

https://dspace.org/

Evaluation of the tests of sensory integration function used with infants

Botha, Marica

2016-02-12
http://hdl.handle.net/10539/19504

Downloaded from a DSpace repository. https://dspace.org/

EVALUATION OF THE TESTS OF SENSORY INTEGRATION FUNCTION USED WITH INFANTS.

Marica Botha

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

Johannesburg

October 2015

DECLARATION

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

_____

M. Botha

on the _____ day of _____ , 2015

DEDICATION

This research study is dedicated to my husband Francois Botha,

whom supported me throughout the process of writing this dissertation,

and to my two daughters Nadia and Ciska.

ABSTRACT

Sensory integrative dysfunction occurs in 5-10% of children. Various tests are used to identify sensory dysfunction in infants in South Africa but they have not been validated in this context. The purpose of this study was to explore the comparison of normative scores, construct validity and diagnostic accuracy of two standardised assessments: the Infant/Toddler Sensory Profile (ITSP), a parent report tool and the Test of Sensory Functions in Infants (TSFI), a therapist administered test on 60 infants. The sample was recruited from child day care facilities in the East Rand. Overall reliability of the ITSP was found to be within an acceptable range, while for the TSFI it was below an acceptable range. The TSFI had poor diagnostic accuracy for the total score on a number of sections. The divergent validity found between the sections of the two tests confirmed that they do not measure the same constructs of sensory processing.

ACKNOWLEDGEMENT

My sincere gratitude goes to the following people:

- My supervisors Denise Franzsen and Lyndsay Koch for their input, support and guidance with this dissertation.
- Me. A. van Jaarsveld for her guidance and support.
- All the supervisors and staff at the various child day care facilities that was used during the data collection phase of this study.
- The South African Institute for Sensory Integration (SAISI), for their financial support in the form of a research grant.
- My family, for their patience and continues support throughout this process.

TABLE OF CONTENT

DECLARATION II
DEDICATION III
ABSTRACT IV
ACKNOWLEDGEMENT V
TABLE OF CONTENT VI
LIST OF FIGURES X
LIST OF TABLES XI
DEFINITION OF TERMS XII
ABBREVIATIONS XV

CHAPTER 1: INTRODUCTION 1

1.1 INTRODUCTION 1
1.2 PROBLEM STATEMENT 4
1.3 RESEARCH QUESTION 5
1.4 PURPOSE OF THE STUDY 5
1.4.1 Aim of the study 6
1.4.2 Objectives 6
1.5 JUSTIFICATION FOR THE STUDY 6
1.6 OVERVIEW OF THE STUDY 7

CHAPTER 2: LITERATURE REVIEW 8

2.1 INTRODUCTION 8
2.2 NORMAL DEVELOPMENT 8
2.2.1 Normal development of sensory systems 9
2.3 SENSORY INTEGRATION 9
2.3.1 Sensory Integration Theory 10
2.3.2 Sensory Integrative Dysfunction 12
2.3.3 Sensory Modulation 15
2.3.4 Dunn's Model of Sensory Processing 17
2.4 ASSESSMENT 20
2.4.1 Concepts of assessment 20
2.4.2 Use of standardised tests for assessment. 21
2.4.3 Assessment of Sensory Integrative Dysfunction (SID). 22

2.4.3.1 Infant/Toddler Sensory Profile (ITSP) 23
2.4.3.2 Test of sensory functions in infants (TSFI) 25
2.4.4 Use of Parent Questionnaire and Therapist Observation tests. 26
2.4.4.1 Parent Questionnaire 26
2.4.4.2 Therapist administered test 27
2.4.5 Critical review of tests 28
2.5 EARLY INTERVENTION 29
2.5.1 South African policy on early intervention 30
2.5.2 Importance of early intervention in sensory integration 31
2.6 CONCLUSION 33
CHAPTER 3: RESEARCH METHODOLOGY 34
3.1 STUDY DESIGN 34
3.2 POPULATION 34
3.2.1 Sampling 34
3.2.2 Sample size 36
3.3 RESEARCH TOOLS 37
3.3.1 Demographic sheets: Compiled by researcher (Appendix A) 37
3.3.2 Infant/Toddler Sensory Profile: by Dunn,W. (Appendix B) 37
3.3.3 Test of Sensory Functions in Infants (TSFI) by De Gangi & Greenspan (Appendix C) 39
3.4 PROCEDURE 40
3.4.1 Data collection procedure 40
3.4.2 Data Analysis procedure 42
3.5 ETHICAL CONSIDERATIONS: 43
CHAPTER 4: RESULTS 45
4.1 INTRODUCTION 45
4.2 DEMOGRAPHICS 45
4.2.1 General Demographics 45
4.2.2 Birth History of Infant participants 46
4.3 COMPARISON OF NORMATIVE DATA OF THE INFANT/TODDLER SENSORY PROFILE (ITSP) AND TEST OF SENSORY FUNCTIONS IN INFANTS (TSFI) 47

4.3.1 Infant/Toddler Sensory Profile (ITSP) 47
4.3.1.1 Comparison to normative data and typical range 47
4.3.1.2 Frequency of typical, probable and definite differences 51
4.3.2 Test of Sensory Functions in Infants (TSFI) 57
4.3.2.1 Comparison to typical range 57
4.3.2.2 Frequency of typical, probable and definite differences 58
4.3.3 Sensitivity and Specificity 62
4.3.4 Construct validity correlation scores for Test of Sensory Functions in Infants (TSFI) and Infant/Toddler Sensory Profile (ITSP). 64
4.3.5 Reliability 66
4.4 SUMMARY 67

CHAPTER 5: DISCUSSION 70

5.1 INTRODUCTION 70
5.2 DEMOGRAPHICS 70
5.3 ASSESSMENT OF SENSORY INTEGRATIVE TESTS FOR INFANTS FOR THE SOUTH AFRICAN CONTEXT 72
5.3.1 Infant/Toddler Sensory Profile (ITSP) 73
5.3.2 Test of Sensory Function in Infants (TSFI) 81
5.4 DIAGNOSTIC ACCURACY OF TESTS 85
5.4.1 Infant/Toddler Sensory Profile (ITSP) 86
5.4.2 Test of Sensory Functions in Infants (TSFI) 88
5.5 CONSTRUCT VALIDITY AND INTERNAL CONSISTENCY OF TESTS FOR SENSORY INTEGRATION FUNCTION IN INFANTS. 91
5.5.1 Construct validity 91
5.5.2 Internal Consistency 92
5.6 OTHER VARIABLES AFFECTION THE USE OF THE STANDARDISED TESTS IN SOUTH AFRICA 93
5.7 LIMITATIONS OF THE STUDY 95
5.8 SUMMARY 96

CHAPTER 6: CONCLUSION 99

6.1 RECOMMENDATIONS 103

REFERENCES 105

APPENDICES 116

APPENDIX A1 117
APPENDIX A2 118
APPENDIX A3 120
APPENDIX B1 121
APPENDIX B2 122
APPENDIX C 126
APPENDIX D 130
APPENDIX E 131
APPENDIX F1 134
APPENDIX F2 137

LIST OF FIGURES

Figure 2.1 Continuum of sensory registration and responsivity. 16

Figure 2.2 Relationships between Behavioural Response and Neurological Thresholds 18

Figure 3.1 Instructions to parents 41

Figure 4.1 Raw scores of processing sections compared to normative data. 48

Figure 4.2 Raw scores of quadrants compared to normative data 48

Figure 4.3 Distribution of scores for visual processing section 53

Figure 4.4 Distribution of scores for quadrant 2: sensation seeking 53

Figure 4.5 Distribution of scores for vestibular processing section 54

Figure 4.6 Distribution of scores for auditory, tactile and oral sensory processing sections 55

Figure 4.7 Distribution of quadrant scores for quadrant 1: low registration, quadrant 3: sensory sensitivity, and quadrant 4: sensation avoiding 56

Figure 4.8 Distribution of scores for combined quadrant: low threshold 57

Figure 4.9 Raw scores compared to normative data (TSFI) 58

Figure 4.10 Distribution of scores for reactivity to vestibular stimulation 59

Figure 4.11 Distribution of scores for adaptive motor functions 60

Figure 4.12 Distribution of scores for reactivity to tactile deep pressure, visual-tactile integration, and ocular-motor control subtests 61

Figure 4.13 Distribution of total test scores 62

LIST OF TABLES

Table 3.1 Distribution of test participants....36

Table 4.1 General Demographics....46

Table 4.2 Birth History....47

Table 4.3 Means Standard deviations, confidence intervals and effect size on raw score analysis for ages of 7-12 months on the Infant/Toddler Sensory Profile (ITSP)....49

Table 4.4 Means Standard deviations, confidence intervals and effect size on raw score analysis for ages of 13-18 months on the Infant/Toddler Sensory Profile (ITSP)....50

Table 4.5 Frequency data for Infant/Toddler Sensory Profile (ITSP)....52

Table 4.6 Frequency data for the Test of Sensory Functions in Infants (TSFI)....59

Table 4.7a Sensitivity and Specificity of Infant/Toddler Sensory Profile (ITSP)....63

Table 4.7b Sensitivity and Specificity of Test of Sensory Functions in Infants (TSFI)....64

Table 4.8 Correlation scores of Test of Sensory Functions in Infants (TSFI), and Infant/Toddler Sensory Profile (ITSP)....65

Table 4.9 Reliability scores for the Infant/Toddler Sensory Profile (ITSP) and Test of Sensory Functions in Infants (TSFI)....66

DEFINITION OF TERMS

Bilateral integration and sequencing - An individual's ability to use two sides of the body in a coordinated manner, using correct timing and being able to complete projected action sequences during motor activities (1).

Child - "Every human being below the age of eighteen years unless, under the law, applicable to the child majority is attained earlier" (art.1) (2).

Diagnostic accuracy – "It relates to the ability of a test to discriminate between the target condition and health. This discriminative potential can be quantified by the measures of diagnostic accuracy such as sensitivity and specificity, predictive values, likelihood ratios, the area under the ROC curve, Youden's index, and diagnostic odds ratio" (p. 1) (3)

Early childhood - The period between birth and eight years of age which is considered a crucial period of development for later outcomes (General comment No. 7) (2).

Early childhood development - "An umbrella term which applies to the processes by which children from birth to at least 9 years grow and thrive, physically, mentally, emotionally, spiritually, morally and socially" (p. 31, par 73) (4).

Early intervention - "A process of assessment and therapy provided to children, especially those younger than age 6, to facilitate normal cognitive and emotional development and to prevent developmental disability or delay." (5).

Gold standard – Any method, intervention, standardised clinical assessment, measurement or procedure of known validity and reliability which is generally regarded to be the best available. It is used to compare new tests and/or results against (6).

Habituation – The simplest form of learning in the CNS and is the process whereby the nerve cells recognize a stimulus as familiar and therefore decrease the transmission of the stimulus as there is no perceived need to continue to respond to the stimulus (7).

Infant – An infant is regarded as a child who is in the early stages of life. This is generally from the first month after birth until the end of the first year (12 months), but sometimes this period can be extended to the age of 24 months (8) (9). For the purpose of this study, infant will indicate children below the age of 18 months.

Postural-ocular control - The activation as well as coordination of muscles in response to the position of the body relative to gravity in order to sustain functional positions while moving and during transitions (1).

Praxis - The ability to conceptualise, plan and execute novel motor actions as well as to organise the sequence of goal directed motor actions. Praxis affords us to adapt and react quickly and in a meaningful manner to new environmental demands (1).

Sensitization - The process whereby stimuli are recognized as important, or potentially harmful, which result in the generation of a heightened response (10).

Sensory discrimination - The ability to differentiate and interpret between the spatial and temporal qualities of sensory information. This can also be described as the "where is it", "what is it" and "when did it occur" response (1). Discrimination takes place in all sensory systems (tactile, vestibular, proprioceptive, auditory, visual, taste and smell).

Sensory integration - "It is the neurological process that organises sensation from the body and environment, and enables us to use our body effectively within the environment" (p.11) (11).

Sensory integration function – Ability of an individual to register, process, integrate, and respond to sensory input (12) as well as organise and process the flow of sensory impulses in a manner that lead to precise information about oneself and the world (13).

Sensory integrative dysfunction (SID) - Difficulty with central nervous system (CNS) processing of sensation, especially tactile, proprioceptive, or vestibular. This manifests as poor praxis and/or poor modulation (14). Thus,

it involves difficulties with processing or organising the sensory information that helps us understand our bodies and the world around us (15).

Sensory modulation - An individual's ability to respond adaptively to sensation over a broad range of intensity and duration (16). The individual therefore needs the ability to regulate the intensity, degree and nature of sensory stimuli and have the capacity to process sensory information in order to generate responses that are appropriately graded in relation to the incoming sensations (11) (17) (18).

Sensory processing – "A process in humans that involves reception of a physical stimulus, transduction of the stimulus into a neural impulse, and the interpretation or conscious experience of that sensation. Sensory processes are foundational to any individual's learning, perception, and action" (19).

Sensory processing disorder – A term used to describe difficulties, with any part of sensory processing, that lead to impairment of daily roles and routines. There are three categories of sensory processing disorder: sensory modulation disorder, sensory based motor disorder and sensory discrimination disorder (20).

ABBREVIATIONS

ADL	Activities of daily living
ASI®	Ayres Sensory Integration®
CNS	Central Nervous system
ITSP	Infant/Toddler Sensory Profile
OT/SI	Occupational therapy using a sensory integration frame of reference for treatment.
SID	Sensory Integrative Dysfunction
TSFI	Test of Sensory Functions in Infants
USA	United States of America
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

When delivering services to clients, occupational therapists follow a specific process. This process, according to the Practice Framework 3rd edition (21) is called the 'occupational therapy process'. This is the client-centred process of assessing and treating in order to achieve targeted outcomes. All this is facilitated by the specific perspective of occupational therapists while using clinical reasoning, activity analysis and collaborating with the client (21).

In order to provide effective treatment to clients, occupational therapists need to be able to accuratly assess and identify the client's specific problems. When using standardised tests it is important to know if the test can be used to provide accurate results for the specific population with which it is used.

Therapists often use standardised tests that have norms for the population for which the test was developed, but never question if the test achieves the same results on different populations. Research on the standardisation of tests has shown different populations often have different normative data, because the environments and culture may influence response in different assessments. It cannot be assumed that norms from the assessment manual can be transferred to a different population (22). It is appropriate however to investigate the applicability of the published norms to a new population to determine if they differ before embarking on a substantial re-norming of any assessment (23). A study done by Van Jaarsveld et al. on the Sensory Integration and Praxis Test (SIPT) on a South African population (24) supported this concept. This study found that on five of the 17 subtests of the SIPT, the South African population achieved higher normative scores than the US population, and therefore the SIPT was under diagnosing children in South Africa (24).

Researchers have indicated that it is important for independent investigators to continue to complete studies and gather psychometric data on existing standardised tests. This applies to any standardised test and should be done in addition to the studies completed by the test authors (25) (26) (27). This type of research can assist in allowing the appropriate early identification of abnormal

development and has been documented as important by DeGangi et al. (28), Wiener et al. (29) and Harris and Daniels (30).

Worldwide there has been an increased emphasis placed on early intervention due to an increased awareness regarding the rights of children (31). Early intervention programs are aimed at both prevention and treatment of developmental disabilities in young children and are relevant in occupational therapy (32). However, standardised tests used by occupational therapists to assess very young children present additional challenges as infants cannot provide information directly, and according to the authors of the Test of Sensory Functions in Infants (TSFI), the wide range of coefficient scores reflects some instability of infant behaviour (33).

The standardised tests used with infants therefore rely on the observation of behaviour by therapists or self-report by parents. The results of these tests are often reliant on comparison to norms established by the test developers. It is important to establish if the norms against which the results of these tests are being compared are relevant in different contexts and populations, as children displaying mild or moderate dysfunction may be left undetected and therefore do not receive early intervention as needed.

Sensory integrative functioning is one of the performance skills which occupational therapists assess from an early age. Sensory processes are foundational to any individual's learning, perception, and action (19) and sensory integrative function includes the registration, modulation and discrimination of sensory input as well as the process of integrating all the information in order to create purposeful, adaptive behaviours in response to the environment we live in (34). When a problem occurs in any area of sensory integrative function, it is called Sensory Integrative Dysfunction (SID) and in order to accurately treat SID, it is important to establish what areas of sensory integrative function is problematic and how it affects the individual's daily functioning.

The presence of SID may be evident very early in life. In a study of eight-month old infants, a high percentage of infants showed sleeping problems, eating difficulties, temper tantrums, and other symptoms. When these difficulties are present from birth, they appear to contribute to development of dysfunctional

parent–infant interaction patterns. These, in turn, can affect the infants' personality development (35). It is possible that some infants are born vulnerable and stay vulnerable. In other instances, toddlers by the age of three years that are regarded as being behind with their development in comparison to the expectations of the developmental curve are more likely to develop some type of SID (36). According to DeGangi et al., when SID is present at an early age, it is very difficult to accurately establish the impact on later learning and emotional development (37).

When testing for SID, the Sensory Integration and Praxis test (SIPT) (38), is considered the 'gold standard' for testing. This test, however, can only be used on children four years of age through eight years eleven months. The SIPT is usually also used together with clinical observations (39) and a test or questionnaire to determine the child's modulation abilities.

At present two standardised tests for infants, the Infant/Toddler Sensory Profile (ITSP) (40) and the TSFI (9), both of which assess components of sensory processing within sensory integrative function, are available and used in research in South Africa (41) (42) (43). Sensory processing according to the new nomenclature is divided into three categories namely sensory discrimination disorder (SDD), sensory modulation disorder (SMD) and sensory-based motor disorder (SBMD). Sensory discrimination disorder is when there is an inability to interpret the qualities of sensory stimuli. Sensory modulation disorder on the other hand is when there is a mismatch between a person's emotional and attentional response towards and environmental demand. Sensory modulation disorder is divided into three subtypes namely sensory over –responsivity, sensory under-responsivity and sensory seeking (20) (44). According to Eeles et al. (2013) the TSFI was designed to be used in research and clinically to assess sensory defensive behaviours including avoiding and sensitivity to input. This indicates testing of sensory discrimination. On the other hand the ITSP assesses the sensory processing ability and the effect on occupational performance based on Dunn's model of sensory processing, thus measuring sensory modulation (45).

Neither of these tests have psychometric properties that have been developed to the extent where the tests can be considered as a 'gold standard' for testing in infants and younger children. Due to the absence of a 'gold standard', careful

evaluation of multiple sources of information is needed as there is an absence of one single test or screening measure that can be used to identify SID. This is particularly important as the detection of SID early in life, is also difficult due to the fact that SID is often co-morbid to other diagnoses like Autism Spectrum Disorder (ASD), developmental delay, attention deficit hyperactivity disorder (ADHD), developmental coordination disorder (DCD), Fragile-X syndrome, Asperger's syndrome, and learning disability (46) (47).

There appear to be no other published studies on the normative data for the ITSP (40) and the TSFI (9) for populations other than that in the United States of America (USA) where the tests were developed. Other international studies have been published on the Sensory Profile (48) for older children however. A study done in Australia, looked at internal consistency results for the Sensory Profile and Sensory Processing Measure and compared their results to the data reported in the test manual. It was found that differences between the norms reported in the test manual and their study group did exist, indicating that norms differ when used on different populations (49). A study in Israel however found similar norms for the Israeli and USA samples (50). Only one study determining diagnostic accuracy of the Sensory Profile has been published to determine how accurate SID can be identified in older children in India (51). Therefore, it is important and necessary to look at the available tests used at an early age, and evaluate their diagnostic properties in the population in which the therapist is working in order for evidence for practice in that population to be established (52).

1.2 PROBLEM STATEMENT

Standardised tests being used to test sensory integration function in infants rely on observation using either parent report of behaviour, or observation by a trained sensory integration therapist. These tests are instruments used to determine early signs of SID in order to determine if further assessment and preventative or remedial treatment is required.

Research shows that observation tests have limitations as usually the therapist administered tests require a great deal of training and since the infant is often only observed for a short period, components of behaviour may be missed. Parent report questionnaires on the other hand can be limited by the parent's perception

of their child, and the validity of parent report questionnaires is also affected by reading ability and ability to interpret lengthy questions (53). It is also important to know the standardised tests being used have been adequately researched for the specific population they are being used on.

The Infant/Toddler Sensory Profile (40), a parent questionnaire, and the Test of Sensory Functioning in Infants (9), a therapist observation test have both been researched and studies have reported the reliability and validity of both tests. There are still some concerns however regarding internal consistency in the birth to six month version of the Infant/Toddler Sensory Profile (ITSP) developed by Dunn in 2002 (40).

The Test of Sensory Functioning in Infants developed by De Gangi in 1988 (37), has validity and reliability that is described as acceptable except for internal consistency scores which have been reported (37). The face and content validity for both tests have been well documented (37) (54) and both tests have acceptable levels of inter-rater and test-retest reliability that have been shown to be consistent in different countries and contexts (55) (56).

The ability of standardised tests to determine SID in infants has been found to differ depending on the infants' age, and no research regarding the norms or diagnostic accuracy of the tests in South African has been completed.

Although both the ITSP (40) and TSFI (9) measure sensory integration function, the tests have been associated with different aspects of sensory processing and it is not known if any association between the constructs of sensory modulation assessed by the ITSP and sensory discrimination assessed by the TSFI exists.

1.3 RESEARCH QUESTION

Can the normative data established in the USA on the standardised tests for assessing sensory integrative function in infants, be applied to infants between the ages of seven to 18 months, in a South African sample?

1.4 PURPOSE OF THE STUDY

The purpose of this study was to determine whether the sensory integration function of full term infants, between the ages of seven to 18 months, in a South

African sample aligns with the normative data established in the USA on two standardised tests - the Infant/Toddler Sensory Profile (ITSP) (40) and the Test of Sensory Functions in Infants (TSFI) (9). Other psychometric data including the construct validity, the diagnostic accuracy and internal consistency were established for the same sample of infants to support the use of these tests in the South African context.

1.4.1 Aim of the study

The aim of this study was to determine the normative data, for a South African sample of full term infants between the ages of seven to 18 months, on the Infant/Toddler Sensory Profile (ITSP) (40), and the Test of Sensory Functions in Infants (TSFI) (9), as well as other psychometric data on the tests that support their ability to identify SID in South African infants and guide the clinical use of the tests with these infants.

1.4.2 Objectives

The objectives of the study were:

1. To compare the scores obtained from the Infant/Toddler Sensory Profile (ITSP) (40), and the Test of Sensory Functions in Infants (TSFI) (9), for infants between the ages of seven to 18 months, in a South African sample to the normative data in the manuals for these tests from United States of America (USA).
2. To determine the diagnostic accuracy of the Infant/Toddler Sensory Profile (ITSP) (40), and the Test of Sensory Functions in Infants (TSFI) (9), on infants between the age of seven and 18 months in a South African sample.
3. To establish the construct validity and internal consistency of the Infant/Toddler Sensory Profile (ITSP) (40), and the Test of Sensory Functions in Infants (TSFI) (9), for this group of infants between the ages of seven and 18 months.

1.5 JUSTIFICATION FOR THE STUDY

The results of this study will determine if the normative data of the tests used to assess sensory integration function developed in the USA, can be used for infants between the ages of seven to 18 months, in a South African sample. This may

assist in the accurate identification of SID earlier in a child's life allowing for early intervention of at risk infants and preventing the requirement for longer periods of therapy later in the child's life. Appropriate therapeutic interventions to reduce the developmental effects of SID and the accompanying behavioural difficulties can be implemented timeously if the dysfunction is recognised early. More positive outcomes may be achieved by targeting infants at risk with early intervention when the brain is more receptive to sensory integration therapy. Knowledge of a child's SID can also help the parent or caregiver with handling of the child (56).

1.6 OVERVIEW OF THE STUDY

This dissertation has six chapters as follows:

Chapter 1 – Introduction.
Chapter 2 – Literature review.
Chapter 3 – Research Methodology.
Chapter 4 – Results.
Chapter 5 – Discussion.
Chapter 6 – Conclusions and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this literature review, normal development and sensory development will be discussed. Sensory integration will be explored with reference to the development of Ayres sensory integration® theory and assumptions of the framework. The model on which the ITSP is based as well as the development of the ITSP and the TSFI will be considered. Early intervention, as well as assessment and the importance thereof, will be reviewed. Particular attention will be given to methods of assessment, the use of standardised tests in assessment, and the importance of the critical review of tests used for assessment and validation of tests on local populations.

2.2 NORMAL DEVELOPMENT

The understanding of normal development is important for occupational therapy intervention with children, as although there is variety in the age at which normative behaviour is reached, normal development forms the basis for both assessment and intervention. Developmental theories typically describe patterns and sequences of development that is found to be accepted as being characteristic for children (57). As described by Kramer and Hinojosa (57), there are many different views and theories on development, with iconic theories having been described by Ayres (11), Freud (58), Skinner (59), and Lerner (60), to name but a few.

It is important for an occupational therapist, to realise that a child does not develop in a vacuum. There are therefore a vast number of factors that are now believed to influence development, and these need to be considered when providing therapy for infants and children. This includes neurological factors, physical aspects, early sensory and cognitive experiences, interaction with the environment and caregivers as well as the cultural climate. The internal environment (child's body and mind) and external environment (human and non-human objects) all influence development. It is clear that although many different areas are assessed independently, motor, psychological, and social development are interrelated and dependent on each other (57).

Child development is currently therefore thought of as multidimensional with many influences and not just a set of age-specific and stage-specific skills and behaviours (57). Ayres in her theory of sensory integration described the effect of sensory experiences and the influence they have on normal development. She believed that the proximal senses, which are vestibular, tactile, and proprioception, should be emphasised because they are primitive and primary, and they are the foundation on which complex occupations scaffolds (11). Sensory input is critical to normal brain function, and if the brain does not get the needed sensory stimulation at certain developmental ages, it leads to brain abnormalities that can lead to behavioural disorders (61) (62).

2.2.1 Normal development of sensory systems

Just as sensory experiences have an influence on normal development, the normal development of the sensory system and aspects which can influence the development of the sensory system need to be considered. If a problem occurs in the development of the sensory system, it will influence the development of other client factors and performance skills.

Sensory development begins during the prenatal period, with the tactile and vestibular systems playing primary roles in the early development of sensory integration. The neonate's primary sensory systems are thought to be associated with responses to both touch and movement (63).

Sensory development occurs as the Central Nervous System (CNS) organises sensory information and adaptive responses occur. The adaptive responses occur as a result of sensory integration which increases in complexity as the child matures. Adaptive responses, in turn, help with the development of sensory integration and the emergence of occupational engagement and social participation (63) (64). Since sensory integration has a significant influence on development, it is important to look at sensory integration in more detail.

2.3 SENSORY INTEGRATION

In 1972, Ayres defined sensory integration as: "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment" (p.11) (11).

In later years, other authors like Bundy, Lane and Murray (14) and Parham and Mailloux (63), provided amended definitions for sensory integration. The commonality in all the definitions is the description of sensory integration as a process involving the use the sensory information, gathered through the senses, by the body's nervous system to allow adaptation of responses according to what is happening in the environment in that moment.

The term sensory integration is often also used to refer to the frame of reference applied in the occupational therapy process for individuals with a functional disorder in the sensory integration process. The theory of sensory integration will be described in further detail.

2.3.1 Sensory Integration Theory

In the late 1950s and early 1960s, the sensory integration theory was developed by Ayres. Due to the importance of her work, it was trademarked in 2007 as Ayres Sensory Integration® (ASI). This was also done in order to distinguish the concepts of ASI® from publications not related to the core principles of the ASI® framework (65), as there have been an increase in publications that have been mistakenly linked to sensory integration as described in the work of Ayres, although they do not truly reflect the principles of her work (66).

Sensory integration theory is a combination of concepts from neuroscience, human development, psychology, and occupational therapy combined into one framework in order to view behaviour and learning (1) (38) (67). Ayres regarded the sensory integrative process as a brain behavioural process and, according to her there are seven theoretical postulates that forms the basis for the sensory integration framework (1).

The three major hypotheses in the sensory integration theory are:

i. Learning is dependent on a person's ability to register and process sensations both from the environment, as well as, movement and to use it in order to plan and organise behaviour.
ii. People with a decreased ability to process sensation may also have problems producing appropriate actions. This may lead to interference with behaviour, as well as, learning.

iii. Increased sensation as part of a meaningful activity, leading to an adaptive interaction, will improve the individual's ability to process sensations. This will in turn enhance learning and behaviour (14).

The main components of ASI® theory were reported by Bundy, Lane, and Murray (14) and include a description of typical sensory integration development, the defining of sensory integration dysfunction and guidance for intervention programs. Only once these three concepts are understood and implemented, can an occupational therapist apply this approach effectively and appropriately.

In order to fully understand ASI®, it is important to understand some of the concepts and definitions. There is currently no consensus regarding the use of terminology in the field of sensory integration especially terminology describing dysfunction. This is causing confusion amongst therapists and the public. There appear to be two different main views. The first view uses the term Sensory Integrative Dysfunction (SID) (1) (11) (14) (65) (68), while the other view uses the term Sensory Processing Disorder (20). It has been proposed to use only the term sensory processing disorder, yet this has not been universally accepted (69).

Although sensory processing disorder/sensory integrative dysfunction has not yet been accepted as a medical diagnosis, SID is accepted and used in the occupational therapy community in order to ensure best practise when treating infants and children. Currently, the sensory processing disorder foundation (70) is leading the research regarding sensory processing disorder and efforts are being made to include it in the Diagnostic and Statistical Manual of Mental Disorders (DSM) (70).

In South-Africa, the training of therapists in sensory integration is done by the South African Institute for Sensory Integration (SAISI). Their vision clearly states:

"To provide training and education in Ayres Sensory Integration® of an internationally accepted standard in order to provide a service of excellence to the ultimate benefit of the client" (71).

In order to stay true to training and views on sensory integration used in South-Africa, for the purposes of this study, terminology associated with ASI® will be used. Therefore, the term Sensory Integrative Dysfunction (SID) will be used instead of Sensory Processing Disorder.

The key abilities that are consistent with function and dysfunction in sensory integration are sensory discrimination, sensory modulation, postural-ocular control, praxis, and bilateral integration and sequencing. Another concept that is important to understand is sensory processing.

Smith-Roley et al. described sensory processing as a term to describe the way sensation is detected, transduced and transmitted through the nervous system (65). According to Miller and Lane (2000), sensory processing is a term that describes the complete process whereby the CNS and peripheral nervous system manage sensory information and includes the reception, modulation, integration, and organisation of stimuli. It also includes the behavioural response to the sensory input. They concluded that the term sensory integration and sensory processing are not interchangeable as sensory integration is only one part of the complete sensory processing process (72).

Ayres Sensory Integration® theory is not just about concepts and definitions, but it also describes dysfunction together with ways to assess and treat the dysfunction. This will therefore now be described in more detail.

2.3.2 Sensory Integrative Dysfunction

Dysfunction can occur in all or just some of the sensory systems, namely the gustatory, olfactory, auditory, visual, tactile, proprioceptive, and vestibular systems resulting in Sensory Integrative Dysfunction (SID) (14). Ayres Sensory Integration® does not only include the theory to help understand sensory development, but it also includes a body of research that validates the presence and existence of different patterns of SID.

Due to the findings of continued research as well as the experience gained by clinicians, sensory integration theory has evolved and has been refined over the years. This has also led to different ways of categorising SID. Ayres described diagnostic patterns based on testing with first the Southern California Sensory Integration Test (SCSIT) and later on the Sensory Integration and Praxis test (SIPT) (38) while Mulligan did research on the diagnostic patterns for SID using the Sensory Integration and Praxis test (73) (74) (75).

Consensus has still not been reached regarding the categorisation of SID, however there are themes and overlapping of taxonomies that occur in all the proposed views on dysfunction. Bundy and Murray indicate SID occurs in two major areas namely poor modulation and poor praxis (76). Miller et al, on the other hand proposed the taxonomy of sensory processing disorder that included three major areas namely sensory modulation disorder, sensory based motor disorder and sensory discrimination disorder (20).

In their article, Mailloux et al. (68), aimed to clarify the patterns of SID in order to assist therapists in the interpretation of assessment information and planning of intervention. The different patterns of SID identified by Mailloux et al. were: Visuodyspraxia and Somatodyspraxia; Vestibular and Proprioceptive Bilateral Integration and Sequencing; Tactile and Visual Discrimination; as well as Tactile Defensiveness and Attention Problems. The identification of these patterns showed a significant relationship to earlier studies by Ayres (38). This reinforced the long held idea that there is a specific association among the sensory system, motor system, and praxis. These associations support the concept that sensory systems function in a synergy rather than in isolation. It was also concluded that ASI® is one of the most developed frames of references to emanate from the profession of occupational therapy. Ayres Sensory Integration® offers occupational therapist a unique understanding of the different ways in which functions, such as praxis, vestibular processing, and tactile perception contribute to and influence participation in daily life and success (68).

In the model for clinical reasoning on possible sensory integration difficulties and dysfunction, van Jaarsveld (77) described how difficulties and dysfunction can occur in sensory modulation and sensory discrimination. Modulation is needed for an individual to sustain engagement in activities regardless variabilities that occur in the body and/or environment. It also contributes to stability in emotions and behaviour as well as supports optimal levels of arousal needed to engage in activities. Difficulties and dysfunction of sensory modulation can be present in one or more of the sensory systems and is reflected in behaviour. In South Africa the Sensory Profile (48), Infant/Toddler Sensory Profile (40) as well as the Sensory Processing Measure (78) is used as standardised tests to identify sensory modulation difficulties and dysfunction (77).

Sensory discrimination is about the quality of the sensory experience. It is about the process of interpreting the qualities of the sensory information in order to add meaning to it. This is done by using past experiences and memories and forming associations about the temporal and spatial qualities of experiences (77). In South Africa the Sensory Integration and Praxis test (38) as well as the Test of Sensory Functions in Infants (TSFI) (9) is used as standardised tests to identify sensory discrimination difficulties and dysfunction.

Because SID has been linked with developmental dysfunction occupational therapists are particularly concerned with SID in infants and children, where the condition interferes with daily functioning at home, in school, and in interactions with peers or adults. Sensory integrative dysfunction also affects routine functions, such as self-care, sleeping, and eating (69). The functional problems associated with SID have been described in detail in the literature by Parham and Mailloux, who outlined seven general categories of expected outcomes for occupational therapy. These outcomes are related to the child's performance skills and occupational engagement and include social participation, adaptive responses, self-confidence and self-esteem, family life, motor skills as well as cognitive, language, and academic performance (63).

DeGangi & Greenspan, described that young children with SID often exhibit delays in the development of skills like balance, coordination, and fine and gross motor skills. Problems with language and visual-spatial skills as well as problematic development of behaviour were also noted, with children displaying distractibility and tactile defensiveness (37). Parham and Mailloux also noted that children with SID are referred for occupational therapy due to concerns regarding behaviour, social functioning, academic functioning, or motor coordination. Sensory integrative Dysfunction leads to problems in all areas of occupational performance as children with this condition tend to avoid sensory or motor challenges. They then often respond with tantrums or refusal to participate when pushed to perform (63).

Research on the prevalence of SID is limited and according to findings of available research Baranek et al. estimated that 40%-80% of children (79) and 3%-11% of adults (80) who also have developmental disabilities, show significant signs of SID. Although the condition is seen in infants and children with and without other

diagnoses, it is estimated that 10%-12% of individuals in the general population, have SID, despite having no identified diagnostic condition (81). In 2004, Ahn et al. (82) did a study on the prevalence of SID in a typically developing kindergarten age population. The outcome of the study indicated that 5.3% of the study population met the criteria for SID.

The literature as described above shows that SID can lead to functional problems in infants, and children are unable to develop client factors, performance skills, and occupational performance areas needed for normal functioning. Looking at the prevalence, SID is seen in infants and children with and without other diagnoses.

2.3.3 Sensory Modulation

The ability to modulate sensory input is vital for our ability to participate in daily occupation. Modulation allows us to filter sensations in order to attend to the relevant input, maintain attention to relevant tasks and also allow us to maintain an optimal arousal level. Inadequate modulation leads to attention diverting to ongoing changes in the sensory environment. Attending to all sensory input changes the arousal level and causes it to not be optimal any more (16).

Early thoughts on sensory modulation dysfunction were that a continuum represented by over- and under responsiveness existed (83) (84). This is illustrated in Figure 2.1 (below). This simplification, although useful, is not adequate to reflect the sensory processing seen in infants and children and was therefore no longer supported by later research.

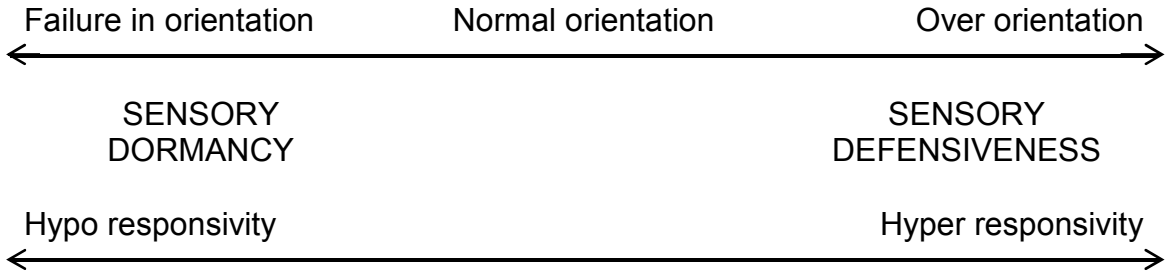


Figure 2.1 Continuum of sensory registration and responsivity.

From: Royeen, C.B., & Lane, S.J. (1991). Tactile processing and sensory defensiveness. In Fisher, A.B., Murray, E.A., & Bundy A.C., Sensory integration: Theory and practice. Philidelphis: F.A. Davis.

In 1991, Royeen and Lane proposed that the over responsiveness might be circular and not linear. Therefore they hypothesised that sensory defensiveness and sensory dormancy are related under sensory modulation disorder. The circular concept allows for a child to shift from over responsiveness to under responsiveness without reaching a state of normal orientation (arousal) between them. They also suggested that a child might display an over responsive reaction to the point of shutting down all sensory input. Once in shut down, the child will display behaviour associated with under responsiveness (85).

In 1997, Dunn proposed a model for sensory modulation disorder that links the neurological threshold to the behavioural response (48) (86). This model will be discussed later in detail as it is the model on which the Infant/Toddler Sensory Profile (ITSP) is based. Wilbarger together with Dunn, made the suggestion, based on their clinical experiences, that sensory modulation, instead of being on a continuum, is multidimensional. They indicated that shifts in the child's responsiveness are due to their inability to find the middle ground of optimal arousal. Therefore, they are unable to interact adaptively to the environment, and this affects their attention, arousal, cognitive processing, and emotional stability (86) (87).

In 2001, Miller, Reisman, McIntosh and Simon proposed yet another model for sensory modulation. It is called the Ecological Model of Sensory Modulation where they differentiate between physiological and behavioural elements of sensory modulation dysfunction. The model includes external and internal dimensions. The external dimensions include task, environment, culture, and relationships. These are all regarded as contextual. The internal dimensions however are emotion, attention, and sensation. These are regarded as personal. The contextual external dimensions influence the personal internal dimensions. When a perfect fit is seen between the task demands, relationships, culture, and environment, as well as, the individual's ability to process emotion, sensation, and

attention, an adaptive performance occurs. However, when the external dimensions impede performance, problems occur (88).

Although there are different models to describe sensory modulation dysfunction, they provide a platform for further research on sensory modulation and sensory modulation dysfunction. Experts in the field of sensory modulation do, however, agree that there are certain behaviours that characterise different kinds of difficulties in sensory modulation (63). These are:

i. Sensory registration problems;
ii. Sensation-seeking behaviours;
iii. Over responsiveness / hyper responsiveness / sensory defensiveness;
    a. Tactile defensiveness (over responsiveness to touch);
    b. Gravitational insecurity (over responsiveness to vestibular sensation);
    c. Over responsiveness in other sensory modalities (auditory, olfactory, taste).

2.3.4 Dunn's Model of Sensory Processing

Winnie Dunn proposed in her conceptual model that both neuroscience and behavioural science can provide information regarding an infant or child's response to sensory events. She proposed that there is an interaction between the neurological threshold and the behavioural response (86). Figure 2.2 shows the conceptual model and the components thereof.

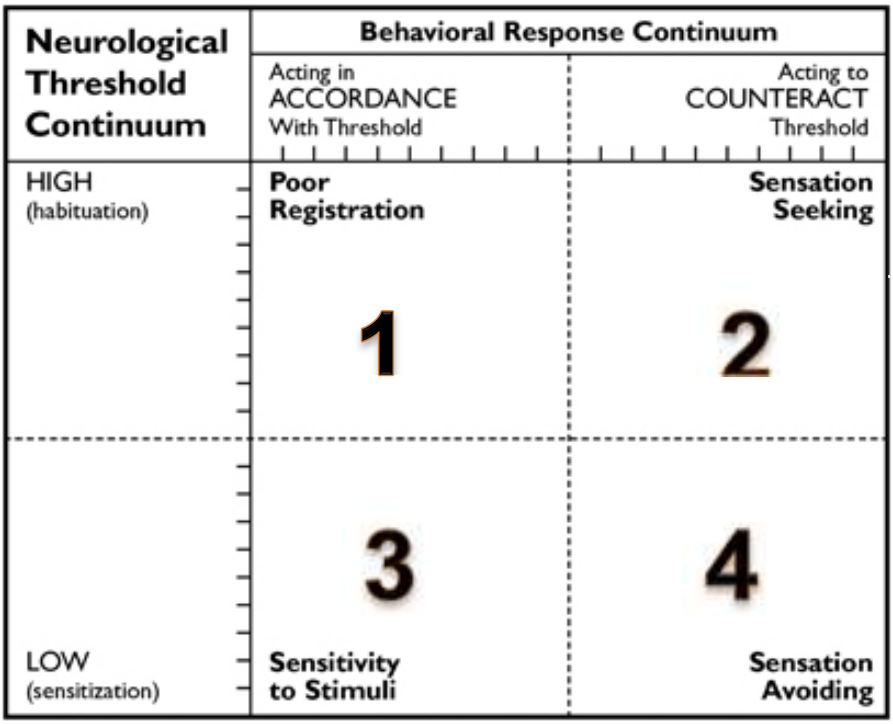


Figure 2.2 Relationships between Behavioural Response and Neurological Thresholds

Based on: Dunn W. The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model. Infants and Young Children.1997; 9(4): p. 23-35.

In Dunn's model, (Figure 2.2), the neurological threshold refers to the amount of stimuli needed for the central nervous system (CNS) to notice or react to stimuli, while the behavioural response indicates the manner in which the infant/child responds in relation to the thresholds.

At one end of the continuum, thresholds are high and require a lot of stimuli to react. On the other end of the continuum the thresholds are low and therefore require very little stimuli to react (48) (86). According to Dunn, neuroscience provides the background for understanding how sensory receptors receive and transmit stimuli, how the central nervous system interprets the information, how the information is used to create motor output, and the importance of modulation of sensory input (48) (86).

In order to be able to modulate effectively, the neurophysiological processes of habituation and sensitization are essential. Habituation is needed in order for a person to focus their attention on a task at hand. It helps young children to focus only on important information. Difficulties in habituation may lead to a person

appearing distractible, agitated or inattentive (48). Sensitization, on the other hand, is important as it enables the child to stay aware of their surroundings. Children use life experiences to develop sensitization as they grow up in order to stay attentive to their surroundings while engaged in learning tasks and play. In order to produce functional behaviours, a continuous interchange between habituation and sensitization is required. The patterns for these interchanges are called thresholds and are established through the experiences of the child (48).

An appropriate adaptive response will be generated when modulation is intact as the nervous system will respond to some stimuli while ignoring other stimuli (48). Maladaptive behaviours are the product of poor modulation between habituation and sensitization. Typically seen maladaptive behaviours can be such as being overly excitable or hyperactive (i.e. too much sensitization – low thresholds), or overly lethargic and inattentive (i.e. too much habituation – high thresholds).

When children respond in accordance with their thresholds, a child with high thresholds would respond to very few stimuli, while a child with low thresholds would respond to many stimuli. However, children can also respond in order to counteract their thresholds. In this case a child will either try to exert excessive energy, seeking stimuli to try and meet high thresholds, or exert energy to avoid triggering low thresholds (86).

The behavioural science model provides us with the means to understand that young children are human beings with interests, motivations, skills, and behavioural patterns to support their performance needs. They are not just simply a collection of neurons and cells (89). In order to produce goal-directed behaviour, several conditions are needed. Stellar and Stellar described these as the internal environment that supports behaviour (CNS processing and modulating sensory input); the external environment that provides opportunities (sensory experiences); and the stimulus that trigger behaviour and learning opportunities (90).

Dysfunctions in any of the mentioned areas, will lead to difficulties in performance in daily life. If the CNS is unable to process sensory information, it may affect the child's ability to learn about the environment, and they then may appear unresponsive or clumsy. Results from sensory modulation research, for example McIntosh, et al. (81), Reynolds & Lane (91), and DeSantis et al. (92), suggest that

sensory modulation difficulties may have an influence on the development of behavioural problems. Suggestions that sensory modulation can affect social interaction have also been made. According to Parham (63), social interaction may be avoided by children who are sensation avoiding, but on the other side, children who are sensation seeking may initiate interactions in an inappropriate manner.

Sensory integration and sensory modulation are important aspects of normal development, and if problems with any aspect of this occur, it can lead to functional problems. In order to prevent problems later in life, early identification through accurate testing is needed as well as early intervention to correct problems and prevent further developmental delays.

2.4 ASSESSMENT

2.4.1 Concepts of assessment

Assessment (evaluation) is the first step in the occupational therapy process (p. S10) (21). This process as described by the Occupational Therapy Practice Framework, 3rd edition (21) consists of three steps: 1) Assessment, looking at the occupational profile and analysis of occupational performance. 2) Intervention, consisting of creating the intervention plan and implementation of the planned intervention. 3) Targeting of outcomes. Step1 (assessment) of this framework, will be discussed in further detail (21).

The first step in the assessment process is the occupational profile. This supplies the therapist with an understanding of the client's interests, experiences, values, needs, occupational history, and patterns of daily living. Information regarding the client's reasons for seeking services, concerns, support system, strengths, as well as priorities are also identified (p. S 10) (21). The client's strengths and problems are more specifically identified during the analysis of occupational performance, which is the next step in the assessment process. During the assessment process the therapist will consider client factors, environment, performance patterns, performance skills, and activity demands, but will only specifically assess selected aspects. In order to identify supports for, and barriers to performance, the client's

actual performance is often observed in context. Throughout the process targeted outcomes are identified (p. S10) (21).

The type and focus of assessment will depend on the practice setting and will therefore differ from setting to setting. Assessment occurs in the initial and every subsequent contact with the client (21). The assessment is one of the most fundamental, but complex steps of the therapy process as the results from the assessment will form the basis for planning the type and intensity of the occupational therapy intervention required (93). As assessment is so fundamental, it is very important that the tests we use are accurate and validated on the population it is used on.

2.4.2 Use of standardised tests for assessment.

Standardised tests have a valid role in the assessment process. Therapists are trained in the use of standardised tests due to the belief that they are more objective and formal than other kinds of assessments which are thought of as “informal” and therefore implying “less objective”. It is however important to remember that there are both advantages and disadvantages to the use of standardised tests (94).

Some of the advantages are that standardised tests have been used for a long time and a variety of tests are readily available. Standardised tests are being promoted as being “objective” because the examiner’s biases do not influence the results. Once the therapist has been trained in the use of the standardised test, it is easy to administer and convenient. Also it is easier to analyse the results from standardised tests than to analyse the results from alternative testing procedures. Tests also allow for comparison of results across various administrations and examiners (94).

Some of the disadvantages of using standardised tests are that the test situation is highly structured and formal and does not always allow for observation of more natural behaviours. Behaviours sampled by the standardised tests may not represent the infant’s functional behaviours. Tests often provide limited opportunity for the infant to initiate interaction, and the role of other family members in the assessment process may be limited by the use of standardised tests (94).

The norms provided by the test often do not accurately reflect the normal population, and tests are often only designed to determine whether an infant has a problem or not. It may not identify an infant's weaknesses and strengths. Although the test is designed to be objective, it is still sometimes possible that some subjective scoring occurs and this can skew the scores a client receives. Stimulus items or procedures used may also not be appropriate for all cultures or socioeconomic backgrounds (94).

When using standardised tests in the assessment process it is important to carefully select the tests being used. The therapist needs to consider the diagnostic accuracy of the test and also, if the test would be valid for the population it is being used on. There are also ethical considerations like that fact that the therapist should be trained in the use of the test, both the administration and interpretation of the results. The therapist needs to decide the role of standardised tests in the assessment process and remember that it is only one tool that can be used in the assessment process, but should ideally refrain from using standardised tests as the only source of information during assessment (94).

2.4.3 Assessment of Sensory Integrative Dysfunction (SID).

As occupational therapists, the main focus when assessing and treating clients is on functioning and participation in activities of daily living (ADL). Even infants and children must be able to perform, function, and participate in ADL activities. It is important to look at the child in totality, and sensory integrative functioning and sensory modulation therefore form a part of what needs to be assessed and treated when working with this population. Sensory integration has an influence on a child's ability to function and partake in ADL activities (37) (63).

As the theory of ASI® is still in a state of evolution, there are very few tests available to assess infants for SID. There are tests available that can be interpreted from an ASI® frame of reference, but they might not be specifically designed to assess SID. In order to accurately measure a construct, an appropriate test is needed that is ideally standardised and supported by strong psychometric properties. Provost and Oetter stated that adequate identification of sensorimotor problems in the naught to three years age bracket requires comprehensive assessment of both the motor systems and abilities as well as the

sensory functions, or the infant's ability to register, process, integrate, and respond to sensory input (12).

Eeles et.al, set out to determine which tests were most accurate to measure SID in the first two years of life. A systematic review of available tests was done, and it was found that only three tests can be used to evaluate SID at this early stage of life. They were the Sensory Rating Scale (12), the Infant/Toddler Sensory Profile (ITSP) (40), and the Test of Sensory Function in Infants (TSFI) (9).

They found it difficult to determine which of the above tests were best to evaluate SID due to challenges of defining constructs in sensory integration as well as the fact that the tests measured slightly different components of SID. The Sensory Rating Scale and ITSP are both parent-report questionnaires, whereas the TSFI is a performance-based assessment.

Eeles et al. recommended that, if the clinician needed to use a questionnaire, the ITSP would be the better choice due to the fact that it has undergone more rigorous evaluation. Further recommendations are that, if time allows, ideally one would administer both the ITSP questionnaire and the TSFI to reliably determine problem areas of sensory integration during infancy, and match parent report with a performance-based standardised test. The information from these tests also need to be analysed alongside other measures of performance, such as parent interviews, observation of behaviour, neurodevelopmental testing, and other relevant background information (95).

2.4.3.1 Infant/Toddler Sensory Profile (ITSP)

The ITSP is a caregiver questionnaire for infants and toddlers, developed from the Sensory Profile (48) and is based on Dunn's conceptual model for understanding sensory processing in daily life (86), as discussed earlier. The Sensory Profile is a judgement-based caregiver questionnaire specifically looking at modulation. During studies of the Sensory Profile, it was found that age does not have a significant influence on the scores. 1,037 children between the ages of three and ten years were tested during the development of the Sensory Profile. Most scores remained constant across all ages tested (48).

However, during the development of the ITSP, it was found that age had an important effect. This was due to the fact that, parents of infants younger than six

months found it difficult to report on many of the behaviours as described in the pilot version of the ITSP. This can be attributed to the fact that, in general, younger infants have a smaller repertoire of behaviours. It was then decided that a smaller set of behaviours will be used in the age group under six months than in the age group of seven to 36 months. 36 items and 48 items were decided on respectively for the two age groups. This was done in order not to miss the opportunity to interpret and identify the more complex behaviours of the older infants and toddlers (54).

The initial studies to develop the ITSP were done in 2002, and during this, Dunn & Daniels highlighted the importance of having some method to identify potentially challenging behaviours in very young infants (below six months of age) in order for early intervention programs to address the problems before they interfere with the infant's developmental experiences (54). A total of 401 infants between the ages of birth and 36 months, were used to collect data for the development. They all completed the pilot version consisting of 48 items. The developers tested the reliability of the ITSP and found that for the sensory sections the standardised item alpha coefficients ranges between 0.37 and 0.77. For the component groupings the standardised item alpha coefficients ranged between 0.60 and 0.82. They also looked at the alpha coefficients for the quadrants form Dunn's model and this ranged from 0.60 to 0.84. After this study, it was decided to do two different sections for the birth to six month age group and the seven to 36 month age group (54).

The ITSP consists of items divided into sensory systems. For children age seven to 36 months, there are five sensory processing section scores, four quadrant scores and a combined quadrant score. The quadrant scores reflect an infant/toddler's responsiveness to sensory experiences. This is based on Dunn's Model of Sensory Processing, as described earlier. Quadrant 1: low registration and quadrant 2: sensation seeking both indicate different high threshold responses. Quadrant 3: sensory sensitivity and quadrant 4: sensory avoiding both indicates different low threshold responses. A score is also provided for a combined quadrant of low threshold which is a combination of quadrant 3 and quadrant 4. The sensory processing scores indicate the infant/toddler's response to the basic sensory systems. The ITSP is described as a tool to link performance

strengths and barriers with the infant/toddler's sensory processing patterns. The test's purpose is to evaluate the possible involvement of sensory processing with the infant/toddler's daily performance patterns. It also provides information regarding the infant/toddler's tendencies to respond to stimuli, and indicate which sensory systems might be contributing to creating barriers to functional performance (40).

The ITSP is widely used for research in infants/toddlers. Studies recently were done by Mulligan & White (96), Ben-Sasson et al. (97), Eeles et al. (45), Germani et al. (98), and Samago-Sprouse et al. (99), to name but a few. These studies however, did not focus on the psychometric properties of the tests. In these studies the tests were used to collect data. There is, however, no known study done in South Africa looking at the normative data of the ITSP and the use of the test on the South African population.

2.4.3.2 Test of sensory functions in infants (TSFI)

According to the authors of the TSFI, the test is designed for infants as young as four months of age, but it is most reliable and valid with infants from seven months to 18 months. It is also better to use the TSFI in conjunction with other developmental assessments, parent interview and clinical observations (100).

The TSFI was developed as a diagnostic tool. On page 1 of the test manual, the TSFI is described as a test that "provides an overall measure of sensory processing and reactivity in infants" (p.1) (9). It also tests five subdomains namely reactivity to tactile deep pressure, adaptive motor functions, visual-tactile integration, ocular-motor control, and reactivity to vestibular stimulation. These subdomains were specifically chosen as they are clinically significant in identifying children with sensory integrative dysfunction and particularly children at risk of developing learning disabilities. The TSFI was developed as both a research tool and a clinical tool to use in the assessment of infants with regulatory disorders, developmental delays as well as infants at risk of developing learning and sensory processing disorders e.g. premature infants (9).

Although the authors conducted preliminary psychometric research on the test, they recommended that further research is needed, especially on the reliability and validity, the test-retest reliability, wider cross section of ages, and a more

extensive sample of infants with developmental delays. The scores obtained for test-retest reliability for the total test scores was 0.81. The correlation coefficient for the different domains depended on the domain and varied from 0.26 to 0.96 (9). In 1997, Jirikowic, et al. (101) did a test-retest reliability study on infants with developmental delays. Results of this study showed that the test-retest reliability of the total test score is borderline (ICC =0.78), and the reliability for the subtest scores were low with the reliability coefficients ranging from 0.54 to 0.74. Their recommendations were that the TSFI results should be interpreted with caution and should be supported by clinical reports. This finding was consistent with DeGangi & Greenspan's (9) recommendations. Recent studies using the TSFI were done by Jaegermann & Klein (102), Lin et. al. (103), and Chorna et al. (104). These studies however, did not focus on the psychometric properties of the tests. In these studies the tests were used to collect data. There is, again, no known study done in South Africa looking at the normative data of the TSFI and the use of the test on the South African population.

2.4.4 Use of Parent Questionnaire and Therapist Observation tests.

There are differences between the use of a parent questionnaire and a therapist administered test for assessment. It is important for a therapist to be aware of the advantages and disadvantages of both types of tests. This will help guide them as to what test or combination of tests to use in order to be able to accurately assess infants.

2.4.4.1 Parent Questionnaire

Research has shown that using parent report questionnaires can have various advantages and disadvantages. Some of these advantages are that it has consistently been shown that the use of parent reports on the child's current skills or deficits can be seen as a source of information that is sensitive, reliable, and valid (105), (106), (107). Involving the parent and using their perceptions is used as part of a client centred approach that is advocated by occupational therapists (21) (105). It is time efficient and can possibly be more accurate than the use of some standardised tests (108), and it can also provide qualitative, accurate assessment of children in a naturalistic environment (105).

The validity of parent report questionnaires were found to be dependent on the quality of the items included. Parent report questionnaires were found to be more accurate if the wording was precise and if the report questionnaire was standardised, as opposed to a non-standardised questionnaire (105). Glasco and Dworkin have also found that information gathered through parent report questionnaires can be influenced by socioeconomic factors, as parents from lower socio-economic areas were found to leave out more questions. This may be due to language problems caused by a lower level of education (105). This needs to be taken into consideration when using parent report questionnaires and the additional use of interviews should also be considered.

It is also found that parents tend to report the infant's skills as better than those found on clinician assessment. This may be due to the fact that infants display skills in a familiar and safe home environment first, before generalisation to other environments can occur. A study by Johnson, et al. found that the accuracy of parent reporting was not affected by socio-demographic factors. Information gathered from the parents was very valuable as they had more contact with the infant and therefore knew the infant best (109).

2.4.4.2 Therapist administered test

Just as with parent report questionnaires, using therapist administered tests have advantages and disadvantages. A disadvantage is that the test is not administered in the infant's natural environment. This can lead to inaccurate results due to the fact that infants often display skills in a familiar and safe environment first before generalisation to other environments occur (105). Sometimes, during therapist administered testing, the infant may respond differently to applied stimuli than when naturally being exposed to the same stimuli.

An advantage of this method of testing is that the test is administered by a trained professional who has received training in administering and interpreting the results of the test. This allows for greater reliability (105).

There are, therefore, clear advantages and disadvantages for using different types of tests. As assessment is a fundamental part of the therapy process (21), it is important for therapist to know more about the tests they use. This will allow them

to decide on the best combination of tests to use for a specific client in order to accurately assess.

2.4.5 Critical review of tests

Many researchers have established that it is important for independent investigators to complete studies and gather psychometric data regarding the tests. This applies to any standardised test and should be done in addition to the studies completed by the test authors (25) (26) (27).

When testing for SID, the Sensory Integration and Praxis test (SIPT) (38), is considered the ‘gold standard’ for testing. This test, however, can only be used on children four years of age through eight years eleven months. There is, therefore, no one test that can be seen as the ‘gold standard’ for testing SID in infants and younger children. Due to the absence of a ‘gold standard’, it is important to carefully evaluate multiple sources of information as there is an absence of one single test or screening measure that can be used to identify SID. It is, therefore, important and necessary to look at the available tests and evaluate their diagnostic accuracy and collect evidence to determine if the test actually measures what the authors of the test indicated (52).

Whenever a test is used to determine the presence of a problem or the need for therapy, it is important to look at the complex psychometric properties of that particular test.

Accuracy indicates the closeness of estimated values to the true values (110). For a test to be accurate, it needs to have sensitivity and specificity within acceptable limits. The sensitivity is the ability of the test to identify the presence of a problem when it is present, while specificity refers to the ability of the test to give negative results when the problem is not present (111).

Many tests used in occupational therapy, however, do not result in a simple decision if a problem is present or not. The tests often produce continuous data that indicate where the client falls on a continuum, and that information is used to decide if treatment is needed or not. In these tests, it is necessary to have a cut-off point, and if the scores are beyond this point, it will be deemed a problem requiring intervention. The sensitivity and specificity of the cut-off score will then

be considered important. The problem with this, however, is that if the sensitivity is set high, the specificity will be lower and vice versa (111).

For the TSFI the reliability for the subtest scores were low with the reliability coefficients ranging from 0.54 to 0.74 (9). For the ITSP during initial development, it was found that for the sensory sections the standardised item alpha coefficients ranges between 0.37 and 0.77. For the component groupings the standardised item, alpha coefficients ranged between 0.60 and 0.82. They also looked at the alpha coefficients for the quadrants from Dunn's model, and this ranged from 0.60 to 0.84 (54). The alpha coefficients for the final test in the seven to 36 month age group for the sensory processing sections range between 0.42 and 0.71. For the quadrant scores, it ranges between 0.69 to 0.86 (40).

Construct validity refers to the capacity of a test to test the intended construct. Construct validity is crucial when the interpretation of the scores from the test, implies an explanation of a behaviour or trait. One method of demonstrating construct validity is the convergent and divergent methods. Assessment of convergent validity involves theoretically derived comparisons (111). Convergent validity refers to the degree, two different measures designed to measure the same underlying trait, consistently measure the same trait (111) (112). Therefore, if there is a high correlation between the scores obtained by the two measures, it indicates convergent validity. Divergence, also known as discriminant validity, refers to the principle that tests that are designed to measure different traits should be unrelated (111).

When critically reviewing a test, the internal consistency of the test should also be considered. Internal consistency indicates whether the items that make up the test correlate with each other. There is a close relationship between internal consistency and validity. If internal consistency is found to be unacceptable, it is however due to problems with reliability. Due to this, internal consistency is seen as evidence for reliability and validity (111).

2.5 EARLY INTERVENTION

Internationally there is not yet consensus regarding what specifically early intervention programs should entail. Programs differ from country to country due to differences in culture, political systems in countries, available resources, and

societal commitment (113). The World Health Organization (WHO) and the United Nations are involved in creating guidelines and codes regarding rights of children and adults. In 1948, the WHO defined health as: “A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (114). The definition has not been changed since, and it implies that every person should have the opportunity and ability to function optimally within their specific environment. Consensus exists internationally that it is within the rights of every child to receive help in order to achieve optimal functioning. These rights of children were codified at the “United Nations Convention on the Rights of the Child”, held on 30 September 1990. It describes that it is the right of every child to survive, develop, be protected from exploitation, as well as have access to health services in order to by healthy (31).

This indicates that although early intervention programs differ from country to country, the importance of these programs is recognised internationally. Therefore, not only should we look at the international view on early intervention, but it is important to look at early intervention in the South African context.

2.5.1 South African policy on early intervention

It is said that, when a nation invests in its youngest citizen, it shows foresight and wisdom, and the nation can therefore be assured of a promising future (115). In South Africa, the term Early Childhood Development is used to describe the policies and programs involved with early intervention. In the interim policy for early childhood development (116), it states that the term early childhood development is aimed at conveying the importance of a holistic approach to child development, and it highlights the importance of considering a child’s health, nutrition, education, psycho-social and additional environmental factors within the context of the family and the community (116).

Early childhood development is important in South Africa and therefore the development of the National Integrated Plan for early childhood development was started in May 2004 (117). In order to give children in South Africa the best start in life, the key aim of the National Integrated Plan is to bring greater coordination to various government departments (Department of Education, Department of Social

development, and Department of Health), that are running existing government programs for early childhood development (117).

The South African Legislature provides for prevention of ill-health and disability as well as early intervention through Chapter 8 of the Child Amendment act of 2007 (118). Section 144 describes the purposes of prevention and early intervention programs, and states that the programs must focus on providing psychological, rehabilitation, and therapeutic programs for children. The programmes may also include early childhood development, promotion of the well-being of children, and the realisation of their full potential (p.56) (118).

According to the Health Act (119), all children below the age of six years should have access to medical care and early childhood development programs as the State provides this free of charge. The South African Government not only values early childhood development and the health of children by providing free medical care, but also has a policy on the reduction of underlying causes of illness, injury, and disability whereby it states that “Prevention is a good way to reduce the burden of disease and improve the quality of life” (p. 5) (120). According to this Policy on Quality of Health care for South Africa, there is a shift from treatment to prevention as it is an important way to reduce the causes of injury, illness, and disability (120).

From the policies and legislature, it can be concluded that there is an emphasis on early intervention, prevention, and early childhood development in South Africa and that it forms an important part of the health system. Emphasis is also shifting to prevention, and in order to have effective prevention and early intervention, accurate testing and identification of problems is vital.

2.5.2 Importance of early intervention in sensory integration

The presence of SID may be evident very early in life and measures used to assess these difficulties, are available for use in infants from birth. In a study of eight-month old infants, a high percentage of infants showed sleeping problems, eating difficulties, temper tantrums, and other symptoms. When these difficulties are present from birth, they appear to contribute to development of dysfunctional parent–infant interaction patterns. These, in turn, can affect the infants’ personality development (35). Assessment should be carried out as soon after birth as

possible, or as soon as problems are suspected in order to recognise and identify problems early.

In their study, Dawson et al. found that early intervention in autism spectrum disorder leads to significant gains in adaptive behaviour and language development (121). In a systematic review of research on early intervention programmes for children with physical disabilities, Ziviani et al. found that the early intervention programmes did create positive outcomes for both the children and their families (122). The importance of early identification of abnormal development has been documented by DeGangi, et al. (28). This study found that children displaying only moderate or mild sensory processing problems and high levels of irritability benefit most from early intervention programs, yet they are often undetected and therefore do not receive early intervention as needed.

According to De Gangi et al., it is very difficult to accurately establish the impact of SID, when present at an early age, on later learning and emotional development. This is due to a lack of assessments that can detect SID in infants, adequately and reliably (37). In a later longitudinal study, DeGangi et al. found that 50% of infants with moderate to severe SID, (specifically looking at regulatory disorders) at the age of seven months also showed those problems at age 36 months (123). Ben-Sasson et al. (36) also found that patterns of sensory sensitivity in early childhood significantly predicted sensory over responsiveness in elementary school. Approximately 33% of infants who had elevated levels of sensory over responsiveness at the age of one and two years were also reported to have elevated sensory over responsiveness in school age. It is possible that some infants are born vulnerable and stay vulnerable or infants that fall behind the developmental curve by the age of three years are more likely to develop some type of SID. Their findings suggested an early acceleration in over-responsivity may serve as a ‘red flag’ for monitoring an infant and referring to early intervention (36).

This indicates that SID can have an impact on the infant’s functioning later in life and can impact on scholastic ability. The early detection and accurate assessment of SID in infants is therefore very important. If the problems can be accurately identified and treated at an early age, the infant has a better chance that normal development will take place and this can prevent or minimise the development of

scholastic problems. It is important that we take a look at available assessments to identify SID in infants.

2.6 CONCLUSION

In conclusion, during a review of the sensory integration literature it was noted that there is currently no concensus on the use of terminology regarding sensory dysfunction. This is creating confusion among the public and therapist alike. The terms sensory integrative dysfunction and sensory processing disorder are currently being used to describe dysfunction of sensory integration. Sensory modulation was discussed as this was primarily evaluated in infants during the research study using the Infant/Toddler Sensory Profile and the Test of Sensory Functions in Infants.

When testing the sensory integrative functions of infants, there is no test that can be regarded as the “gold standard” of testing in this population. It is, therefore, important to evaluate different tests that are currently available in order to determine if the tests are accurate enough to effectively indicate SID in this population as it can have an influence on their further development and scholastic abilities later in life. Early intervention and the use thereof was also looked at as the literature shows that early intervention is important, and also in South Africa the government places an emphasis on early intervention.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter describes the study design and participant sample for the study. A detailed description of the instruments and procedure used for data collection is provided. The ethical considerations for this study are also included at the end of this chapter.

3.1 STUDY DESIGN

A cross-sectional, descriptive, correlation study was used. A cross-sectional study was used as the researcher tested participants only once to collect the relevant data. The study can be described as descriptive as no attempt was made to manipulate any of the independent variables (124).

As the research looked at the normative data and accuracy of two standardised tests for SID in infants, data only needed to be collected once. Due to this, a cross-sectional research design was suitable for the study.

The researcher then also aimed to determine if there was any relationship between the constructs of the different tests (ITSP and TSFI). This design was suitable as all variables that were compared are tested at one point in time, and this makes comparison of the data more reliable. Correlation research is described as one of two types of descriptive research. This design was suitable for the study as the research aimed to determine if there was a correlation between two standardised tests for SID in infants.

3.2 POPULATION

Infants between the ages of seven and 18 months were included in the study. The participant sample was recruited from child day care facilities in the East Rand area.

3.2.1 Sampling

A cluster sampling method was used to select the participants for the study. This is a type of probability sampling method by which a group was selected and all the members of the group were invited to participate in the research. In this study, the

group identified was infants between the ages of seven and 18 months that attended a child day care facility. All parents of infants in the target age were given the opportunity to participate if they wished to do so. A degree of convenience was involved as child day care facilities in a geographical area close to the researcher were used.

The sample for the study was determined using the following inclusion and exclusion criteria.

Inclusion criteria:

- Full term infants, born between 37 and 42 weeks gestation.

Exclusion criteria:

- Infants born before 37 weeks gestation.
- Infants with a diagnosed birth defect or gestational illness.

The sample was obtained using the following procedure:

The researcher set out to identify child day care facilities in the East Rand area. This specific area was targeted out of convenience as this is an area well known to the researcher and in close proximity to where the researcher resides and works.

Child day care facilities were identified through drive-by sightings, sightings of advertisement signs, local newspaper advertisements, internet searches, and by-word-of-mouth.

A total of 29 child day care facilities were approached. The breakdown of responses from the child day care facilities were as follows:

- Five child day care facilities did not have any infants in the correct age range.
- One child day care facility had only one infant in the correct age range, but the researcher then chose not to use the facility.
- Six child day care facilities accepted forms from the researcher, but had no response from parents.
- 17 child day care facilities were used during the study.

Table 3.1 (below) indicates the distribution of test participants between the different child day care facilities that were used during data collection for this study.

Table 3.1 Distribution of test participants

Study Code	Number of infants	Study code	Number of infants
S001	6	S010	4
S002	8	S011	4
S003	3	S012	2
S004	4	S013	7
S005	2	S014	1
S006	2	S015	3
S007	1	S016	5
S008	5	S017	2
S009	1		
		Total:	**60**

3.2.2 Sample size

The sample size was determined by a sample size calculation using the population of possible number of infants in the child day care facilities. In an article by Bartlett (125), tables are given to determine sample size. This was used to determine sample size for this study. The tables are calculated using Cochran's sample size formulas. The margin of error was set to 0.03. The population size for this study was estimated based on 17 day care facilities and was determined to be approximately 140 infants. The sample size was determined to be 60 participants, which is more than the 55 participants for a population of 100 but less than the 75 participants for a population of 200. For this sample size, the alpha value is 0.05 with a t-value of 1.96 (125).

3.3 RESEARCH TOOLS

The following measures were used to collect all data for the study:

3.3.1 Demographic sheets: Compiled by researcher (Appendix A)

The researcher compiled two demographic sheets to gather demographical data that were deemed important in the study.

The first sheet was used to gather demographic information from the parents of the infant participants and was divided into two parts. Part one was personal information (Appendix A1) from both the mother and the father. This also included the infant's name and date of birth. For ethical purposes, this sheet was kept separately, and only the researcher had access to this information. Part two was a coded sheet (Appendix A2), gathering information regarding the pregnancy and birth, medical history of the infant as well as parental history.

The second sheet was to gather demographic information from the child day care facilities used in the study (Appendix A3). This was completed by the head of the facility/manager and contained information regarding location and contact information of the child day care facility. Information was also gathered regarding the number of infants cared for, infant-caregiver ratios and business hours.

3.3.2 Infant/Toddler Sensory Profile: by Dunn,W. (Appendix B)

The Infant/Toddler Sensory Profile (ITSP) is in the form of a parent questionnaire (Appendix B1) that requires 15 minutes to complete. It provided a criterion-referenced method for measuring an infant's sensory processing behaviour. The information gathered from the questionnaire helps to profile the effect of sensory processing on functional performance in the daily life of the infant. Caregivers complete a judgment-based questionnaire of 48 items (seven- to 36-months) aimed at reporting the frequency with which infants respond to various sensory experiences on a five point scale. The parents are asked to check the box on the key that best describes the frequency of their infant's behaviours on the scale as: "When presented with the opportunity, your child… **Almost Always** (90% or more of the time), **Frequently** (75% of the time), **Occasionally** (50% of the time), **Seldom** (25% of the time) or **Almost Never** (10% or less of the time)".

The ITSP provides validated and reliable scores for infants between the ages of birth and 36 months. There are two classification systems, one for infants aged birth to six months, and one for infants aged seven to 36 months. For the purposes of this study, only the classification system from seven to 36 months was used. This test was standardised in the United States of America, involving infants from a variety of ethnic groups (40).

The reliability and validity of the ITSP has low overall consistency for the section scores obtained for the infant group from birth to six months, therefore only quadrant scores are available. The Coefficient Alpha for the quadrant scores vary from 0.56 to 0.82. There is no evidence of test-retest reliability for this age group. Due to the lack of test-retest reliability and low coefficient alpha scores, the researcher decided to only test infants from age seven months to 18 months. The ITSP can be used with infants/toddlers up to the age of 36 months, but the other standardised measure (TSFI) being used in this study can only be used up to the age of 18 months. Therefore infants older than 18 months were not included in the study. For the age group from seven months to 36 months, section scores and quadrant scores are provided.

The scoring procedure, as set out in the test manual (40), requires the user to complete the Summary Score Sheet (Appendix B2) after the parents completed the questionnaire. The Quadrant Grid is completed by assigning a score of one to five to responses on the parent questionnaire. A score of 1 corresponded to ‘Almost always’, 2 to ‘Frequently’, 3 to ‘Occasionally’, 4 to ‘Seldom’, and 5 to ‘Almost never’. The scores are then added to obtain the total score for each quadrant section. The total scores for quadrant 3 and quadrant 4 are also added together to give a combined quadrant score for low threshold. The total scores are then transferred to the Quadrant Summary which indicates the range each quadrant score and the combined quadrant of low threshold score falls in. The ranges are:

- ‘Typical performance’ range. Scores between +1 SD and -1 SD.
- ‘Probable difference’ less than others/ more than others. Scores between -1 SD and -2 SD is described as probable difference more than others. This indicates over responsiveness and scores between + 1 SD and +2 SD is

described as probable difference less than others. This indicates under responsiveness.

- 'Definite difference' less than others/ more than others. Scores less than -2 SD are described as definite difference more than others. This indicates over responsiveness. Scores above +2 SD is described as definite difference less than others. This indicates under responsiveness.

3.3.3 Test of Sensory Functions in Infants (TSFI) by De Gangi & Greenspan (Appendix C)

The Test of Sensory Functions in Infants (TSFI) is in the form of a therapist administered observational test that requires 20 minutes to be completed. It is used as a screening tool for SID in infants. It is especially valuable when used in conjunction with other developmental tests, as it can help identify infants at risk for learning and emotional disorders (9). It is standardised for infants between the ages of four and 18 months, and is specifically recommended for infants with regulatory disorders, developmental delay, and infants that might be at risk of developing sensory processing or learning disorders.

The test consists of 24 items divided into five subtests of sensory processing and reactivity. These subtests are: deep pressure, adaptive motor functions, visual–tactile integration, ocular–motor control, and vestibular stimulation. For each item, a sensory stimulus was applied to the infant, using materials and the procedure described in the manual. The infant's reaction was observed, and items were scored according to criteria provided, ranging from adverse to normal – a score of 0, 1, or 2 is allocated to items depending on the infant's response. The allocation of the score to the response differs from item to item, and the manual is used for scoring of each item. Subtest scores provided a profile of five domains and a total test score for the infant's age group. Scores below the cut off indicated potential problems (9).

The scoring procedure as set out in the test manual (9) requires the test user to add the scores of each subtest after administration. The subtest scores are then transferred onto the Profile form and this categorised the score into ranges of:

- Normal. Scores above -1 SD.
- At risk. Scores below -1 SD but above -2 SD.

- Deficient. Scores below -2 SD.

All the scores from the different subtests are added together to calculate the Total Test score. This score is also categorised as above.

3.4 PROCEDURE

3.4.1 Data collection procedure

Ethical clearance was obtained from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand (Appendix D). The research sample was obtained according to the procedure described above (see sampling).

Permission from all child day care facilities involved in the study was obtained, and managers received a written information sheet regarding the study (Appendix E) and had an opportunity to ask questions after the study was explained to them. Managers of the child day care facilities then completed the demographic sheet for child day care facilities (Appendix A3). Managers and teachers at the child day care facilities handed packages of forms to parents of infants that were in the correct age group (seven to 18 months of age). The package was compiled by the researcher, and was in the form of an envelope, containing the following:

- Information sheet for parents (Appendix F1) and consent form (Appendix F2).
- Personal information sheet (Appendix A1).
- Demographic sheet (Appendix A2)
- ITSP Caregiver Questionnaire (Appendix B1).

Instructions to the parents were placed on the front of the envelope (Figure 3.1 below).

Instructions:

Please read enclosed information carefully. You are welcome to contact **Marica Botha** on **082 335 6386** if you have any questions.

If participating:

1. Complete all forms – please complete all questions.
2. Place forms back in envelope and seal.
3. Return to school as soon as possible (within 7 days of receiving).

If you choose not to participate:

- Please return envelope with **ALL** content in **unsealed** envelope within 7 days of receiving.

Thank you.

Figure 3.1 Instructions to parents

The researcher collected the completed forms from the child day care facilities. All forms were checked, and all infants meeting the requirements of the inclusion and exclusion criteria were included in the study. On the same day that the completed forms were collected and checked, the TSFI was administered with the help of the infant's caregiver. In isolated cases, the parents requested to be present during the testing, and they then assisted the researcher, after special arrangements were made with parents in order to accommodate their request. Assistance from care givers and parents were in the form of them holding the child on their lap as per the test procedure set out in the test manual.

After all completed forms were collected and tests were administered, the tests were scored according to the procedure in the test manuals, as described earlier. On the demographical section of the ITSP Summary score sheet (Appendix B2), as well as the personal information section of the TSFI Administration and scoring form (Appendix C), a study code was used instead of the infant's name. This was done for ethical purposes of confidentiality. If the infant was found to have definite difference scores on test scores, parents were contacted, and they were provided

with a resource list in order to obtain occupational therapy treatment by a sensory integration certified therapist if they so wished.

After scoring was done, all data were typed into Excel spreadsheets in preparation for further analysis.

3.4.2 Data Analysis procedure

The demographical data was analysed using descriptive statistics and percentages, ranges, and means were calculated according to the total sample of participants.

For the data analysis of the test scores, the raw scores from both the ITSP and the TSFI were used. Although not all the data was normally distributed the median and mean scores were very similar and therefore the mean scores of the sample in this study were used and compared to range of typical or normal scores given in the manuals for the ITSP (40) and TSFI (9).

The effect size between the means presented by Dunn for the ITSP for typical children and the means obtained in this study were also determined.

In order to compare the scores of the ITSP and the TSFI, the z-scores for participants for both tests were determined.

Frequency data were also calculated for each component on the z-scores, -2 SD to +2 SD for the ITSP and -2 SD to 0 SD for the TSFI. For all the sections and subtests on the tests, the percentage of participants scoring in each of the standard deviations was compared to the normal distribution. In order to establish if the range of the participants observed test score frequencies differed from the expected frequencies in each standard deviation on the normal distribution (Gaussian curve). Chi squared tests were used.

This data were also used to establish the accuracy, sensitivity, specificity, and misclassification of the two tests.

To determine construct validity of the tests the researcher used z-score data which were continuous so the parametric Pearson's correlation coefficient was calculated in order to establish if there is any correlation between the different sections of the two tests. This was done to determine if the tests were convergent

or divergent and thus measuring the same or a different construct. Convergent validity refers to the degree, two different measures designed to measure the same underlying trait, consistently measure the same trait (111) (112). Therefore, if there is a high correlation between the scores obtained by the two measures, it indicates convergent validity. Divergence, also known as discriminant validity, refers to the principle that tests that are designed to measure different traits should be unrelated (111).

Finally, the internal consistency of both tests was determined by calculating Cronbach's alpha. This measure determined the reliability of the items on each test to measure the construct the test was designed to measure for this sample of participants.

3.3 ETHICAL CONSIDERATIONS:

The researcher applied for ethical clearance from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, before the start of the research. Data collection only started once ethical clearance was obtained (Appendix D). Permission was obtained from the child day care facilities in the form of a signed, informed consent form (Appendix E).

All parent(s)/legal guardian(s) were provided with an information sheet (Appendix F1) to explain the research and were requested to sign informed consent (Appendix F2 response sheet) before entering the research project.

Participation in this project was voluntary and any parent/legal guardian was free to withdraw their infant at any point. There were no consequences for such withdrawal.

As infants are a particularly vulnerable group special care was taken during the assessment of the infants. The special measures included:

Parents/legal guardians could request to be present during the testing session.

The testing sessions were conducted at the child day care facility which is a familiar setting for the infant. This was done in order for the infant to be comfortable and to reduce the risk of the infant being distressed during the testing session.

Testing sessions were conducted in the presence of the infant's regular caregiver. This, again, was done in order for the infant to be comfortable and to reduce the risk of the infant being distressed during the testing session.

If any signs of distress (like crying or pulling away from the researcher) were seen during the testing session, the test was stopped. If the infant could be calmed down, testing was restarted, but only continued if no signs of distress were noted.

Some parts of the standardised test (TSFI) required the tester to hold and handle the infant. If this caused distress (crying or pulling away from the researcher), the caregiver was instructed and received a demonstration of how to administer that particular test item. The researcher then only observed the infant's reaction to the specific administered input. According to the test manual (9), this is an acceptable manner to administer the test.

To ensure confidentiality, all participants in this research were allocated a study code. This number was used on all data sheets. The participant's information was kept separate. Only the researcher had access to the participant's information that was kept in a separate sheet and protected by passwords. It was important that the researcher was able to identify participants in case they needed to be contacted. Contact with parents was needed if the infant was found to have 'definite difference scores' on the tests. They were provided with a resource list in order to obtain occupational therapy treatment by a sensory integration certified therapist if they so wished. No personal information was published.

CHAPTER 4: RESULTS

4.1 INTRODUCTION

For this study, the sensory integration function of 60 infants between the ages of seven to 18 months was assessed using the Infant/Toddler Sensory Profile (ITSP), and the Test of Sensory Functions in Infants (TSFI), which was administered by the researcher. The sensory profile of the participants was established for each test, and the results were compared to the normative data from the test manuals. Diagnostic accuracy specifically looking at accuracy, specificity, sensitivity, and misclassification rate of the two tests was determined. Results also reflect the construct validity and internal consistency of the two tests.

4.2 DEMOGRAPHICS

4.2.1 General Demographics

Demographic data was gathered by means of a questionnaire compiled by the researcher. The questionnaire was completed by parents of the infant participants. Table 4.1 focuses on demographics of the infant participants as well as the age of their mothers, at the time of testing, and duration of time the infant spends at the day care facility each day.

The gender distribution for the infant participants was found to have slightly more males (56.7%) than females (43.3%). The infants were divided into age bands with a range of three months. The smallest percentage (6.7%) of infants fell in the age group seven to nine months and the highest percentage (40.0%) in the age group between 15 to 18 months. The lack of significant difference between the age groups for the scores on the ITSP and TSFI, except vestibular scores on the ITSP ($p \leq 0.02$), meant that the groups could be considered comparable, and therefore no further analysis according to age groups was considered.

The highest percentage of mothers (52.5%) was between the ages of 25 to 30 years, at the time of testing, with the youngest mother being age 20 years. Only 5.0% (n=3) of the participants attended child day care facilities for half day with the largest proportion (95.0%) of participants attending day care on a full day basis. All the parents could afford day care facilities, and this places them in a middle

socioeconomic status. All the parents were English first or second language and the day care centres all used either English/Afrikaans or both languages as the language for education.

Table 4.1 General Demographics

n (%)				
Gender	Male		34 (56.7%)	
	Female		26 (43.3%)	
Ages	**Infants n = 60 Range Mean(SD)**		**Mothers n = 59 Range Mean(SD)**	
	7 to 18 months 13.68 (3.33)		20 to 40 years 29.93 (4.29)	
	n (%)		**n (%)**	
	7-9 months	4 (6.7%)	15 to 20 years	1 (1.7%)
	10-12 months	22 (36.7%)	21 to 25 years	6 (10.2%)
	13-15 months	10 (16.6%)	26 to 30 years	31 (52.5%)
	16-18 months	24 (40.0%)	31 to 35 years	12 (20.3%)
			36 to 40 years	9 (15.3%)
Attendance at Child Day Care Facilities	Mornings only		3 (5.0%)	
	Full day		57 (95.0%)	

4.2.2 Birth History of Infant participants

The data relating to the infant's birth history included birthing position, mode of birth and birth weight. Table 4.2 indicates that most participants (68.3%) were in the head first birthing position at the time of birth. Unfortunately quite a number of participants (20.0%) did not indicate birthing position. Only a small percentage (21.7%) of infants was born via normal vaginal delivery, and therefore a very large number of infants in the sample (78.3%) were born via caesarean section, of which 56.6% were planned caesarean sections. Looking at birth weight, the highest number of infants (40.0%) had a birth weight between 3.0 kg and 3.5 kg, and only a small percentage fell below 2.5 kg (5.0%: n=3) and above 4.0 kg (1.7%: n=1).

Table 4.2 Birth History

n (%)		
Birthing position	Head first	41 (68.3%)
	Breech	7 (11.7%)
	Unknown	12 (20.0%)
Mode of birth	Normal	13 (21.7%)
	Planned Caesarean Section	34 (56.6%)
	Emergency Caesarean Section	13 (21.7%)
Birth weight	**Range Mean(SD)**	
	2.2 to 4.05 kg 3.2 kg (0.43)	
	2.0 to 2.5 kg	3 (5.0%)
	2.5 to 3.0 kg	17 (28.3%)
	3.0 to 3.5 kg	24 (40.0%)
	3.5 to 4.0 kg	15 (25.0%)
	4.0 to 4.5 kg	1 (1.7%)

4.3 COMPARISON OF NORMATIVE DATA OF THE INFANT/TODDLER SENSORY PROFILE (ITSP) AND TEST OF SENSORY FUNCTIONS IN INFANTS (TSFI)

4.3.1 Infant/Toddler Sensory Profile (ITSP)

4.3.1.1 Comparison to normative data and typical range

The means of the raw score data obtained from testing a South African sample were compared to the normative data found on the ITSP score sheet. The data obtained for the processing sections is reflected in Figure 4.1 and data for the quadrant scores is reflected in Figure 4.2.

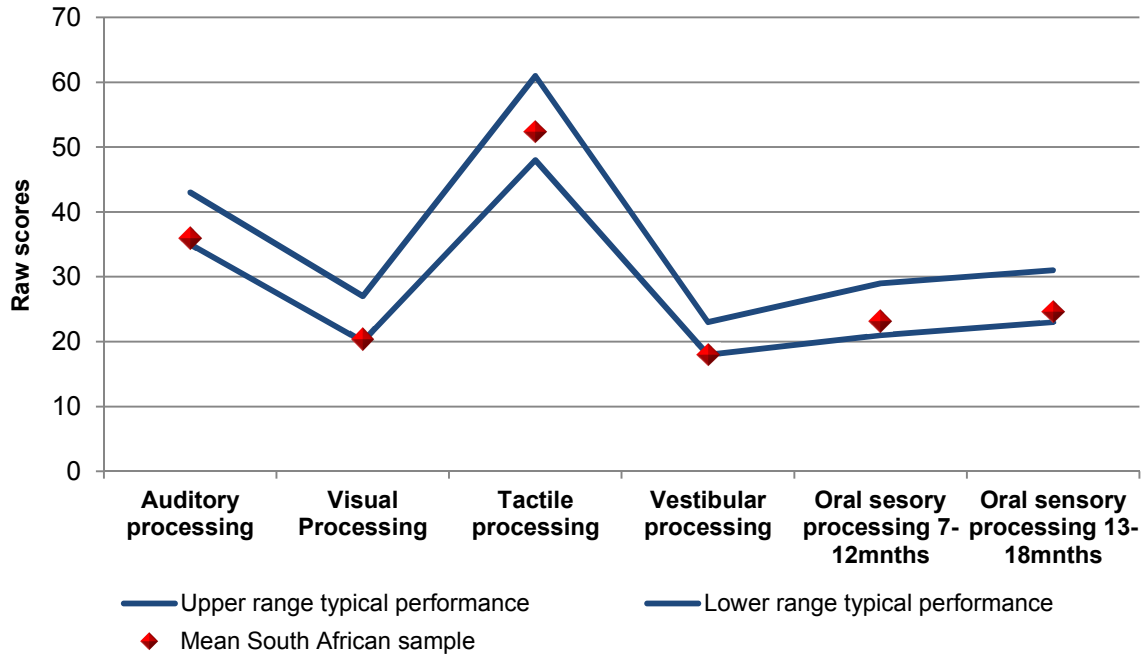


Figure 4.1 Raw scores of processing sections compared to normative data.

In Figure 4.1 (above) it was found that for five of the six processing sections the mean score for the South African sample was in the lower ranges of the typical performance range. The scores for the tactile processing section were centred in the typical performance range.

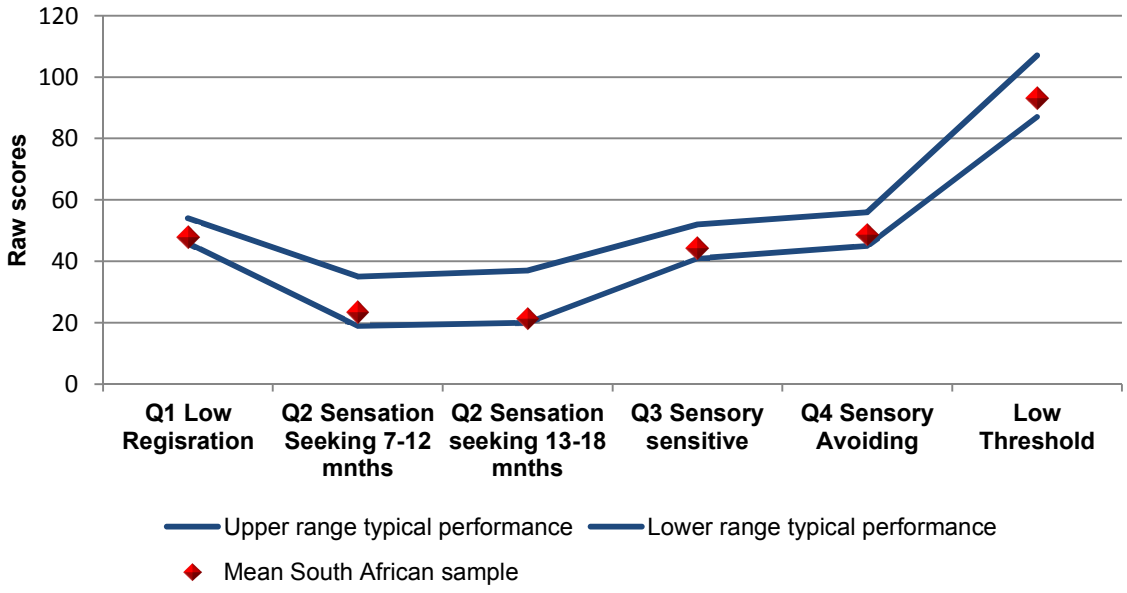


Figure 4.2 Raw scores of quadrants compared to normative data

In Figure 4.2 (above) it was found that on the scores from all the quadrants, mean raw scores for the South African sample, were in the lower ranges of the typical performance range.

Table 4.3 Means Standard deviations, confidence intervals and effect size on raw score analysis for ages of 7-12 months on the Infant/Toddler Sensory Profile (ITSP)

	7-12 months n= 26 Mean (SD)				
Sensory Processing section	**Manual**	**Study**	**95% confidence intervals**	**Cohen's *d***	**Effect size**
Auditory Processing	39.80 (3.51)	37.85 (3.60)	36.40 - 39.28	0.35	0.28
Visual Processing	22.47 (3.29)	20.30 (2.10)	19.45 - 21.16	0.80	0.36
Tactile Processing	54.82 (6.15)	52.65 (7.10)	49.80 - 55.51	0.33	0.16
Vestibular Processing	19.61 (2.78)	18.69 (3.40)	17.32 - 20.06	0.30	0.14
Oral Sensory Processing	33.12 (4.81)	23.08 (3.50)	21.68 - 24.47	2.43	0.76
Quadrant 1: Low registration	49.94 (3.86)	47.54 (4.44)	45.75 - 49.33	0.75	0.27
Quadrant 2: Sensation Seeking	33.57 (8.00)	23.46 (5.91)	21.07 - 25.85	1.43	0.58
Quadrant 3: Sensory Sensitivity	46.51 (4.66)	45.12 (5.61)	42.85 - 47.38	0.26	0.13
Quadrant 4: Sensation Avoiding	50.11 (5.53)	48.88 (6.61)	46.21 - 51.55	0.20	0.10
Combined Quadrant: Low Threshold	96.81 (9.85)	94.00 (11.06)	89.53 - 98.46	0.27	0.13

Table 4.4 Means Standard deviations, confidence intervals and effect size on raw score analysis for ages of 13-18 months on the Infant/Toddler Sensory Profile (ITSP)

13-18 months n=34 Mean (SD)					
Sensory Processing section	**Manual**	**Study**	**95% confidence intervals of means**	**Cohen's *d***	**Effect size**
Auditory Processing	38.98 (3.55)	36.47 (4.83)	34.78 - 38.15	0.77	0.28
Visual Processing	22.93 (3.40)	20.29 (2.50)	19.42 - 21.16	0.82	0.40
Tactile Processing	54.73 (6.11)	50.35 (6.54)	48.07- 52.63	0.96	0.32
Vestibular Processing	20.26 (2.44)	17.85 (3.35)	16.68 - 19.02	0.82	0.38
Oral Sensory Processing	34.70 (4.82)	24.62 (3.77)	23.30 - 25.93	2.58	0.75
Quadrant 1: Low registration	33.47 (8.22)	48.29 (4.30)	46.80 - 49.79	0.49	0.24
Quadrant 2: Sensation Seeking	47.11 (4.66)	21.47 (5.54)	19.54 - 23.04	1.71	0.65
Quadrant 3: Sensory Sensitivity	50.28 (3.78)	43.83 (5.51)	41.90 - 45.74	0.64	0.30
Quadrant 4: Sensation Avoiding	50.88 (5.30)	48.62 (5.59)	46.67 - 50.56	0.43	0.21
Combined Quadrant: Low Threshold	97.89 (9.26)	92.44 (10.26)	88.86 - 96.02	0.55	0.36

Effect size was calculated for the mean scores provided in the manual of the ITSP and the mean scores from this study. The oral processing section and quadrant score for quadrant 2: sensation seeking, for both age groups had moderate effect sizes.

4.3.1.2 Frequency of typical, probable and definite differences

The frequency of the interpretation scores (z-scores) for the different sensory processing sections and quadrant scores in the ITSP indicated some differences from those expected according to a normative distribution. The normative distribution, as plotted on a Gaussian curve, indicate the following distribution:

- Definite Difference – 4.2%
    - Definite Difference less than others – 2.1%
    - Definite Difference more than others – 2.1%
- Probable Difference – 27.2%
    - Probable Difference less than others – 13.6%
    - Probable Difference more than others – 13.6%
- Typical Performance – 68.2%

It was found that, in the sections and quadrants, namely visual processing (63.3%), vestibular processing (56.7%), and low registration (66.7%), fewer participants fell into the typical performance range than expected for the normal distribution (Table 4.5).

More participants than expected fell into the probable difference range (more and less than others combined) in the visual processing section (35.0%) and quadrant 2: sensation seeking (31.7%). It was only in the visual processing section (1.7%) that fewer participants fell into the definite difference range. This aspect could not be judged for quadrant 2: sensation seeking.

Table 4.5 Frequency data for Infant/Toddler Sensory Profile (ITSP)

	n (%)					
Sensory Processing section	**Definite Difference less than others 2.1%**	**Probable Difference less than others 13.6%**	**Typical Perfor-mance 68.2%**	**Probable Difference more than others 13.6%**	**Definite Difference more than others 21.1%**	**Chi Squared test *p-value***
Auditory Processing	0 (0.0%)	0 (0.0%)	44 (73.3%)	12 (20.0%)	**4 (6.7%)**	**0.04**
Visual Processing	0 (0.0%)	0 (0.0%)	**38 (63.3%)**	**21 (35.0%)**	1 (1.7%)	0.12
Tactile Processing	0 (0.0%)	2 (3.3%)	44 (73.3%)	10 (16.7%)	**4 (6.7%)**	0.16
Vestibular Processing	0 (0.0%)	**3 (5.0%)**	**34 (56.7%)**	**14 (23.3%)**	**9 (15.0%)**	**0.00**
Oral Sensory Processing	**1 (1.7%)**	1 (1.7%)	46 (76.7%)	9 (15.0%)	**3 (5.0%)**	**0.04**
Quadrant 1: Low registration		4 (6.7%)	**40 (66.7%)**	8 (13.3%)	**8 (13.3%)**	**0.00**
Quadrant 2: Sensation Seeking	0 (0.0%)	**1 (1.7%)**	41 (68.3%)	**18 (30.0%)**		0.08
Quadrant 3: Sensory Sensitivity		2 (3.3%)	46 (76.7%)	9 (15.0%)	**3 (5.0%)**	0.13
Quadrant 4: Sensation Avoiding		4 (6.7%)	45 (75.0%)	6 (10.0%)	**5 (8.3%)**	**0.01**
Combined Quadrant: Low Threshold		2 (3.3%)	49 (81.7%)	4 (6.7%)	**5 (8.3%)**	**0.00**

Blank squares indicates areas that are not scored for this age groups

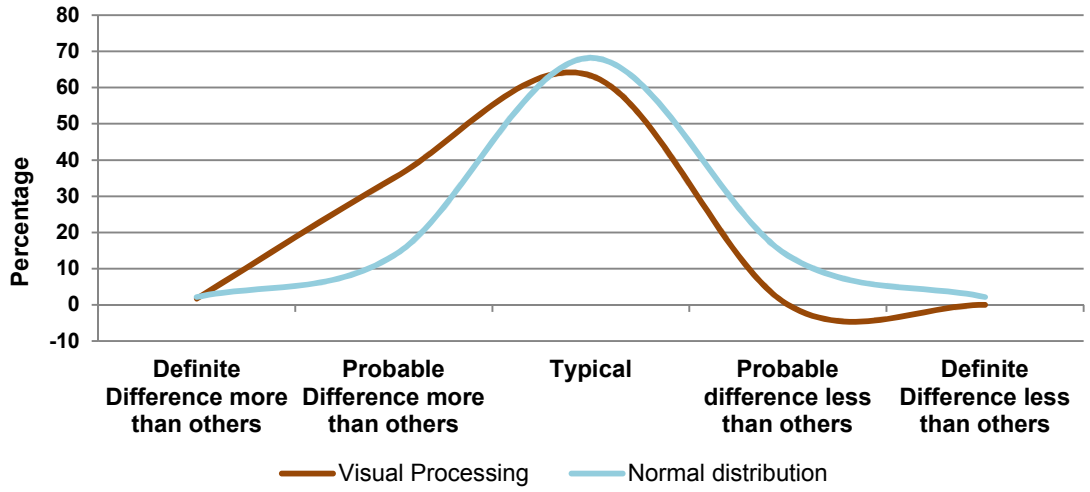


Figure 4.3 Distribution of scores for visual processing section

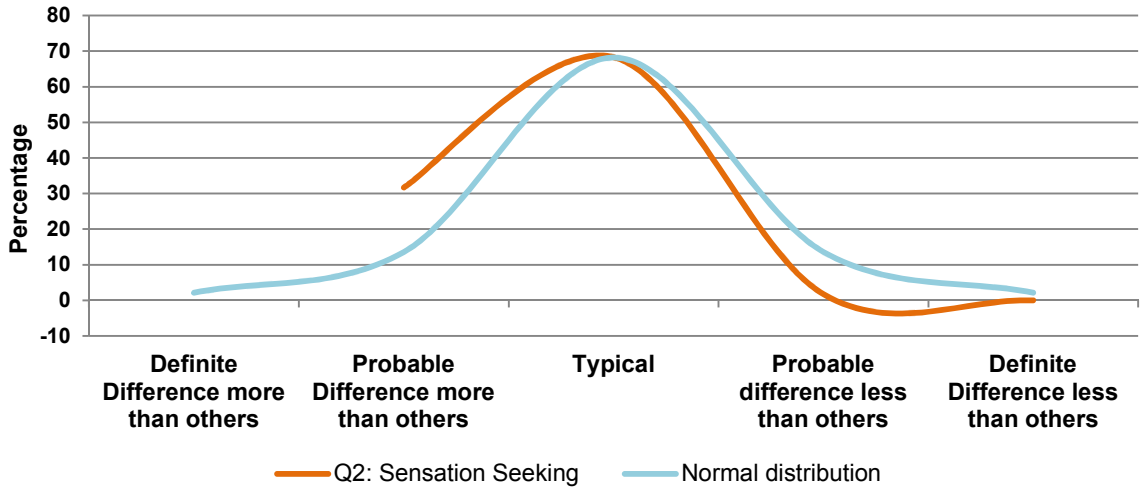


Figure 4.4 Distribution of scores for quadrant 2: sensation seeking

More participants than expected fell into the definite difference range (more than others) on nine of the ten sections and quadrants. It is important to note the percentage of infants falling into the definite difference range on the vestibular processing section (15.0%) as it is much higher than expected (4.2%). This was the only section that also had a higher percentage of infants that scored in the probable difference range (28.3%).

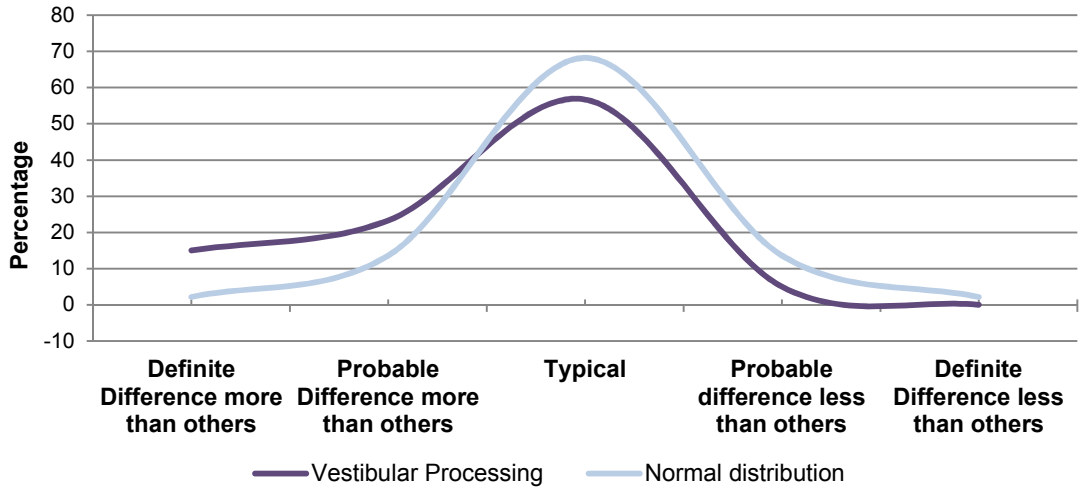


Figure 4.5 Distribution of scores for vestibular processing section

Other section that scored above the expected values in the definite difference category were auditory processing (6.7%), tactile processing (6.7%), and oral processing (5.0%). It can be seen that for these sections the probable difference 'less than others' was always lower but the probable difference 'more than others' was slightly higher or fell into expected ranges. For auditory processing (73.3%), tactile processing (73.3%), and oral processing (76.7%) there was slightly more than expected number of participants (68.2%) scoring in the typical range (Figure 4.6).

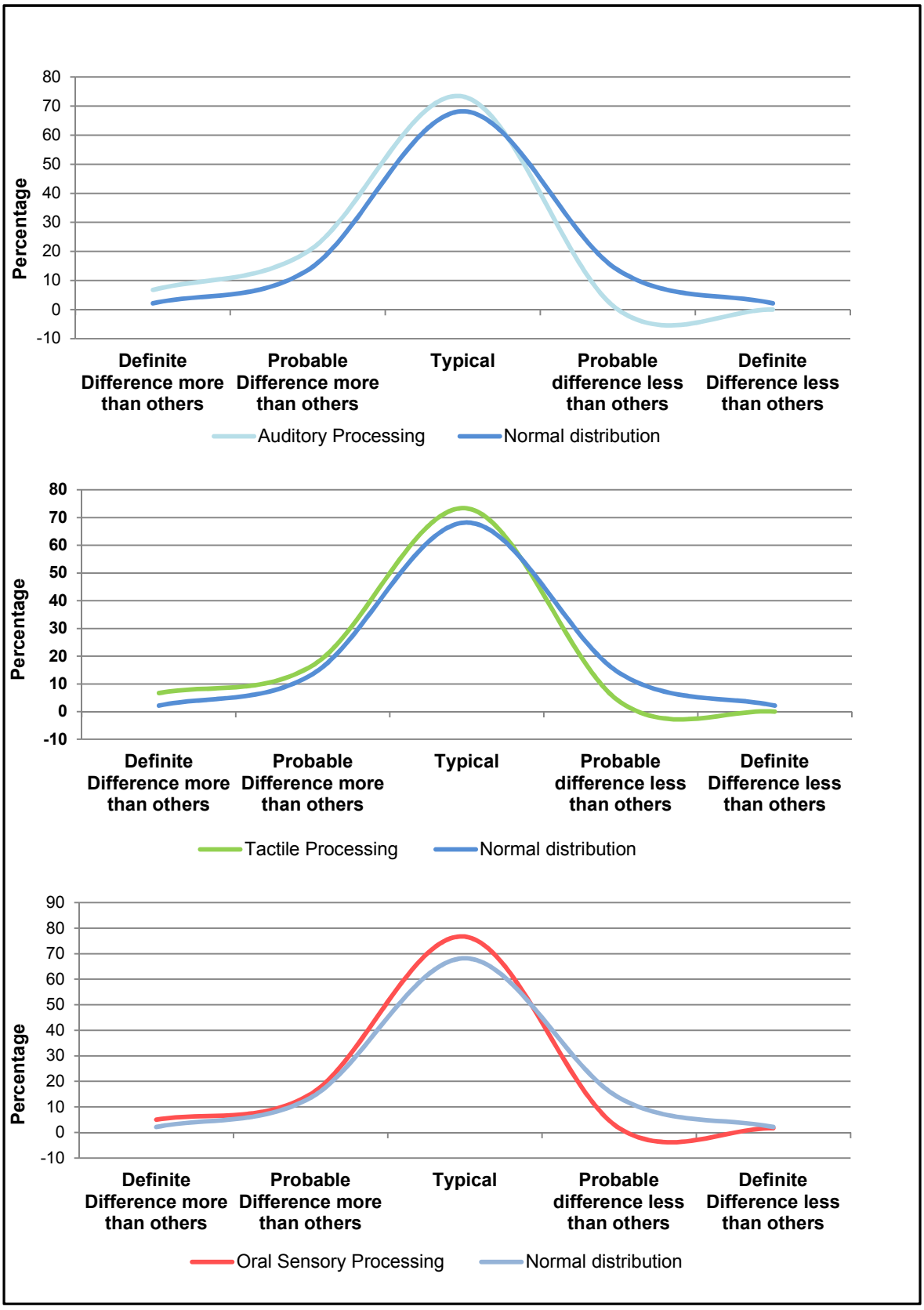


Figure 4.6 Distribution of scores for auditory, tactile and oral sensory processing sections

For the quadrant scores, quadrant 1: low registration (13.3%), quadrant 3: sensory sensitivity (5.0%), quadrant 4: sensation avoiding (8.3%) had a higher percentage

of participants that scored in the definite difference ‘more than others’ (2.1%) as well.

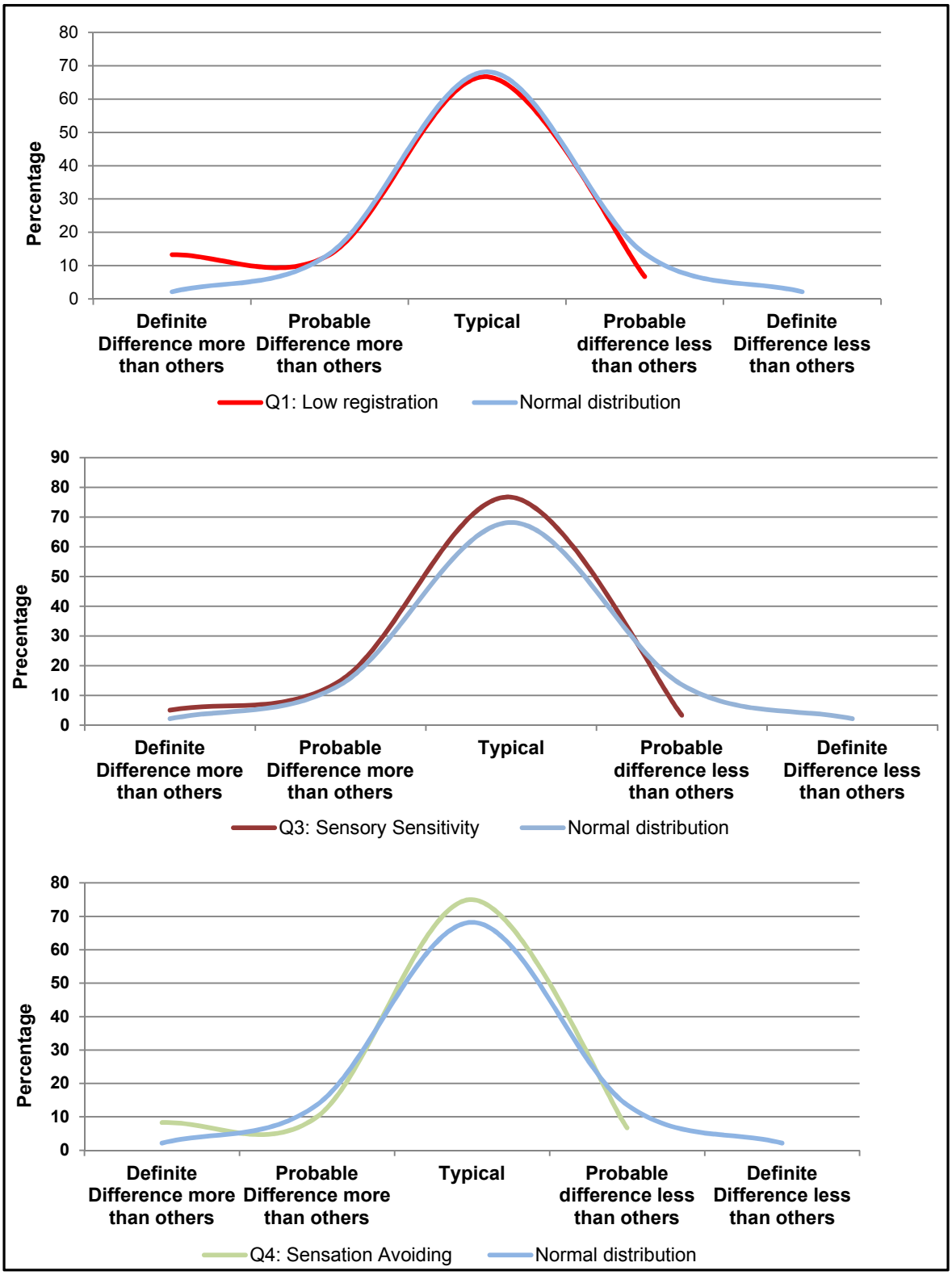


Figure 4.7 Distribution of quadrant scores for quadrant 1: low registration, quadrant 3: sensory sensitivity, and quadrant 4: sensation avoiding

A similar result was found for the combined quadrant: low threshold where the percentage of participants was higher for definite difference 'more than others' (8.3%) although a higher percentage of participants scored in the typical range (81.7%).

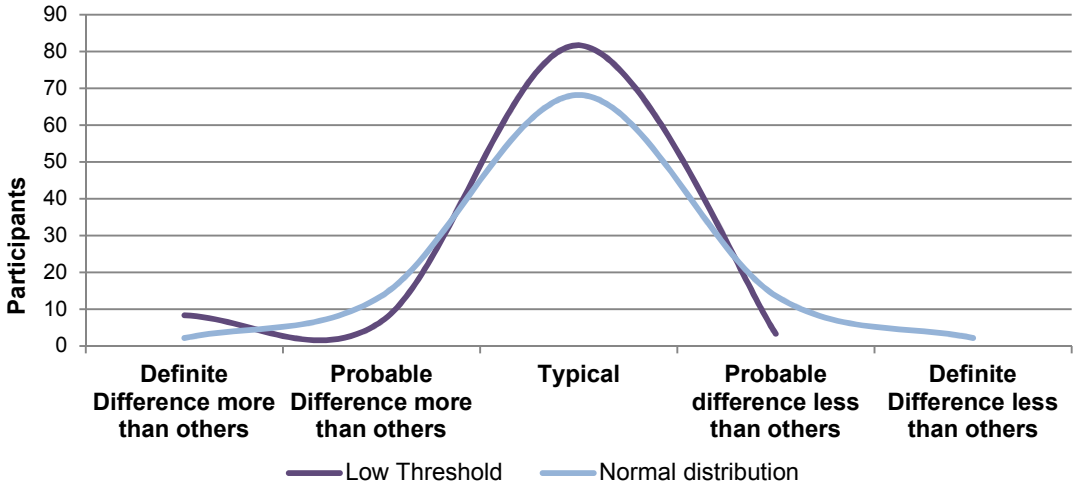


Figure 4.8 Distribution of scores for combined quadrant: low threshold

It was found that six of the ten sections and quadrants were significantly different ($p \leq 0.05$) from the expected normal curve. Only the results for the visual processing ($p \geq 0.12$) and tactile processing ($p \geq 0.16$) section, as well as the sensory seeking ($p \geq 0.08$) and sensory sensitivity ($p \geq 0.13$) quadrants were found to fall within the normal expected range.

The majority of scores indicating problems with sensory integration function fell into the probably more and definitely more than most range. Very few participants scored in the probably less than most and definitely less than most range.

4.2.1 Test of Sensory Functions in Infants (TSFI)

4.3.2.1 Comparison to typical range

In Figure 4.9 below, it was found that scores for five of the subtests as well as the total test score (seven to nine months) were in the lower ranges of the typical performance range. The subtests were reactivity to tactile deep pressure (seven to18 months), adaptive motor functions (seven to nine months), visual tactile integration (seven to 18 months), ocular-motor control (seven to 18 months), and reactivity to vestibular stimulation (seven to 12 months). The scores for three subtests, adaptive motor functions (10 to 12 months), adaptive motor functions (13

to 18 months), reactivity to vestibular stimulation (13 to 18 months), as well as the total test score (eight to 18 months) were below the normal ranges.

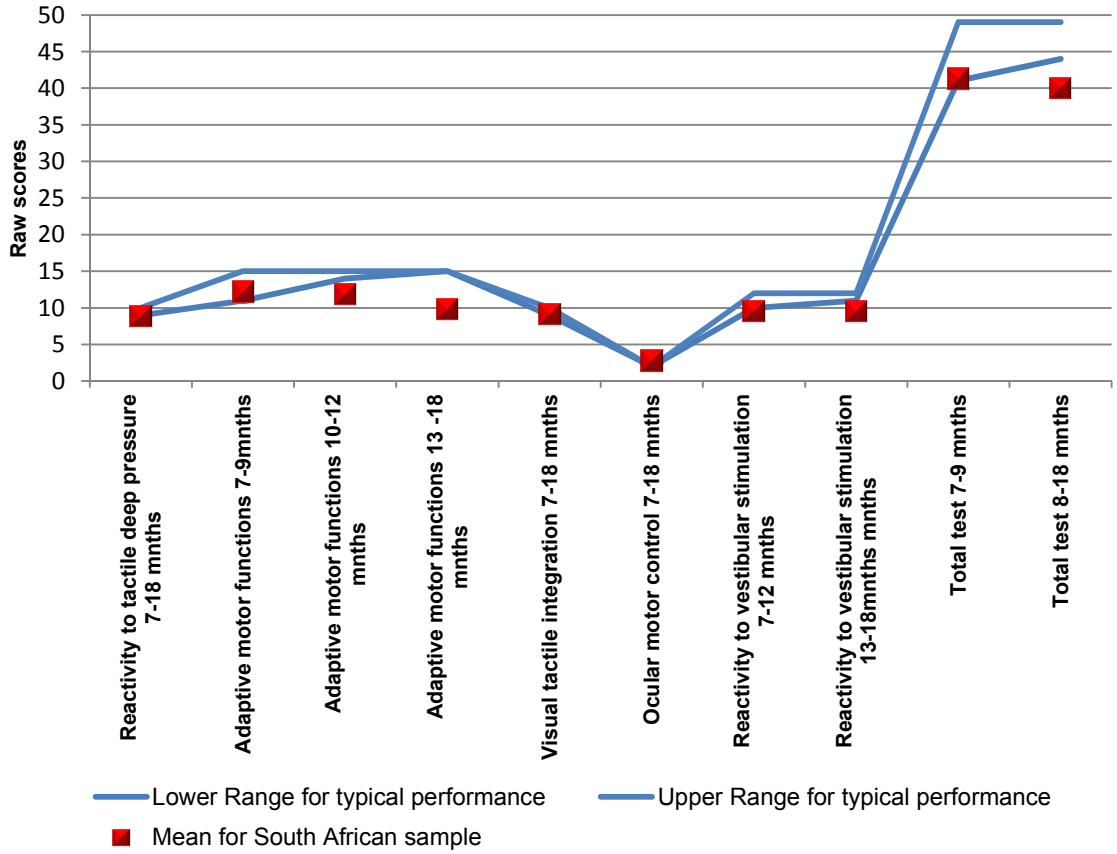


Figure 4.9 Raw scores compared to normative data (TSFI)

4.3.2.2 Frequency of typical, probable and definite differences

The frequency of the interpretation scores (z-scores) for the different subtests and total test score in the TSFI indicated some differences from those expected according to a normative distribution. The normative distribution, as plotted on a Gaussian curve, indicate the following distribution:

Deficient – 4.2%

At risk – 27.2%

Normal – 68.2%

Frequency of the interpretation scores for the different subtests and total test scores obtained by the TSFI are represented in Table 4.6.

Table 4.6 Frequency data for the Test of Sensory Functions in Infants (TSFI)

Research group n = 60 n (%)				
Subtest	**Normal 68.2%**	**At risk 27.2%**	**Deficient 4.2%**	**Chi Squared test p-value**
Reactivity to Tactile Deep Pressure	44 (73.3%)	6 (10.0%)	**10 (16.7%)**	***0.00**
Adaptive Motor Functions	**16 (26.7%)**	12 (20.0%)	**32 (53.3%)**	***0.00**
Visual-Tactile Integration	48 (80.0%)	7 (11.7%)	**5 (8.3%)**	***0.00**
Ocular-Motor Control	50 (83.3%)	9 (15.0%)	1 (1.7%)	***0.01**
Reactivity to Vestibular Stimulation	**31 (51.7%)**	7 (11.7%)	**22 (36.6%)**	***0.00**
Total Test scores	**25 (41.7%)**	12 (20.0%)	**23 (38.3%)**	***0.00**

* $p<0.05$

In one subtest, the reactivity to vestibular stimulation (51.7%), it was found that fewer participants fell into the 'normal' performance range (68.2%) than expected, with a higher percentage of participants falling into the deficient category (36.6%).

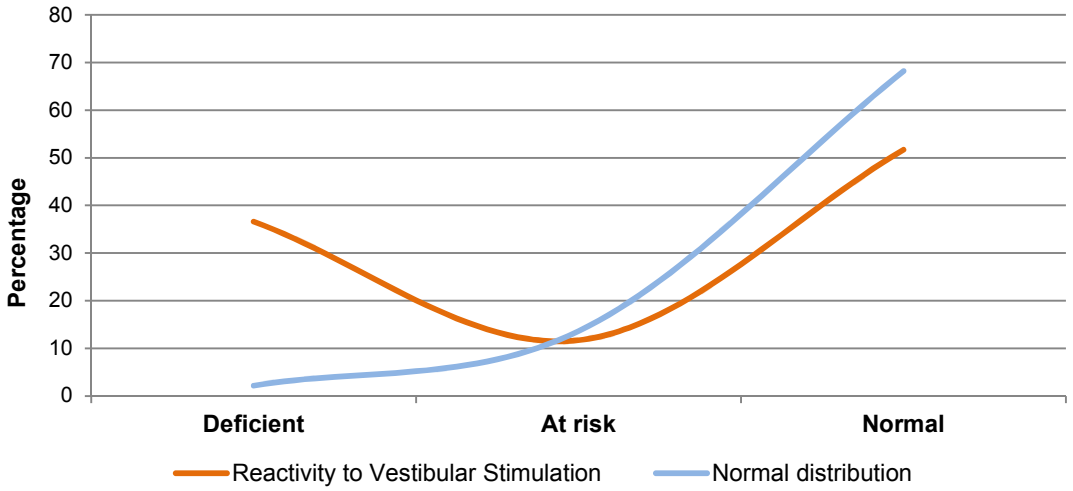


Figure 4.10 Distribution of scores for reactivity to vestibular stimulation

The score for the subtest of adaptive motor function (26.7%), less than half of the participants tested within the expected ranges for the normal distribution (68.2%)

and more participants tested within the ‘deficient’ range (53.3%) than what is expected for the normal distribution (4.2%).

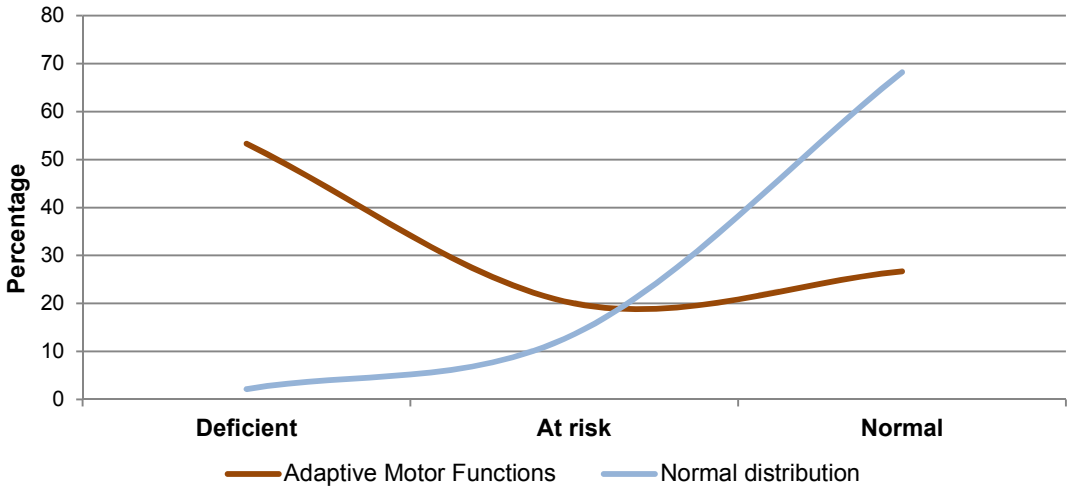


Figure 4.11 Distribution of scores for adaptive motor functions

It was found that in five of the six subtests more participants tested within the ‘deficient’ range than what is expected for the normal distribution (4.2%).

Only the ocular-motor control subtest (1.7%) had fewer participants test with in the ‘deficient’ range. Reactivity to tactile deep pressure (16.7%), and visual-tactile integration (8.3%) subtests, tested higher than expected within the ‘deficient’ range, they had scores that were more than double the expected score of 4.2%. These subtests also had a higher percentage of participants within the normal ranges.

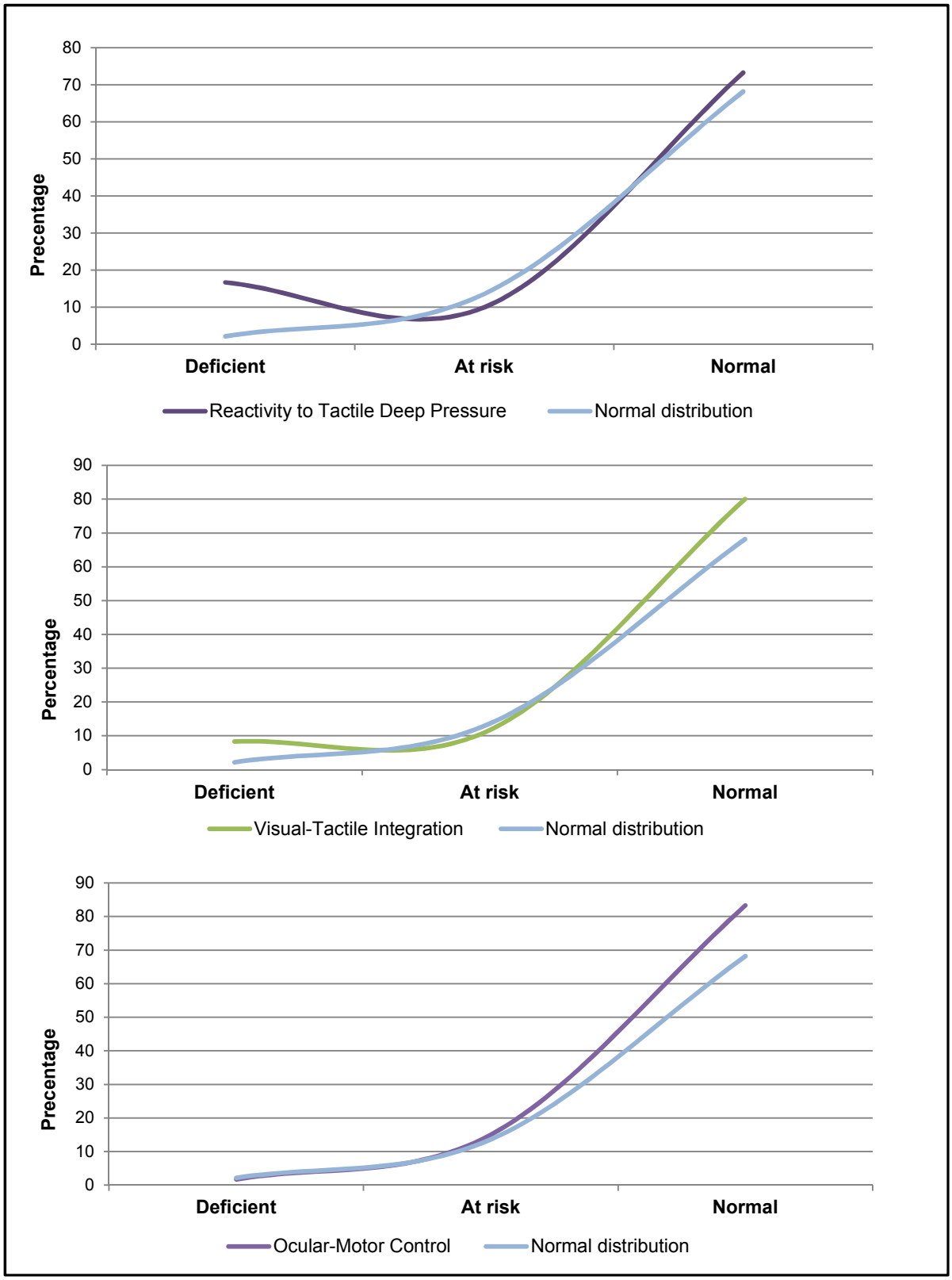


Figure 4.12 Distribution of scores for reactivity to tactile deep pressure, visual-tactile integration, and ocular-motor control subtests

The total test score distribution was affected by the distributions for reactivity to vestibular stimulation and adaptive motor function, and a high percentage of the

participants fell into the deficient category with a marked reduction in those scoring in the normal category (Figure 4.13).

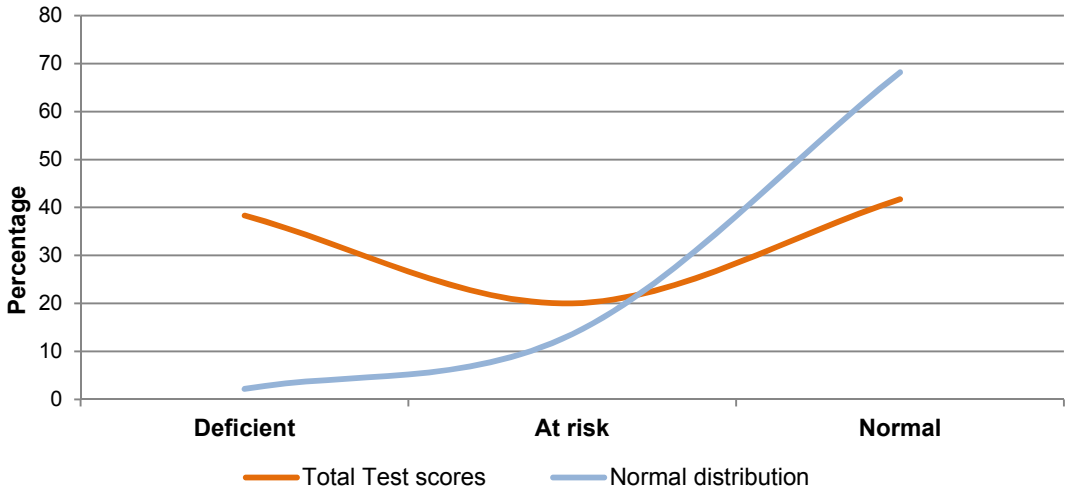


Figure 4.13 Distribution of total test scores

All the subtests had fewer participants that tested within the 'At risk' range than what is expected for the normal distribution (27.2%).

In all five subtests and the total test score, it was found that the scores obtained differ significantly ($p \leq 0.05$) from the normal distribution (Table 4.6).

4.3.3 Sensitivity and Specificity

To assess the validity of the ITSP and TSFI for the test population, the accuracy, sensitivity and specificity was determined by using the frequency data presented above, in comparison to the expected number of cases compared to the normal distribution (Table 4.7a and 4.7b).

Accuracy indicates the closeness of estimated values to the true values (111). For a test to be accurate it needs to have sensitivity and specificity within acceptable limits. Sensitivity refers to the ability of a measurement tool to detect the presence of a condition or problem when it is indeed present. Specificity, on the other hand, refers to the ability of a measurement tool to produce negative results when the condition or problem is absent. Sensitivity and specificity need to be considered to establish the usefulness of a measurement tool or instrument in determining the existence of a problem or whether treatment is needed (124) in order that sensory integration dysfunction is not over or under identified in infants.

For the sensitivity and specificity of the Infant/Toddler Sensory Profile (ITSP) (Table 4.7a) the following were noted:

All the accuracy scores as well as the specificity scores were acceptable at above 80%. The specificity for the vestibular processing section however was just above 80%, indicating participants without a problem may have been identified with dysfunction. A number of sections and quadrants had sensitivity rates below 80% which indicates participants with a problem may not be identified. This was a concern for the section of oral sensory processing (73.7%), and quadrant scores for sensory sensitivity (73.7%), sensation avoiding (78.9%). The lowest sensitivity was seen for combined quadrant: low threshold (57.9%). The highest misclassification rate was for the combined quadrant: low threshold (6.7%). The misclassification rate indicates how many children will be under/over identified by the test. The ideal will be that a test has a 0.0%.

Table 4.7a Sensitivity and Specificity of Infant/Toddler Sensory Profile (ITSP)

Research group n = 60					
Sensory Processing section	**Number of correct cases**	**Accuracy**	**Sensitivity**	**Specificity**	**Mis-classifi-cation rate**
Auditory Processing	57	95.0%	84.2%	100.0%	2,5%
Visual Processing	57	95.0%	100.0%	92.7%	2.5%
Tactile Processing	57	95.0%	84.2%	100.0%	2.5%
Vestibular Processing	53	88.3%	100.0%	82.9%	5.8%
Oral Sensory Processing	55	91.7%	**73.7%**	100.0%	4.2%
Quadrant 1: Low registration	59	98.3%	100.0%	97.6%	0.8%
Quadrant 2: Sensation Seeking	60	100.0%	100.0%	100.0%	0.0%
Quadrant 3: Sensory Sensitivity	55	91.7%	**73.7%**	100.0%	4.1%
Quadrant 4: Sensation Avoiding	56	93.3%	**78.9%**	100.0%	3.3%
Combined quadrant: Low Threshold	52	86.7%	**57.9%**	100.0%	6.7%

Table 4.7b Sensitivity and Specificity of Test of Sensory Functions in Infants (TSFI)

Research group n = 60					
Sensory Processing section	**Number of correct cases**	**Accuracy**	**Sensitivity**	**Specificity**	**Mis-classifi-cation rate**
Reactivity to Tactile Deep Pressure	57	95.0%	84.2%	100.0%	2.5%
Adaptive Motor Functions	35	**58.3%**	100.0%	**39.0%**	**20.8%**
Visual-Tactile Integration	53	88.3%	**63.2%**	100.0%	5.8%
Ocular-Motor Control	51	85.0%	**52.6%**	100.0%	7.5%
Reactivity to Vestibular Stimulation	50	83.3%	100.0%	**75.6%**	8.3%
Total Test scores	44	**73.3%**	100.0%	**61.0%**	**13.3%**

For the sensitivity and specificity of the Test of Sensory Functions in Infants (TSFI) (Table 4.7b), the following were noted:

The accuracy scores for the subtest of adaptive motor functions (58.3%) and the total test score (73.3%) were below the acceptable rate of 80%. The sensitivity for two of the six sections was below 80%. These were the subtests of visual-tactile integration (63.2%) and ocular-motor control (52.6%), indicating that some participants who do not have dysfunction may be identified as having a problem.

Three of the six sections had specificity scores below 80%, indicating that participants without a problem may have been identified with dysfunction. The sections were the subtests of adaptive motor functions (39.0%), reactivity to vestibular stimulation (75.6%), as well as the total test score (61.0%). The misclassification rates for adaptive motor functions (20.8%), visual-tactile integration (58.0%), and total test score (13.3%) were all high.

4.3.4 Construct validity correlation scores for Test of Sensory Functions in Infants (TSFI) and Infant/Toddler Sensory Profile (ITSP).

In order to determine if the two tests had any constructs that were similar in terms of sensory processing the scores for the sections and quadrants of the ITSP and

the subtests and total test score on the TSFI were correlated. The researcher was aware that the developers of the tests had designed the test for different constructs of sensory processing – sensory modulation and sensory reactivity, and results of the correlation confirm the divergence of these two constructs.

There were no moderate correlations between the sections and quadrant scores obtained on the ITSP, and the subtest/total test score obtained by the TSFI. All the correlations were weak and too low to account for the test items to be considered as measuring the same constructs. The constructs in the tests can therefore be considered to be divergent.

Table 4.8 Correlation scores of Test of Sensory Functions in Infants (TSFI), and Infant/Toddler Sensory Profile (ITSP)

ITSP	TSFI					
	Reactivity to Tactile Deep pressure	Adaptive Motor Functions	Visual-Tactile Integration	Ocular-Motor Control	Reactivity to Vestibular Stimulation	Total Test Score
Auditory Processing	0.03	0.25	0.12	-0.08	0.10	0.13
Visual Processing	-0.08	0.19	-0.15	0.12	0.10	0.08
Tactile Processing	-0.12	0.04	-0.12	-0.06	-0.04	-0.14
Vestibular Processing	-0.13	0.22	0.05	0.07	-0.08	0.03
Oral Sensory Processing	-0.10	0.23	-0.00	0.16	-0.00	0.10
Quadrant 1: Low Registration	-0.02	0.03	0.03	-0.09	0.03	0.04
Quadrant 2: Sensory Seeking	-0.16	0.08	-0.17	**0.26**	0.09	-0.05
Quadrant 3: Sensory Sensitivity	0.04	0.16	0.02	-0.02	-0.16	0.05
Quadrant 4: Sensory Avoiding	-0.17	0.21	-0.00	-0.07	0.03	0.09
Low Thresh Hold	-0.09	**0.35**	0.16	-0.00	0.10	0.22

4.3.5 Reliability

The Cronbach alpha for this sample of participants for the TSFI was calculated as 0.69 and for the ITSP as 0.84.

Table 4.9 Reliability scores for the Infant/Toddler Sensory Profile (ITSP) and Test of Sensory Functions in Infants (TSFI)

Research group n = 60		
Infant/Toddler Sensory Profile (ITSP)		
Sensory Processing section	**Cronbach alpha for study**	**Cronbach alpha scores from manuals**
Auditory Processing	0.84	0.70
Visual Processing	0.84	0.55
Tactile Processing	0.81	0.72
Vestibular Processing	0.83	0.43
Oral Sensory Processing	0.82	0.55
Quadrant 1: Low registration	0.84	0.70
Quadrant 2: Sensation Seeking	0.86	0.86
Quadrant 3: Sensory Sensitivity	0.81	0.72
Quadrant 4: Sensation Avoiding	0.80	0.70
Combined quadrant: Low Threshold	0.80	0.83
Test of Sensory Functions in Infants (TSFI)		
Reactivity to Tactile Deep Pressure	0.71	Cronbach alpha scores for internal consistency are not available in the manual.
Adaptive Motor Functions	**0.66**	
Visual-Tactile Integration	**0.63**	
Ocular-Motor Control	0.70	
Reactivity to Vestibular Stimulation	**0.66**	
Total Test scores	**0.50**	

For the ITSP (Table 4.9), all the sections and quadrants had a Cronbach alpha within acceptable ranges of $\alpha \geq 0.70$. For the TSFI, three subtests had Cronbach alpha below acceptable ranges. These were adaptive motor functions (0.66), visual-tactile integration (0.63), and reactivity to vestibular stimulation (0.66). The Cronbach alpha for the total test score (TSFI) was also below acceptable ranges (0.50).

For the scores of the Infant/Toddler Sensory Profile (ITSP), the Cronbach alpha scores obtained in this study were higher that the scores indicated in the test manual. This was for all the sections and quadrants except for quadrant 2: sensation seeking where the score in both cases were the same (0.86), and the combined quadrant: low threshold where the score in the manual (0.83) is higher than in this study (0.80).

4.4 SUMMARY

In this chapter, the demographics of the infant participants in this study and their mothers were presented showing the sex, age and birth history. It was found that there were slightly more male than female participants. The ages of the participants ranged from seven to 18 months, and the highest percentage of infants fell in the age group of 15 to 18 months with a mean age of 13.68 months. The age of the mothers, at the time of birth, ranged between 20 years and 40 years with a mean age of 29.93 years. The highest percentage of mothers was between the ages of 25 and 30 years.

The birth history showed that most infants were in the head first birth position during birth. Unfortunately, there were participants that were unable to give information regarding birth position. A very high percentage of infants in the sample were born via caesarean section, with only a small percentage of normal, vaginal deliveries.

The sensory integration function of the participants was tested using a parent questionnaire, the Infant/Toddler Sensory Profile (ITSP) and a therapist observation test, the Test of Sensory Functioning in Infants (TSFI).

The data for both the ITSP and TSFI were compared to the normative data and typical range. This was done by comparing the means of the raw score data

obtained from testing a South African sample. All the section and quadrant scores for the ITSP were found to be within the lower ranges of the typical performance ranges, except for the tactile processing section score that was centred in the typical performance ranges. For the TSFI it was found that the scores for the subtests of adaptive responses (10 to 12 months), adaptive motor response (13-18 months), as well as the total test score (10 to 18 months) was below the typical ranges.

Overall the mean scores and frequency distributions for the South African sample indicate a higher percentage of participants fell into the definite difference 'more than others' on the ITSP and frequency results of the ITSP showed a significant difference from what is expected to be a normal distribution on six of the ten section and quadrant scores. In five of these a higher percentage of participants fell into the typical range.

Frequency data for the test showed that significantly more infants tested within definite difference/deficient ranges on the ITSP and the TSFI. For the TSFI, it was found that there was a significant difference from the normal distribution in all five the subtests as well as the total test score. For both tests it was noted that the sections that relate to vestibular processing, had high percentages of infants that tested within the definite difference/deficient ranges.

The sensitivity, specificity of the two tests was determined based on the frequency of the results against the expected normal distribution. It was found that, for the ITSP, there were four sections with sensitivity below 80%. This indicates that some participants with a problem may be identified as having no dysfunction. These were the section for oral sensory processing and the quadrants for sensory sensitivity, sensation avoiding, and combined quadrant of low threshold. In this study group, if the interpretation criteria are applied to the results, 15% (n = 9) of infants are identified with problems that need further assessment. For the TSFI, it was found that there was one subtest, namely adaptive motor functions as well as the total test score, with very low accuracy and low specificity, which indicates that participants without a problem may be identified as dysfunctional. Two subtests had low sensitivity indicating that participants with a problem may be identified as having no dysfunction. These were the sections for visual-tactile integration and ocular-motor control. When applying the interpretation criteria to the TSFI tests

done on the study population, it was found that 33.3% (n = 20) of infants are identified as having difficulties that require further assessment.

The correlation scores used to determine the construct validity indicates that there is no significant correlation between the sections of the two tests. This indicates divergent validity and that the tests do not measure the same constructs and cannot be used interchangeably.

Reliability of the ITSP (α = 0.84) was found to be within acceptable ranges, and all the sections and quadrants also had reliability within acceptable ranges for this sample. For the TSFI, the overall reliability was below acceptable ranges (α = 0.69). The TSFI subtest scores for adaptive motor functions (α = 0.66), visual-tactile integration (α = 0.63), and reactivity to vestibular stimulation (α = 0.66) it was found that reliability was below acceptable ranges. The total test score reliability (α = 0.50) is low.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

In this chapter, the demographic information of the total participant group will be discussed. The results of assessing 60 infants between the ages of seven to 18 months using the Infant/Toddler Sensory Profile (ITSP) and the Test of Sensory Functions in Infants (TSFI) in the context of this South African sample will be considered in comparison to the normative data from the test manuals and normal distribution. The diagnostic accuracy specifically looking at accuracy, specificity, and sensitivity of the two tests will be discussed. The results from analysing the construct validity and internal consistency of the two tests will also be discussed.

5.2 DEMOGRAPHICS

During the study, the researcher made use of 17 child day care facilities to recruit participants. Many more day care centres were approached, but participants could not be recruited as they did not meet the inclusion criteria in terms of age, or the facilities were not willing to participate in a research study, or parents did not give informed consent. Data was collected over a period of 11 months.

The total of 60 infants included in the study, of which 34 are males and 26 females, were amongst the 45.0% of children below the age of five years reported as attending a pre-school facility in Gauteng (126). The participants' ages range between seven months and 18 months with a mean age of 13.68 months. The smallest group of participants were between the ages of seven months and nine months, and this is due to the fact that the child day care facilities had fewer infants in this age group. This is an age group that requires a higher infant to care giver ratio, and many of the facilities have limited space and resources and therefore had fewer infants in this age group. The largest percentage of infants in the study was between the ages of 16 and 18 months (Table 4.1).

The ages of the mothers at the time of the study ranged between 20 years and 40 years with a mean age of 29.93 years. There is a worldwide trend that the age of mothers giving birth is increasing. A news report published in the Mail online (2014) reported that the average age of woman giving birth in England and Wales

is now 30 years compared to 29.8 in 2012 (127). In the 1970's, more mothers were under the age of 25 when giving birth than above the age of 25. In 2006, the average age of woman giving birth in South Africa was 28.7 years (128). The average age of the mothers in this study would be close to this range as the mean age of 29.93 years is calculated at the time of the study when the infants were between seven and 18 months old, and not the age of mothers at time of birth (Table 4.1).

Of the infants participating in the study, 95% attended child day care facilities for the duration of a full day. Child day care facilities that participated in the study accommodated infants from between 06h00 and 07h00 in the morning until 17h30 to 18h00 in the evening. The high percentage of infants attending full day can probably be attributed to the fact that day care facilities are specifically used by working parents to take care of their infants (Table 4.1). This is supported by the fact that all the child day care facilities are privately run so the participants' parents had the financial security to afford these facilities for their infants.

Information regarding birth demographics indicated that 68.3% of participants assessed in this study were born in the normal head first presentation and 11.7% were born in breach birth presentation, The breech birth presentation was higher than reported in the literature (Table 4.2) where Impey and Pandit (129) as well as Hofmeyr and Gyte (130) indicate an occurrence of 3-4% for full term births. Moodley et al. (131) reported only a 2.4% incidence of breech births in a district hospital in South Africa. This question was not completed for 20% of the participants possibly due to the mothers not understanding the term "birth position" or the parents being unsure of the birth position.

The mode of birth reported indicates that 21.7% of participants were born via normal vaginal delivery, and 78.3% were born via caesarean section (Table 4.2) a rate much higher than the WHO's suggested acceptable caesarean rate of 10% to 15%. When only looking at the caesarean section, it is seen that 72.3% were planned caesarean sections and 21.7% were emergency caesarean sections (Table 4.2).

In South Africa, a very high caesarean rate has been reported in the private health sector (132), with 72.8% of all the births paid for by the medical scheme being

caesarean section. Tshibangu et al. (133) found a steady increase in caesarean sections over the period between 1998 and 2000. They suggest the high rate of caesarean sections found in South Africa might be due to either fear for litigation due to an increase of malpractice cases; maternal requests for caesarean sections or the HIV status of the patient (133).

The 78.3% of participants born via caesarean section seen in the small sample of this study was slightly higher than the average for South Africa, which may be accounted for by the fact that all the parents in this sample were from an urban, middle to high income setting. Cavallaro et al. (134) also found that there is an increase in caesarean section rate in urban, higher income setting due to easier access to medical care, as well as the people's ability to pay for the cost of the caesarean section.

The birth weight of participants in the study ranges from 2.2 kg to 4.05 kg, with a mean of 3.2 kg. Forty percent of the participants had a birth weight between 3.0 kg and 3.5kg. The mean birth weight reflected in this study is within the ranges considered as a normal birth weight for full term infants. The normal birth weight, according to the Atlas of neonatal pathology (135), is a weight between 2.5 kg and 4.0 kg.

The participants in this study were all born at full term (between 37 and 42 weeks gestation), as per the inclusion and exclusion criteria. They also had no diagnosed birth defect or gestational illness, as stipulated in the exclusion criteria. There were also no reports of any major medical difficulties since birth. Due to these inclusion and exclusion criteria the participants were therefore, considered to be typical infants.

5.3 ASSESSMENT OF SENSORY INTEGRATIVE TESTS FOR INFANTS FOR THE SOUTH AFRICAN CONTEXT

The first objective of this study was to compare the results of a South African sample of infants on tests of sensory integration function in infants, namely the Infant/Toddler Sensory Profile (ITSP) and the Test of Sensory Functions in Infants (TSFI), to the USA norms for these tests. The participants in South African sample were full term infants between the ages of seven to 18 months, attending child day care facilities in the East Rand of Gauteng.

It is important to consider two aspects when reviewing standardised tests for other populations or samples, that is whether the population norms differ significantly from the norms of the individuals the test was standardised on, due to differences in the context and culture or whether the test items are not valid for the new population or sample and need to be changed or rescored for these individuals.

The raw score data obtained from testing the South African sample was therefore compared to the normative data in the test sample as no “gold standard” is available to assess sensory integration function in infants. The results for the ITSP and TSFI were compared to both the normative data found in the test manuals, and to a normal Gaussian distribution on which the interpretation of these tests is based.

5.3.1 Infant/Toddler Sensory Profile (ITSP)

According to the ITSP manual, the sensory processing section summary sheet provides a visual representation of the infant’s sensory processing abilities (40). For the interpretation of the quadrant scores, the theoretical model of sensory processing, based on the infant’s neurological thresholds (Figure 2.2) is used. Different behavioral responses to thresholds are seen. Infants can act passively (low registration and sensory sensitivity), thus the infant responds in accordance with their threshold, or infants can act actively (sensory seeking and sensation avoiding), thus their response is counteracting the threshold. Tendencies to respond are influenced by genetics, environmental demands, task, and experience.

There is interaction between the continua, and it is important to remember that every infant has some of each of these responsiveness characteristics. They can, therefore, have sensation seeking for touch and sensory sensitivity for sound. Although one quadrant may appear to dominate, the other patterns of responsiveness can still be present.

It is also important to remember that when an infant/toddler has behaviors consistent with one of the quadrants, that on its own does not provide a reason to conclude that the infant/toddler is dysfunctional. When an infant has performance difficulties in activities of daily living, behavior consistent with the quadrants can

help to identify reasons for their behavior and also help to find ways to address the problem (40).

The raw scores for the South African sample were compared to the means in the ITSP manual. In the ITSP manual (40), the mean and standard deviation scores are given in age bands of seven to 12 months and 13 to 18 months. Infants from the South African sample were also divided into these age groups in order to compare the data.

When reviewing the results for the six processing sections of the ITSP the comparison of the raw scores obtained from testing the South African sample in five of the six processing sections the mean scores for this sample were in the lower ranges of the typical performance range for the normative data found on the ITSP score sheet. Only the score for the tactile processing section were centred in the typical performance range (Figure 4.1). For the quadrant scores, it was found that the mean raw scores from all the quadrants were in the lower ranges of the typical performance range (Figure 4.2).

It was necessary to determine therefore how important these differences were clinically in terms of interpreting dysfunction in infants in South Africa. It was therefore also necessary to determine if these differences indicated a probable or definite difference. This was achieved by calculating effect sizes between the South African and USA means as well as comparing the South African data to normal Gaussian curves.

Effect sizes (*d*, Cohen) (136) were then calculated to confirm the standardised differences between the South African sample and the USA norms which are independent of the sample sizes used. The magnitude of *d* was explored to determine if the norms in the manual, from the USA standardisation group, provide an adequate measure of performance on the South African test population. Effect size (*d*) can be described as small ($d \leq 0.2$), medium ($d = 0.5$) or large ($d = 0.8$) (136).

An effect size of $d \leq 0.2$ is considered to be clinically insignificant as the groups overlap by 85.2%. It is suggested that even an effect size of d = 0.4 can be considered as small as the overlap between the groups is more than 70% this can be accepted and thus does not require separate norms for interpretation. This was

supported in a study on the use of the SIPT on the South African population. Van Jaarsveld et al. indicated that an effect size of $d \leq 0.4$ was acceptable whereas effect size $d > 0.4$ presents challenges in terms of interpretation of results (24)

The positive effect sizes of the South African sample mean that scores were all lower than those of the American sample. Relative to the American sample the South African sample tends towards the “more than others” scores on the Infant/Toddler sensory profile.

Looking at the effect sizes for the section and quadrant scores on the ITSP (Table 4.3), it was found that in the younger age group (seven to 12 months), scores on only one of the six sections showed a medium effect size of above 0.4 (Table 4.3). This was for *oral sensory processing* (0.76). One quadrant, *quadrant 2: sensation seeking* (0.58) also showed a medium effect size.

The same results were found for the older age group (13 to 18 months), where the scores for the oral sensory processing section (0.75) and *quadrant 2: sensation seeking* (0.65) both also had medium effect sizes (Table 4.4).

Looking at the medium effect size in the oral processing section, the norms reported by Dunn in the ITSP manual (40) fall into the probable difference ‘less than others’ range, while the means for the sample in this study fall into the typical range which accounts for the difference found.

For *quadrant 2: sensation seeking* it was clear that while the means reported by Dunn fall on the upper limit of typical the mean for the sample in this study fell in the lower end of the typical range. This accounts for the difference which may need to be considered when assessing infants in the South African context.

If we consider that effect size $d > 0.4$ presents challenges in terms of interpretation of results (24), the results of this study found that in most sections and quadrants, in both age groups, the effect sizes were below 0.4 (Table 4.3 and Table 4.4) indicating the assessment can be used with children in the South African sample with little concern as there is less than half a standard deviation between the means.

Mean scores cannot be considered ideal on the type of ordinal data obtained on the ITSP and therefore the frequency distribution of the scores was determined

and the results were considered based on the Gaussian curve as suggested in the test manual. A significant difference was found for five of the nine quadrants and sections when compared to the expected normal distribution (Table 4.5). For infants aged seven months to 36 months, scores are classified as 'Typical performance' with scores between +1 SD and –1 SD from the mean. Scores on the left of the graphs between -1 SD to -2 SD ranges, are described as probable difference "more than others", indicating over responsiveness. Scores on the right of the graphs within +1 SD to +2 SD ranges, are described as probable difference "less than others", indicating under responsiveness. Scores on the left of the graph, below -2 SD are described as definite difference "more than others" indicating severe over responsiveness and scores on the right of the graph, higher than +2 SD are described as definite difference "less than others", indicating severe under responsiveness (40). All the differences in the section and quadrant scores will now be discussed:

The *Vestibular processing section* showed the greatest deviation from the normal expected values (Table 4.5 and Figure 4.5). Frequency results for this section that test the infant's ability to process movement inputs and the infant's response to movement (40) indicated that less participants than expected, in this study, tested in the typical performance range (56.7%). The percentage of participants with a probable difference range (28.3%) tested very close to the 27.2% expected range when the sections for probable difference *"more than others"* and probable difference *"less than others"* are combined. The definite difference range (combined frequency for *"more than others"* and *"less than others"*) for vestibular processing was 15.0% which significantly exceeds the expected 4.2%. All of the participants tested within the definite difference "*more than others*" range and could be considered as over-responsive to vestibular input and movement. Since, for this section of the ITSP the sensitivity, specificity, and accuracy were within acceptable limits (Table 4.7a), it can therefore be assumed that it is the participants themselves in this sample that present with a difference in vestibular processing when compared to the USA norms. This was confirmed by a misclassification rate of 5.8%. This aspect therefore needs to be further researched as the norms for this section did not indicate a large effect size when the means of raw scores were compared.

These findings indicate that the vestibular processing results on the ITSP should be interpreted with caution in the South African context.

In two other sections a significant difference was found between the expected and actual frequency, as more participants (6.7%) tested within the definite difference range when the definite difference *"more than others"* and definite difference *"less than others"* were combined (Table 4.5). These were the *auditory and tactile, processing sections* (Figure 4.6). For both these sections it was found that the percentage of participants that tested in the typical range (73.3%) was higher than the expected 68.2%. Since the diagnostic accuracy was within acceptable limits (Table 4.7a), it can be assumed that the slightly higher percentage of participants in this sample who had a problem with auditory and tactile processing means that the scoring and items for this section of the test are suitable for use on the South African sample. It was found that all the participants tested within the definite difference "*more than others"* range, which indicated that they have dysfunctional over-responsiveness compared to their peers (54).

Difficulties with oral sensory processing can lead to feeding problems, as it is found that children with these difficulties often have a diet with limited variety as they avoid food with certain textures (14) (63). Although the results for the *oral sensory processing section,* which tests the infant's ability to process sensations within the mouth and the infant's response to taste, touch, and smell stimuli to the mouth (40), were similar to those for *auditory* and *vestibular processing* (Table 4.5 and Figure 4.6), the specificity for this section of the test was not within acceptable levels (Table 4.7a). Thus, as discussed in 5.4.1 some of the participants with dysfunction may not have been identified as having difficulties. The means for the *oral sensory processing section,* as indicated in the ITSP test manual, also fall into an atypical range so there may be some problem with the test items themselves for this section.

For the last section of the ITSP *visual processing,* which tests the infant's ability to process visual inputs or ability to react to things seen (40), no significant difference from the expected distribution of scores was found. The number of participants that fell within the typical range (63.3%) was lower than the expected range (68.2%). This was due to a higher than expected number of participants (35.0%) that scored within the probable differences *"more than others"* range (Table 4.5

and Figure 4.3). This indicates that the infants in the South African sample were over responsive to visual input when compared to the USA norms. These participants would only be at risk for visual processing problems but show no definite dysfunction as the sensitivity, specificity, and accuracy for this section was within acceptable limits (Table 4.7a).

Significant differences between the expected frequencies on the normal distribution and those found differed for the quadrant scores except for quadrant 2: *sensation seeking* and quadrant 3: *sensory sensitivity*.
The scores for quadrant 1 refer to *low registration* which assesses the infant's awareness of all types of sensation available (40). *Low registration* indicates that the infant registers less sensory input, and this can lead to an infant appearing overly lethargic and inattentive (86). In this quadrant, a significant difference was found between the expected and observed frequency for the definite difference range (13.3%), where all the participants fell into the definite difference "*more than others"* range as scores cannot be obtained in the definite difference "*less than other"* range for this quadrant. Fewer participants (66.7%) fell into the typical range than the expected 68.2% (Table 4.5 and Figure 4.7). Since the sensitivity, specificity, and accuracy for this quadrant (Table 4.7a) was within acceptable limits, it can be assumed that participants themselves in this sample showed slightly more dysfunction with low registration and this aspect should be researched further for a South African population or sample.

According to Dunn's theoretical model of sensory processing (40) infants that present with dysfunction in quadrant 1: low registration can appear uninterested with a flat or a dull affect. This is due to the brain not getting what it needs to generate responses, and this leads to the apathetic, self-absorbed appearance. Within the context of the infants being in child day care facilities, it is worrying that more infants test with a definite difference within quadrant 1. These infants will appear quiet, and the caregivers might therefore interpret this as the infants being content and not needing attention. This might result in the infants receiving less stimulation, when in fact they need more stimulation. Dunn suggests that intervention planning for infants in quadrant 1 should focus on enhancing task features and contextual cues by increasing the contrast of stimuli or by decreasing the predictability of routine (40). In the setting of the child day care facility, the

infants are constantly exposed to a set routine, and this will therefore not help the infant to overcome these deficits.

There was no significant difference in the expected frequencies of participants with probable and definite differences for quadrant 2: *sensory seeking*, although slightly more participants tested within the probable difference range (31.7%) than expected (27.2%) for the normal distribution, when the probable difference *"more than others"* and probable difference *"less than others"* scores where combined (Table 4.5 and Figure 4.4), probably because there is no definite difference *"more than others"* for this quadrant. In this quadrant, *sensory seeking* specifically measures the infant's interest in and pleasure with all types of sensation (40) and indicates that the infant will seek more sensory input, leading to the infant appearing overly excitable or hyperactive (86). The sensitivity, specificity, and accuracy were within acceptable limits (Table 4.7a), and therefore the distribution of the scores for participants in this quadrant can be accepted as typical.

In *quadrant 3: sensory sensitivity,* which indicates that the infant is more sensitive to sensory input and will often display avoiding behaviours (86) and specifically measures the infant's ability to notice all types of sensations (40). In this quadrant, only a slightly higher than expected percentage of participants tested within a definite difference "*more than others*" category (5.0%) for the normal distribution (Table 4.5 and Figure 4.7). Again in this quadrant, scores cannot fall into the definite difference *"less than others"* ranges. These participants were, therefore, over-responsive and noticed more sensations than their peers. In this quadrant it was also found that more infants tested in the typical range (76.7%) than the expected 68.2% (Table 4.5 and Figure 4.7). According to Dunn's theoretical model of sensory processing (40) (86), it can be hypothesised that infants with sensory sensitivity have over-reactive neural systems, and they are therefore aware of every sensory stimulus around them. They are unable to habituate to input. Infants testing in quadrant 3 should be provided with sensory experiences that support them to continue tasks and to minimise the chances for the threshold to be fired repeatedly. The specificity and accuracy for *quadrant 3: sensory sensitivity* were within acceptable limits, but the low sensitivity (Table 4.7a) means that participants may not be identified as having difficulties as the test under identified dysfunction.

This is supported by the results with a higher number (76.7%) of participants testing in the typical range (Table 4.5 and Figure 4.7).

A significant difference from the normal distribution and an unacceptable low level of sensitivity was also found for quadrant 4: *sensation avoiding* as well as the combined quadrant: *low threshold* indicating the test may be under identifying participants with difficulties in these quadrants (Table 4.7a) in the South African sample. Both the quadrants had more infants test in the typical range than the expected 68.2%. In *quadrant 4: sensation avoiding* the results for the typical range was 75.0% and for the *combined quadrant: low registration* it was 81.7% (Table 4.5 and Figure 4.7). Even so, there was a significant difference from the expected frequencies on a normal distribution with a higher percentage of participants (8.3%) testing with a definite difference in the "*more than other*" category on both quadrants (Table 4.5 and Figure 4.7). In both quadrants 4 and the combined quadrant scores cannot fall into the definite difference *"less than others"* range.

Quadrant 4: *sensation avoiding* relates to an infant avoiding contact with sensations as they overwhelm their systems. Quadrant 4 specifically measures the infant's need for controlling the amount and type of sensations available to them (40). The combined quadrant: *low threshold* indicates that neurons trigger more often and thus cause more frequent reactions to stimuli in the environment (86). For quadrant 4, the researcher did not identify any questions that may have affected the results.

The combined quadrant: *low threshold* is a score obtained from the combined scores of quadrant 3 and quadrant 4. It is relevant to aspects of poor sensory processing (40) and infants who react to stimuli whether they are important or not. According to Dunn's theoretical model of sensory processing (40) (86), it can be hypothesised that infants with *sensory avoiding* (quadrant 4), might display very disruptive behaviours as meeting their thresholds are uncomfortable and frightening. They might engage in emotional outburst in order to get out of situations that they find threatening. They might be perceived as being stubborn or controlling as they often create rituals for behaviour as it allows for familiar patterns of input. In intervention with infants in quadrant 4, the infant's need to avoid sensations should be honoured and opportunities for the infant to experience new sensations should be planned very carefully.

According to Dunn, the score for the combined quadrant of *low threshold* can only be taken into account if both the quadrant 3 (*sensory sensitivity*) and the quadrant 4 (*sensory avoiding*) scores are outside the typical performance range (40).

In summary significant differences from the normal distribution were seen in three of the six section scores and two of the four quadrants scores as well as the scores for the combined quadrant. Those of greatest concern are the section for *visual and vestibular processing* and quadrant 1: *low registration* where the typical scores were significantly lower than expected. The *vestibular processing section* and quadrant 1: *low registration* had a much higher percentage of participants in the definite difference category while *vestibular and visual processing sections* had a high percentage of participants in the probable difference category. The *vestibular processing section* was the most divergent and results from this section should be considered with care in the South African sample.

Therefore these are the sections and quadrants of the test that should be of concern and probably need to be further researched on a South African population.

5.3.2 Test of Sensory Function in Infants (TSFI)

When scoring the TSFI the scoring procedure as set out in the test manual (9) requires the test user to add the scores of each subtest after administration as well as to calculate the Total Test score, by adding the totals of all the subtests together. The subtest scores and total score are then transferred onto the Profile form and this categorised the score into ranges of:

- Normal. Scores above -1 SD.
- At risk. Scores below -1 SD but above -2 SD.
- Deficient. Scores below -2 SD.

According to the test developer, if an infant obtains scores below the cut off scores for the ‘normal’ range on the *total test score*, it is indicative of potential problems. These can be considered to be suspect or even abnormal sensory reactivity and processing. If together with this an infant also has delays in cognitive or motor skills, they should be referred to an occupational therapist to determine if intervention is needed. It is also recommended that infants with ‘deficient’ scores

on the total test score or particular subtest scores, should be monitored throughout their preschool years for deficits in other areas of sensory integration such as motor planning, visual-motor skills or bilateral motor coordination (9).

Firstly the raw scores obtained from testing the South African sample were compared to the normative data found on the TSFI score sheet (Figure 4.9). Since no mean scores have been published except those for dysfunctional infants (101), for the TSFI the means of this study were compared to the normal score ranges from the TSFI manual (9). It was found that five of the sections as well as the total test score (seven to nine months) were in the lower ranges of the typical performance range. These sections were *reactivity to tactile deep pressure* (seven to 18 months), *adaptive motor functions* (seven to nine months), *visual tactile integration* (seven to 18 months), *ocular-motor control* (seven to 18 months), and *reactivity to vestibular stimulation* (seven to 12 months). The scores for three sections namely, *adaptive motor functions* (10 to 12 months), *adaptive motor functions* (13 to 18 months), *reactivity to vestibular stimulation* (13 to 18 months), as well as the *total test score* (eight to 18 months) were below the normal range (Figure 4.9).

Due to a lack of published mean scores for the population the TSFI was developed on, the researcher was unable to calculate the effect sizes (*d*, Cohen) (136) for the raw score data. Calculation of *d* requires means and standard deviations and this was not available.

When looking at the frequency results for the TSFI compared to the normal distribution, a significant difference for all five subtests as well as the total test score from the expected normal distribution (Table 4.6) is seen. The differences in the subtest and total test scores will now be discussed.

In the *reactivity to tactile deep pressure* subtest, which refers to the infants ability to react to deep pressure applied to the arms, hands, stomach, soles of the feet, mouth, and total body when held at the shoulder (9), a significant difference is noted (Table 4.6 and Figure 4.12). More infants were found to be in the deficient ranges (16.7%) than the expected 4.2%. There were also more participants that tested in the normal ranges (73.3%). The accuracy, sensitivity and specificity for this subtest were within normal ranges. According to the information used for

interpretation of the test scores, an infant with scores that fall in the deficient ranges should be considered to be tactile defensive (9).

Percentages in the *adaptive motor functions* subtest, which reflects the infant's ability to initiate and motor plan exploratory movements when handling textured toys (9), were significantly higher than expected with 53.3% of participants that tested within the deficient range (Table 4.6 and Figure 4.11). The accuracy and specificity of this subtest was found to be below acceptable levels indicating infants without deficits may be identified with deficits and (Table 4.7b), this will be discussed in 5.4.2.

According to the information used for interpretation of the test scores, infants with poor adaptive motor functions should be further tested for abnormal neuro-motor functions and delayed motor skills (9). When all the results of this subtest are reviewed, the researcher feels that the high number of infants testing in the deficient range in this case was probably due to the criteria for the scoring on the test item which means this may not be a true reflection of the functions of the test population.

In the results for the *visual-tactile integration* subtest, there appears to be a slight move towards the deficient range in the test which affects the frequency data for this subtest. A significantly higher percentage of participants (8.3%) testing within the deficient range as well as in the normal range (80.0%), when compared to the normal distribution (Table 4.6 and Figure 4.12). This subtest assesses the infant's ability to tolerate and visually orientate to tactile input (9). For this subtest, the accuracy and specificity of the test was found to be within acceptable ranges, but the sensitivity (63.2%) was lower than the acceptable range (Table 4.7b) indicating that the test may identify children with a deficit when there is none.

In the ocular-motor control subtest, again significant differences from the normal distribution were seen (Table 4.6 and Figure 4.12). More infants (83.3%) tested in the normal range than the expected 68.2%. This subtest, according to the manual (9), tests lateralization of the eyes as well as visual tracking. This is not an area treated by occupational therapists and infants with problems in this area should therefore be referred to a developmental optometrist or ophthalmologist. The sensitivity of this test (Table 4.7b) was found to be well below acceptable levels

indicating infants with this deficit may be underdiagnosed which in this case was related to problems with the test items rather than the infant's response.

In the *reactivity to vestibular stimulation* subtest, a significant difference was also found with a higher percentage (36.3%) of participants testing within the deficient range than the expected 4.2% for the normal distribution (Table 4.6 and Figure 4.10). There were also fewer participants (51.7%) that tested in the normal ranges. This subtest assesses the infant's reaction to different movements. During testing, participants are moved in a vertical plane (up and down), circular motion (to right and to left) as well as inverted (prone and supine). The occurrence of nystagmus is also noted after the circular movement. According to the interpretation information in the manual, an infant with a deficient score may be considered posturally insecure and should be referred to an occupational therapist for further testing of the neuro-motor functions and other vestibular based functions (9). This subtest had specificity below acceptable levels. This again indicates that infants may be found to have deficiencies when there were none, a finding that was true for the total test score as well.

The *total test score* is derived from adding up the totals of all the subtests (9). For the total test score again a significant difference is found from the normal distribution. It was found that there were fewer participants (41.7%) in the normal ranges and more participants in the deficient range (38.3%) than what would be expected (Table 4.6 and Figure 4.13). In summary the TSFI showed significant differences for all sub tests from the expected normal with the *adaptive motor functions* subtest, the *reactivity to vestibular stimulation* subtest and the total score having significantly less participants than expected in the typical category and significantly more than expected in the deficient category. For this test this appears to be related to both differing function in the participants and items on the test that affect the scores they obtained. When using the test results to determine if an infant requires intervention the researcher used the interpretation information as described in the TSFI manual (pp. 16 to 21) (9). The principles used in the example were followed where the infant tested within deficient ranges on the total test score as well as three sections scores. In this South African sample, 33.3% of the infants tested with the TSFI would according to the results need to be referred for further testing and intervention. However, due to problems with the sensitivity,

specificity and accuracy of the test, this is inaccurate as the test was found to over identify problems in this sample. In order to use the TSFI with accuracy in a South African sample, the subtests need to be standardised on the population.

Although more participants than expected scored in the deficient category in the *reactivity to tactile deep pressure* subtest this subtest accuracy results show that it is acceptable for use with this sample.

5.4 DIAGNOSTIC ACCURACY OF TESTS

The second objective of this study was to determine the diagnostic accuracy of tests for sensory integration function on a sample of South African infants between seven and 18 months. The researcher made use of two tests, namely the Infant/Toddler Sensory Profile (ITSP), and the Test of Sensory Functions in Infants (TSFI) as limited information on the discriminative indexes of these tests is available.

Since these tests are used clinically to assess infants as well as for research purposes in South Africa (41) (42) (43), it was important to take a critical look at the tests to determine the diagnostic accuracy for their use in this context. Many researchers like Anastasi & Urbina (25), Downing (26), as well as Steiner & Norman (27) have established that it is important for independent investigators to complete studies in different contexts and gather psychometric data regarding standardised tests to ensure their validity, to compliment the studies completed by the test authors.

This is because assessment is one of the most fundamental, but complex steps in the occupational therapy process which forms the basis for planning the type and intensity of the intervention required (93). As assessment is so fundamental, it is very important for the tests used to have acceptable diagnostic accuracy, and the complex psychometric properties of the tests should therefore be examined. Some aspects of the psychometric properties, namely the accuracy, sensitivity, and specificity of the ITSP (40) and the TSFI (9) were established for the South African sample against the expected normal distribution of scores for typical performance/normal, probable difference/at risk, and definite difference/deficient categories.

In a number of sections and subtests on both tests, the frequency of participants scoring definite and probable differences was higher than expected. It was necessary to consider if the results found were due to accuracy, sensitivity or specificity of the test for this sample or the presence of dysfunction in the participants.

5.4.1 Infant/Toddler Sensory Profile (ITSP)

While the accuracy scores for the ITSP were within the acceptable level of 80% as determined by McCauley & Swisher (137), one section and three quadrants showed sensitivity below the acceptable level (Table 4.7a). It is possible, therefore, that this test may under identify sensory integration dysfunction in infants for *oral sensory processing* (73.7%), quadrant 3: *sensory sensitivity* (73.7%), quadrant 4: *sensation avoiding* (78.9%), and the combined quadrant: *low threshold* (57.9%). This occurred due to the greater than expected percentage of participants who scored in the typical category for these sections and quadrants and therefore according to the USA norms infants displaying atypical behaviour associated with this section and quadrants might not be identified as having problems.

For quadrant 3: *sensory sensitivity* the scores were not statistically significantly different from the expected normal distribution. The misclassification rates for for *oral sensory processing* and all three quadrants were from 3% - 7% which means this is the percentage in the group of those with a problem that may be missed.

The miscalculation may be related to the questions on the ITSP and for the *oral sensory processing section,* the low sensitivity may be related to the test questions answered by the parents for this section. For this section, the researcher identified two of the questions that might have been difficult for the parents of the infants between seven to 12 months to answer, and this may have affected the results. These were:

- “My child resists having teeth brushed.”
- “My child refuses to drink from a cup” (138).

Developmentally, the skill of drinking from a cup does not fully develop until the age of 12 months (139), and teeth emergence in infants vary widely, with the first

teeth sometimes emerging before the age of four months, but sometimes as late as 12 months (140). If the infant has not yet teethed or cannot yet drink from a cup, the question will be very difficult to answer and might skew the results of this section of the test.

For *quadrant 3: sensory sensitivity*, the low sensitivity may have been related to one question of the 12 questions included in this quadrant, that might have been difficult for the parents of the infants between seven to 11 or 12 months to answer and this may have affected the results. The question was:

- "My child bumps into things, seeming to not notice objects in the way" (138).

This question will be difficult to answer if the infant has not yet started crawling, a skill that emerges roughly at age nine months depending on the infant (141).

Another section that had a high misclassification rate indicating over identification of dysfunction by the test was *vestibular processing* with a 5.8% misclassification rate and due to this section having lower specificity (82.9%) than sensitivity (100%) although both were in acceptable limits, it indicates that it will over identify 6% of infants of those with no problems as dysfunctional, based on USA norms.

Based on these results on the ITSP in the context of this South African sample, the difference in the functioning seen in the participants when compared to infants in the USA were in acceptable limits for most sections and quadrants. Even so, only the sensitivity was below the acceptable 80% for one section and three quadrants. The ITSP can be considered valid in terms of accuracy and specificity for this sample but it is clear that the scores for these sections and quadrants need to be interpreted with care clinically if a small percentage of infants are not to be underdiagnosed on one section and three quadrants which under identified SID for the small sample.

Although extensive research has been done on the ITSP by the author and independent researchers (54) (86) (96) (97) (98), and the test has been found to be a valid tool to use in this South African context, therapists need to be aware of discrepancies in the psychometric properties and that like the SIPT the ITSP may result in under diagnosing of SID (24).

5.4.2 Test of Sensory Functions in Infants (TSFI)

For the TSFI it was found that only one subtest, namely *reactivity to tactile deep pressure* had no problems with accuracy, sensitivity and specificity (Table 4.7b). The misclassification rate was also low at 2.5% (Table 4.7b). As the sensitivity is lower than the specificity, it indicates that misclassifications were due to under identification of problems but within acceptable limits of two to three infants in 100.

The subtests of *visual-tactile integration* (63.2%) and *ocular-motor control* (52.6%) both had sensitivity below acceptable ranges (Table 4.7b) and the subtest of *visual tactile integration* had a misclassification rate of 5.8% (Table 4.7b). Thus approximately 6% of infants with dysfunction may go unrecognised and be misclassified as the low sensitivity indicated that the test is under identifying infants with problems. This is supported by the frequency scores (Table 4.6 and Figure 4.12) that indicated a high number of infants (80.0%) testing in the 'normal' range.

The scoring criteria for items 6b to 10b on the test were found to be a problem which affected the sensitivity and misclassification rate as very few infants did not respond to the object presented even though the researcher presenting it was a stranger (141).

> 0 = Hyper-reactive response: This is when the infant shows panic, expresses severe discomfort or cries.
>
> 1 = Hypo-reactive response: This is when the infant does not appear to notice the specific object used in that item on their body.
>
> 2 = Normal response: This is when the infant tolerates and notices the specific object (9).

In the *ocular-motor control subtest,* the even lower sensitivity also indicated the test was under identifying infants with a problem based on the expected frequency of dysfunction. This finding is supported by the frequency scores where a significantly higher than expected percentage (83.3%) of infants were found in the 'normal' range (Table 4.6 and Figure 4.12). This subtest reflects the infant's ability to control eye movements with only two items being tested - whether an infant notices an object being moved in their peripheral visual field as well as their

tracking of a moving object. It is possible that these two items do not allow enough information to accurately discriminate problems with ocular-motor control although for this section the misclassification rate (Table 4.7b) was much lower at 7.5%.

The subtest *reactivity to vestibular stimulation* (75.6%) had a specificity score below an acceptable range, while the subtest of *adaptive motor functions* (39.0%) and the *total test score* (61.0%) showed specificity as well as accuracy below acceptable ranges (Table 4.7b).

The subtest of *adaptive motor functions* had the lowest specificity in the TSFI with a misclassification rate of 20.8% indicating approximately 12 infants in the study group without dysfunction would be identified with dysfunction. This indicates that this subtest is over identifying problems in infants who do not have difficulties. This is supported by the frequency scores (Table 4.6 and Figure 4.11) where more infants were found to have scores in the deficient range (53.3%).

In this subtest, the scoring criteria for items 6a to 10a on the test were found to affect the specificity, accuracy and misclassification rate of the test. For these items, the scoring is as follows:

> 0 = No response: The infant does not notice the object placed on them (adhesive tape on dorsum of hand, furry mitt on foot, rubber squeak toy on stomach, paper on face, yarn bound loosely around both hands in midline), and makes no attempt to remove it.
>
> 1 = Disorganised response: The infant show flailing disorganised movements in reaction to objects placed on them.
>
> 2 = Partial response: There is an attempt to remove the object, but the infant fails.
>
> 3 = Organised response: The infant easily removes the object from their body parts (9).

During testing, the researcher observed varied reactions from the infants and found that the younger infants (7 to 9 months) found motor reactions required to especially remove the sticky tape from their hand and furry mitt from their foot very difficult. This might be due to the infants not having developed these skills yet or not have been exposed to similar situations, and therefore they do not know how

to react. A lot of the infants looked confused by the items and did not know how to react, although they were encouraged by the researcher to remove the objects. It is also felt that learned responses might have an influence on the scoring of this test as it is unknown to what extend the infants are taught to leave clothing items alone and not to remove them. The researcher feels this influenced the infant's responses resulting in the high identification of problems.

The low specificity for the *reactivity to vestibular stimulation* also indicates a possible over identification of vestibular problems in the TSFI. The misclassification rate (Table 4.7b) indicated that 8.3% of infants tested in the group without dysfunction were over identified. This is supported by the frequency scores (Table 4.6 and Figure 4.10) where significantly more infants tested in the deficient range (38.3%). Some cognisance must be taken here of the high percentage of participants with vestibular processing problems on the ITSP and this result lends credence to the need to further investigate the vestibular norms for this South African sample, even though the *reactivity to vestibular stimulation* and vestibular processing subtests show no correlation.

The low specificity and accuracy rates for the total test were influenced by the results on the subtest of *adaptive motor functions* and indicated that the total test score was over identifying infants as having problems. The total test score is calculated by adding the scores for all the subtests, therefore this score is affected by the diagnostic accuracy of the subtests. As there were problems with the diagnostic accuracy of all the subtests, the diagnostic accuracy of the total test score cannot be expected to be within acceptable limits.

The misclassification rate indicated that approximately 13% of infants with no dysfunction will be misclassified as having a problem (Table 4.7b). This is supported by the frequency scores (Table 4.6 and Figure 4.13) where more infants fell in the 'deficient' range (38.3%) and fewer in the 'normal' range (41.7%).

The finding that the TSFI over identifies children as having problems is supported by the test developers DeGangi and Greenspan (37) who have recommended further testing on the reliability and validity of the test. They report that the test is better for normal infants between four to 10 months and sensory defensiveness in

older infants. This was not found for this study as the younger infants were those who could not remove the items in the subtest of *adaptive motor functions.*

A discriminative index showing false normal results of between 14% and 45% is contrary to the findings of this study where the false delayed percentage was much higher at 4.1% to 38.1% above the expected deficient ranges. The reported false delay rate is 7%-19% (9) (142).

Jirikowic et al. (101) who researched the test-retest reliability as well as the reliability of the TSFI on dysfunctional infants also found the reliability of the subtests to be low, therefore recommending that the results from the TSFI should be interpreted with caution and should be supported by clinical reports. These findings are supported by this study where the accuracy, sensitivity, specificity and misclassification rate of the TFSI cannot be considered acceptable for this small sample. The results indicate problems with the construction and scoring of the test, so the sensory integration difficulties within the sample have not been clearly identified.

5.5 CONSTRUCT VALIDITY AND INTERNAL CONSISTENCY OF TESTS FOR SENSORY INTEGRATION FUNCTION IN INFANTS.

The third objective of the study was to establish the construct validity as well as the internal consistency ITSP and TSFI.

5.5.1 Construct validity

The construct validity of the ITSP and the TSFI was assessed to establish whether the two tests, which both assess sensory function, measure the same or different characteristics. This was done as the manuals for both tests state that they test sensory processing (9 p. 1) (45 p. 1) but not necessarily whether it is the reception, transduction and interpretation of a stimulus (19). One method of demonstrating construct validity is to determine if a test is convergent or divergent with another test measuring the same or a different construct. Assessment of convergent validity involves theoretically derived comparisons (111). Convergent validity refers to the degree, two different measures designed to measure the same underlying trait, consistently measure the same trait (111) (112). Therefore,

if there is a high correlation between the scores obtained by the two measures, it indicates convergent validity. Divergence, also known as discriminant validity, refers to the principle that tests that are designed to measure different traits should be unrelated (111).

The principle of construct validity was tested for the sections, quadrants, and subtests of the ITSP and TSFI (Table 4.9). There was however no significant correlations between the sections and quadrant scores obtained on the ITSP and the subtest/total test score obtained by the TSFI. There was only a weak correlation (r = 0.35) between the combined quadrant score of *low threshold* (ITSP) and the subtest score of *adaptive motor functions* (TSFI). Since this subtest and quadrant both had some indication of either sensitivity or specificity problems and were significantly different from the expected norms this association has been disregarded. The correlation however, is also too low to account for the variability in the test items to be considered as measuring the same constructs. It can therefore be concluded that although the test manuals indicate that both tests assess sensory processing, the construct validity indicates divergent validity and they are not measuring the same areas of sensory processing.

The Sensory Rating Scale (12), another test of infants' sensory processing has been correlated with 28 items on the ITSP (five items had a correlation above 0.50). There was a low correlation between items related to sensation seeking (ITSP) and this suggests that this is an area that can be considered unique to the ITSP. The researcher is currently unaware of any other studies that looked at the convergent validity of the ITSP and the TSFI. The results of this study confirmed that for this sample the ITSP and the TSFI measures different constructs of sensory processing, modulation and discrimination, although from the description in the manuals this is not clear.

5.5.2 Internal Consistency

Internal consistency refers to the extent to which all items in a test work together to create a homogeneous test that measures a specific construct (95) (143). Evaluating the internal consistency of a test is important as it indicates the validity of the test and to ensure reliability, it is important to determine the internal consistency before a test can be used for assessment and/or research purposes

(144). Investigators should not rely on alpha estimates as published in the manual, but should measure Cronbach's alpha each time the test is researched on a different sample (144). Acceptable ranges for Cronbach's alpha differ in the literature, but according to Nunnaly (145), $\alpha \geq 0.7$ is acceptable.

Using the data compared to the normal distribution, the Cronbach's alpha for the ITSP was calculated to be 0.84. The Cronbach's alpha for the sensory processing sections and quadrants ranged from 0.80 to 0.86 in this sample. This indicates that the ITSP has good internal consistency when used on a South African sample. Looking at the reliability of the section and quadrant scores for the ITSP (Table 4.9), it was found that Cronbach's alphas were all above acceptable levels and found to be better than those reported by Dunn (40) found from 0.43 to 0.86. The Cronbach alpha for *quadrant 2: sensation seeking* was the same as that reported by Dunn and was lower in the South African sample for the *combined quadrant: low threshold.*

The internal consistency of the TSFI was moderate and was calculated as 0.69 for the total test (Table 4.9) and the Cronbach's alpha scores for the subtests ranged from 0.50 to 0.71 with three subtests and the total test score obtaining scores below the acceptable rate of 0.70 (145). Unfortunately there are no Cronbach's alpha scores for internal consistency available in the test manual, and the scores from the South African sample could therefore not be compared to the USA sample used for standardisation. In the study done by Eeles et al. in 2013 (95) they also commented that no reliability studies on the internal consistency of the TSFI have been conducted (95).

Currently, no study can be found where the TSFI was standardised on the South African population or where scores on a South African population is compared to the results obtained on the original population used to standardise the test.

5.6 OTHER VARIABLES AFFECTION THE USE OF THE STANDARDISED TESTS IN SOUTH AFRICA

Another variable that affects the use the ITSP for assessment is that of it being a parent report questionnaire. In this study the parents of the participants all spoke English as a first or second language so this did not affect their ability to complete the questionnaire as indicated by the high internal consistency scores.

Research has shown that using parent report questionnaires as part of assessment can have various advantages and disadvantages. Some of these advantages are that it has consistently been shown that the use of parent reports on the child's current skills or deficits can be seen as a source of information that is sensitive, reliable, and valid (105) (106) (107). Results from this study also showed that most sections and quadrants of the ITSP had acceptable internal consistency when used with the South African parents, and this parent report can be used for assessment. Involving the parent and using their perceptions is used as part of a client centred approach that is advocated by occupational therapists (21) (105). It is time efficient and can possibly be more accurate than the use of some standardised tests (108). It can also provide qualitative, accurate assessment of children in a naturalistic environment (105).

Research further indicated that the validity of parent report questionnaires was found to be dependent on the quality of the items included (105). Glasco and Dworkin have also found that information gathered through parent report questionnaires can be influenced by socioeconomic factors, as parents from lower socio-economic areas were found to leave out more questions. This may be due to language problems caused by a lower education (105). This was not the case in this study as the parents came from a middle class socioeconomic group as all the parents were working. The professions varied, but most parents were in professions requiring at least completion of schooling (Gr. 12). All questionnaires included in the study were fully completed by the parents.

It is also found that parents tend to report the infant's skills as better than those found on clinician assessment. This may be due to the fact that infants display skills in a familiar and safe home environment first before generalisation to other environments can occur. A study by Johnson, et al. found that the accuracy of parent reporting was not affected by socio-demographic factors. Information gathered from the parents was very valuable as they had more contact with the infant and therefore knew the infant best (109).

Using therapist administered tests like the TSFI also has advantages and disadvantages. Disadvantages are that the test is not administered in the infant's natural environment. This can lead to inaccurate results due to the fact that infants often display skills in a familiar and safe environment first before generalisation to

other environments occur. Sometimes during therapist administered testing, the infant may respond differently to applied stimuli than when naturally being exposed to the same stimuli (105). During this study, the infants were all tested at the child day care facilities they attend daily, with their caregivers/parent present. The test administrator (researcher) however was unfamiliar to the infants, and this can still have an influence on the results of the test. The advantage of using the TSFI is that the researcher is very familiar with the test and its administration. She was able to observe the problematic subtest scoring and interpret the results of the test. This allow for greater reliability (105).

There are, therefore, clear advantages and disadvantages for using different types of tests. As assessment is a fundamental part of the therapy process (21), it is important for therapist to know more about the tests they use. This will allow them to decide on the best combination of tests to use for a specific client in order to accurately assess. It is also important to use tests with acceptable validity. Using tests that over identify infants with problems will lead to infants not needing services, being treated, and over servicing will occur. The opposite, however, can also occur where, if a test under identify, infants with problems might not receive the intervention they need. This study has supported the notion that when assessing specifically infants under certain circumstances, parent report questionnaires can be as sensitive and reliable than therapist administered tests.

5.7 LIMITATIONS OF THE STUDY

The study was limited by the very specific homogeneous sample as all participants attend child day care facilities in a geographical area with middle to high income. This makes it difficult to generalize findings to other infant groups in South Africa.

Due to the lack of any gold standard, the tests were compared to scoring on a normal distribution based on research on a sample based in the United States of America, and therefore not scores standardised on a sample in South Africa. This may account for the issues with sensitivity seen for some sections, quadrants, and subtests on the ITSP and TSFI.

The sample size was also small and the results should therefore be interpreted with caution and cannot be generalised. The study warrants further investigation

into the psychometric properties of the ITSP and TSFI with different South African samples.

The identification of sensory dysfunction in the infants was affected by the validity of the TSFI in particular, and the difficulties found cannot be considered as accurate for some subtests. Therefore, follow up for difficulties identified on the TSFI must be made with care as a number of problems appear to be over identified.

5.8 SUMMARY

Normative data of the ITSP and TSFI were compared to the results for the South African test population, and frequency scores were also compared to the normal distribution. The accuracy of the ITSP and the TSFI in terms of the accuracy, sensitivity, specificity, and misclassification rate of the tests as well as the construct validity and internal consistency on a sample of South African infants between the ages of seven to 18 months, was examined.

When comparing the means of the raw score data obtained from testing a South African sample, it was found that all the section and quadrant scores on the ITSP was within the lower ranges of the typical, except for one section score (tactile processing) which was found to be centred in the typical performance range (Figure 4.1). For the TSFI the mean scores from the South African sample were compared to the normal score range of the test manual and it was found that five of the subtest scores and the total test score (seven to nine months) were within the lower ranges of the typical performance range. The other three subtest and total test score (13 to 18 months) were below the typical performance range (Figure 4.9).

In order to establish the specificity and sensitivity of these tests (Table 4.7a and Table 4.7b), the frequency scores (Table 4.5 and Table 4.6) of the interpretation data for both tests are compared to what would be expected on a normal distribution. The accuracy, sensitivity, specificity and misclassification rate (Table 4.7a) on the ITSP was found to be within acceptable limits for *auditory processing section*, *visual processing section*, *tactile processing section*, *vestibular processing* section, quadrant 1: *low registration,* and quadrant 2: *sensory seeking*. Sensitivity below acceptable levels is seen for *oral sensory processing* section, quadrant 3:

sensory sensitivity, quadrant 4: *sensation avoiding,* and combined quadrant *low threshold*. On the TSFI, the sensitivity, specificity, and accuracy (Table 4.7b) were found to be within acceptable limits for only the *reactivity to tactile deep pressure* subtest. Accuracy was found to be low for the subtest of *adaptive motor functions* and *total test score*. Specificity was found to be low for the subtests of *adaptive motor functions*, *reactivity to vestibular stimulation,* and the *total test score*. The sensitivity was found to be below acceptable levels in the subtests for *visual-tactile integration* and *ocular-motor control*. The misclassification score was found to be high for *adaptive motor functions*, *visual-tactile integration* and the *total test score*.

The validity of the tests may have been affected by questions in some sections of the ITSP being difficult for parents of the younger infants to answer as the infants might not have developed certain skills yet. On the TSFI, specific scoring criteria for some test items might have had an influence on the test scores. The use of the tests on a South African population when it was standardised on an American population, might also have an influence.

Based on the results where the tests were found to have acceptable validity in terms of accuracy and specificity, the sensory integration function of the participants that differed significantly from the expected normal distribution were considered (Table 4.5 and Figure 4.3 to Figure 4.9). Since low sensitivity under identifies problems, the sections and quadrants with low sensitivity were not excluded when considering the identification of dysfunction by the ITSP. Significant differences were seen in the sections of *auditory processing, vestibular processing*, *oral sensory processing*, *quadrant 1: low registration*, *quadrant 4: sensation avoiding,* and *combined quadrant* of *low threshold*, as more participants test within the definite difference range.

The low accuracy and specificity on the TSFI affected all subtests and the total test scores, which indicated significant differences from the expected normal values (Table 4.6 and Figure 4.9 to Figure 4.13). Only the results on the *reactivity to tactile deep pressure* subtest could be considered valid. Again, subtests with low sensitivity cannot be excluded as difficulties present may not have been indented in the *visual-tactile integration* and *ocular-motor control* subtests. These difficulties may be related to environmental influences on the development of sensory integration function in the infants in the child day care setting.

The construct validity of the ITSP and the TSFI (Table 4.8) indicated divergent validity. It is therefore confirmed that the tests cannot be considered as measuring the same constructs within sensory processing. The results indicate that, although the manuals indicate that both tests measure sensory processing, the way that the constructs have been designed in the tests assess a different combination of sensory processing constructs.

The internal consistency (Table 4.9) for the ITSP was found to be acceptable as Cronbach alpha for the sample were calculated to be 0.84. When comparing the internal consistency of the sections and quadrants with the Cronbach alpha scores in the manual, the scores for the South African sample was found to be higher than that of the test manual for all the sections and quadrants except for *quadrant 2: sensation seeking* where in both cases scores were found to be the same, and the *combined quadrant: low threshold* where the score in the manual is higher than in this study. Internal consistency for the TSFI was found to be moderate as the Cronbach alpha for the sample were calculated to be 0.69. Scores could not be compared to the manual as the internal consistency is not published. Eeles et al. hypothesized that the ITSP is a more comprehensive measure and recommended that if the clinician needed to use a questionnaire, the ITSP would be the better choice due to the fact that it has undergone more rigorous evaluation (95).

CHAPTER 6: CONCLUSION

The purpose of this study was to establish if the Infant/Toddler Sensory Profile (ITSP) (40) and the Test of Sensory Functions in Infants (TSFI), used to determine the sensory integration function of infants in a sample of full term South African infants, between the ages of seven to 18 months aligned with the normative data established in the USA for the tests. Other psychometric data including the construct validity, the diagnostic accuracy and internal consistency on both tests were established for the same sample of infants to support the use of these tests in the South African context.

A total of 60 infants were included in the study, and all infants attended child day care facilities. Inclusion criteria for the study stipulated that infants should be born after a full term pregnancy, thus born between 37 and 42 weeks gestation.

Since no 'gold standard' is available to assess sensory integration function in infants the results for the ITSP and TSFI were compared to the raw score normative data found in the test manuals. The z-scores were also, compared to a normal Gaussian distribution on which the interpretation of these tests is based.

The validity of the two tests based on accuracy, sensitivity, specificity, and misclassification rate was analysed based on the frequency scores of a normal distribution. Both tests were interpreted based on standard deviations from the mean.

The mean raw scores for the South African sample fell into the range of scores for the typical USA sample reported in the test but mostly at the lower range indicating a trend towards '*more than others'* scores. Effect sizes (*d*, Cohen) (136) calculated using the raw score data showed the test provided an adequate measure of performance for most sections and quadrants on the South African test population. The South African sample was divided into age bands of seven to 12 months and 13 to 18 months, in order to compare the means in the test manual.

An affect size of $d \leq 0.4$ is considered acceptable indicating the norms provided for the USA sample can be applied to the South African sample, whereas an effect size of $d > 0.4$ presents challenges in terms of interpretation of results (24). It was

found that in both the younger age group (seven to 12 months) as well as the older age group (13 to 18 months), scores on one of the six sections and one quadrant showed a medium effect size. This was for *oral sensory processing section* (0.76 and 0.75 respectively) and *quadrant 2: sensation seeking* (0.58 and 0.65 respectively). This indicated that the scores from the *oral sensory processing section* and *quadrant 2: sensation seeking* needed to be interpreted with caution on this South African sample.

When looking at the frequency results for the ITSP compared to the normal distribution, a significant differences for five of the nine quadrants and sections from the expected normal distribution is seen. A significantly higher percentage of participants had scores in the definite difference range '*more than others*' in three sections and three quadrants. The greatest percentage was seen for the *vestibular processing* section with 15% of infants, testing in this range. As this section of the test demonstrates acceptable validity and reliability, it is felt that there is a true problem with the normative scores in vestibular processing in this sample which appear to differ from those reported of infants in the USA. A similar result was found with a high percentage (13.3%) of the participants also tested in the definite difference range '*more than others*' for *quadrant 1: low registration*. Low registration indicates that the infant registers less sensory input, and this can lead to an infant appearing overly lethargic and inattentive (86).

The results from the validity analysis indicated that, for the ITSP, one section and three quadrants showed sensitivity below the acceptable level of 80% as determined by McCauley & Swisher (137). These were *oral sensory processing*, *quadrant 3: sensory sensitivity*, *quadrant 4: sensation avoiding,* and *combined quadrant* of *low threshold.* All these items therefore under identified problems. Accuracy and specificity was within acceptable levels for all section and quadrant scores on the ITSP. The misclassification rate for the ITSP sections and quadrants where found to be low with the highest misclassification rate found for the *combined quadrant: low threshold* at 6.7%. It was concluded therefore that this test can be considered valid for this sample but standardisation on a South African population would be ideal. According to interpretation criteria as indicated in the ITSP manual (40), 15% (n = 9) of participants in the sample would have been identified as in need of further assessment.

The results also indicate that a parent report questionnaire has advantages, such as that it can be seen as a source of information that is sensitive, reliable, and valid (105) (106) (107). Involving the parent and using their perceptions is used as part of a client centred approach that is advocated by occupational therapists (21) (105). It is time efficient and can possibly be more accurate than the use of some standardised tests (108), and it can also provide qualitative, accurate assessment of infants and children in a naturalistic environment (105).

The internal consistency of the ITSP was found to be 0.84 for the total test, indicating the test was reliable for identifying the sensory integration functioning in this sample. When comparing the internal consistency of the sections and quadrants with the Cronbach alpha scores in the manual, the scores for the South African sample was found to be higher than that of the test manual for all the sections and quadrants except for *quadrant 2: sensation seeking* where in both cases scores were found to be the same, and the *combined quadrant: low threshold* where the score in the manual is higher than in this study. This is consistent with many other studies (45) (96) (97) (98) (99) that used the ITSP and found that it is a reliable test in this sample as well.

When the results for the TSFI were considered, due to a lack of published mean scores for the population the TSFI was developed on, the researcher was unable to calculate the effect sizes (*d*, Cohen) (136) for the raw score data from this study.

The comparison of the mean scores for the South African sample to the range of scores for the normal sample in the USA showed differences in the subtests of *adaptive motor functions* (10 to 12 months), *adaptive motor functions* (13 to 18 months), *reactivity to vestibular stimulation* (13 to 18 months), as well as the *total test score* (eight -18 months).

When looking at the frequency results for the TSFI compared to the normal distribution a significantly higher percentage of participants had scores that differed from the normal distribution on all the subtests and total score. Only the *reactivity to tactile deep pressure* subtest had validity and reliability within acceptable ranges. Due to the low accuracy and specificity, as well as the low internal consistency of some of the other subtests and total test score, the

researcher is of the opinion that the high frequency scores might be due to inaccuracies within the test. It is recommended that further research is needed regarding the use of the TSFI and specifically the use thereof on a South African sample.

The accuracy, sensitivity, specificity, and misclassification scores for the TSFI indicate that only the *reactivity to tactile deep pressure* subtest had validity scores within acceptable limits. Two subtests, namely *visual-tactile integration* and *ocular-motor control* had low sensitivity and are therefore under identified problems. Two subtests, namely *adaptive motor functions* and *reactivity to vestibular stimulation* as well as the *total test score* had low specificity indicating they are over identifying problems. Misclassification rates for four of the five subtests as well as the total test score were high. It was concluded that the TSFI cannot be considered a valid measure to use in typical infants in this South African sample and the test needs revision before standardisation on a South African population can be considered. The psychometric properties of certain items on the test appear to be responsible for these results. This results in 33.3% (n = 20) of infants in the sample as being identified in need of further assessment. This percentage is too high and can result in waste of time and money as the test is over identifying problems.

This especially applies to the subtest of *adaptive motor functions*, where the accuracy and specificity scores were very low. This does support the findings of the test authors DeGangi and Greenspan that the total test score can be more accurately used to exclude normal infants than to detect delayed infants. They suggested that the *total test score* can be used reliably for infants from seven to 18 months for screening decisions, and the subtest scores can be used for diagnostic decisions except for *adaptive motor functions* and *reactivity to vestibular stimulation* subtests (9).

The reliability of the TSFI had a moderate Cronbach's alpha of 0.69 for the total test for this sample and most subtests had internal consistency below acceptable levels. The test items do not show consistency for the measurement of one construct and cannot be considered reliable for this sample. Scores could not be compared to the manual as the internal consistency is not published.

The results for the construct validity of the ITSP and the TSFI indicate there were no significant correlation between the sections and quadrant scores obtained on the ITSP and the subtest/total test score obtained by the TSFI. Correlation scores ranged between -0.17 and 0.35. The construct validity of the ITSP and the TSFI indicated divergent validity. These results confirmed that the tests measure different constructs of sensory processing – namely modulation and discrimination. The results indicate that, although the manuals indicate that both tests measure sensory processing, the way that the constructs have been designed in the tests assess a different combination of sensory processing constructs.

The study was important as the results pertaining to psychometric data of the tests, used to assess sensory integration function in infants, may assist in the screening and identification of Sensory Integrative Dysfunction (SID) earlier in a child's life, allowing for early intervention of at risk infants and preventing the requirement for longer periods of therapy later in the infant's life. Appropriate therapeutic interventions to reduce the developmental effects of SID and the accompanying behavioural difficulties can be implemented timeously if the dysfunction is accurately recognised early on in life. More positive outcomes may be achieved by targeting infants at risk with early intervention when the brain is more receptive to sensory integration therapy. Knowledge of an infant's sensory integration function can also help the parent or caregiver with handling of the infant (56).

6.1 RECOMMENDATIONS

According to the findings of this study, the following recommendations are made:

- As the study had a relatively small sample, it might be inaccurate to generalize the findings, but it is recommended that further research is needed regarding the use of the TSFI and specifically the use thereof on a South African population. The use of the ITSP on a South African population should also be further researched.
- It is recommended that further research is needed regarding the influence of the child day care environment on the development of sensory integration function in infants.

- Due to the findings of this study, the researcher recommend that the TSFI be used in conjunction with other tests, parent interviews, relevant background information, results from neurodevelopmental testing, as well as skilled observations of the infant's behaviour. This is consistent with recommendations by DeGangi (37) as well as Eeles et al. (45).

REFERENCES

1. Schaaf RC, Schoen SA, Smith Roley S, Lane SJ, Koomar J, May-Benson TA. A frame of Reference for Sensory Integration. In Kramer P, Hinojosa J. Frames of References for Pediatric Occupational Therapy. 3rd ed. Philadelphia: Lippincott, Williams & Wilkenson; 2009. p. 99-186.

2. Secretary-General UN. Status of the Convention on the Rights of the Child, Report of the Secretary-General. United Nations, General Assembly Sixty-fifth session; 2 August 2010. Report No.: A/65/206.

3. Simundic AM. Researchgate website. [Online].; 2008 [cited 2015 June 29. Available from: http://www.reasearchgate.net.

4. Bengu SME, Schoema R. White Paper on Education and Training. Cape Town: South-African Government, Department of Education; 1995.

5. Editors of the American Heritage Dictionaries. The American Heritage Medical Dictionary. New York: Hougton Mifflin Harcourt Publishing Company; 2007 [cited 2014 July. Available from: http://medical-dictionary.thefreedictionary.com/early+intervention.

6. Segen M. Segen's Medical Dictionary.: Farlex.Inc.; 2012 [cited 2015 06 18. Available from: http://medical-dictionary.thefreedictionary.com/gold+standard.

7. Cohen LB. Uses and misuses of habituation and related preferences paradigms. Infant and Child Development. 2004; 13: p. 349-352.

8. Mosby. Mosby's Dental Dictionary: Elsevier.Inc; 2008 [cited 2015 06 15. Available from: http://medical-dictionary.thefreedictionary.com/infant.

9. DeGangi GA, Greenspan SI. Test of Sensory Functions in Infants (TSFI) User's Manual; 1989.

10. Kandel E, Schwartz J, Jessell T. Cellular mechanisms of learning and the biological basis of individuality New York: Elsevier; 1993.

11. Ayres AJ. Sensory integration and learning disorders Los Angeles: Western Psychological Services; 1972.

12. Provost B, Oetter P. The sensory rating scale for infants and young children: development and reliability. Physical & Occupational Therapy Pediatrics. 1993; 13: p. 15-35.

13. Ayres AJ. Sensory integration and the child. Los Angeles: Western Psychological Services; 1979.

14. Bundy AC, Lane SJ, Murray EA. Sensory integration: Theory and Practice. 2nd ed. Philadelphia: F.A. Davis; 2002.

15. Coleman GG, Mailloux Z, Smith Roley S. Sensory integration Answers for Parents. Santa Rosa, CA:

Crestport Press; 2004.

16. Lane SJ. Sensory Modulation. In Bundy AC, Lane SJ, Murray EA. Sensory Integration Theory and Practice. 2nd ed. Philidelphia: FA Davis Co.; 2002. p. 101-123.

17. Dunn W, Brown C. Factor analysis on the Sensory Profile fram a national sample of children without disabilities. The American Journal of Occupational Therapy. 1997 July/August; 51(1): p. 490-499.

18. Kern JK, Graver CR, Carmody T, Alonzo A, Mehta JA, Trivedi MH. Examining sensory modulation in individuals with autism as compared to community controls. Research in Autism Spectrum Disorders. 2008; 2: p. 85-94.

19. Kandel ER, Schwartz J, Jessel TMl. Principles of neural science. 4th ed. New York: GcGraw-Hill; 2000.

20. Miller LJ, Anzalone ME, Lane SJ, Cermak SA, Osten ET. Concept Evolution in Sensory Integration: A Proposed Nosology for diagnosis. American Journal of Occupational Therapy. 2007 March/April; 61(2): p. 135-140.

21. Association of American Occupational Therapy. Occupational Therapy Practice Framework: Domain and Process (3rd ed.). American Journal of Occupational Therapy. 2014 March/April; 68 (Supplement1): p. S1-S48.

22. Dunn W. Perfomance of typical children on the Sensory Profile: An item analysis. American Journal of Occupational Therapy. 1994; 48: p. 967-974.

23. Butcher JN. Translation and adaptation of the MMPI-2 for international use. In Butcher JN. International adaptations fo the MMPI-2: Research and clinical applications. Minneapolis: University of Minnesota Press; 1996. p. 26-43.

24. van Jaarsveld A, Mailloux Z, Herzberg DS. The use of the Sensory Integration and Praxis tests with South African children. South African Journal of Occupaitonal Therapy. 2012 December; 42(3): p. 12-18.

25. Anastasi A, Urbina S. Psychological testing. Upper Saddle River, NJ: Prentice Hall International.; 1997.

26. Downing SM. Validity: On the meaningful interpretation of assessment data. Medical Education. 2003; 37(9): p. 830.

27. Streiner DL, Norman GR. Health measurement scales: A practical guide to their development and use. Oxford: UK: Oxford University Press; 1995.

28. DeGangi GA, Sickel R, Wierner A, Kaplan E. Fussy babies: do treat or not do treat? British Journal of Occupational Therapy. 1996; 56(10): p. 457-464.

29. Wiener A, Long T, DeGangi G, Dataille B. Sensory processing of infants born prematurely or with regulatory disorder. Physical & Occupational Therapy in Pediatrics. 1996; 16(4): p. 1-17.

30. Harris S, Daniels L. Content validity of the Harris Infant Neuromotor Test. Physical Therapy. 1996; 76(4): p. 727-737.

31. UNICEF. Fact sheet: A summary of the rights under the Convention on the Rights of the Child.

32. Davidson DA. Psychosocial Issues Affecting Social Participation. In Case-Smith J, O'Brien JC. Occupational Therapy for Children. Maryland Heights, Missourri: Elsevier; 2010. p. 404-433.

33. DeGangi GA,Berg RA, Greenspan SI. The clinical measurement of sensory functioning in infants: A preliminary study. Physical & Occupational Therapy in Paediatrics. 1988; 8(2-3): p. 1-23.

34. Ayres AJ. Sensory integration and the child Los Angeles: Western Psychological Services (Original work published 1976); 2005.

35. DeGangi GA,DiPietro JA,Greenspan SI,Porges SW. Psychophysiological caracteristics of the regulatory disordered infant. Infant Behaviour and Development. 1991; 14: p. 37-50.

36. Ben-Sasson A, Carter AS, Briggs-Gowan MJ. The Development of Sensory Over-responsivity From Infancy to Elementary School. Journal of Abnormal Child Psychology. 2010.

37. DeGangi GA, Greenspan SI. The development of sensory functions in infants. Physical and Occuptational Therapy Pediatrics. 1988; 8: p. 21-33.

38. Ayres AJ. Sensory Integration and Praxis Test manual Los Angeles: Western Psychological Services; 1989.

39. South African Iinstitute of Sensory Integration (SAISI) Research Committee. Clinical Observations adapted from Ayres. 1986.

40. Dunn W. Infant/Toddler Sensory Profile User's Manual. In. San Antonio: Psychological Corporation; 2002. p. 59-68.

41. Nieder-Heitmann E. Impact of a sensory developmental care programme for very low birth weight preterm infants in the neonatal intensive care unit. Dissertation for Occupational Therapy Masters Degree. University of Stellenbosch, Occupational Therapy Department; 2010.

42. Jorge J, de Witt PA, Franzsen D. The effect of a two-week sensory diet on fussy infants with regulatory sensory processing disorder. South African Journal of Occupational Therapy. 2013 December; 43(3): p. 28-34.

43. Lecuona E. Sensory Integration Intervention and the Development of the Extremely Low to Very Low Birth Weight Premature Infant. Dissertation for Master in Occupational Therapy. University of the Free State, Occupational Therapy Department; 2012.

44. Mitchell AW, Moore EM, Roberts EJ, Hachtel KW, Brown MS. Sensory Processin Disorder in Children Ages Birth-3 Years Born Prematurely: A Systematic Review. American Journal of Occupational Therapy. 2015 January/February; 69(1): p. 1-11.

45. Eeles AL, Anderson PJ, Brown NC, Roslyn JL, Boyd N, Spittle AJ, et al. Sensory profiles of children born before 30 weeks' gestation at 2 years of age and their environmental and biological predictors. Early Human Development. 2013; 89(9): p. 727-732.

46. Watling R, Bodison S, Henry D, & Kuhaneck H. (2006). "Sensory Integration: It's not just for children." AOTA's Sensory Integraion Special Interest Section Quaterly,29 (4), 1-4.

47. Koenig KP, Rudney S. Performance Challenges for children and adolescents with difficulty processing and integrating sensory information: A Systematic Review. American Journal of Occupational Therapy. 2010 May/June; 64(3): p. 430-442.

48. Dunn W. The Sensory Profile, User's Manual San Antonio, TX: The Psychological Corporation; 1999.

49. Brown T, Morrison IC, Stagnitti K. The Reliability of Two Sensory Processing Scales Used with School-Age Children: Comparing the Resoponse Consistency of Mothers, Fathers and Classroom Teaschers Rating the Same child. Journal of Occupational Therapy, Schools & Early Intervention. 2010; 3: p. 331-347.

50. Neuman A. Patterns of response to sensory stimuli encountered in daily activities: A comparison between 3 to 10-year-old Israeli and American children without disabilities. Occupational Therapy International. 2006 January; 25(13): p. 79-99.

51. Benjamin TE, Crasta JE, Suresh APC, Alwinesh MJT, Kanniappan G, Padankatti SM, et al. Sensory Profile Caregiver Questionnaire: A Measure for Sensory Impairment Among Children with Developmental Disabilities in India. Indian Journal of Pediatrics. 2014 December; Supplimnet 2: p. S183-S186.

52. Crawford SG, Wilson BN, Dewey D. Identifying Developmental Coordination Disorder: Consistency Between Tests. Physical & occupational therapy in paediatrics. 2001; 2(3): p. 29-50.

53. Habib E, Magalhaes L. Development of a questionnaire to detect atypical behaviour in infants. Revista Brasileira de Fisioterapia. 2007; 11(3): p. 155-161.

54. Dunn W, Daniels DB. Initial Development of the Infant/Toddler Sensory Profile. Journal of Early Intervention. 2002; 25(1): p. 27-41.

55. May-Benson TA,Koomaar JA,Teasdale A. Incidence of pre-, peri-, and post-natal birth and developmental problems of children with sensory processing disorder and children with autism spectrum disorder. Frontiers in Integrative Neurosciences. 2009; 31(November): p. 10.

56. Crepeau-Hobson M. The Relationship Between Perinatal Risk Factors and Sensory Processing

Difficulties in Preschool Children. Journal of developmental and physical disabilities. 2009; 21(4): p. 315–328.

57. Kramer P, Hinojosa J. Developmental Perspective: Fundamentals of Developmental Theory. In P. K, Hinojosa J. Frames of reference for Pediatric Occupational Therapy. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2009. p. 23-30.

58. Freud S. Standard Edition of the Complete Psychological works of Sigmund Freud. London: Hogarth Press; 1966.

59. Skinner BF. About Behaviourism New York: Vintage Books; 1974.

60. Lerner RM. Concepts and Theories of Human Development. 3rd ed. Mahwah, New Jersey: Lawrence Erlbaum Associates; 2002.

61. Hensch TK. Critical period plasticity in local cortical circuits. Nature reviews. Neuroscience. 2005; 6: p. 877-888.

62. Jacobs SE, Schenider ML. Neuroplasticity and the enviromnent. In Roley SS, Blanche EI, Schaaf RC. Understanding the nature of sensory integratio with diverse populations. San Antonio,TX: Therapy Skills Builder; 2001. p. 29-42.

63. Parham LD, Mailloux Z. Sensory Integration. In Case-Smith J, O'Brien JC. Occupational Therapy for children. 6th ed. Elsevier: Mosby; 2010. p. 235-372.

64. Parham LD. Sensory integration and occupation. In Bundy AC, Lane SJ, Murray EA. Sensory integration: Theory and practice. Philadelphia.: F.A. Davis.; 2002. p. 413-434.

65. Smith-Roley S, Mailloux Z, Miller-Kuhaneck H, Glennon E. Understanding Ayers Sensory Integration. OT Practice. 2007; 12(17): p. CE-2.

66. Parham LD, Cohn ES, Spitzer S, Koomar JA, Miller LJ, Brett-Green B, et al. Filelity in Sensory Integration Intervention Research. American Journal of Occupational Therapy. 2007 March/April; 61(2): p. 216-227.

67. Lane SJ, Schaaf RC. Examining the Neuroscience Evidence for Sensory-Driven Neuroplasticity: Implications for Sensory-Based Occupational Therapy for Children and Adolenscents. The American Journal of Occupational Therapy. 2010 May/June; 44(3): p. 375-390.

68. Mailloux Z, Mulligan S, Smith-Roley S, Blanche E, Cermak S, Coleman GG, et al. Verification and Clarification of Patterns of Sensory Integrative Dysfunction. The American Journal of Occupational Therapy. 2011 March/April; 65(2): p. 143-151.

69. Miller LJ, Anxalone M,Cermak SA,Lane SJ,Osten B,Wieder S,Greenspan SI. Regulatory-Sensory Processing Disorders Work Group, Diagnotic Manual for Infancy and Early Childhood. 17399th ed. Meryland: ICDL; 2005.

70. Miller LJ. Sensory Processing Disorder (SPD) Foundation. [Online]. [cited 2014 June 28. Available from: http://spdfoundation.net/.

71. South African Institute for Sensory Integration. [Online]. [cited 2014 August 02. Available from: http://www.instsi.co.za.

72. Miller LJ, Lane SJ. Toward a Concensus in Termonology in Sensory Integration Theory and Practice: Part 1: Taxonomy of Neurophysiological Process. Sensory Integration Special Interest Section Quarterly. 2000 March; 23(1).

73. Mulligan S. An analysis of score patterns of children with attention disorders on the Sensory Integration and Praxis Tests. American Journal of Occupational Therapy. 1996; 50: p. 647-654.

74. Mulligan S. Patterns of sensory integration dysfunction: A confirmatory factor analysis. American Journal of Occupational Therapy. 1998; 52: p. 819-828.

75. Mulligan S. Cluster analysis of scores of children on the Sensory Integration and Praxis Test. OTJR: Occupation, Participation and Health. 2000; 20: p. 256-270.

76. Bundy AC, Murray EA. Sensory Integration: A. Jean Ayres' Theory Revisited. In Bundy AC, Lane SJ, Murray EA. Sensory Integration Theory and Practice. 2nd ed. Philadelphia: F.A. Davis Company; 2002. p. 3-29.

77. van Jaarsveld A. Model for Clinical Reasoning on possible Sensory Integration Difficulties and Dysfunctions. SAISI Newsletter. 2011: p. 7-12.

78. Parham LD, Ecker C, Kuhaneck HM, Henry DA, Glennon TJ. Sensory Processing Measure Torrance, CA.: Western Psychological Services; 2007.

79. Baranek GT, Chin YH, Greiss Hess LM, Yankee JG, Hatton DD, Hooper SR. Sensory Processing Correlates of Occupational Performance in Children with Fragile X Syndrome: Preliminary Findings. American Journal of Occupational Therapy. 2002; 56(5): p. 538-546.

80. Baranek GT, Foster LG, Berkson H. Tactile defensiveness and stereotyped behaviours. American Journal of Occupational Therapy. 1997; 51: p. 91-95.

81. McIntosh DN, Miller LJ, Shyu V, Hagerman RJ. Sensory-modulation disruption, electrodermal responses, and functional behaviours. Developmental Medicine & Child Neurology. 1999; 41: p. 608-615.

82. Ahn R, Miller L, Milberger S, McIntosh.D.. Prevalence of parent's perceptions of sensory processing disorder among kindergarten children. American Journal of Occupational Therapy. 2004; 58(3): p. 287-293.

83. Fisher AG, Murray EA. Introduction to sensory integration theory. In Fisher AG, Murray EA, Bundy AC. Sensory Integration: Theory and Practice. Philidelphia: F.A. Davis; 1991. p. 3-26.

84. Knickerbocker BM. A holistic approach to learning disabilities. Thorofare, NY.: C.B. Slack.; 1980.

85. Royeen CB,& Lane SJ. Tactile processing and sensory defensiveness.. In Fisher AB,Murrya EA,&Bundy AC. Sensory integration: Theory and practice. Philidelphis: F.A. Davis.; 1991. p. 108-133.

86. Dunn W. The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model. Infants and Young Children. 1997; 9(4): p. 23-35.

87. Wilbarger P, & Wilbarger J. Sensory defensiveness in children aged 2-12: An intervention guide for parents and other caregivers. Denver: Avanti Educational Programs; 1991.

88. Miller LJ, Reisman J, McIntosh DN, Simon J. An exological model of sensory modulation: Performance of children with Fragile X Syndrome. In Smith-Roley S, Blanche EI, Schaaf RC. Understanding the nature of sensory integration in divers populations. San Antonio: Therapy Skill Builders; 2001. p. 57-82.

89. Royeen C. Neuroscience Foundations of Human Performance Rockville: American Occupational Therapy Association; 1991.

90. Stellar J, Stellar E. The Neurobiology of Motivation and Reward New York: Springer-Verlag; 1985.

91. Reynolds S, Lane SJ. Diagnostic Validity of Sensory Over-responsivity: A Review of the Literature and Case Report. Journal of Autism & Developmental Disorders. 2008; 38: p. 516-529.

92. DeSantis A, Harkins D, Tronick E, Kaplan E, Beeghly M. Exploring an integrative model of infant behaciour: What is the relationship among temperament, sensory processing and neurobehavioral measures? Infant Behaviour & Development. 2011; 34: p. 280-292.

93. Stewart BK. Occupational Therapy evaluation in Pediatrics. In Case-Smith J, O'Brien JC. Occupational Therapy for Children. Sixth Edition ed. Missouri: Mosby Elsevier; 2010. p. 193-211.

94. Hegde MN, Pomaville F. Standardized Assessment. In Hegde MN, Pomaville F. Assessment of Communication Disorders in Children: Resources and Protocols. 2nd ed. Dan Diego: Plural Publishing Inc.; 2012. p. 41-66.

95. Eeles AL, Spittle AJ, Anderson PJ, Brown N, Lee KJ, Boydlex RN,DW. Assessments of sensory processing in infants: a systematic review. Developmental Medicine & Child Neurology. 2013; 55: p. 314-326.

96. Mulligan S, White BP. Sensory and Motor Behaviors of Infant Siblings of Children with and without Autism. American Journal of Occupational Therapy. 2012 September/October; 89(9): p. 555-566.

97. Ben-Sasson A, Soto TW, Martinez-Pedraza F, Carter AS. Early sensory over-responsivity in toddlers with autism spectrum disorders as a predictor of family impairment and parenting

stress. Journal of Child Psychology and Psychiatry. 2013; 54(8): p. 846-853.

98. Germani T, Zwaigerbaum L, Bryson S, Brain J, Smith I, Roberts W, et al. Brief Report: Assessment of Early Sensory Processing in Infants at High-Risk of Autism Spectrum Disorder. Journal of Autism and Developmental Disorders. 2014 in print. Published online 27 June 2014.

99. Samango-Sprouse CA, Stapleton EJ, Alaibadi F, Graw R, Vickers R, Haskell K, et al. Identification of infants at risk for autism spectrum disorder and developmental language delay prior to 12 months. Autism. 2014. In print, Published online on 18 February 2014.

100. DeGangi GA, Berk RA, Greenspan SI. The clinical measurement of sensory functioning in infants: A preliminary study. Physical & Occupational Therapy in Paediatrics. 1988; 8(2-3): p. 1-23.

101. Jirikowic TL, Engel JM, Deitz JC. The Test of Sensory Functions in Infants: Test-Retest Reliability for Infants with Developmental Delays. The American Journal of Occupational Therapy. 1997; 51(9): p. 733-738.

102. Jaegermann N, Klein PS. Enhancing mothers' interactions with toddlers who have sensory-processing disorder. Infant Mental Health Journal. 2010; 31(3): p. 291-311.

103. Lin CK, Wu HM, Wang HY, Tseng MH, Lin CH. Age as a factor in sensory integration in Taiwanese children. Neuropsychiatric Disease and Treatment. 2013; 9: p. 995-1001.

104. Chorna O, Solomon JE, Slaughter JC, Stark AR, Maitre NL. Abnormal sensory reactivity in preterm infants during the first year correlates with adverse neurodevelopmental outcomes at 2 years of age. ADC Fetal & Neonatal edition. 2014 in press. Published online 22 July 2014.

105. Glasco FP, Dworkin PH. The Role of Parents in the Detection of Developmental and Behavioural Problems. Pediatrics. 1995 June; 95(6): p. 829-836.

106. Faraone SF, Biedernam J, Milberger S. How reliable are maternal reports of their children's psycopathology? One-year recall of psychiatric diagnoses of ADHD children. Journal of the American Academy of Child and Adolescent Psychiatry. 1995; 34: p. 1001.

107. Wilson BN, Kaplan BJ, Crawford SG, Campbell A, Dewey D. Reliability and Validity of a Parent questionnaire on Childhood Motor Skills. American Journal of Occupational Therapy. 2000; 54(5): p. 484-493.

108. Fox MA, Lent B. Clumsy Children: primer on developmnetal coordination disorder. Canadian Family Physician. 1996; 42: p. 1965-1971.

109. Johnson S, Marlow N, Wolke D, Davidson L, Marston L, O'Hare A, et al. Validation of a parent report measure of cognitive development in very preterm infants. Developmental Medicine and Child Neurology. 2004; 46: p. 389-397.

110. EUROSTAT EC. European Quality Assurance in Vocational Education and Training. [Online].; 2007

[cited 2015 January 8. Available from: http://www.eqavet.eu/qa/gns/glossary/a/accuracy-of-measurement.aspx.

111. Kielhofner G. Developing and Evaluation Quantitative Data Collection Intruments. In Kielhofner G. Research in Occupational Therapy: Methods of Inquiry for Enhancing Practice. Philadelphia: F.A. Davis Company; 2006. p. 155-176.

112. Brown T, Morrison IC, Stagnitti K. The convergent validity of two sensory processing scales used with school-age children: Comparing the Sensory Profile and the Sensory Processing Measure. New Zealand Journal of Occupational Therapy. 2010; 57(2): p. 55-65.

113. Guralnick MJ. International Perspectives on Early Intervention: A Search for Common Ground. Journal of Early Intervention. 2008 March; 30(2): p. 90-101.

114. World Health Organization. Preamble to the Constitution of the World Health Organization as addopted by the International Health Conference, New York, 19 June - 22 July 1946; signed on 22 July 1946 by the representatives of 61 States. In Official Records of the World Health Organization; 1948 no 2. p. 100.

115. Shonkoff J, Richter L, van der Gaag J, Bhutta Z. An integrated scientific framework for child survival and early childhood development. Pediatrics. 2012; 129(2): p. 1-13.

116. Department of Education. Interim policy for early childhood development. Interam policy. South-African Government, Department of Education; 1996.

117. UNICEF. National Integrated Plan for Early Childhood development in South Africa 2005-2010. 2005..

118. South Africa. Children's Amendment Act 2007. Government Gazette. 2007 March; 513(30884).

119. South Africa. National Health Act, 2003. Government Gazette. 2004 July; 469(26595).

120. Mseleku TD. A Policy on Quality in Health Care for South Africa. Policy. Pretoria: South African Government, National department of Health; 2007.

121. Dawson G, Rogers S, Munson J, Smith M, Winter J, Greenson J, et al. Randomized, Controlled Trail of an Intervention for Toddlers With Autism: The Early Start Denver Model. Pediatrics. 2010; 125: p. e17-e23.

122. Ziviani J, Feeney R, Rodger S, Watter P. Systematic review of early intervention programms for children from birt to nine years who have a physical disability. Australian Occupational Therapy Journal. 2010; 57: p. 210-223.

123. DeGangi GA, Breinbauer C, Roosevelt JD, Porges S, Greenspan S. Prediction of childhood problems at three years in children experiencing disorders of regulation during infancy. Infant Mental Health Journal. 2000; 21(3): p. 156-175.

124. Kielhofner G. Research in Occupational Therapy: Methods of inquiry for Enhanching Practice Philadelphia: F.A. Davis company; 2006.

125. Bartlett JE, Kortlik JW,Higgins CC. Organizational Research: Determining Appropriate Sample Size in Survey research. Informatin Technology, Learing and Performance Journal. 2001; 19(1): p. 43-50.

126. Statistics South Africa. South Africa's young children: their family and home environment, 2012. Pretoria: Statistics South Africa; 2012. Report No.: 03-10-07.

127. Chorley M. Mailonline. [Online].; 2014 [cited 2014 September 02. Available from: http://www.dailymail.co.uk/news/article-2694534.

128. Nation Master. South Africa Health Stats. [Online]. [cited 2014 September 02. Available from: http://www.nationmaster.com/country-info/profiles/South-Africa/Health.

129. Impey L, Pandit M. Tocolysis for repeat external cephalic version in breech presentation at term: A randomized, double blind, placebo-controlled trail. British Journal of Obstetrics and Gynaecology. 2005; 112: p. 627-631.

130. Hofmeyr GJ, Gyte GML. Interventions to help external cephalic version for breech presentation at term(Review). Cochrane Database System Review. 2010;(1).

131. Moodley J, Dhedun SM, J D. Breech presentation at a district level hospital in South Africa. SA Family Practice. 2010; 52(1): p. 64-68.

132. Discovery Health Matters. Pregnancy - A simple guide to birth options. [Online].; 2013 [cited 2014 September 9. Available from: http//:www.discovery.co.za/discovery_co.za/web/linked_content/pdfs/health/birth_options.pdf.

133. Tshibangu KC, De Jongh MA, De Villiers DJ, Du Toit JJ, Shah SMH. Incidence and outcome of caesarean section in the private sector - 3 year experience at Pretoria Gynaecological Hospital. South African Medical Journal. 2002; 92(12): p. 956-959.

134. Cavallaro FL, Cresswell JA, Franca GVA, Aluisio CGV, Barros AJD, Ronsmans C. Trends in caesarean delivery by country and wealth quintile: Cross-sectional surveys in southern Asia and sub-Saharan Africa. Bulletin of the Qorld Health Organization. 2013 December; 91: p. 914-922D.

135. Atlas of neonatal pathology. Classification of newborn infants by weight and gestation. [Online]. [cited 2014 November 19. Available from: https://atlases.muni.cz/atlases/novo/atl_en/main+novorozenec+klasnov.html.

136. Cohen J. A Power Primer. Psychological Bulletin. 1992; 112(1): p. 155-159.

137. McCauley RJ, Swisher L. Psychometric review of language and articulation tests for preschool children. Journal of Speech and Hearing Disorders. 1984; 49: p. 34-42.

138. Dunn W. Infant / Toddler Sensory Profile Caregiver Questionnaire. 2002.

139. Schuberth LM, Amirault LM, Case-Smith J. Feeding Intervention. In Case-Smith J, O'Brien JC. Occupational Therapy for Children. 6th ed. Maryland Hights, Missouri: Mosby Elsevier; 2010. p. 446-473.

140. National Health Services. Teething symptoms and how babies' teeth emerge [Online]. [cited 2014 November 19. Available from: http://www.nhs.uk/conditions/pregnancy-and-baby/pages/teething-and-tooth-care.aspx.

141. Case-Smith J. Developmet of Childhood Occupations. In Case-Smith J, O'Brien JC. Occupational Therapy for Children. 6th ed. Maryland Heights, Missouri: Mosby Elsevier; 2010. p. 56-83.

142. Connolly BH, Montgomery P. Therapeutic exercise in Developmental Disabilities. 3rd ed. New York: Slack incorporated; 2005.

143. Kielhofner G, Tomita MR. Appenndix B: Summary of Common Research Statistics. In Kielhofner G. Research in Occupational Therapy. Philadelphia: F.A. Davis Company; 2006. p. 314-325.

144. Tavakol M, Dennick R. Making sense of Cronbach's alpha. International Journal of Medical Education. 2011; 2: p. 53-55.

145. Nunnaly J. Psycometric Theory New York: McGraw-Hill; 1978.

146. Association AOT. Occupational Therapy Practice Framework: Domain and Process (3rd ed.). American Journal of Occupational Therapy. 2014 March/April; 68 (Supplement1): p. S1-S48.

APPENDICES

A1 Personal information

A2 Demographic sheet for parents

A3 Demographic sheet for child day care centres

B1 Infant/Toddler Sensory Profile – caregiver questionnaire

B2 Infant/Toddler Sensory Profile – summery score sheet

C Test of Sensory Functions in Infants – Administration and Scoring Form

D Ethical Clearance

E Request for permission to conduct research – child day care facilities

F1 Information sheet for parents

F2 Informed consent from parents

APPENDIX A1

PERSONAL INFORMATION

(To be kept separate)

Please complete information where needed and mark appropriate box with an X

PARENT / GUARDIAN INFORMATION

Study code:

	FATHER:		**MOTHER:**
Surname:	_____	Surname:	_____
Name:	_____	Name:	_____
Occupation:	_____	Occupation:	_____
Age:	_____	Age:	_____
Cell number:	_____	Cell number:	_____

CHILD'S INFORMATION

Name of child: _____ Child's Surname: _____

Date of birth: _____

Child's sex: Male ☐ Female ☐

APPENDIX A2

DEMOGRAPHIC SHEET:

INFORMATION OF THE CHILD: (for office use only)

Study Code: _____ Age: _____

Please complete information where needed and mark appropriate box with an X

Name of Day Care facility child attends: _____

Child is in day care:	Mornings only:	☐	Full day:	☐
Duration of pregnancy:	Full term pregnancy (37 to 42 weeks):	☐	Premature birth (less than 37 weeks):	☐
Birth position:	Normal, head first:	☐	Breach (head up or lying sideways)	☐
Method of delivery:	Normal, vaginal delivery:	☐	Planned Caesarean section: ☐	Emergency Caesarean section: ☐

This child is the _____ **of** _____ **children in the family.**

Were there any complications, illnesses, or stress during pregnancy?	NO	YES. Please specify:	
Were there any complications during labor or delivery?	NO	YES. Please specify:	
What was your child's birth weight?			
What were your child's Apgar scores?		At 1 minute:	At 5 minutes:
Please indicate age/sex of any siblings.			
Does your child have a history of ear infections?	NO	YES.	
		How many?	

		At what ages?	
Does your child currently take any medication?	NO	YES. Please specify:	
Does your child have any allergies?	NO	YES. Please specify:	
Has your child experienced any major injuries or hospitalisations?	NO	YES. Please specify:	
Does your child have a history of seizures?	NO	YES. Please specify:	
Have your child experienced any respiratory problems?	NO	YES. Please specify:	
Is your child currently being breastfed?	NO	YES. Please specify:	
Is your child currently being bottle fed?	NO	YES. Please specify:	
Are you experiencing any feeding difficulties?	NO	YES. Please specify:	
Do your child frequently spit up or have reflux?	NO	YES. Please specify:	
Did your child have problems with appetite or weight gain?	NO	YES. Please specify:	
Have any of the child's siblings received or is currently receiving occupational therapy?	NO	YES. Please specify:	
Is there any history of the Mother and/or Father receiving occupational therapy?	NO	YES. Please specify:	
Have your child achieved the following skills and at what age?	Sitting	YES / NO	Age:
	Rolling	YES / NO	Age:
	Belly crawling	YES / NO	Age:
	Crawling	YES / NO	Age:
	Cruising	YES / NO	Age:

Thank you for taking the time to complete this form.

APPENDIX A3

DEMOGRAPHIC SHEET: CHILD DAY CARE FACILITIES

(To be kept separate)

Study code:	

1. CHILD DAY CARE FACILITY INFORMATION

Name: _____

Tel: _____

E-mail: _____

Physical Address: _____

_____

Code: _____

Name of manager: _____

Total number of children cared for: _____

Number of children between age of 7 to 12 months: _____

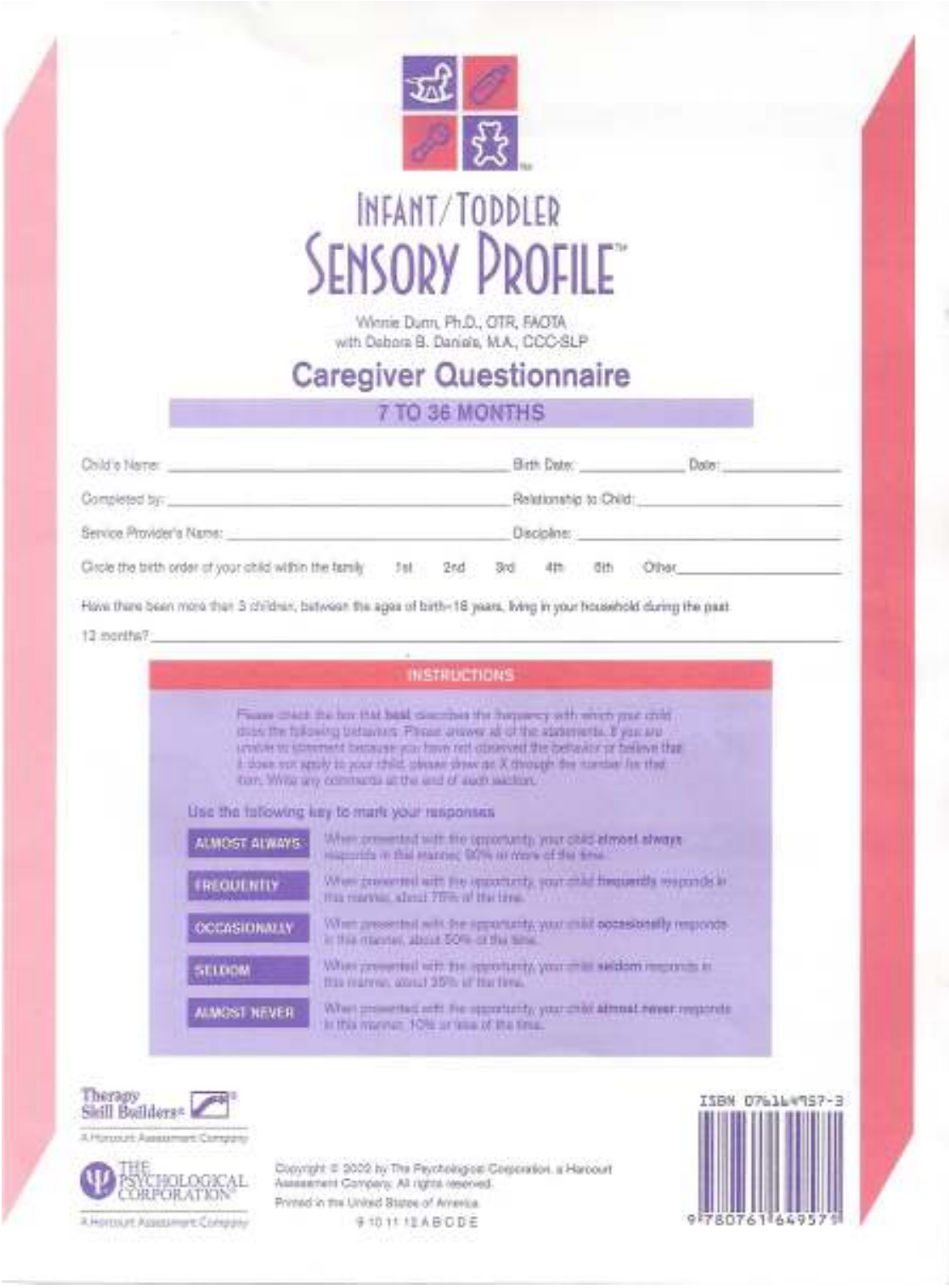
Total number of caregivers: _____

Number of caregivers per age group/class _____

Hours facility is open: _____ to _____

APPENDIX B1

INFANT/TODDLER SENSORY PROFILE CAREGIVER QUESTIONNAIRE



INFANT/TODDLER
SENSORY PROFILE™

Winnie Dunn, Ph.D., OTR, FAOTA
with Debora B. Daniels, M.A., CCC-SLP

Caregiver Questionnaire

7 TO 36 MONTHS

Child's Name: _____ Birth Date: _____ Date: _____

Completed by: _____ Relationship to Child: _____

Service Provider's Name: _____ Discipline: _____

Circle the birth order of your child within the family 1st 2nd 3rd 4th 5th Other_____

Have there been more than 3 children, between the ages of birth–18 years, living in your household during the past 12 months? _____

INSTRUCTIONS

Please check the box that best describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Write any comments at the end of each section.

Use the following key to mark your responses

ALMOST ALWAYS	When presented with the opportunity, your child almost always responds in this manner, 90% or more of the time.
FREQUENTLY	When presented with the opportunity, your child frequently responds in this manner, about 75% of the time.
OCCASIONALLY	When presented with the opportunity, your child occasionally responds in this manner, about 50% of the time.
SELDOM	When presented with the opportunity, your child seldom responds in this manner, about 25% of the time.
ALMOST NEVER	When presented with the opportunity, your child almost never responds in this manner, 10% or less of the time.

Therapy Skill Builders®
A Harcourt Assessment Company

THE PSYCHOLOGICAL CORPORATION®
A Harcourt Assessment Company

Copyright © 2002 by The Psychological Corporation, a Harcourt Assessment Company. All rights reserved.
Printed in the United States of America.
9 10 11 12 A B C D E

ISBN 0761649757-3
9 780761 649571

Item		A. General Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	1	My child's behavior deteriorates when the schedule changes.					
	2	My child avoids playing with others.					
	3	My child withdraws from situations.					

Note: You do not calculate a Raw Score Total for this section.

Comments

Item		B. Auditory Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	4	I have to speak loudly to get my child's attention.					
	5	I have to touch my child to gain attention.					
	6	My child enjoys making sounds with his/her mouth.					
	7	My child takes a long time to respond, even to familiar voices.					
	8	My child startles easily at sound, compared to other children the same age.					
	9	My child is distracted and/or has difficulty eating in noisy environments.					
	10	My child ignores me when I am talking.					
	11	My child tries to escape from noisy environments.					
	12	My child finds ways to make noise with toys.					
	13	It takes a long time for my child to respond to his/her name when it is called.					
		Section Raw Score Total					

Comments

Item		C. Visual Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	14	My child enjoys looking at moving or spinning objects (for example, ceiling fans, toys with wheels, floor fans).					
	15	My child enjoys looking at shiny objects.					
	16	My child avoids eye contact with me.					
	17	My child refuses to look at books with me.					
	18	My child does not recognize self in the mirror.					
	19	My child enjoys looking at own reflection in the mirror.					
	20	My child prefers fast-paced, brightly colored TV shows.					
		Section Raw Score Total					

Comments

2

Item		D. Tactile Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	21	My child resists being held.					
	22	My child becomes agitated when having hair washed.					
	23	My child avoids getting face/nose wiped.					
	24	My child is distressed when having nails trimmed.					
	25	My child resists being cuddled.					
	26	My child is upset by changes in the bath water temperature, from one bath to the next.					
	27	My child avoids contact with rough or cold surfaces (for example, squirms, arches, cries).					
	28	My child becomes very upset if own clothing, hands, and/or face are messy.					
	29	My child gets upset with extreme differences in room temperature (for example, hotter, colder).					
	30	My child becomes anxious when walking or crawling on certain surfaces (for example, grass, sand, carpet, tile).					
	31	My child enjoys playing with food.					
	32	My child seeks opportunities to feel vibrations (for example, stereo speakers, washer, dryer).					
	33	My child bumps into things, seeming to not notice objects in the way.					
	34	My child enjoys splashing during bath time.					
	35	My child uses hands to explore food and other textures.					
		Section Raw Score Total					

Comments

Item		E. Vestibular Processing	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
	36	My child requires more support for sitting than other children the same age (for example, infant seat, pillows, towel roll).					
	37	My child enjoys physical activity (for example, bouncing, being held up high in the air).					
	38	My child enjoys rhythmical activities (for example, swinging, rocking, car rides).					
	39	My child becomes upset when placed on back to change diapers.					
	40	My child resists having head tipped back during bathing.					
	41	My child cries or fusses whenever I try to move him/her.					
		Section Raw Score Total					

Comments

Item		F. Oral Sensory Processing	Almost Always	Frequently	Occasionally	Seldom	Almost Never
	43	My child licks/chews on nonfood objects.					
	43	My child mouths objects.					
—	44	My child is unaware of food or liquid left on lips.					
—	45	My child refuses all but a few food choices.					
—	46	My child resists having teeth brushed.					
—	47	My child refuses to drink from a cup.					
—	48	My child refuses to try new foods.					
		Section Raw Score Total					

Comments

What do you see as your child's strengths? _____

_____

_____

_____

_____

What are your concerns? _____

_____

_____

_____

_____

STOP HERE IF YOUR CHILD IS 7 TO 36 MONTHS OLD.

ICON KEY	
—	Low Registration
∿	Sensation Seeking
ⓖ	Sensory Sensitivity
—	Sensation Avoiding

SCORE KEY	
1	Almost Always
2	Frequently
3	Occasionally
4	Seldom
5	Almost Never

APPENDIX B2

INFANT/TODDLER SENSORY PROFILE SCORE SHEET



INFANT/TODDLER
SENSORY PROFILE™

Winnie Dunn, Ph.D., OTR, FAOTA

Summary Score Sheet

Child's Name: _____ Gender: ☐ Male ☐ Female

Questionnaire Completed by: _____

Relationship to Child: _____

Service Provider's Name: _____

Discipline: _____

	YEAR	MONTH	DAY
Date Tested			
Date of Birth			
Chronological Age			

☐ Early Intervention/Preschool Services ☐ Physical Therapy

☐ Occupational Therapy ☐ Speech Therapy

☐ Other (please specify) _____

☐ Mental retardation ☐ Cerebral Palsy

☐ Down Syndrome ☐ Fragile X

☐ Speech or Language Impairment ☐ Reflux

☐ Autism/Pervasive Developmental Disorder (PDD) ☐ Multiple disabilities

☐ Developmental Delay ☐ Traumatic brain injury

☐ Emotional disturbance or serious behavioral difficulties ☐ Other neurological disorder

☐ Attention disorder (ADD, ADHD) ☐ Other health conditions (e.g., cardiac disorder, asthma)

☐ Visual Impairment/Blindness ☐ Regulatory disorder

☐ Hearing Impairment/Deafness ☐ Other (please specify): _____

7 to 36 Months Summary Score Sheet

Quadrant Grid

Instructions: Transfer from the Caregiver Questionnaire (7 to 36 months) the item raw score that corresponds with each item listed. Add the Raw Score column to get the Quadrant Raw Score Total for each quadrant.

QUADRANT 1 — Low Registration

Item	Raw Score
4	
5	
7	
10	
13	
16	
18	
03	
06	
44	
47	
Quadrant Raw Score Total	

QUADRANT 2 — Sensation Seeking

Item	Raw Score
6	
12	
14	
15	
19	
20	
31	
32	
34	
35	
37	
38	
42	
43	
Quadrant Raw Score Total	

QUADRANT 3 — Sensory Sensitivity

Item	Raw Score
1	
8	
9	
22	
24	
25	
29	
29	
30	
39	
41	
Quadrant Raw Score Total	

QUADRANT 4 — Sensation Avoiding

Item	Raw Score
2	
3	
11	
17	
21	
23	
28	
27	
40	
45	
46	
48	
Quadrant Raw Score Total	

ICON KEY	
—	Low Registration
S	Sensation Seeking
@	Sensory Sensitivity
|	Sensation Avoiding

Low Threshold (combined quadrant score)

Instructions: Add Sensory Sensitivity and Sensation Avoiding Quadrant Raw Score Totals to get the Low Threshold Raw Score Total

Low Threshold Raw Score Total	___ + ___ = ___

Quadrant Summary

Instructions: Transfer the Quadrant Raw Score Totals from the 7 to 36 months Quadrant Grid to the corresponding Quadrant Raw Score Total box for the appropriate ages. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference)*.

Quadrant	Quadrant Raw Score Total	Less Than Others ← Definite Difference	Less Than Others ← Probable Difference	Typical Performance	→ More Than Others Probable Difference	→ More Than Others Definite Difference
1. Low Registration (7–36 months)	/55	**	55	54 —— 46	45 —— 43	42 —— 11
2. Sensation Seeking (7–12 months)	/70	70 —— 44	43 —— 36	35 —— 19	18 —— 14	**
2. Sensation Seeking (13–18 months)	/70	70 —— 46	45 —— 35	37 —— 20	19 —— 14	**
2. Sensation Seeking (19–24 months)	/70	70 —— 50	49 —— 42	41 —— 25	24 —— 16	15 —— 14
2. Sensation Seeking (25–30 months)	/70	70 —— 50	49 —— 43	42 —— 27	26 —— 19	18 —— 14
2. Sensation Seeking (31–36 months)	/70	70 —— 59	58 —— 49	48 —— 28	27 —— 18	17 —— 14
3. Sensory Sensitivity (7–36 months)	/55	**	55 —— 53	52 —— 41	40 —— 38	35 —— 11
4. Sensation Avoiding (7–36 months)	/80	**	80 —— 57	56 —— 45	44 —— 39	38 —— 12
Low Threshold	**Raw Score Total**	Note: The score is only relevant when both Quadrant 3 and Quadrant 4 are included in Typical Performance range.				
Low Threshold (7–36 months)	/118	**	118 —— 108	107 —— 87	86 —— 77	76 —— 23

Sensory Processing Section Summary (7 to 36 Months)

Instructions: Transfer the Section Raw Score Totals from the 7 to 36 months Caregiver Questionnaire to the corresponding Section Raw Score Total box for the appropriate ages. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference)*.

Sensory Processing Section	Section Raw Score Total	Less Than Others ← Definite Difference	Less Than Others ← Probable Difference	Typical Performance	→ More Than Others Probable Difference	→ More Than Others Definite Difference
A. General Processing	No section raw score total is calculated for the General Processing Section.					
B. Auditory Processing (7–36 months)	/50	50 —— 48	47 —— 44	43 —— 35	34 —— 31	30 —— 10
C. Visual Processing (7–36 months)	/35	35 —— 32	31 —— 28	27 —— 20	19 —— 16	15 —— 7
D. Tactile Processing (7–24 months)	/75	75 —— 68	67 —— 62	61 —— 48	47 —— 42	41 —— 15
D. Tactile Processing (25–36 months)	/75	75 —— 72	71 —— 65	64 —— 51	50 —— 44	43 —— 15
E. Vestibular Processing (7–36 months)	/50	50 —— 27	29 —— 24	23 —— 15	17 —— 15	14 —— 5
F. Oral Sensory Processing (7–12 months)	/35	35 —— 33	32 —— 30	29 —— 21	20 —— 17	16 —— 7
F. Oral Sensory Processing (13–18 months)	/35	–	35 —— 32	31 —— 23	22 —— 19	18 —— 7
F. Oral Sensory Processing (19–24 months)	/35	–	35 —— 33	32 —— 24	23 —— 20	19 —— 7
F. Oral Sensory Processing (25–30 months)	/35	–	35 —— 33	32 —— 25	24 —— 22	21 —— 7
F. Oral Sensory Processing (31–36 months)	/35	–	35 —— 34	33 —— 25	24 —— 21	20 —— 7

*Classifications are based on the performance of children without disabilities (n = 489)
**There can be no Definite Difference for this section in this age range.

Note: Reproducible Growth Curves for Children 7 to 36 months, for Sensation Seeking, Tactile Processing, and Oral Sensory Processing, are available in Appendix A of the *Infant/Toddler Sensory Profile User's Manual*.

Therapy Skill Builders®
A Harcourt Assessment Company
THE PSYCHOLOGICAL CORPORATION®
A Harcourt Assessment Company

Copyright © 2002 by The Psychological Corporation, a Harcourt Assessment Company. All rights reserved.

Printed in the United States of America
7 8 9 10 11 12 A B C D E
Visit www.SensoryProfile.com for additional information and updates.

ISBN 0-7616-4959-X
9 780761 649595

APPENDIX C

TSFI ADMINISTRATION AND SCORE SHEET

Test of Sensory Functions in Infants (TSFI)

Administration and Scoring Form

Georgia A. DeGangi, Ph.D., O.T.R., and Stanley I. Greenspan, M.D.

Published by
WPS. WESTERN PSYCHOLOGICAL SERVICES
12031 Wilshire Blvd., Los Angeles, CA 90025-1251
Publishers and Distributors

Name of Infant: _____

Birth Date: _____ Date of Testing: _____

Age (in months): _____ Sex: ☐ M ☐ F

Reason for Referral: _____

_____

Directions

Administer the test according to the instructions presented in the Manual (WPS Catalog No. W-262C). During administration, score the items and record the item scores on the other side of this form. Each item is scored using a numerical rating scale. The criteria for scoring are summarized on the back of this form and detailed in the Manual. Determine the infant's score on each item according to these criteria and enter the number on the right.

After administration, add the item scores for each subtest and enter the total next to the subtest name. Add the five subtest scores to obtain the Total Test Score and enter that number on the bottom right of the page. Then transfer the subtest scores and the Total Test Score to the profile form below by entering the scores in the appropriate boxes under the column heading "Score."

To use the profile form, place an "X" in the box that includes the infant's score on each subtest and the Total Test. Complete the profile by connecting the X's.

Profile Form

Subtest	Score	4–6 months			7–9 months			10–12 months			13–18 months		
		Normal	At Risk	Deficient	Normal	At Risk	Deficient	Normal	At Risk	Deficient	Normal	At Risk	Deficient
Reactivity to Tactile Deep Pressure		9–10	8	0–7	9–10	8	0–7	9–10	8	0–7	9–10	8	0–7
Adaptive Motor Functions		7–15	6	0–5	11–15	10	0–9	14–15	13	0–12	15	14	0–13
Visual-Tactile Integration		4–10	3	0–2	9–10	7–8	0–6	9–10	7–8	0–6	9–10	7–8	0–6
Ocular-Motor Control		1–2		0	2	1	0	2	1	0	2	1	0
Reactivity to Vestibular Stimulation		10–12	9	0–8	10–12	9	0–8	10–12	9	0–8	11–12	10	0–9
Total Test		33–49	30–32	0–29	41–49	38–40	0–37	44–49	41–43	0–40	46–49	41–43	0–40

Additional copies of this form (W-262B) may be purchased from WPS. Please contact us at 800-648-8857, Fax 310-478-7838, or www.wpspublish.com.
Copyright © 1989 by WESTERN PSYCHOLOGICAL SERVICES. Not to be reproduced in whole or in part without written permission. All rights reserved. Printed in the U.S.A.

Scoring Form

	Item Score	Subtest Score
Scoring for Items 1–5: 0 = Adverse 1 = Mild Defensive 2 = Integrated		
1. Response to Touch: Arms and Hands. Rub the outside of the infant's forearm firmly from elbow to palm, then rub the inside from the palm to the elbow. Repeat twice.		
2. Response to Touch: Stomach. Firmly rub the infant's stomach—back and forth—3 times slowly. Repeat once.		
3. Response to Touch: Soles of Feet. Firmly rub the infant's foot from heel to toes, back to heel, then up to toes again. Repeat once.		
4. Response to Touch: Mouth. With finger, rub firmly around mouth to complete circle starting and ending at the midline of the upper lip.		
5. Response to Touch: Held at Shoulder. Hold infant against your shoulder (stomach facing you) without bouncing or other movement for 10 seconds.		
Reactivity to Tactile Deep Pressure Subtest Score →		
Scoring for Items 6a–10a: 0 = No Response 1 = Disorganized 2 = Partial 3 = Organized		
6a. Adaptive Motor: Tape Placed on Hand. Place tape with red dot in the middle on the back of infant's hand, pressing the middle but leaving the ends free. Observe for 30 seconds.		
7a. Adaptive Motor: Furry Mitt on Foot. Place the furry paw mitt on infant's foot. Observe 30 seconds before removing.		
8a. Adaptive Motor: Squeak Toy on Stomach. While infant is resting on back, place rubber squeak toy on stomach. Remove after 30 seconds.		
9a. Adaptive Motor: Paper on Face. While the infant is semireclining, place 8½" × 11" piece of paper on the infant's face. Observe for 30 seconds.		
10a. Adaptive Motor: Yarn Around Both Hands. While infant is supine or sitting, have parent hold infant's hands together at midline. Wrap yarn loosely around infant's hands. Remove yarn after 20 seconds if infant does not remove it.		
Adaptive Motor Functions Subtest Score →		
Scoring for Items 6b–10b: 0 = Hyperreactive 1 = Hyporeactive 2 = Normal		
6b. Visual-Tactile: Tape Placed on Hand. Score item 6a for visual-tactile integration.		
7b. Visual-Tactile: Furry Mitt on Foot. Score item 7a for visual-tactile integration.		
8b. Visual-Tactile: Squeak Toy on Stomach. Score item 8a for visual-tactile integration.		
9b. Visual-Tactile: Paper on Face. Score item 9a for visual-tactile integration.		
10b. Visual-Tactile: Yarn Around Both Hands. Score item 10a for visual-tactile integration.		
Visual-Tactile Integration Subtest Score →		
Scoring for Item 11: 0 = No Response 1 = Integrated		
11. Eye Lateralization: Orange Tennis Ball. While infant is supine or sitting, interest infant in toy at midline, then hold orange tennis ball in the infant's peripheral visual field and slowly move to central visual field in an arc.		
Scoring for Item 12: 0 = Poorly Integrated 1 = Well Integrated		
12. Visual Tracking: Finger Puppet. With infant supine or sitting, hold finger puppet in front of infant, 12 to 18 inches away just below eye level. Move puppet horizontally to left and then across midline to the right. Then move the puppet in vertical plane, and lastly, in a circle. Prompt with "watch the puppet" if the infant loses attention.		
Ocular-Motor Control Subtest Score →		
Scoring for Items 13, 14a, 15a, 16, 17: 0 = Adverse 1 = Mildly Defensive 2 = Integrated		
13. Response to Movement: Vertical Plane. Hold infant upright while you are standing. Say, "We're going to go up and down. Here we go." Move infant up and down 3 times.		
14a. Response to Movement: Circular to the Right. Hold infant around the thorax. Say, "Now let's go around." Complete a 360-degree turn to the right in about 2 seconds.		
15a. Response to Movement: Circular to the Left. Hold infant around the thorax. Say, "Now let's go around." Complete a 360-degree turn to the left in about 2 seconds.		
16. Inverted: Prone. Hold infant around thorax. Say, "Now let's go upside down." Lower infant's head toward the floor, hold for 1 second, then resume upright position.		
17. Inverted: Supine. Hold infant around thorax. Say, " Upside down again." Lower infant's head toward floor face up, supporting the neck of younger infants. Hold position briefly and return to upright position.		
Scoring for Items 14b and 15b: 0 = No Nystagmus 1 = Presence of Nystagmus		
14b. Nystagmus: Right. Score item 14a for nystagmus.		
15b. Nystagmus: Left. Score item 15a for nystagmus.		
Reactivity to Vestibular Stimulation Subtest Score →		
Total Test Score →		

APPENDIX D

ETHICAL CLEARANCE CERTIFICATE

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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mrs Marcia Botha

CLEARANCE CERTIFICATE	M110830
PROJECT	Integration Functioning in a Infant Group Born in Breech Birth Presentation
INVESTIGATORS	Mrs Marcia Botha.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	26/08/2011
M1108300DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 27/10/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

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

DECLARATION OF INVESTIGATOR(S)

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

APPENDIX E

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa

REQUEST FOR PERMISSION TO CONDUCT RESEARCH – CHILD DAY CARE FACILITIES

The Manager,

_____ Day care Centre

Dear Sir/Madam,

I am, Marica Botha, an occupational therapist, completing a master degree at the University of the Witwatersrand. I am doing research into Sensory Integration assessment of infants: Parent report questionnaire vs clinician observation report. The normal process of sensory integration begins before birth and continues throughout life and involves the child's ability to interpret and react to sensory input in the environment. When the sensory integration process is disordered, problems may occur with learning, motor skills and behaviour.

In order to accurately assess the sensory functioning of infants, it is necessary to compare the information gained through parent's questionnaires and information gained from therapist observation testing. This will enable therapists to use accurate assessment for infant sensory functioning. The study will also compare sensory functioning of infants born via normal (vaginal) delivery and infants born via caesarean section.

I would like permission to conduct the research at your day care facility and request that caregivers/ you hand out information letters to all parents whose child is between the ages of 7 months and 12 months. The letter would include a permission slip which the parents/guardian would fill in and sign. You will also be asked to complete a short demographic questionnaire, regarding the facility, with information needed for the study.

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

After the researcher have received the consent and completed forms, an observational test will be conducted, on the infant, at the day care facility. This will take 20 minutes to administer and the infant will not experience any pain. The test will look at, for instance, the infant's response to being touched at different places on their bodies e.g. hands, feet, shoulders.

Confidentiality – All personal information will be kept confidential and secure by the researcher. . Only the researcher will have access to personal information, on all other documents, a numbering system will be used to identify subjects.

Marica Botha

If further information is required, the researcher may be contacted at:

082 335 6386
E-mail: maricab4@gmail.com .

In case of any complaints / problems, please report this to the secretary of the Human Research Ethical Committee (Medical), University of the Witwatersrand: Anisa Keshav 011 717-1234.

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

RESPONSE SHEET

I have read the proposed study letter and agree to the research can be carried out at this day care centre and caregivers will be able to give the information letters to parents of infants who attend the facility.

Name of Day care facility: _____

Manager Name: _____

Signature: _____

Date: _____

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

INFORMATION SHEET FOR PARENTS

Hello.

I am, Marica Botha, an occupational therapist, completing a master degree at the University of the Witwatersrand. I am doing research into *Sensory integration assessment of infants: Parent report questionnaire vs clinician observation report.*

The normal process of sensory integration begins before birth and continues throughout life and involves the child's ability to interpret and react to sensory input in the environment. When the sensory integration process is disordered, problems may occur with learning, motor skills and behaviour.

In order to further develop the assessment of the sensory functioning of infants, I would like to compare the information gained through parent's questionnaires and information gained from therapist observation testing. This will improve therapist's ability to ensure accurate assessments of infant sensory functioning. The study will also compare sensory functioning of infants born via normal (vaginal) delivery and infants born via caesarean section.

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

What is involved in the study – If you consent to participate in this study, the following procedure will be followed:

- You will be asked to complete a demographic questionnaire with information needed for the study. This information will be treated as confidential at all times and will be available to only the researcher who will keep it locked away. No names or personal details will be published.

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

- You as parent will also be asked to complete a Sensory Profile – this is a standardised questionnaire with 48 questions about your infant's behaviour. For each question you will tick a choice of how often behaviour occurs (Almost Always, Frequently, Occasionally, Seldom, or Almost Never). It will take no more than 15 minutes to complete.
- All forms will be send home from your child's day care facility. It will be appreciated if you can complete the forms and send it back to school (in a sealed envelope provided), as soon as possible.
- After completing the questionnaire, the researcher will conduct a standardised observational assessment on your infant. This will be done at the day care facility. You are welcome to request to be present, if not, the caregiver will be asked to be present and to assist where needed. This will take 20 minutes to administer and your infant will not experience any pain. The test will look at, for instance, the infant's response to being touched at different places on their bodies e.g. hands, feet, shoulders.
- If after this testing your child is found to have problems, you will immediately be contacted and provided with a resource list of occupational therapists should you wish to follow up with further assessment and treatment by a sensory integration certified therapist.

Are there any Risks of being involved in the study?

Both measures being used in this study are non-invasive and pose no health risk to you or your infant. All testing will be done with you, or the caregiver present and if at any time it is felt that the infant is uncomfortable, testing will be discontinued.

Participation is voluntary, this means that refusal to participate will involve no penalty or loss of benefits to which the participant is otherwise entitled, and you may discontinue participation at any time without penalty or loss of benefits.

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

Confidentiality – All efforts will be made to keep personal information confidential. Only the researcher will have access to personal information, on all other documents, a numbering system will be used to identify subjects. However, personal information may be disclosed if required by law. All data from the study will be stored in a secure location for 6 years according to HPCSA regulations.

Benefits of being in the study –

Benefits of participating in this study are that your child will receive sensory integration evaluation, and if any problems are detected, you will be immediately informed and you will have the option of following up with therapy for your child immediately. Research has shown that early intervention with sensory integration and developmental problems are very important.

The participants will be given pertinent information on the study while involved in the project and after the results are available.

Marica Botha

If further information is required, the researcher may be contacted at:
Marica Botha
082 335 6386
E-mail: maricab4@gmail.com

In case of any complaints / problems, please report this to the secretary of the Human Research Ethical Committee (Medical), University of the Witwatersrand: Anisa Keshav 011 717-1234.

Occupational Therapy
School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

INFORMED CONSENT

Study title - *Parent report questionnaire vs clinician observation report.*

I, _____ (full name and surname), parent / guardian

of _____ (full name and surname of infant) hereby

acknowledge the following:

- I have read, and fully understood the information sheet regarding the aforementioned research project.
- I have been given the opportunity to ask questions arising from the information, and all my questions have been answered to my satisfaction.
- I feel that I have been given enough information regarding the research project.

I hereby give my informed consent to the following:

- That my child may be tested by the researcher, as explained in the information sheet, for the said research.
- That may the need arise, the session may be videotaped at the discretion of the researcher.

Signature: _____ Researcher: Signature : _____

Date: _____ Date: _____

Witness Signature: _____

Date: _____