Occupational/Physiotherapy/Speech/Remedial) ☐

Age when the difficulties were identified: ______________________________________

Types of difficulties: ____

____

____

____

____

____

Educational Psychologist ☐

Age when the difficulties were identified: ______________________________________

Types of difficulties: ____

____

____

____

General Practitioner (GP) ☐

Age when the difficulties were identified: ______________________________________

Types of difficulties: ____

____

Neurologist ☐

Age when the difficulties were identified: ______________________________________

Types of difficulties: ____

____

Optometrist ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ______________________________

____

Other ☐

Age when the difficulties were identified: ______________________________

Types of difficulties: ______________________________

____

APPENDIX E

Quick Screening Procedure for Referral to Occupational Therapy

Use of these observations should be administered by a qualified Occupational Therapist

Name :	Gender : M / F	Defensive Reactions :
Date of Assessment :	Preferred Hand : L / R	Following Instructions :
Date of Birth :	Fidgety Behavior :	Self Confidence :
Chronological Age :	Attention :	Other Impressions :

Key to Observations:

♠Gross Motor
♣Fine Motor
♥Visual Perception
♦Attention and Concentration

COMPOSITE SCORE:

	Typical	At Risk	Problematic
4 - 4½yr:			
4½+yr:			
5 - 5½yr:			
5½+ yr:			

TASK	INSTRUCTIONS		OBSERVATIONS	SCORING	NORMS	
Draw-a-Person Test:	Ask the child to draw a picture of a person on an A4 piece of paper		Are you concerned about:	Score according to norms:	3 yrs	Circle for head, lines/scribble for arms & legs
		1	□ ♣ Use of Preferred Hand			
		1	□ ♠Sitting posture	DRAW-A-PERSON Age Equivalent:	4 yrs	Head with eyes, mouth, arms, legs/feet
		1	□ ♠Positioning of body / arm			
		1	□ ♠Support of page with non-preferred hand			
		1	□ ♣Pencil pressure		5 yrs	Draws man with body & 8 parts. Head with facial features (mouth & nose), arms & legs attached to trunk at correct point, sometimes 2D legs & clothing.
		1	□ ♠Midline crossing			
		1	□ ♣Pencil grip			
Visual Motor Integration Test		1	□ ♣Closure of shapes			
	Ask the child to copy the figures presented on to a piece of paper	1	□ ♠Lifting hand frequently		6 yrs	Drawing consists of 12 parts. Neck, hands, 2 articles of clothing, 4X as long as wide.
		1	□ ♣Tremor			
		1	□ ♣Jerky movements when drawing			
		1	□ ♣Associated movements			
	Ask the child to name the objects after drawing – if not done spontaneously.	1	□ ♥Changing direction of lines		3 yrs	I —
		1	□ ♥Spatial orientation	VMI Age Equivalent:	4 yrs	I — O +
		1	□ ♥Directionality		5 yrs	□ (square) Δ (triangle)
		1	□ ♥Distortions (too small/large/irregular)	TOTAL:	6 yrs	☐ (rectangle)
		1	□ Planning	Typical /At Risk /Problematic	6 yrs 6mnth	◊ (diamond)
		1	□ ♥Names fewer than 3 shapes			
		1	□ ♣Does not draw recognizable shapes	4 - 4½yr:		
		1	□ ♣Speed (too fast/slow)	4½+yr:		
		1	□ ♦Talks self through task	5 - 5½yr:		
		3	• Does not meet Draw-a-man Norms	5½+ yr:		
	TOTAL:	3	• Does not meet VMI Norms			

The complete screening procedure can be obtained from the West Rand Occupational Therapists in Private Practice. No part of this screening procedure may be reproduced or utilized prior to training

Movement Assessment Battery for Children – 2

Test Record Form Age Band 1 (3-6 years)

Code (for administrator use only):__________________ Gender: M / F

School: Class/year/grade:

Assessed by:

Referral source:

Preferred (writing) hand:

	Year	Month	Day
Date tested			
Date of birth			
Chronological age			

Movement ABC-2
Checklist completed? Y / N

Item Scores and Equivalent Standard Scores

Item code	Name of item	Raw score (best attempt)	Item Standard Score
MD 1*	Posting Coins preferred hand		
	Posting Coins non-pref hand		
MD 2	Threading Beads		
MD 3	Drawing Trail 1		
A&C 1	Catching Beanbag		
A&C 2	Throwing Beanbag onto mat		
Bal 1*	One-Leg Balance best leg		
	One-Leg Balance other leg		
Bal 2	Walking Heels Raised		
Bal 3	Jumping on Mats		

Total Test Score
Sum of 8 item **standard** scores:

*For Posting Coins and One-Leg Balance, look up standard score for each limb, add these and divide by 2. If the result is above 10, round up; if below 10, round down.

Three Component Scores†

Manual Dexterity^ MD 1 + MD 2 + MD 3

Component score	Standard Score	Percentile

Aiming & Catching^ A&C 1 + A&C 2

Component score	Standard Score	Percentile

Balance^ Bal 1 + Bal 2 + Bal 3

Component score	Standard Score	Percentile

^In each case sum the item standard scores.

Total Test Score	Standard Score	Percentile Rank

†For confidence intervals, see Examiner's Manual p139 (Chapter 7)

1

The complete record form can be obtained from by Pearson Education, Inc.

The Beery–Buktenica
Developmental Test of Visual–Motor Integration

Beery™ VMI

Sixth Edition

Ages 2 through 7 (SHORT FORM)

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

Code (for administrator use only):______________

Sex: ◯ F ❑ M

School: ______________ Grade: ______

Examiner: ______________

Test Date: ____ year ____ month ____ day

Birth Date: ____ year ____ month ____ day

Chronological Age: ____ year ____ month

(Count more than 15 days as one month.)

SUMMARY

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

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

Comments and Recommendations:

PROFILE

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

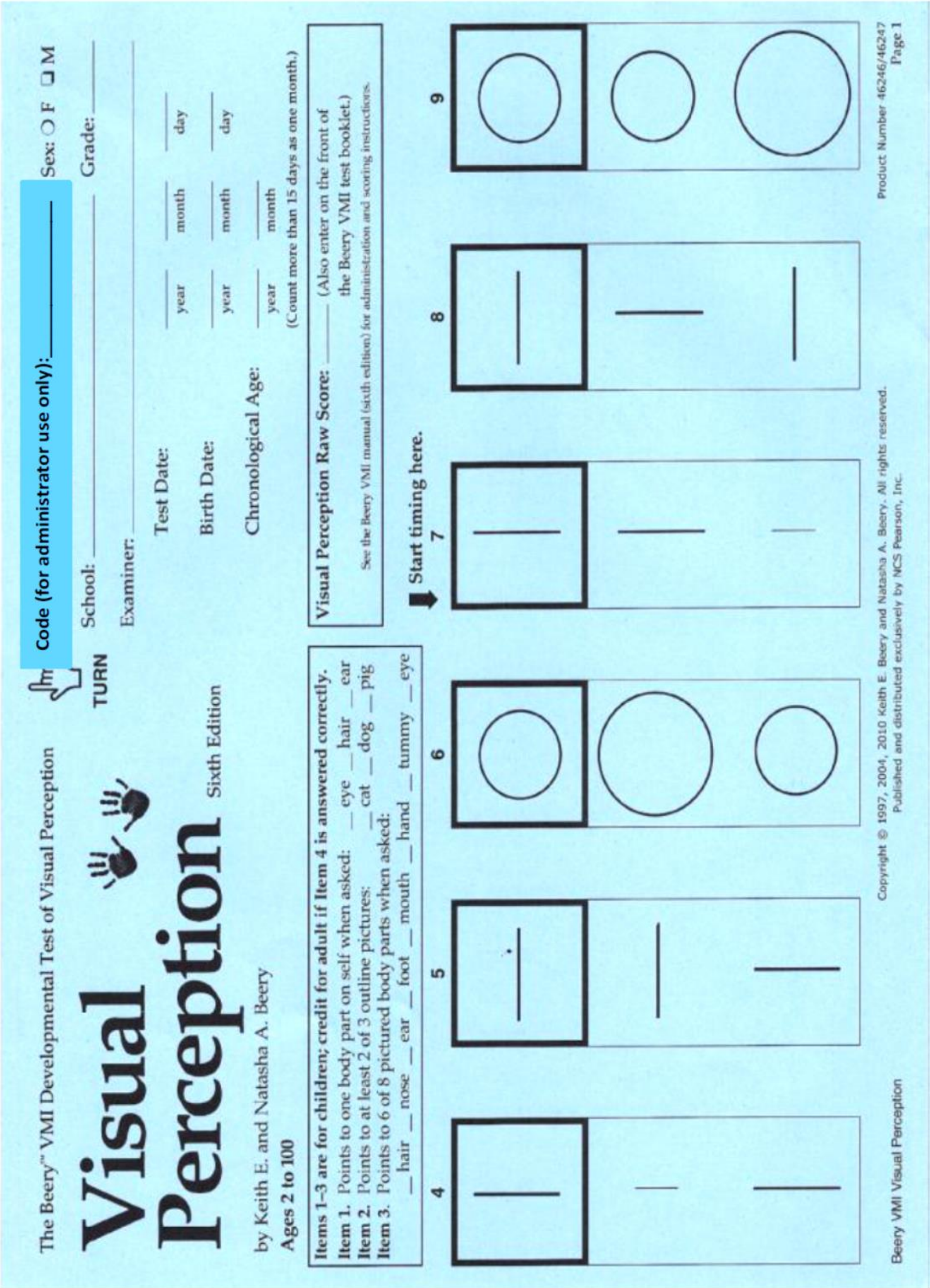
Begin testing on page 1. Turn booklet over with bound edge toward the examinee. If subtests are used, always test in this order: VMI → Visual → Motor.

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

Product Number 46243/46244

The complete forms can be obtained from NCS Pearson, Inc.

APPENDIX G 2



The Beery™ VMI Developmental Test of Visual Perception

Code (for administrator use only): ____________

Sex: ○ F ❑ M

TURN

School: ____________ Grade: ____

Examiner: ____________

Visual Perception

Sixth Edition

by Keith E. and Natasha A. Beery

Ages 2 to 100

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

(Count more than 15 days as one month.)

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

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

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

Item 3. Points to 6 of 8 pictured body parts when asked:

__ hair __ nose __ ear __ foot __ mouth __ hand __ tummy __ eye

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

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

Start timing here.

4 5 6 7 8 9

Beery VMI Visual Perception

Product Number 46246/46247

Page 1

The complete form can be obtained from NCS Pearson, Inc.

APPENDIX H

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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Lauren J Vial

CLEARANCE CERTIFICATE	**M120711**
PROJECT	Construct Validity of the Quick Screening Procedure for Referral to Occupational Therapy Version 1 for Grade 0 Learners with and without Barriers to Learning
INVESTIGATORS	Miss Lauren J Vial.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	27/07/2012
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 29/09/2012 **CHAIRPERSON** ....
(Professor PE Cleaton-Jones)

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

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

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use: Reference no. D2014/318

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	11 December 2013
Validity of Research Approval:	10 February to 3 October 2014
Previous GDE Research Approval letter reference number	D2013/247 dated 5 December 2012
Name of Researcher:	Vial L.J.
Address of Researcher:	24 Longfellow Road
	Farrarmere
	Benoni
	1501
Telephone Number:	011 425 4853 / 082 492 7648
Email address:	laurenj.vial@gmail.com
Research Topic:	Psychometric evaluation of the Quick Screening for referral to Occupational therapy - Version 1 (QSPROT-1) for Grade 0 learners with and without barriers to learning
Number and type of schools:	EIGHT Primary and EIGHT LSEN Schools
District/s/HO	Ekurhuleni North; Ekurhuleni South; Johannesburg East; Johannesburg North and Johannesburg South

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 to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

1

Making education a societal priority

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

The following conditions apply to GDE research. The researcher 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:

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *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, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *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.*
8. *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.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *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.*
11. *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.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *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.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director 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:

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

APPENDIX J

Further details regarding the training procedures on the MABC-2 for the research assistants

In the first three-hour workshop, the test was demonstrated by the researcher on the research assistants. They then practiced on the researcher using the cue cards for the remainder of the session. The research assistants were required to read through the administration procedures for the assessment of the required age-band for the research project, and were also required to practice administration on another person or child with similar materials during their own time for a further two to three hours.

In the second three-hour workshop, the research assistants were required to administer the test on the researcher again, and were given the opportunity to clarify the list of misunderstandings or questions that were compiled during their time of independent study of the test. Errors in administration were pointed out, and the research assistants were given the opportunity to practice these aspects again. Scoring discrepancies were discussed.

APPENDIX K

LEARNER'S VERBAL ASSENT FORM (QSPROT-1)

Psychometric evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning

I ________________________________, his/her teacher, hereby agree that the researcher has introduced herself to ______________________________________ in the following manner:

"Hello, my name is Lauren. We are going to have fun together. I would like to do some drawing and cutting, and standing on one leg and catching a bean bag with you today. Would you like to come and do this with me?"

I agree that he/she has agreed to participate in the study titled **Psychometric evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning**, in the presence of myself.

______________________________ ______________________________

Signed Date

LEARNER'S VERBAL ASSENT FORM (M ABC-2 and Beery-VMI)

Psychometric evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning.

I ________________________________, his/her teacher hereby agrees that the researcher has introduced herself to ______________________________________ in the following manner:

"Hello, my name is [………………]. We are going to have fun together. I would like to play with a money box and thread beads, and do some catching and throwing, standing on one leg, jumping, drawing and matching with you today. Would you like to come and do this with me?"

I agree that he/she has agreed to participate in the study titled **Psychometric evaluation of the Quick Screening Procedure for Referral to Occupational Therapy - Version 1(QSPROT-1) for Grade 0 learners with and without barriers to learning**, in the presence of myself.

______________________________ ______________________________

Signed Date

APPENDIX L

Table M1 The cut-offs for 5 year olds to pass or fail the activity items of the Quick Screening Procedure for Referral to Occupational Therapy

	COLUMN 1: Explanation of the norms to pass the activity items at the time of the research study (2014)	COLUMN 2: Explanation of the cut-offs that were considered to reflect a problem (based on the norms of performance specified at the time of the research study)
Task 1 A: Draw-a-person	• A drawing consisting of a body and eight additional parts; • The eight parts could include the head, some facial features, as well arms and legs (drawn as sticks or two-dimensional); • The drawing could be with or without clothing[2,3]; Additional guidelines given by one author of the QSPOT-1: • Stick figures are accepted if containing a body and eight additional parts	• A drawing consisting of a body and less than eight parts (ie. less than eight parts altogether). Additional guidelines given by one author of the QSPOT-1: • If it appears that the drawing has been taught, eg. too much detail in the face at the expense of detail elsewhere. • No legs or arms.
Task 1 B: Visual motor integration	• Must be able to draw the horizontal and vertical lines, the vertical-horizontal cross, the circle, square and triangle (six basic required shapes) • Additional shapes (rectangle with diagonal cross, and diamond) are also administered, but not strictly required for five year olds[2,3].	• Draws five or fewer of the six required shapes.
Task 1 B: VMI (naming shapes)	• Must name at least three or more shapes.	• Names two or fewer shapes[2,3].

Table M1 The cut-offs for 5 year olds to pass or fail the activity items of the Quick Screening Procedure for Referral to Occupational Therapy (continued)

	COLUMN 1: Explanation of the norms to pass the activity items at the time of the research study (2014)	COLUMN 2: Explanation of the cut-offs that were considered to reflect a problem (based on the norms of performance specified at the time of the research study)
Task 2: Cutting	• Good control on the straight lines, curves and sharp corner[2,3].	• Inability to meet the adjacent criteria. Additional guidelines given by one author of the QSPOT-1: • Inability to keep the picture of the clown as a single unit.
Task 3 A: One-leg standing balance (eyes open)	• Stand on one leg with hands on the hips for ten to 12 seconds with eyes open[2,3].	• Stand on one leg with hands on the hips for less than ten seconds with eyes open.
Task 3 B: One-leg standing balance (eyes closed)	• Stand on one leg with hands on hips for two or more seconds with eyes closed.	• Stand on one leg with hands on hips for less than two seconds with eyes closed.
Task 4: Catching	• Must catch a minimum of six out of ten beanbags[2,3]. • Catches in the hands away from the chest, and against the chest are allowed[2,3].	• Catching the beanbag five or fewer times out of ten.

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